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## **WILL THE U.S. BANK RECAPITALIZATION SUCCEED? LESSONS FROM JAPAN \***

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### **Abstract**

The U.S. government is using a variety of tools to try to rehabilitate the U.S. banking industry. The two principal policy levers discussed so far are employing asset managers to buy toxic real estate securities and making bank equity purchases. Japan used both of these strategies to combat its banking problems. There are also a surprising number of other similarities between the current U.S. crisis and the recent Japanese crisis. The Japanese policies were only partially successful in recapitalizing the banks. We explain why that was the case and then compare the current U.S. plans with those pursued in Japan. While the U.S. plans are still in flux, it appears that U.S. is at risk for running into some of the same problems that hobbled the Japanese policies.

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## I. Introduction

The U.S. government has taken a schizophrenic policy approach to the ongoing credit crisis. In the Treasury's deliberations with Congress, it stressed idea of purchasing troubled assets to stabilize the financial system. Thus, the Troubled Assets Relief Program (TARP) became the central part of the Emergency Economic Stabilization Act (EESA). But within a week of passing the legislation, attention shifted to buying equity in financial institutions. Subsequently the Capital Purchase Program (CPP) within the TARP is using \$250 billion of public funds to acquire stakes in banks in the form of preferred shares and warrants, with \$145 billion already allocated to nine major banks. It appears possible that asset purchases may even be abandoned altogether.

The focus on the capital shortage is good news since economists widely agree that the lack of capital is the fundamental problem plaguing the banks (Baldwin and Eichengren (2008)). But, the try everything approach without careful regard for implications also bears an eerie resemblance to Japan's decade-long response to its financial crisis. The big difference thus far is that the U.S. is moving much more quickly than Japan did.<sup>1</sup> Hence it is instructive to look back at Japan's experience to see what did and did not work.

We begin with a review of the macroeconomic environment that prevailed in Japan and the U.S. during these episodes. While it is widely known that the banking problems in both countries began after a sharp increase in land prices, the events in Japan from late 1997 to early 1999 closely track developments in the U.S. in 2008. One important similarity is the bank credit crunch that prevailed in both instances. More importantly, the Japanese banks emerged from the acute phase of its crisis with seriously undercapitalized banks.

We next describe the string of Japanese asset purchase plans and capital injection programs that were pursued to combat the banking problems. There were four main problems with these strategies. First, the asset purchase plans were too narrow. The scope of assets to be purchased and the set of financial institutions included were limited, thus precluding a comprehensive plan. Second, the loan purchases that did take place, especially in the 1990s, involved little restructuring of the borrowers. This resulted in many of the companies operating with few changes while typically receiving more loans that subsequently went bad. Third, the capital purchase plans ran into trouble in getting the banks to accept funding. Fourth and most importantly, the overall amount of government money committed was too small to recapitalize the banks. Hence, the banks only really returned to being adequately capitalized in 2006 and 2007, when macroeconomic conditions improved and after supervision policy had changed.

We close by drawing on the Japanese experience to evaluate the troubled asset purchase program and the CPP. In broad terms, the two programs mimic many elements of the Japanese plans. We present data comparing the largest U.S. banks, particularly in terms of the risks that they face from continued deterioration in the economy. Based on publicly available data it is hard to make confident assessments about the solvency of the banks. The lesson from Japan is that the details of the potential recapitalization program will be critical in determining whether any injections will increase the banks' capital levels and hence their lending capacity. There are too many open issues about how the TARP will proceed to tell whether it can avoid the mistakes made in Japan.

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<sup>1</sup> Udell (2008) points out further similarities in the evolution of the governments' responses in Japan and the U.S. He summarizes by saying "More generally, as new events unfolded in Japan, regulators ... had to use a combination of existing tools, new tools that stretched the regulatory limits of existing institutions, and go to the legislature for new authority and funding. We witnessed the same combination in the evolution of the response of U.S. authorities."

## II. Macroeconomic Conditions in the U.S. and Japan

The initial source of the banking losses in both countries stemmed from the dramatic real estate price increases and subsequent declines. Figure 1 shows price indices for land in both countries.<sup>2</sup> For the U.S. we show the Case-Shiller index for major cities which peaked in the second quarter of 2006. The index for Japan covers residential land prices in six major cities, which peaked in the third quarter of 1990. In the figure, we have shifted dates to align the peaks. Prices rose more in Japan than in the U.S. and then, ominously, fell for roughly 15 years – this basic pattern holds in all the major land price indices for Japan. During these fifteen years, the period from late 1997 to early 1999 is generally recognized as the acute phase of Japan's banking problems (see Hoshi and Kashyap (2001) Chapter 8). We start with a summary of the events from that period because they are remarkably similar to developments in the U.S. in 2008.

### 1. The Acute Phase of Japan's Crisis

The episode began when a mid-sized securities firm, Sanyo Securities, declared bankruptcy in early November 1997.<sup>3</sup> This resulted in Japan's first interbank loan default. Two weeks later a major bank, Hokkaido Tokushoku, lost the ability to borrow in the interbank market and was forced to declare bankruptcy. This was the first major bank failure in postwar Japan. A week later one of the four major securities dealers, Yamaichi Securities, failed after rumors, subsequently shown to be true, that it had accumulated massive off balance sheet losses through an illegal tobashi scheme.<sup>4</sup> Finally, before the month ended, Tokuyo City Bank, a regional bank, also failed.

Figure 2 shows the Japan premium calculated as the difference between 3-month Eurodollar Tokyo Interbank Borrowing Rate (TIBOR) and the 3-month Eurodollar London Interbank Borrowing Rate (LIBOR).<sup>5</sup> Relative borrowing costs for both banks jumped immediately on the news of Sanyo's demise (11/3/1997).

The stress was evident in the domestic interbank loan market (call market) as well. Figure 3 shows the difference between the maximum and the minimum of the overnight call rate (uncollateralized) for each day from November 1997 to April 1999.<sup>6</sup>

As Fukuda (2008) points out, the difference reflects not only the range of intraday fluctuations of the call rate but also the difference between the rates for the most creditworthy bank and the least creditworthy bank. The figure shows that the spread

<sup>2</sup> We thank Takatoshi Ito for suggesting this way of displaying the data.

<sup>3</sup> Contemporaneous descriptions and analysis of the Japanese banking crisis can be found in Cargill, Hutchison, and Ito (2001), Hoshi and Kashyap (2001, Chapter 8), and Nakaso (2001).

<sup>4</sup> In a tobashi scheme, a security company hides capital losses of one corporate customer by selling a part of the portfolio at an inflated price to another customer (whose accounting period is different from the first customer's so that they did not have to disclose the losses at the same time). When the second customer's accounting year end arrives, the portfolio is sold to another customer (who may be the same as the first) to hide losses again. Barring a reversal of market prices, the cycle cannot continue forever and the securities company ends up shouldering the losses eventually.

<sup>5</sup> We thank Kimie Harada and Takatoshi Ito for providing the data for the figure. Eurodollar TIBOR is calculated by a financial information company QUICK as the average interbank rate of the middle 9 of 13 reference banks (the highest two and the lowest two banks are excluded). The 13 banks include two non-Japanese banks, but their rates were almost always excluded as the two lowest rate, making TIBOR effectively the average rate for Japanese banks. Eurodollar LIBOR is calculated by the British Bankers Association as the average interbank rate of the middle 8 of 16 reference banks. Three Japanese banks are included in the 16 reference banks, but their rates were almost always excluded as three of the four highest rates, making LIBOR effectively the average rate for non-Japanese banks. See Ito and Harada (2005).

<sup>6</sup> We thank Shin-ichi Fukuda for providing the data for the figure.

jumped in November 1997 and stayed high for the next 16 months, suggesting some banks had extreme trouble borrowing for even overnight.

Before the end of 1997, the government decided that they could not avoid using public funds to deal with the financial crisis and announced that they planned to earmark ¥10 trillion to put into the banking sector. While the discussion of how to use the public funds was underway, the government approved a pair of accounting changes that were designed to allow the banks to make their public financial statements look better than was truly warranted. These rules allowed the banks to choose to use either market or book values for the banks' holdings of stocks in other firms and for the banks' real estate holdings.

Virtually all the banks' real estate assets were on their books at the historical acquisition prices (typically decades old), so even though land prices were well below peak values, a switch to market values instantly raised the value of the banks' assets. Conversely, the banks were harvesting capital gains on their stock holdings in order to report positive earnings. By early 1998 the banks had about ¥24 trillion of stockholdings on their books. Typically upon selling the shares to collect the capital gains the banks would quickly buy back the shares to retain the relationships with their clients. By 1998, the market price for many of the shares that had been sold and re-purchased was below the book value for these shares. Hence, the banks could further inflate the value of the assets by recording value of the shareholdings at book value.

On February 16, 1998, the Diet passed the Financial Function Stabilization Act, which allowed the government to use ¥30 trillion of public funds (¥17 trillion for protecting depositors of failed banks and ¥13 trillion for bank recapitalization). As we describe below, the government used ¥1.8 trillion out of the ¥13 trillion to recapitalize major banks in March of 1998, but it was unsuccessful in stabilizing the situation. Public dissatisfaction with the government's response continued to build through the spring and in June, the Liberal Democratic Party, the dominant partner in the ruling government coalition, lost 17 of its 61 seats in the Upper House election. The Hashimoto government resigned and a new government led by Keizo Obuchi assumed power.

The new government immediately began formulating further plans for dealing with the banking problems. By October, another major bank, Long-Term Credit Bank of Japan (LTCB), was on the brink of failure. The legislature at that point reached agreement on two pieces of compromise legislation (between the government and the leading opposition party) to deal with both insolvent institutions, which was the focus of the opposition, and to help solvent, but under-capitalized banks, which the LDP's concern.<sup>7</sup> In October, LTCB was nationalized using the new framework. In December, Nippon Credit Bank, NCB, was nationalized. From 1996 onward an unlimited deposit guarantee had been in place in Japan (that was scheduled to end in 2001, but ultimately was extended). In November of 1997, following the default of Sanyo Securities, the BOJ informed market participants that interbank loans were also protected (*Kin'yu Business*, February 1998, p.7). For both LTCB and NCB, all the creditors (including subordinated debt holders) of the banks were fully paid, although the existing equity holders saw their stakes eliminated.

The second major recapitalization of the banks using mostly preferred share purchases by the government was undertaken in March 1999. From Figure 2, we can see that the Japan premium declined after this injection. At that time some observers thought this would prove to be a turning point in the Japanese crisis.

One noteworthy aspect of this entire period was the divergence between the government's characterization of the condition of the banking industry and that of outsiders. For example, in the August 1998 IMF Article 4 consultation, the IMF's

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<sup>7</sup> The Financial Revitalization Act set up the framework to restructure failing systemically important banks through nationalization, and the Prompt Recapitalization Act allowed the government to inject capital into healthy banks. See Fuako (2000) for more details on these laws.

Executive Directors were very frank in calling for much more aggressive action by the government :

Rigorous enforcement of the self-assessment framework is needed so that banks recognize and provision against the full extent of bad loans. Several Directors suggested that these results be published for individual banks to increase transparency.

In contrast, on February 2, 1999 as the second capital injection was being debated, Eisuke Sakikabara, the Vice Minister of Finance, declared that the banking crisis would be over within 2 weeks. By the end of the month the U.S. Deputy Treasury Secretary, Lawrence Summers, gave a speech asserting that even with the capital infusion anticipated by Sakakibara, the Japanese banks remained significantly undercapitalized. Kashyap (2002) reports estimates from six private-sector bank analysts on the health of the banking system showing that each analyst estimated that the system was insolvent as of August 2002.

## 2. The 1998 Credit Crunch in Japan

Despite the disagreements over the degree of capital adequacy, there seems to be general agreement that there was a tightening of bank credit terms that contributed to mediocre growth during this period. For instance, the Bank of Japan minutes from January 1998 state :

Members noted that the current phase of the economy featured (1) a substantial decline in private consumption, which had remained relatively stable in past economic recessions; (2) a significant deterioration of confidence in the economic outlook not only in the household sector but also the corporate and financial sectors, leading to amplified concern about the economy; and (3) a vicious circle created by interaction between the real economy and financial activity whereby an increasingly stagnant economy brought about a decline in stock prices, which led to more cautious financial institution behavior, which in turn negatively influenced corporate activity and sentiment." The minutes go on to report that "the prospects for a more restrictive lending attitude of financial institutions and its possible effects were discussed in detail." (emphasis in the original).

There are three types of evidence typically cited to support these concerns. One indicator comes from the TANKAN survey conducted quarterly by the Bank of Japan on business expectations. The survey includes one question that asks firms whether they perceive financial institutions' lending

standards to be tight or accommodative. The replies are reported as a diffusion index that shows the difference in the percentage experiencing easy access to credit minus those experiencing difficult access. Hence, a decrease in the index represents a perception of tough access to credit. Figure 4 shows this index over the last 25 years. While the interpretation of this type of evidence can be questioned, the figure does show a very rapid shift in business perceptions about credit availability during 1998. Motonishi and Yoshikawa (1999) add this series to a standard investment regression and find that the deterioration in credit terms was an important driver of corporate investment during this period.

A second bit of suggestive evidence can be seen by the contrast in corporate financing patterns during this period. Kashyap, Stein and Wilcox (1993) show that in the U.S. a

comparison of commercial paper issuance and bank lending helps identify periods of tight bank credit.<sup>8</sup> Throughout most of long stagnation of the Japanese economy commercial paper issuance and bank lending generally moved together, suggesting that lack of bank credit was not an acute problem. The notable exception is during 1998 when loan volumes were plummeting and commercial paper issuance by businesses soared.

A third indicator comes from Woo (1999). He correlates lending patterns at individual banks with the capital position of banks for each year from 1991 through 1997. In the early part of the decade the better capitalized banks were less prone to increase lending. That pattern flips and in 1997 the better capitalized banks are much more likely to lend. He interprets this as evidence of a capital shortage of the banks. As with the other facts we have pointed to, this finding is subject to multiple interpretations, but they are all consistent with the conventional view that there was a credit crunch during this period in Japan.

### 3. The Parallels to the U.S. in 2008

We see an eerie parallel between these events and those that have transpired in the U.S. in the latter part of 2008. In particular, in September 2008, the U.S. had multiple failures or near failures that required government support of large institutions (Fannie Mae and Freddie Mac, Lehman Brothers and AIG.) Debt guarantees were broadly extended. Interbank loan rates spiked. Preferred share purchases were made in all the largest banks at the same terms. The incumbent government lost an election and was replaced. A credit crunch seems to be unfolding. The October 2008 FOMC minutes describe the situation almost identically to the Bank of Japan description above :

[FOMC] Participants were concerned that the negative spiral in which financial strains lead to weaker spending, which in turn leads to higher loan losses and a further deterioration in financial conditions, could persist for a while longer.

By November the U.S. government had made a second capital injection into Citibank where the preferred share purchase was about equal to the market capitalization of the bank the day before the deal was announced. In light of all these similarities we turn now to a detailed investigation of how the Japanese policy responses fared.

## III. Japanese Asset Management Companies and Recapitalization Programs

Assessing the asset purchase plans is complicated because this was done in a piecemeal fashion over the course of more than a decade. The full list of entities that were involved is shown in Table 1.

### 1. The History of Asset Management Companies in Japan

The first asset management company (AMC) in Japan was the Cooperative Credit Purchasing Company (CCPC) established in December 1992. The CCPC, described best by Packer (2000), was a private entity. The government was not involved because of the vigorous public resistance to proposals to use of taxpayer funds to rescue banks. Failing

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<sup>8</sup> This test presumes that the commercial paper market is functioning normally so it would not be a helpful indicator for an extreme situation such as current U.S. case.



to get direct government help, the private sector banks then created the CCPC, presumably with encouragement from the government.

The CCPC used funds loaned by the founding banks to buy bad loans. The loan sales to the CCPC generated tax benefits for the banks because once the loans resided with the CCPC the selling banks could recognize losses immediately that reduced their taxes. The CCPC was also supposed to collect on or sell the purchased loans, but this process was extremely slow. In the first five years, the CCPC sold only a third of the loans it bought. Its loan disposal became somewhat faster after 1998. The CCPC was liquidated in 2004. Over the 12 years of its existence, the CCPC bought the bad loans of only ¥15.4 trillion (about \$147 billion) in face value and ¥5.8 trillion (about \$55 billion) in appraisal value.

A second asset management company, Tokyo Kyodo Bank was set up in January 1995 using a combination of government and private funds. The Bank of Japan financed more than 90% of its capital. The rest of the capital came from private-sector banks. Tokyo Kyodo was originally formed to manage the assets held by two failed credit unions in Tokyo, Tokyo Kyowa Credit Union and Anzen Credit Union. Later Tokyo Kyodo absorbed assets of other failed credit unions and was renamed the Resolution and Collection Bank (RCB).

A third asset management company, the Housing Loan and Administration Corporation (HLAC), was established in 1996 to manage loans of failed *jusen*, troubled housing loan companies that were taken over by the government and wound down in 1996. The HLAC was financed by both private banks and public funds. Both the RCB and HLAC dealt with assets of failed institutions and did not buy loans from supposedly solvent banks. Because the regulators were not able to put banks into receivership until the passage of the Financial Revitalization Act in 1998, the scope and effectiveness of these entities was necessarily limited.

The RCB and the HLAC were merged to create the Resolution and Collection Corporation (RCC) in 1999, and this new institution was allowed to buy bad loans from solvent banks (though they were not compelled to sell any) in addition to manage assets of failed financial institutions. From 1999 to June 2005 (when RCC stopped buying assets), the RCC spent a mere ¥353 billion to purchase 858 loans with a face value of ¥4.0 trillion from solvent banks. Starting 2001, the RCC also started to reorganize the borrowers behind the non-performing loans. From 2001 to 2008, the RCC restructured 127 borrowers. The RCC also participated in the reorganization of 450 borrowers in its role as a major creditor. In total (for these 577 borrowers), ¥6.2 trillion of debt was restructured.

The RCC also started selling and collecting the loans aggressively. From March 2001 to March 2008, the amount of loans on the RCC balance sheet declined by ¥4.7 trillion (from ¥5.8 trillion to ¥1.1 trillion).<sup>9</sup> Most of those loans were sold at prices above the RCC acquisition prices: from 2001 to 2008, the total revenue from disposing of these loans amounted to ¥6.2 trillion.

The final AMC, the Industrial Revitalization Corporation of Japan (IRCJ), was established in 2003 with the purpose of restructuring the bad loans they purchased and turning around the borrowers. The IRCJ was set up as a joint stock company almost exclusively owned by the Deposit Insurance Corporation and its debt was guaranteed by the government. The IRCJ had two years to buy nonperforming loans and an additional three years to finish restructuring them. IRCJ bought and successfully restructured non-performing loans for 41 borrowers of the total face value of ¥4.0 trillion, which included several notable companies like Daiei and Kanebo, and finished all the restructuring by April 2007, one year earlier than the initial deadline.

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<sup>9</sup> The accounting figures are from the RCC web site: <http://www.kaisyukikou.co.jp>.

## 2. Lessons Regarding the Asset Management Companies

Overall, Japan's experience with asset management companies was mixed at best. There were a number of design problems that limited their effectiveness. First, some of the AMCs were only able to contract with specific type of financial institutions (for example HLAC). A systemic solution requires the ability to buy assets from all impaired institutions, solvent or not.

Second, the scale of the operations was often small. Table 2 shows the history of loan losses in Japan. Cumulatively over the years between 1992 and 2005, Japanese banks wrote off about ¥96 trillion, roughly 19% of GDP.<sup>10</sup> So the size of the problem required considerably more resources than most of the AMCs were given.

Third, especially in early years, they were slow in selling off the loans they purchased and just functioned as warehouses of bad loans. Land prices were still falling and they presumably did not want to realize capital losses. Not until the early 2000s, did they begin attempting to restructure the loans and rehabilitate the underlying borrowers thus addressing the source of the bad loan problem.

Finally, and most importantly, the Japanese experience also suggests that the purchase of nonperforming loans did not solve the capital shortage problem; it is possible that a much bigger, comprehensive program might have eliminated the uncertainty of the value of assets that remained on banks' balance sheets and allowed them to find willing investors to contribute new capital. But, because none of the Japanese AMCs were designed to overpay for the bad loans, just removing some of the assets did not rebuild capital.

## 3. Bank Capital Injections in Japan

Given these problems, the Japanese government eventually resorted to measures besides AMCs. To attack the undercapitalization, the Japanese government opted for a series of public re-capitalization programs. A list of the programs is shown in Table 3.

As mentioned previously, the Financial Function Stabilization Act made ¥13 trillion (about \$124 billion) of government money available to buy subordinated debt (or preferred shares in a few cases) in undercapitalized but supposedly solvent banks. Subordinated debt can be counted as a part of regulatory capital (as long as it does not exceed Tier I capital) and would give the purchasing bank a buffer to absorb losses without having to default on promises to depositors.

This program was initially shunned by the banks. There are two reasons why the banks might not have wanted the assistance. One explanation is that the banks feared applying for the funds would be admitting to large future losses than had been previously disclosed (or that their ability to raise funds elsewhere would be missing). This negative signal would push down the value of existing equity.

A second logical possibility is that the banks balked because new securities would be senior to the existing equity claims. Were the banks to recover, the existing owners would not be able to reap the benefits until after the government's claims were paid. Either interpretation suggests that accounting for the incentives of the existing equity holders could be important in designing recapitalization schemes.

After some cajoling by the government, each of the major banks applied for almost an identical amount of public funds. Table 4a, compiled from the data on the Deposit Insurance Corporation web site ([http://www.dic.go.jp/english/e\\_katsudou/e\\_katsudou3-2.pdf](http://www.dic.go.jp/english/e_katsudou/e_katsudou3-2.pdf))

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<sup>10</sup> The figures are from the web site of the Financial Services Agency: <http://www.fsa.go.jp>.

shows the amount and type of public funds each bank received. Eight of nine received ¥100 billion (less than \$1 billion) in the form of subordinated debt or loans, although the interest rate on subordinated debt was different, presumably reflecting perceived health of the institution. The other one (Dai-ichi Kangyo) received almost the same amount (¥99 billion) in return for preferred shares which included an option to convert them into common shares. The focal amount of ¥100 billion was set at the level that the healthiest bank, Bank of Tokyo Mitsubishi, was willing to ask for, so for most of the banks, the amount was far less than they needed to restore their capital. In total, only ¥1.8 trillion (about \$17 billion) was distributed to 21 banks in the spring of 1998.

Nippon Credit Bank (NCB) and Long-Term Credit Bank of Japan (LTCB), the two banks that would fail later in the year, each received funding under this program in the form of preferred shares. For both banks, the government also acquired the option to convert the preferred shares into common shares starting on October 1, 1998. The conversion period was 9.5 years for the LTCB and 19.5 years for the NCB. Thus, the NCB, which was considered to be weaker of the two, was subject to a longer threat of (partial) government takeover. NCB also applied for a ¥230 billion subordinated loan, but the loan was not approved (*Kin'yu Business*, May 1998, p.8). Ultimately the preferred shares of these two banks were converted into common shares when each was nationalized (October 28, 1998 for LTCB and December 17, 1998 for NCB).

The second recapitalization, briefly mentioned earlier, took place on the heels of these failures in the Spring of 1999. The size of the second program was larger, with ¥25 trillion (about \$238 billion) available for recapitalization.<sup>11</sup> All the major banks except for the most healthy one (Bank of Tokyo Mitsubishi) applied. This time, the government (Financial Reconstruction Commission: FRC) evaluated the applications using the inspection information provided by the FSA and the BOJ. Perhaps most importantly, the FRC checked whether the amount of capital each bank requested would be sufficient to cover the under-reserving for non-performing loans once they applied reasonable provision rates (70% for doubtful loans and 15% for loans requiring special attention, for example). The FRC evaluated and approved revitalization plans that banks submitted. Although the FRC did not turn down any applications, this time, the capital injections after bank inspections were better conceived than the ones in 1998. The government ultimately put ¥7.5 trillion (about \$71 billion) into the 15 banks in the form of preferred shares and subordinated debt with various terms and conversion options into common shares. Nakaso (2001) argues that this amount was sufficient to cover the under-reserving and unrealized capital losses of shareholdings at these 15 banks.

Table 4b, created from the data published by the Deposit Insurance Corporation ([http://www.dic.go.jp/english/e\\_katsudou/e\\_katsudou3-1.pdf](http://www.dic.go.jp/english/e_katsudou/e_katsudou3-1.pdf)) shows the deals for each bank. Most banks sold multiple instruments to the government. As with the previous year's plan, most of the preferred shares gave the government an option to convert them into common equity during a certain interval. If the government still held any preferred shares at the end of the interval the government was required to convert all of these shares into common shares. This requirement implies that the government would suffer a capital loss if the conversion option is out of the money at the end of the interval.

It would have been possible to design these securities so that weak banks would face the threat of conversion and dilution of existing shareholders sooner than healthy financial institutions, but this is not what happened. If anything, the tables show a tendency for healthier financial institutions to have earlier initial conversion dates.

<sup>11</sup> The government also set aside ¥18 trillion for nationalization of failed banks. Combined with the ¥17 trillion for depositor protection (mentioned earlier), the total size of the financial stabilization package was ¥60 trillion.

Stronger banks would favor earlier conversion so that they could lower the dividend rate on preferred shares.

The government did not seem to optimally exercise the conversion option. For instance, Omura, Mizukami, and Yamazaki (2002) give an example where the fair value of the convertible preferred shares exceeded what the government had paid early in the conversion period, but the government failed to exercise the option before the bank stock declined. Had the government acted, it could have recovered twice as much as was possible in 2002. They suspect that the government never intended to exercise the options. Instead this instrument could rationalize low dividend rates that were intended to provide a subsidy to the banks. The use of multiple securities with various terms also obscured the cost of the bailout.

The 1999 recapitalization had calming effects on the financial market. As seen in Figure 2, the higher interbank loan rate that Japanese banks were required to pay compared with the U.S. and European banks, disappeared soon after the recapitalization. In this sense, the 1999 recapitalization, together with the introduction of a scheme for orderly closure of systemically important banks through nationalization in 1998, ended the acute phase of the banking crisis.

The Prompt Recapitalization Act expired on March 2001, but capital shortages continued to be a problem and so the government put together a couple of more small scale recapitalization programs. First, the revision of the Deposit Insurance Act allowed the government to provide public capital to banks. Specifically, Section 102-1 of the revised Deposit Insurance Act justified the use of public funds to help troubled (but not failed) systemically important banks. This was used to prop up Resona Bank in June of 2003. The government bought ¥0.33 trillion of common shares and ¥1.66 trillion of preferred shares of Resona.

Second, the Act of Strengthening Financial Functions (ASFF) was passed in June 2004. The law allowed the government to inject public capital into banks without justifying their systemic importance. From its inception to expiration at the end of October 2008, ¥40.5 billion was injected into two regional banks (both in 2006). In late 2008 the Japanese government proposed a revision of the ASFF, so that it could continue to inject capital into the banking sector when it is necessary.

#### **4. The Chronic Capital Shortage Problems**

Despite all these programs, the banks' capital shortage persisted. Table 5 shows data from Fukao (2008) on the condition of capital in the banks. As late as March of 2002, for example, Japanese banks collectively had ¥29.3 trillion of core capital (equity capital and capital reserves) to buffer the risks associated with assets of ¥744.8 trillion and loans of ¥440.6 trillion; so stated capital was equal to 3.9% of the assets and 6.7% of the loans. However, ¥10.7 trillion of core capital was in the form of deferred tax assets, which are tax deductions the banks would be able to claim in the future for the past loan losses if they become profitable. If the banks do not regain their profitability, the tax deferred assets disappear. Moreover, many banks still did not have sufficient level of loan loss reserves.

Fukao (2003) estimated the amount of under-reserving, which should be really written off from the current capital. This deficit represents a failure to set aside "adequate" reserves. To calculate adequate reserves, the amount of classified bad loans is multiplied by one minus the expected recovery rate for each class of loans, which is estimated using the data from the 1990s. This leads to two potential biases. On the one hand, because the recovery rate from bad loans improved after the 1990s this procedure is likely to overestimate the level adequate reserves (and hence under-reserving) during the 2000s. On the other hand, because many outside observers believed that the banks were

consistently overstating the quality of their loans the estimates for the level of adequate reserves would have been too low. As of March 2002, Fuako concludes that banks reserves were ¥6.9 trillion too low.

To give a rough sense of the capital deficit we subtract the deferred tax assets and under-reserving from the official capital to arrive at what we call “modified capital.” As of March 2002 modified capital was just ¥11.7 trillion, of which ¥7.2 trillion had been contributed by the government, so the Japanese banking sector had hardly any private capital.

As a point of reference we can compare the modified capital to the capital that the banks would have if they had equity equal to three percent of assets, as is required in the U.S. We call the difference between modified capital and this lower bound the capital gap. As shown in the last column of Table 5 shows that this gap was consistently positive between 1997 and 2005.

## 5. Lessons from the Capital Injections

There were several reasons why the capital deficit continued despite the recapitalization programs. First, the sizes of the programs were too small. Even the most comprehensive of the programs, the recapitalization under the Prompt Recapitalization Act, injected only 8.7 trillion yen, which was about 1 percent of total bank assets (and less than 2% of total loans). Second, even after nationalizing two major banks, the Japanese regulators did not force other major banks to clean up their non-performing loans. Instead they were allowed to operate even with huge amounts of non-performing loans on their books. The amount of non-performing loans (disclosed by banks) actually increased from 29.6 trillion yen (March 1999) to 42.0 trillion yen (March 2002).

Finally, related to the second problem, the recapitalization programs emphasized loan volumes rather than restoration of bank capital. The distinction was important because the Japanese banking sector had begun the 1990s having rapidly expanded lending during the boom years of the late 1980s, even though loan demand by large firms was falling due to financial deregulation that made bond financing easier for them.<sup>12</sup> Thus, the Japanese banks had more loans on their books than would be desired by their customers over the medium term. Hoshi and Kashyap (2005) argue that consolidation was therefore inevitable and that the government could have exploited this inevitability to lower the costs to the taxpayer by concentrating the capital injections on the better capitalized banks. Doing so would have avoided putting capital into failing institutions and would have rewarded better run banks. To the extent that reorganizations were needed they could be led by the private sector rather than the government. The recapitalization programs, however, did not realize the problem of overbanking.

Instead, the only objective that was pursued forcefully as part of the recapitalization was that banks were required to increase their lending, especially to small and medium firms. The recapitalized banks were required to report the amount of loans to small and medium firms every six months. The FSA periodically requested the recapitalized banks to increase lending to small and medium firms.<sup>13</sup> When some banks substantially cut back the lending to small and medium firms, the FSA started to issue business improvement orders. From 2001 to 2004, five banks received business improvement

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<sup>12</sup> Hoshi and Kashyap (2000) show that the financial deregulation opened up the option of nonbank financing for large customers and the banks responded by increasing their lending to real estate developers and small and medium firms.

<sup>13</sup> FSA (2006, pp.693-699) lists the public announcements that the FSA made to the recapitalized banks to increase small and medium firms loans. The counts on business improvement orders also come from this report.

orders because they reduced lending to small and medium firms (Shinsei Bank in 2001, UFJ Holdings and Asahi Bank in 2002, Mizuho Holdings in 2003, and UFJ Holdings again in 2004). These orders required the banks to increase lending or be subject to fines.

This preference for directed lending created some high profile conflicts. Tett (2003) provides many examples regarding the experience of Shinsei Bank, the successor to LTCB. When LTCB emerged from nationalization and was up for sale, the government insisted that all bidders promise to accept all the loans on the books that a government committee deemed to be performing. The winning bidder, an American-led consortium, determined that many of their existing customers were not profitable and should not objectively receive credit. The government contested this assessment and pressed the bank to maintain lending.<sup>14</sup>

The main problem with the Japanese approach was that the banks were kept in business for far too long with insufficient capital. This limited the banks willingness to recognize losses and they took extraordinary steps to cover up their condition and in doing so retarded growth in Japan (Caballero, Hoshi and Kashyap (2008) and Peek and Rosengren (2005)).<sup>15</sup> The U.S. policymakers seem to appreciate that this was extremely costly and appear to be trying to avoid it. For instance, Treasury Secretary Paulson explicitly said that some banks will fail even with the TARP.<sup>16</sup>

## 6. The Role of the Takenaka Plan and Macroeconomic Recovery in Rebuilding Bank Capital

Given that the capital injections do not seem to be responsible for the elimination of the capital gap, what was? One important ingredient were the changes initiated in late 2002 and early 2003 at the behest of Heizo Takenaka, who was newly appointed to head the government's financial reform efforts. Within a month of his appointment, Takenaka announced the Financial Revival Program (*Kin'yū Saisei Program*) that called for (1) more rigorous evaluation of bank assets, (2) increasing bank capital, and (3) strengthening governance for recapitalized banks (Omura, Mizukami, and Kawaguchi, 2006, p.4).

Takenaka, in his memoirs, explains that he attempted to use six measures to end the nonperforming loans problem at major Japanese banks. Specifically he sought (1) to have banks make more rigorous evaluation of assets using discounted expected cash flows or market prices of non-performing loans, (2) to check cross-bank consistency in classifying loans to large debtors, (3) to publicize the discrepancy between the banks' self evaluations and the FSA's evaluations, (4) to be prepared to inject public funds if necessary, (5) to prohibit banks from declaring unrealistically large deferred tax assets, and (6) to impose business improvement orders for banks that substantially underachieved the revitalization plans. He concludes he was successful in implementing all of these six with possible exception of (5) (which in the end he had to leave to the discretion of banks and their accountants).<sup>17</sup>

<sup>14</sup> This case was complicated because as part of the sale Shinsei had the right to return loans to the government if they could shown to be non-performing. Hence Shinsei had an incentive to take this position.

<sup>15</sup> See Peek (2008) for a survey of the evidence on the behavior of the banks in the 1980s and 1990s. He also presents new analysis showing that bank assistance to distressed firms during the 1990s was different (and less effective) than the aid in the 1980s.

<sup>16</sup> "Paulson Says U.S. to Use All 'Authorities' in the Crisis," *Bloomberg.com*, October 8, 2008.

<sup>17</sup> Some of these measures were implemented actually before Takenaka became the Minister. For example, the FSA conducted special inspections of major banks from October 2001 to March 2002 and publicized the result in April 2002 (<http://www.fsa.go.jp/news/newse/e20020412-1.html>). The use of the discounted cash flow method in an attempt to achieve consistent evaluation of non-performing loans to large debtors, however, was new, and introduced in the special inspection for March 2003 period under Minister Takenaka.

The FSA followed the “Takenaka Plan” and became tougher in its audits of the banks. In the early part of 2003, this pressure led many of the largest banks to issue shares (typically through private placements) to improve their capital ratios. Resona Bank’s capital ratio for March 2003 fell below 4% after it was not allowed to count five years worth of tax deferred assets as capital. The FSA used the Deposit Insurance Act section 102-1 and injected capital into Resona Bank.

In August 2003, the FSA also issued business improvement orders to fifteen recapitalized banks and financial groups, including five major ones (Mizuho, UFJ, Mitsui Sumitomo, Mitsui Trust, and Sumitomo Trust) for failing to meet their profit goals for March 2003. They were required to file business improvement plans and report their progress each quarter to the FSA.

UFJ Holdings was found to have failed to comply with its revised plan in March 2004 and received another business improvement order. The CEOs of UFJ Holdings, UFJ Bank, and UFJ Trust were forced to resign, and the salaries for the new top management were suspended. The dividend payments (including those on preferred shares) were stopped. Salaries for the other directors were cut by 50%, their bonus had already been suspended, and the retirement contributions for the management were also suspended. The number of regular employees was reduced and their bonuses were cut by 80%.<sup>18</sup>

Finally there was a shift in the workout policies pursued by the IRCJ and the RCC. From the middle of 2003 onwards much more emphasis was put on reorganizing troubled borrowers led. Figure 4 shows that the origination of new Non-Performing Loans (shown in the top half of the graph) began to slow from 2003 onwards. Likewise, from 2003 to 2005, a substantial number of bad loans were removed from the banks’ balance sheets.

Table 6 offers a closer look at the evolution of capital between 2003 and 2007. Over this period the banks’ official capital grew by ¥15 trillion. There were two big sources of gains. The first was improved operating performance that led to higher retained earnings. This is consistent with the improved loan loss performance indicated in Figure 4. The second major contributor was capital gains on the stock portfolio.

Table 7 gives some annual figures on the nature of the gains. We see two important patterns in this table. First, the operating performance improves sharply in 2006 and 2007. The profitability in the prior two years is unremarkable. This is particularly interesting because GDP growth was respectable from 2003 onwards. So there was a lag between the macroeconomic improvements and the performance of the banks. Looking more closely at the income and expense data shows that 2006 was time when the banks were able to substantially raise revenue and cut costs.

The second, hardly surprising, observation is that the capital gains tracked the movements in aggregate stock prices. As shown in the bottom of the table, the Nikkei 225 average showed two big jumps during this period, one between March 2003 and March 2004 and then a second between March 2005 and March 2006. Combining these two observations suggests that in the Japanese case the performance of the aggregate economy was paramount in the recovery of bank capital.

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<sup>18</sup> UFJ Holdings, 2004, Keiei no Kenzenka no tame no Keikaku no Gaiyo (Management Revitalization Plan: Abstract). ([http://www.fsa.go.jp/kenzenka/k\\_h160924/ufj\\_a.pdf](http://www.fsa.go.jp/kenzenka/k_h160924/ufj_a.pdf))

#### IV. The U.S. Crisis and Responses

Before diving into our evaluation it is helpful to review the key developments in the U.S. The problems for the U.S. financial system started with increased defaults of subprime and other nontraditional mortgage loans as the housing boom came to an end. During the housing boom of the 2000s, risky mortgage loans were securitized, structured into various types of financial products, and distributed to investors all around the world. But the risk diversification was far from complete and many financial institutions increased their ownership of real estate related assets. For example, Udell (2008) points out that large U.S. commercial banks increased the proportion of real estate loans in their portfolio from 44% in 2003 to 53% by 2007. As the underlying mortgages become non-performing, the values of their derivative securities declined, and the financial institutions that held the securities started to suffer losses. Given the leverage in the financial system these losses were significant relative to the equity of these firms (Greenlaw et al. (2008)).

By early 2008, the financial problem started to jeopardize the viability of large financial institutions. In March 2008, the Bear Stearns nearly failed and was rescued by JP Morgan with financial assistance from the Federal Reserve System.

By September, more financial institutions encountered serious funding problems and asked for government assistance. First, Fannie Mae and Freddie Mac, the two government sponsored mortgage giants, were rescued by the government. Shortly afterwards, Lehman Brothers, a major investment bank, also sought help. The government was reluctant to provide financial assistance to Lehman and encouraged other financial institutions to rescue it. No financial institutions were willing to step up without government help. Running out of alternatives, Lehman filed for bankruptcy on September 15.

Financial market conditions shifted notably in the week that followed. The cost of insuring the debt of many other financial institutions jumped noticeably. Stock markets around the world dropped sharply. A money market mutual fund informed investors that it would not be able to redeem claims at par value. Press reports described credit markets as frozen. One example being that financial firms' ability to issue commercial paper for more than a week seems to have disappeared: the average maturity of newly issued commercial paper dropped from over one month to less than 5 days. Another troubled investment bank, Merrill Lynch, was acquired by Bank of America. The U.S. government rescued the largest U.S. insurance company, AIG Insurance.

Toward the end of that week, the regulators announced several measures aimed at calming the markets. The Federal Reserve Bank decided to insure the money market funds. The Treasury announced the idea of setting up a facility to buy non-performing assets from financial institutions. The Securities Exchange Commission imposed a temporary ban on short sales of financial stocks.

The Treasury's idea was developed into the Troubled Asset Relief Program (TARP) and was included in the bill for the Emergency Economic Stabilization Act (EESA). Many politicians worried about committing \$700 billion on the program that would be run by the Treasury without much oversight, and the bill was initially voted down by the Congress. The government quickly revised the bill, adding some additional measures to stimulate the economy, and the revised bill passed the Congress on October 3.

The TARP, the central part of the bill, did not change very much in the revision.

Within a week, the Treasury started to shift the focus from the original idea of buying trouble assets to buying bank shares to increase the bank capital. On October 14, the Treasury announced that it would use \$125 billion to inject capital into nine large financial institutions by buying preferred shares with warrants to buy common shares. The Republicans lost the Presidential election on November 4. On November 12, the Treasury



announced that the original TARP plan of buying troubled assets would be postponed indefinitely.

In several important respects the problems facing the U.S. differ from the Japanese case, and the U.S. responses so far partially reflect these differences. Perhaps most important among these is that losses in the U.S. have not come from bad loans to businesses. Thus, there is no need to restructure or liquidate the borrowers' businesses. The social concerns over the massive displacement associated with wide-scale restructuring and the lack of political will to force this adjustment constituted a major stumbling block in Japan. This is one problem that is not yet present in the U.S. The major part of the U.S. problem is in non-performing mortgages and the securities backed by them. Restructuring mortgages involve different challenges than rehabilitating the industrial borrowers.

The critical question is whether the regulatory measures of the U.S. government will rebuild capital in the banking system. Here it appears that many of the same problems that were evident in Japan arise.

## **1. Evaluating the Asset Purchase Proposal in Light of the Japanese Experience**

First, consider the original version of the TARP that focused on government purchase of troubled assets. As of this writing, December 2008, the Treasury seems to have decided not to pursue this strategy, but some members of Congress continue to support this approach. One issue is whether the banks will want to sell their assets to the government. The possible stigma from participating and loss in the option value for the existing shareholders from a recovery will have to be overcome. Perhaps the easiest way to overcome these problems would be to pay more for the assets than the current market prices, assuming the banks have already marked the value of those assets to market. Doing so eliminates the stigma (since accepting a subsidy is rational for even a well-capitalized bank).

The law and the Treasury's intentions were never clear on how the prices for the assets would be set and the choice of assets to purchase would be determined. The law instructs the Treasury Secretary to "use the authority under this Act in a manner that will minimize any potential long-term negative impact on the taxpayer, taking into account the direct outlays, potential long-term returns on assets purchased, and the overall economic benefits of the program, including economic benefits due to improvements in economic activity and the availability of credit, the impact on the savings and pensions of individuals, and reductions in losses to the Federal Government."

In acquiring assets the Treasury was to "make such purchases at the lowest price that the Secretary determines to be consistent with the purposes of this Act."

If the current market prices of the distressed assets are below their fundamental values, as many market participants and government officials have suggested, this may create room for the government to pay substantially more than the market prices. But nobody knows how far the market prices are from the fundamental values and the Treasury sent mixed messages about whether it preferred to pay above prevailing market prices.<sup>19</sup>

Other regulatory measures that accompany the TARP would have also discouraged financial institutions from selling the assets to the Treasury. For example, the restrictions

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<sup>19</sup> For instance, there was considerable discussion over how the Treasury might design a reverse auction to minimize the cost to the Treasury of acquiring assets.

on the executive pay (if they were to have any teeth) may have stopped some banks from coming forward. Moreover, the ESSA mandated that the Securities and Exchange Commission study the impact of mark-to-market accounting on financial institutions and bank failures. If mark-to-market were suspended many banks may prefer not to sell their troubled assets since they might be able to carry those assets on their balance sheets at what they claim to be the fair value.

For the original TARP to recapitalize the banks successfully, the scale of the program would also be extremely important. There was little discussion of how the size of the program was determined. To judge the adequacy of \$700 billion program, it is important to recall that just in 2006 and 2007, over \$1.4 trillion of non-traditional mortgages were originated. With the U.S. economy in recession and contracting substantially at the end of 2008, there are bound to be many other impaired assets residing on bank balance sheets. So, if the original TARP was successful in getting participation, its size would have become the constraint.

Yet another impediment to using the original TARP to recapitalize would be the structure of most banks' liabilities. Suppose that the troubled assets purchased by the Treasury does raise the value of the troubled assets and hence the value of bank assets. This would also lead to an increase in the market value of the banks' liabilities. But banks have both debt and equity. For many of the largest banks their debt is trading below the face value. The debt is senior to the equity, hence for firms with debt this is not valued at par the increase in the value of the debt will limit the increases in the value of the equity. This logic suggests that for the original TARP to create capital the asset purchases would need to be targeted at firms whose debt was not impaired or had been restructured.

The final challenge that the original TARP would have faced is planning an orderly way to dispose of the assets. The law gives the Treasury Secretary full discretion over the timing of any sales, taking into consideration the goal of maximizing overall returns on the portfolio. Japanese AMCs, at least in their early years, just held on to the acquired assets. This approach is counter-productive, because people worried that these assets could be dumped at any time and the overhang can keep prices depressed. On the other hand, immediately dumping all the assets does not work, either. The prices would presumably move back to about their current levels, and reduce the prices of similar assets that the banks still own.

## 2. Evaluating the CPP in Light of the Japanese Experience

Turning to the CPP, which seems to be the central part of the TARP as of this writing, some different issues arise. Most important will be making sure that the banks do want to participate. The U.S. government was successful coercing the participation of major banks for a first round of equity purchases. But the cooperation came with some risky compromises. One similarity to the Japanese program was the offer of capital to all the largest banks without auditing to determine their health. The U.S. banks are also permitted to continue to pay dividends, which will redirect some of the money spent by the government. Finally, the banks that sold shares to the government were also allowed to rollover expiring debt between October 2008 and June 2009 with a government guarantee. We review the risks associated with each of these compromises in turn.

The implications of the lack of auditing are already apparent in the handling of the Citibank. According to the Wall Street Journal:<sup>20</sup>

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<sup>20</sup> "U.S. agrees to rescue struggling Citigroup", page A1, November 24, 2008.

In late September, the company reached an agreement for a government-financed acquisition of Wachovia Corp. Under that planned deal, Citigroup and the government were going to divvy up the losses on \$312 billion of assets, with Citigroup absorbing the first \$30 billion in losses and the government shouldering the remainder. Citigroup described that arrangement as intended to insulate it from Wachovia's risky mortgage assets. But Citigroup also would have been able to unload some of its own assets, according to people familiar with the matter.

Thus it was apparent that government was aware that Citigroup was in trouble in September. Nonetheless, in October Citigroup was able to participate in the first round of the CPP with the same terms as the other banks. A month later Citigroup required a second capital injection. The Wall Street Journal described the deliberations over the second round of assistance as<sup>21</sup>:

Inside the government it was far from clear that action was needed. Citigroup's stock price was tumbling, but there was no sense the company was in danger of failing. But over the weekend, as they pored through Citigroup's books, it became clear to top officials that the company needed government help.

If these reports are correct, then through November, the government was still making rescue decisions with limited information on the condition of the banks. The same news article quoted Stuart Plessner, an equity analyst at the credit rating agency Standard and Poor's, as saying "we are concerned that losses may eventually exceed the government's backstop."

In Japan the recovery started with the toughening of the regulatory audits. In the U.S. the analogy might involve using a common set of prices to evaluate the banks' portfolios. This would be imperfect since the banks continue to hold many illiquid assets, but doing so would establish the relative health of the banks, so that if further capital injections are needed the money could be concentrated on the best ones.

The Japanese banks were also allowed to pay dividends even after the 1999 recapitalization, but the Japanese banks that received capital were required to file Revitalization Plans and had to show that dividend payments were consistent with a path to recovery. Under the injections made in the first tranche of the CPP, banks were allowed to continue paying dividends on common stock, provided they made the payments to preferred shares, at the same rate they had been paying. Scharfstein and Stein (2008) estimated that this meant that in principle the nine TARP banks could have paid out just over \$25 billion of the \$125 billion in the first year – although with the second Citibank deal, Citi must seek government approval to pay any dividends, so the total maximum payout for the remaining banks would be just over \$22 billion.

Veronesi and Zingales (2008) attempt to quantify the size of the windfalls for debt holders as a result of the capital purchase program. Their core calculation presumes that by virtue of the debt guarantees that accompanied the capital purchases, the banks effectively can rollover their expiring debt at the same cost as the government faces. They approximate the savings as being equal to the change in the price of default insurance on the debt that occurred over the weekend when the CPP was announced. As they note, this calculation is confounded by the general equilibrium gains for the entire economy that might have been created by virtue of program. For instance, General Electric Capital (GE Capital), a financial services company that did not receive any funding in the first round of injections saw the cost of insuring its debt drop substantially. Veronesi and Zingales use the drop of the insurance premium for GE Capital as a benchmark and then compute any additional savings for the TARP nine banks. They find the debtholders at the TARP-9

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<sup>21</sup> "Citigroup faces pressure to slim down", page A1, November 25, 2008

saw their claims rise by about \$100 billion (over and above what would have been expected based on the change at GE Capital). While the GE Capital control is imperfect, their calculations suggest that the transfers to the debtholders may have been quite large.

Each of these concerns goes in the direction of suggesting that the money spent as part of the CPP may not increase the value of the equity and hence increase the risk bearing capacity of the banks. This is the purpose of the program and if the banking system emerges with too little capital, the program will likely be judged to have failed.

### 3. Risks for U.S. Looking Ahead

To gauge the amount of the funding required Table 8 reports selected data for the nine institutions that received capital under the October 14 agreement. The table shows the condition of the firms prior to these injections and includes the mergers that were completed through September.<sup>22</sup> The second and third columns of the table show the total assets and the off-balance sheet commitments to lend that were in place. We include commitment data because draw downs on commitments are largely outside the control of the banks. Once the Merrill Lynch and Bank of America merger is complete, the U.S. banking system will feature four giants firms that each have assets over \$1.8 trillion and have combined levels of commitments and assets of between \$3 and 4 trillion each.

The next four columns in the table present information intended to give hints about the exposure of the banks to further deterioration in the real estate market and the broader economy. These measures are all ratios where the denominators are the sum of total assets plus total commitments. The lending column ratio takes loans plus commitments to be the numerator of the ratio. The four giants have very different business models from the other banks, and in particular have a much higher risk of suffering substantial loan losses.

The next three measures disaggregate the banks' assets into those related to real estate, credit cards and other consumer exposures. The numerators are respectively, real estate loans and real estate related securities plus real estate related commitments; credit card loans to individuals plus credit card related securities and credit card commitments; and all other consumer loans and securities.

We draw two main conclusions from these indicators. First, the two biggest risks going forward relate to potential credit card losses and further real estate related losses. Second, there is remarkable heterogeneity across the banks in exposures to these two factors. Wells Fargo and the other smaller institutions have little credit card risk. In contrast, Wells, in part due to its acquisition of Wachovia, has by far the most real estate risk. On these figures, Citigroup looks somewhat insulated from real estate, but based on subsequent data that came to light around the time of the second capital injection, Citigroup had some legally separate real estate entities that it has taken back onto its balance sheet. Hence data through December will show Citigroup as having a larger real estate exposure. Without knowing the details of the loan provisioning at the bank level, we cannot be sure of the exact risks that each institution face, but it seems very likely that the exposures are heterogeneous.

The following column shows the ratio of total bank equity to total assets. Prior to the capital injections the banks also differed substantially on this dimension. Citigroup's need for extra capital is not surprising. One could also see why Wells Fargo would have been much less interested in taking on additional capital than the other institutions. These data

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<sup>22</sup> More specifically, the data for Wells Fargo includes Wachovia, the JP Morgan Chase data include Washington Mutual and Bear Sterns, the Bank of America includes Countrywide but not Merrill Lynch. In the next draft of the paper we will be able to update the data through December using the common regulatory filings required for bank holding companies.

may help to explain why some of the firms would have fought hard to preserve their right to pay dividends.

The final column shows the dividend payouts for the upcoming year that were permissible as of the first capital injection.<sup>23</sup> These numbers are based on the payout rates through the second quarter of the year. Besides being large in aggregate, the dividend payment patterns are consistent with the capital ratios. The three better capitalized giants were already paying substantially more than Citigroup.

Finally, in the period after the Lehman Brothers failure, it appears that a credit crunch has taken hold in the U.S. Data from surveys of bank loan officers has shown a progressive tightening of lending standards from the middle of 2007 onwards. Better evidence on this is provided by Ivashina and Scharfstein (2008). They focus on new lending to large borrowers and show that this type of bank lending dropped precipitously between August and October of 2008.

To demonstrate that this was not simply a change in loan demand associated with the deteriorating economy they present two pieces of evidence. First, they show that many companies drew down lines of credit even though they had no immediate need for cash. These pre-emptive draw downs were typically explained by the borrower's concern about credit availability given the disruptions in credit markets (see their Exhibit 2).

From Table 8 we can see that the proportion of unused loan commitments relative to existing assets varies substantially for the large banks. Ivashina and Scharfstein exploit this type of variation to see whether banks with relatively larger amounts of existing unused commitments (and hence potential future lending that they cannot control) are cutting back more current lending. They find part of the commitment differences are explained by the differences in deposits, as predicted by Kashyap, Rajan and Stein (2002), and controlling for deposits, the banks with more unused commitments have reduced lending more.

Based on Table 8 the \$145 billion that has been injected into these major banks looks small. It is less than 1% of total assets and commitments, and less than 5% of banks' exposure to the real estate or credit cards. Although this very crude comparison ignores the existent provisioning, it shows that the risk capital injections through the CPP turn out to be insufficient to solve the capital shortage and credit crunch.

## V. Conclusions

The U.S. financial system is in very fragile shape. As in the recent Japanese financial crisis, the shortage of capital is the fundamental problem that must be fixed. The U.S. bailout plan was originally very similar to the Japanese approach before the late 1990s in that it does not clearly identify the capital problem as critical and instead proposed using AMCs to remove distressed assets from bank balance sheets. When Japan used AMCs, their effectiveness was limited in part because they did not purchase enough assets. AMCs did not help recapitalization, either, and Japan had to come up with different mechanisms to use public funds for recapitalization. Both these risks are also present for the U.S. plan.

Subsequent to the Congressional debate over the TARP and the testimony over its purpose, the Treasury has shifted the focus to the capital purchase program. Japan teaches us that challenges related to capital injections differ somewhat from the challenges related to asset purchases. Inducing banks to participate is one factor. It is also critical to make

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<sup>23</sup> We thank David Scharfstein for supply these figures. Note that Citigroup is restricted following its second capital injection.

sure that enough money is spent so that banks actually emerge adequately capitalized. Finally, care should be taken not to waste money propping up financial institutions that will ultimately fail. To deal with these issues, the details of the recapitalization program are important. Without careful thinking of the details, even a well-intentioned program could go awry.

Finally, the U.S. response to the crisis has been much faster and more aggressive than in Japan. Compressing so many policy changes, including several policy reversals, into such a short period has created a very fluid environment. Japan's prolonged response meant that its various policies were expiring at different times. For the U.S., many temporary programs will need to be renewed or terminated in 2009. This suggests that discussions regarding an exit strategy for many of these interventions will have to be compressed as well.

## References

- Baldwin, Richard and Barry Eichengreen, 2008, Rescuing our Jobs and Savings: What G7/8 Leaders Can Do To Solve the Global Credit Crisis, VoxEU.org, London.
- Caballero, Ricardo J., Hoshi, Takeo and Anil K Kashyap, 2008, "Zombie Lending and Depressed Restructuring in Japan", *American Economic Review*, forthcoming.
- Cargill, Thomas, Michael Hutchison, and Takatoshi Ito, 2001, *Financial Policy and Central Banking in Japan*, Cambridge, MA: MIT Press.
- Fukao, Mistushiro, 2000, "Recapitalizing Japan's Banks: The functions and problems of Financial Revitalization Act and Bank Recapitalization Act", *Keio Business Review*, 38, pp. 1-16.
- Fukao, Mitsuhiro, 2003, "Financial sector profitability and double gearing," in *Structural Impediments to Growth in Japan*, Magnus Blomstrom, Jenny Corbett, Fumio Hayashi, and Anil Kashyap (eds.), Chicago: University of Chicago Press, pp. 9-35.
- Fukao, Mitsuhiro, 2008, "Beikoku-hatsu Kin'yu Kiki to Nihon no Kin'yu System (Global Financial Crisis and Japanese Financial System)", Japan Center for Economic Research, Financial Study No. 19, October 2008.
- Fukuda, Shin-ichi, 2008, "The Role of Monetary Policy under Financial Turbulence: What Role did the Quantitative Easing Policy Play in Japan?" CIRJE Discussion Paper, J-205.
- Greenlaw, David, Hatzius, Jan, Kashyap, Anil K, and Hyun Song Shin, 2008, "Leveraged Losses: Lessons from the Mortgage Market Meltdown", *Proceedings of the U.S. Monetary Policy Forum No. 2*, Rosenberg Institute, Brandeis International Business School and Initiative on Global Markets, University of Chicago Booth School of Business. Hoshi, Takeo, and Anil K Kashyap, 2000, "The Japanese Banking Crisis: Where did it come from and how will it end?" *NBER Macroeconomics Annual* 1999, pp.129-201.
- Hoshi, Takeo and Anil K Kashyap, 2001, *Corporate Financing and Governance in Japan: The Road to the Future*, MIT Press, Cambridge: MA.
- Hoshi, Takeo and Anil K Kashyap, 2005, "Solutions to Japan's Banking Problems: What might work and what definitely will fail" in Takatoshi Ito, Hugh Patrick, and David Weinstein eds., *Reviving Japan's Economy: Problems and Prescriptions*, MIT Press, pp. 147-195.
- Ito, Takatoshi, and Kimie Harada, 2005, "Japan Premium and Stock Prices: Two Mirrors of Japanese Banking Crises," *International Journal of Finance and Economics*, 10, 195-211.
- Ivashina, Victoria and David Scharfstein, 2008, "[Bank Lending During the Financial Crisis of 2008](#)", mimeo, Harvard Business School.
- Kashyap, Anil K, 2002, "Sorting out the Japan's Financial Crisis", *Economic Perspectives*, Federal Reserve Bank of Chicago, 2002/Q4, pp. 42-256.

- Kashyap, Anil K, Stein, Jeremy C., and David W. Wilcox, 1993, "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance", *American Economic Review*, vol. 83(1), pp. 78-98.
- Kashyap, Anil K, Rajan, Raghuram G. and Jeremy C. Stein, "Banks as Liquidity Providers: An Explanation for the Co-Existence of Lending and Deposit-Taking," *Journal of Finance*, 2002, LVII(1), pp. 33-74.
- Motonishi, Taizo and Hiroshi Yoshikawa, 1999, "Causes of the Long Stagnation of Japan during the 1990s: Financial or Real?", *Journal of the Japanese and International Economies*, 13, pp. 181-200.
- Nakaso, Hiroshi, 2001, "The Financial Crisis in Japan during the 1990s: How the Bank of Japan Responded and the Lessons Learned," BIS Papers No.6.
- Omura, Keiichi, Shinji Mizukami, and Yoichi Yamazaki (2002). "Kōteki Shikin ni yoru Shihon Chūnyū Hōshiki ni tuite (On the Method of Capital Injection using Public Funds)," Director General for Economic Assessment and Policy Analysis, Cabinet Office, Discussion Paper 02-1.
- Omura, Keiichi, Shinji Muzukami, and Ken-ichi Kawaguchi, 2006, "Kin'yū System Antei-ka Seisaku no Kenshō (Evaluation of the Financial System Stabilization Policy)," Waseda University Institute of Finance, Working Paper 06-005.
- Packer, Frank, 2000, "The Disposal of Bad Loans in Japan: The Case of CCPC," in *Crisis and Change in the Japanese Financial System*. Takeo Hoshi and Hugh Patrick, eds. Boston, Mass.: Kluwer Academic Publishers, pp. 137-57.
- Peek, J., and E. Rosengren (2001), "Determinants of the Japan Premium: Actions Speak Louder than Words," *Journal of International Economics*, Vol. 53, No. 2, pp. 283-305.
- Peek, Joe and Eric S. Rosengren, 2005, "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan", *American Economic Review*, 95(4), pp. 1144-1166.
- Peek, Joe, 2008, "The Contribution of Bank Lending to the Long-Term Stagnation in Japan", mimeo, University of Kentucky.
- Scharfstein, David S. and Jeremy C. Stein, 2008, "The Bailout Doesn't Pay Dividends", *New York Times*, October 20, 2008.
- Takenaka, Heizo, 2006, *Kōzō Kaikaku no Shinjitsu: Takenaka Heizo Daijin Nisshi (True Story on Structural Reform: Diary of Minister Heizo Takenaka)*. Tokyo, Japan: Nihon Keizai Shimbun Shuppan.
- Tett, Gillian, 2003, *Saving the Sun: A Wall Street Gamble to Rescue Japan from its Trillion-Dollar Meltdown*, Harper-Collins: New York, NY.
- Udell, Gregory F., 2008, "Wall Street, Main Street and a Credit Crunch: Some Thoughts on the Current Financial Crisis," *Business Horizons*, forthcoming.
- Veronesi, Pietro and Luigi Zingales, 2008, "Paulson's Gift", mimeo, University of Chicago Booth School of Business.



**Table 1: Asset Management Companies in Japan**

(¥ Trillion)

Name	Dates (purchases)	Target Purchases	Actual Amount Spent [book value]	Amount Collected	Comments
Cooperative Credit Purchasing Co. (CCPC)	12/1992-3/2001	Non-performing loans with land collateral of contributing banks	5.8 [15.4]	NA	Bank financed, created tax benefits by buying loans Liquidated in 3/2004
Tokyo Kyodo Bank	1/1995-4/1999	Initially assets of failed credit unions, later assets of any failed banks	4.718 [NA]	5.362	Reorganized as Resolution and Collection Bank (RCB) in 9/1996
Housing Loan and Administration Corp. (HLAC)	7/1996-4/1999	Loans of failed <i>jusen</i> (specialty housing loan companies)	4.656 [NA]	3.233	Financed with mix of public and private money
Resolution and Collection Corp.	4/1999-6/2005	Combined RCB and HLAC, mandate extended to allow purchases of assets from solvent banks	0.356 [4.046]	0.649	Starting in 2001 also reorganized loans, ultimately involved in restructuring 577 borrowers
Industrial Revitalization Corp. of Japan	5/2003-3/2005	Buy non-performing loans through 2005, restructure them within 3 years	0.53 [0.97]	NA [0.094 surplus as of 5/2007]	Restructured 41 borrowers with 4 trillion total debt Closed in 5/2007

**Table 2: Loan Losses in Japan**

(¥ Trillion)

Date	Loan Losses	Cumulative Loan Losses since 4/1992	Number of Major Banks
3/1994	3.872	5.512	21
3/1995	5.232	10.744	21
3/1996	13.369	24.113	20
3/1997	7.763	31.877	20
3/1998	13.258	45.135	20
3/1999	13.631	58.766	17
3/2000	6.944	65.710	18
3/2001	6.108	71.818	18
3/2002	9.722	81.540	15
3/2003	6.658	88.198	13
3/2004	5.374	93.572	13
3/2005	2.848	96.420	13
3/2006	0.363	96.783	11
3/2007	1.046	97.829	11
3/2008	1.124	98.953	11

Table 3: Capital Injection Programs in Japan

(¥ Trillion)

Legislation	Date	Securities Used	Number of financial institutions (# with nonzero outstanding balance)	Amount Injected	Amount Sold or Collected to date (as of September 2008)
Financial Function Stabilization Act	3/1998	Preferred shares, subordinated debt	21 (2)	1.816	1.653 [1.626 (book)]
Prompt Recapitalization Act	3/1999 - 3/2002	Preferred shares, subordinated debt	32 (10)	8.605	8.820 [7.556 (book)]
Financial Reorganization Promotion Act	9/2003	Subordinated debt	1 (0)	0.006	0.006 [0.006 (book)]
Deposit Insurance Act (Article 102-1)	6/2003	Common shares, preferred shares	1 (1)	1.960	0.611 [0.017 (book)]
Act for Strengthening Financial Functions	11/2006- 12/2006	Preferred shares	2 (2)	0.041	0.000

Table 4a March 1998 Capital Injection Terms

(¥ billion)

	S&P Rating	Total Funds	Preferred shares					Subordinated debt/loans			
			Type	Amount	dividend rate	Conversion start date	Forced conversion date	Type	Amount	yield for 5 years	yield after 6th year
City banks											
Dai-ichi Kangyo	BBB+	99	CPS	99	0.75	7/1/1998	8/1/2005				
Fuji	BBB+	100						SDP	100	L+1.10	L+2.60
Sakura	BBB	100						SDP	100	L+1.20	L+2.70
Sanwa	A-	100						SD10	100	L+0.55	L+1.25
Sumitomo	A-	100						SDP	100	L+0.90	L+2.40
Tokyo Mitsubishi	A	100						SDP	100	L+0.90	L+2.40
Asahi	BBB+	100						SLP	100	L+1.00	L+2.50
Daiwa	BBB-	100						SLP	100	L+2.70	L+2.70
Tokai	BBB+	100						SDP	100	L+0.90	L+2.40
Long-term Credit bank											
Industrial Bank of Japan	A-	100	CPS	130	1.00	10/1/1998	4/1/2008	SD10	100	L+0.55	L+1.25
LTCB of Japan	BBB-	177.6						SLP	46.6	L+2.45	L+3.95
Nippon Credit Bank	NR	60	CPS	60	1.00	10/1/1998	4/1/2018				
Trust banks											
Mitsubishi Trust	A-	50	CPS	32	2.50	7/1/1998	8/1/2018	SDP	50	L+1.10	L+2.60
Sumitomo Trust	A-	100						SDP	100	L+1.10	L+2.60
Mitsui Trust	BBB+	100						SDP	100	L+1.45	L+2.95
Chuo Trust	NR	60						SLP	28	L+2.45	L+3.95
Toyo Trust	NR	50						SDP	50	L+1.10	L+2.60
Regional Bank											
Bank of Yokohama	BBB	20						SLP	20	L+1.10	L+2.60
Hokuriku Bank	NR	20						SLP	20	L+2.45	L+3.95
Ashikaga Bank	NR	30						SDP	30	L+2.95	L+4.45

Notes. L: 6-month yen LIBOR, CPS: Convertible Preferred Shares, SDP: Perpetual Subordinated Debt, SLP: Perpetual Subordinated Loan, SD10: 10-year Subordinated Debt. S&P Rating is for the long-term debt. We thank Kaoru Hosono for sharing the rating data.

(¥ billion)

	S&P Rating	Total Funds	Preferred shares					Subordinated debt/loans				
			Type	Amount	dividend rate	Conversion start date	Forced conversion date	Type	Amount	yield	yield after step-up	step-up date
City banks												
Dai-ichi Kangyo	BBB	900	CPS	200	0.41	8/1/2004	8/1/2006	SD10	100	L+0.75	L+1.25	4/1/2004
			CPS	200	0.70	8/1/2005	8/1/2008	SD11	100	L+0.75	L+1.25	4/1/2005
			NCPS	300	2.38							
Fuji	BBB+	1,000	CPS	250	0.40	10/1/2004	2/1/2009	SDP	200	L+0.65	L+1.35	4/1/2004
			CPS	250	0.55	10/1/2006	2/1/2011			L+2.15	L+1.35	4/1/2009
			NCPS	300	2.10							
Sakura	BBB	800	CPS	800	1.37	10/1/2002	10/1/2009					
Sanwa	BBB+	700	CPS	600	0.53	7/1/2001	8/1/2008	SDP	100	L+0.34	L+1.34	10/1/2004
Sumitomo	BBB+	501	CPS	201	0.35	5/1/2002	2/27/2009					
			CPS	300	0.95	8/1/2005	2/27/2009					
Asahi	BBB+	500	CPS	300	1.15	7/1/2002	12/1/2009	SLP	100	L+1.04	L+2.54	4/1/2009
			CPS	100	1.48	7/1/2003	12/1/2014					
Daiwa	BB+	408	CPS	408	1.06	6/30/1999	4/1/2009					
Tokai	BBB-	600	CPS	300	0.93	7/1/2002	3/31/2009					
			CPS	300	0.97	7/1/2003	3/31/2009					
Long-Term Credit												
Industrial Bank of Japan	BBB+	600	CPS	175	0.43	7/1/2003	9/1/2009	SDP	250	L+0.98	L+1.48	4/1/2004
			CPS	175	1.40	9/1/2003	9/1/2009					
Trust banks												
Mitsubishi Trust	BBB	300	CPS	200	0.81	7/31/2003	8/1/2008	SDP	100	L+1.75	L+2.25	4/1/2004
Sumitomo Trust	BBB	200	CPS	100	0.76	4/1/2001	3/31/2009	SD12	100	L+1.53	L+2.03	4/1/2006
Mitsui Trust	BBB-	400	CPS	250.3	1.25	7/1/1999	8/1/2009	SLP	150	L+1.49	L+1.99	3/31/2004
Chuo Trust	NR	150	CPS	150	0.90	7/1/1999	8/1/2009					
Toyo Trust	NR	200	CPS	200	1.15	7/1/1999	8/1/2009					
Regional Bank												
Bank of Yokohama	BBB	200	CPS	70	1.13	8/1/2001	7/31/2009	SDP	50	L+1.65	L+2.15	4/1/2004
			CPS	30	1.89	8/1/2004	7/31/2009	SL10	50	L+1.07	L+1.57	4/1/2004

Notes: L: 6-month yen LIBOR, CPS: Convertible Preferred Shares, SDP: Perpetual Subordinated Debt, SLP: Perpetual Subordinated Loan, SDn: n-year Subordinated Debt. S&P Rating is for the long-term debt. We thank Kaoru Hosono for sharing the rating data.

(¥ Trillion)

Date	Official Core capital	Deferred Tax Assets	Estimated Under-reserving	Modified Capital	Capital held by the government	Bank Assets	Capital Gap
	A	B	C	D=A-B-C	E	F	G=0.03*F-D
Mar-96	27.9	0.0	NA	27.9	0.0	846.5	-2.5
Mar-97	28.5	0.0	15.0	13.5	0.0	856.0	12.2
Mar-98	24.3	0.0	4.9	19.4	0.3	848.0	6.0
Mar-99	33.7	8.4	4.0	21.3	6.3	759.7	1.5
Mar-00	35.6	8.2	5.8	21.6	6.9	737.2	0.5
Mar-01	37.6	7.1	7.5	23.0	7.1	804.3	1.1
Mar-02	30.2	10.6	6.8	12.8	7.2	756.1	9.9
Mar-03	24.8	10.6	5.4	8.8	7.3	746.3	13.6
Mar-04	29.0	7.2	5.7	16.1	8.9	746.7	6.3
Mar-05	31.4	5.7	6.9	18.8	8.1	745.9	3.6
Mar-06	37.3	2.3	8.3	26.7	5.2	766.9	-3.7
Mar-07	40.0	1.3	9.4	29.4	3.5	761.1	-6.5
Mar-08	34.8	3.6	10.2	21.0	3.1	780.7	2.4

**Source::** Assets and core capital are from the Bank of Japan for all domestically licensed banks. Deferred tax and under-reserving estimates are from Fukao (2008) based on "Analysis of Bank Financial Statements," various issues and securities reports for individual banks.

**Note:** Core capital, sometimes referred to as Tier I capital, includes equity capital and capital reserves. Fukao also estimates that prior to 2001 there were substantial unrealized portfolio gains that could have been available as capital. The after tax amounts he reports from 1996 to 2000 are 12.8, 6.7, 3.1, 2.6 and 6.1 trillion yen respectively.

**Table 6: Capital Evolution for Japanese Banks 2003-2007**

(¥Trillion and percent)

	March-07	March-03	Change	Percent contribution to change
<b>Official Capital</b>	<b>40.0</b>	<b>24.8</b>	<b>15.2</b>	<b>100.00%</b>
Common stock	9.3	10.2	-0.9	-6.13%
Capital surplus	8.7	8.6	0.1	0.39%
Retained earnings	13.4	4.4	9.0	59.07%
Net unrealized gains on stocks and others	8.2	0.1	8.1	53.25%
Revaluation reserve for land	1.0	1.5	-0.6	-3.70%
Net deferred gains on hedging instruments	-0.3	0	-0.3	-2.07%

Note: Some small components have been omitted and because of this and rounding columns may not sum to totals.

**Table 7: Profit Decomposition for Japanese Banks 2004-2007**

(¥ Trillion, except Nikkei and GDP growth)

	Cumulative (3/04-7/03)	March-07	March-06	March-05	March-04	March-03	Difference (3/07-3/04)
Net income	8.1	3.4	4.2	1.3	-0.8		4.2
Operating profits	11.5	4.3	4.8	1.9	0.5		
Extraordinary profits - Extraordinary losses	2.8	0.4	1.2	0.7	0.5		
Operating income		19.2	18.0	16.9	17.6		1.6
Operating expenses		14.9	13.3	15.0	17.0		-2.2
Unrealized capital gains		8.2	6.8	3.7	3.1		
Nikkei 225		17,287	17,059	11,688	11,715	7,973	
GDP growth (percent change from one year earlier)		1.7	2.5	2.4	2.0	2.1	

**Table 8: Selected Data on Major Institutions Participating in the TARP**

(\$Billion, and percent)

Data as of September 2008 (except Morgan Stanley and Goldman Sachs as August)			Exposure to					
Name	Total Assets	Total Commitments	Lending	Real Estate	Credit Card	Other Consumer	Equity/ Assets	Max Dividend Payout
JPMORGAN CHASE	2,251.5	1,223.6	57.8%	19.2%	25.3%	1.8%	6.5%	5.67
BANK OF AMERICA	1,836.5	1,423.1	73.3%	29.4%	28.8%	3.0%	8.8%	5.84
MERRILL LYNCH	875.8	123.7	20.0%	8.8%	0.0%	0.5%	4.4%	2.22
STATE STREET CORP	286.7	50.9	20.3%	7.4%	1.1%	2.7%	4.6%	0.41
CITIGROUP	2,050.1	1,560.0	65.0%	12.4%	32.9%	4.3%	6.1%	3.49
BANK OF NY MELLON	267.6	45.5	33.4%	9.9%	0.2%	0.4%	10.3%	1.10
WELLS FARGO (includes Wachovia)	1,382.9	476.9	75.5%	45.7%	6.2%	5.2%	7.0%	4.52
MORGAN STANLEY	987.4	162.0	15.8%	21.9%	0.0%	0.0%	3.6%	1.20
GOLDMAN SACHS	1,081.8	78.5	9.3%	8.3%	0.0%	0.0%	4.2%	0.55
<b>TOTAL</b>	<b>11,020.3</b>	<b>5,144.3</b>	<b>54.5%</b>	<b>21.1%</b>	<b>19.3%</b>	<b>2.6%</b>	<b>6.3%</b>	<b>25.0</b>
Note: Combined Merrill Lynch and Bank of America	2,712.2	1,546.8	60.8%	24.5%	22.0%	2.4%	7.4%	8.1

Figure 1: Land Prices in Japan and the U.S.

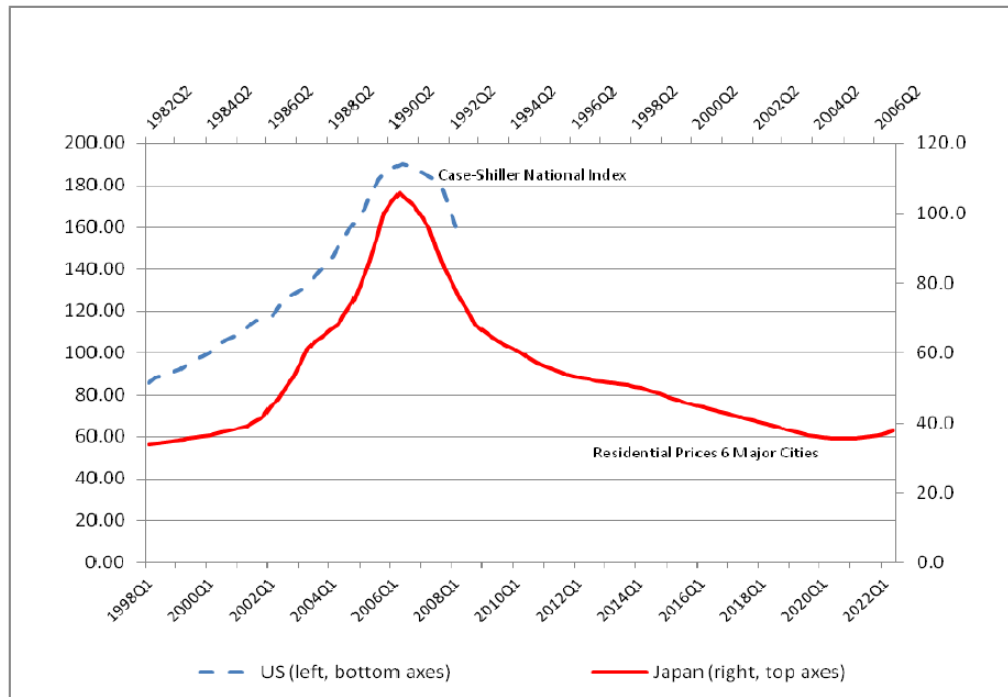


Figure 2: Japan Premium: 3-month Euro-dollar TIBOR minus 3-month Euro-dollar LIBOR

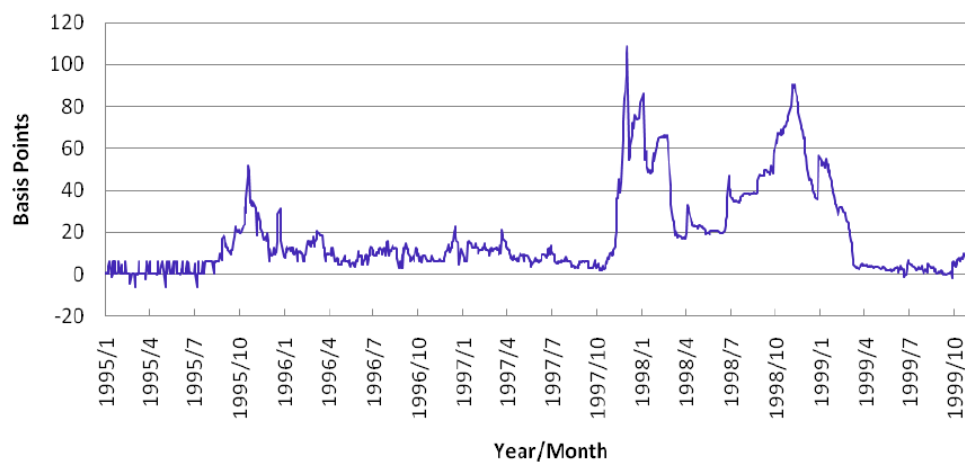


Figure 3: Difference Between the Daily Maximum and Minimum Overnight Call Rate

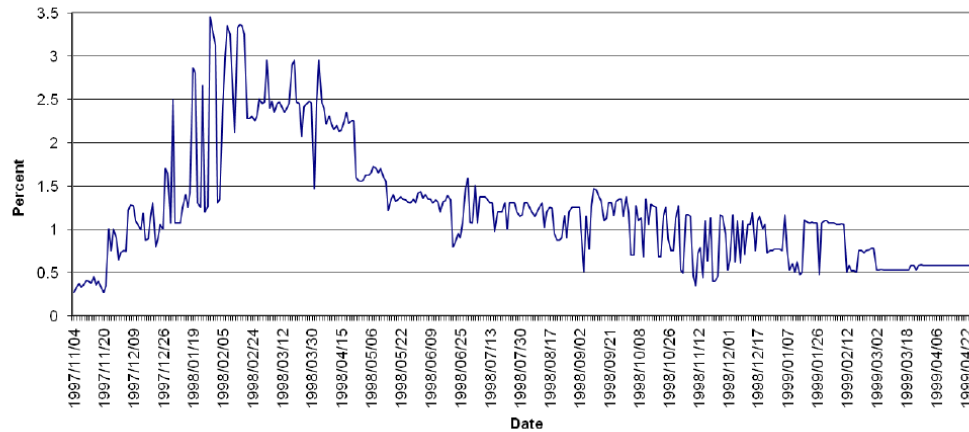
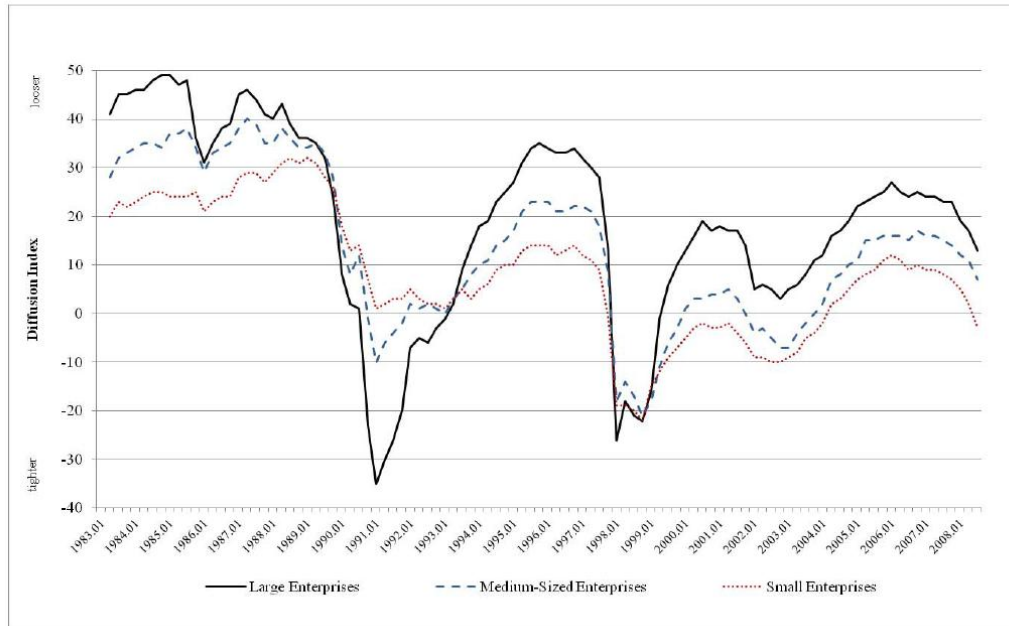


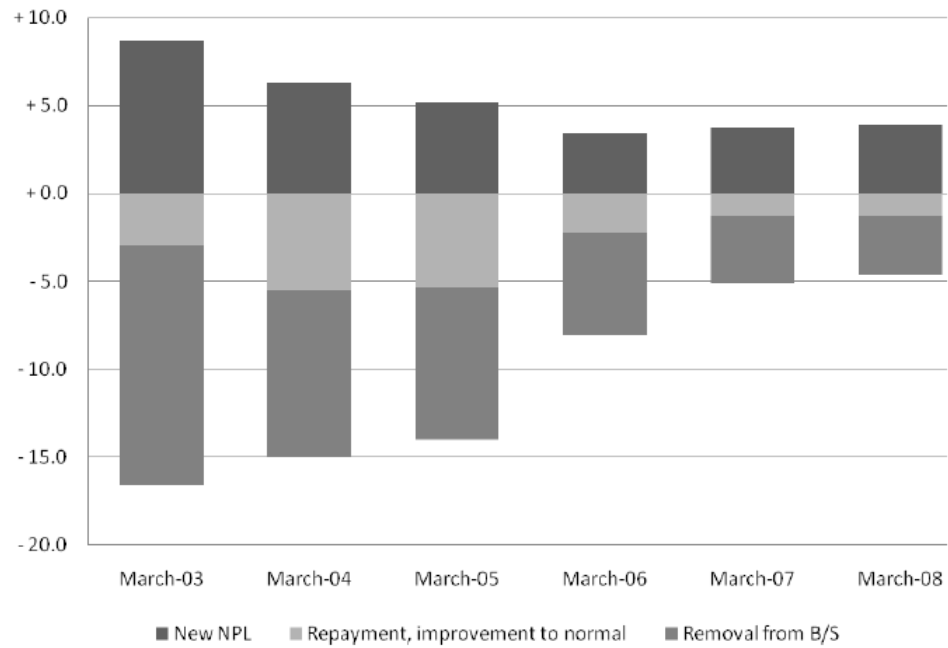
Figure 4: Survey Data on Lending Attitude of Japanese Banks

(Difference Between the Percent of Respondents Reporting Looser and Reporting Tighter)



**Figure 5: Changes in Non Performing Loans**

(₩ Trillion)





# Financial Intermediation and the Post-Crisis Financial System with Implications for Korea\*

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## Abstract

Securitization was meant to disperse credit risk to those who were better able to bear it. In practice, securitization appears to have concentrated the risks in the financial intermediary sector itself. This paper outlines an accounting framework for the financial system for assessing the impact of securitization on financial stability. If securitization leads to the lengthening of intermediation chains, then risks become concentrated in the intermediary sector with damaging consequences for financial stability. Covered bonds are one form of securitization that do not fall foul of this principle. I discuss the role of countercyclical capital requirements and the Spanish-style statistical provisioning in mitigating the harmful effects of lengthening intermediation chains. For Korea, the stability of funding emerges as a key consideration. Covered bonds may play a role in stabilizing the funding arrangement for banks.

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## I. Introduction

The recent financial crisis has the distinction of being the first post-securitization crisis in which banking and capital market developments have been closely intertwined. Historically, banks have always reacted to changes in the external environment, expanding and contracting lending in reaction to shifts in economic conditions. However, in a market-based financial system built on securitization, banking and capital market developments are inseparable, and the current crisis is a live illustration of the potency of the interaction between the two.

Securitization was meant to disperse credit risk to those who were better able to bear it, but in the financial crisis the risks appear to have been concentrated in the financial intermediary sector itself, rather than with the final investors. To understand the true role played by securitization in the financial crisis, we need to dispose of two pieces of received wisdom concerning securitization - one old and one new. The old view, now discredited, emphasized the positive role played by securitization in dispersing credit risk, thereby enhancing the resilience of the financial system to defaults by borrowers.

But having disposed of this old conventional wisdom, the fashion now is to replace it with a new one that emphasizes the chain of unscrupulous operators who passed on bad loans to the greater fool next in the chain. We could dub this new fashionable view the "hot potato" hypothesis, since the bad loan is like a hot potato passed down the chain. The idea is attractively simple, and there is a convenient villain to blame, and so has figured in countless speeches given by central bankers and politicians on the causes of the subprime crisis.

But the new conventional wisdom is just as flawed as the old one. Not only does it fall foul of the fact that securitization worked well for thirty years before the subprime crisis, it fails to distinguish between selling a bad loan down the

	Total reported sub-prime exposure (US\$bn)	Percent of reported exposure
Investment Banks	75	5%
Commercial Banks	418	31%
GSEs	112	8%
Hedge Funds	291	21%
Insurance Companies	319	23%
Finance Companies	95	7%
Mutual and Pension Funds	57	4%
Leveraged Sector	896	66%
Unleveraged Sector	472	34%
Total	1,368	100%

Figure 1.1: Subprime exposures by type of institution (source: Greenlaw, Hatzius, Kashyap and Shin (2008))

chain and issuing liabilities backed by bad loans. By selling a bad loan, you get rid of the bad loan and it's someone else's problem. In this sense, the hot potato is passed down the chain to the greater fool next in the chain. However, the second action has a different consequence. By issuing liabilities against bad loans, you do not get rid of the bad loan. The hot potato is sitting on your balance sheet or on the books of the special purpose vehicles that you are sponsoring. Thus, far from passing the hot potato down the chain to the greater fool next in the chain, you end up keeping the hot potato. In effect, the large

financial intermediaries are the last in the chain. While the investors who buy your securities will end up losing money, the financial intermediaries that have issued the securities are in danger of larger losses. Since the intermediaries are leveraged, they are in danger of having their equity wiped out, as some have found to their cost.

Indeed, Greenlaw, Hatzius, Kashyap and Shin (2008) report that of the approximately 1.4 trillion dollar total exposure to subprime mortgages, around half of the potential losses were borne by

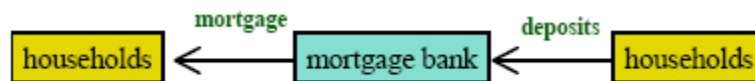


Figure 1.2: Short Intermediation Chain

US leveraged financial institutions, such as commercial banks, securities firms and hedge funds. When foreign leveraged institutions are included, the total exposure of leveraged financial institutions rises to two thirds (see Figure 1.1). Far from passing on the bad loans to the greater fool next in the chain, the most sophisticated financial institutions amassed the largest exposures to the bad assets.

A characteristic feature of financial intermediation based on the US-style securitization system is the long chains financial intermediaries involved in channeling funds from the ultimate creditors to the ultimate borrowers. The difference can be illustrated in figures 1.2 and 1.3. Figure 1.2, depicts a traditional deposit taking bank that collects deposits and holds mortgage assets against household borrowers. Until around 1990, the bulk of home mortgage assets in the United States were held by savings institutions and commercial banks (see Adrian and Shin (2008)).

In recent years, however, the proportion of home mortgages held in government sponsored enterprise (GSE) mortgage pools have become the dominant holders. The chain of financial intermediation has become correspondingly much longer and more heavily dependent on overall capital market conditions. Figure 1.3 illustrates one possible chain of lending relationships whereby credit flows from the ultimate creditors (household savers) to the ultimate debtors (households who obtain a mortgage to buy a house). In this illustration, the mortgage asset is held in a mortgage pool - a passive firm whose sole role is to hold mortgage assets and issue liabilities (mortgage-backed securities, MBSs) against those assets.

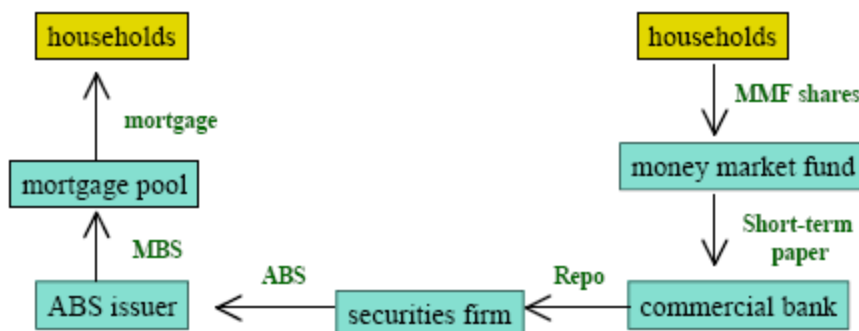


Figure 1.3: Long Intermediation Chain

The mortgage-backed securities might then be owned by an asset-backed security (ABS) issuer who pools and tranches the MBSs into another layer of claims, such as collateralized debt obligations (CDOs). Then, a securities firm (a Wall Street investment bank, say) might hold CDOs on their own books for their yield, but finances such assets by collateralized borrowing through repurchase agreements (repos) with a larger commercial bank. In turn, the commercial bank would fund its lending to the securities firm by issuing short term liabilities, such as financial commercial paper. Money market mutual funds would be natural buyers of such short-term paper, and ultimately the money market fund would complete the circle, since household savers would own shares to these funds.

Of course, the illustration in Figure 1.3 is a simple example of potentially much more complex and intertwined relationships. For instance, the same security could be used several times in repo lending as the lender turns round and pledges the same security as collateral to another lender (the practice known as "re-hypothecation"). In that case, the chain would be much longer and more involved. Nor does the illustration take account of off-balance sheet vehicles such as structured investment vehicles (SIVs) or ABCP conduits that the commercial bank might set up in order to finance the direct holding of CDOs and other asset-backed securities.

What is noticeable from the institutions involved in Figure 1.3 is that they were precisely those institutions that were at the sharp end of the financial crisis of 2007 and 2008. Subprime mortgages cropped up in this chain, and the failure of Bear Stearns and Lehman Brothers owed to problems in the smooth function of this chain. This realization begs the question of what advantages can be gained by such long intermediation chains.

One possible argument might be that securitization enables the dispersion of credit risk to those who can best bear losses. We have already commented on the apparent failure of this particular mechanism, but we will return to examine it more closely below. Leaving that to one side, another possible justification for long intermediation chains is that there is an inherent need for maturity transformation in the financial system because ultimate creditors demand short-term claims, and that the process of stringing together long lending relationships make it easier to perform the overall maturity transformation role.

There are well known arguments for the desirability of short-term debt for incentive reasons - in particular in disciplining managers. Calomiris and Kahn (1991) have argued that demand deposits for banking arose naturally as a response by the bank's owners and managers to commit not to engage in actions that dissipate the value of the assets, under pain of triggering a depositor run. Diamond and Rajan (2001) have developed this argument further, and have argued that the coordination problem inherent in a depositor run serves as a commitment device on the part of the depositors not to renegotiate in the face of opportunistic actions by the managers. When the bank has the right quantity of deposits outstanding, any attempt by the banker to extort a rent from depositors will be met by a run, which drives the banker's rents to zero. Foreseeing this, the banker will not attempt to extort rents. In a world of certainty, the bank maximizes the amount of credit it can offer by financing with a rigid and fragile deposit-only capital structure.

However, in both Calomiris and Kahn (1991) and Diamond and Rajan (2001), the focus is on traditional bank deposits, where the creditors are not financial intermediaries themselves. However, what is notable about the financial boom and bust cycle witnessed recently is that the largest fluctuations in ultra short term debt has not been associated with the liabilities to retail depositors, but rather with the liabilities to other financial intermediaries. Adrian and Shin (2009) compare the stock of repurchase agreements of US primary dealers plus the stock of financial commercial paper expressed as a proportion of the M2 stock. M2 includes the bulk of retail deposits and holdings in money market mutual funds, and so is a good proxy for the total stock of liquid claims held by ultimate creditors against the financial intermediary sector as a whole. As recently as the early 1990s, repos and financial CP were only a quarter of the size of M2. However, the total

rose rapidly reaching over 80% of M2 by the eve of the financial crisis in August 2007, only to collapse with the onset of the crisis.

The ultra-short nature of the financial intermediary obligations to each other can be better seen when plotting the overnight repos component of the overall repo series. Figure 1.4 plots the size of the overnight repo stock, financial commercial paper and M2, normalized to be equal to 1 on July 6th, 1994 (the data on overnight repos are not available before that date). The stock of M2 has grown by a factor of around 2.4 since 1994, but the stock of overnight repos grew almost seven-fold up to March 2008. Brunnermeier (2009) has noted that the use of overnight repos became so prevalent that, at its peak, the Wall Street investment banks were rolling over a quarter of their balance sheets every night. What is evident from Figure 1.4 is that the rapid growth and subsequent collapse of the overnight repos cannot be easily explained by the demand for short-term liquid claims of retail depositors.



Figure 1.4: Overnight repos, financial commercial paper and M2 (normalized to 1 on 6 July 1994)

## II. An Accounting Framework

Consider a stylized financial system for the allocation of credit in the economy depicted in Figure 2.1. The financial system channels savings from the lenders to ultimate borrowers. The ultimate lenders are households, either directly or indirectly through institutions such as pension funds, mutual funds and life insurance companies.

Some credit will be directly provided from the lender to the borrower. Treasury bonds or municipal bonds are a good example of such direct credit where the lender holds a direct claim on the borrower. However, the sizeable borrowing of the household sector - either mortgages or consumer

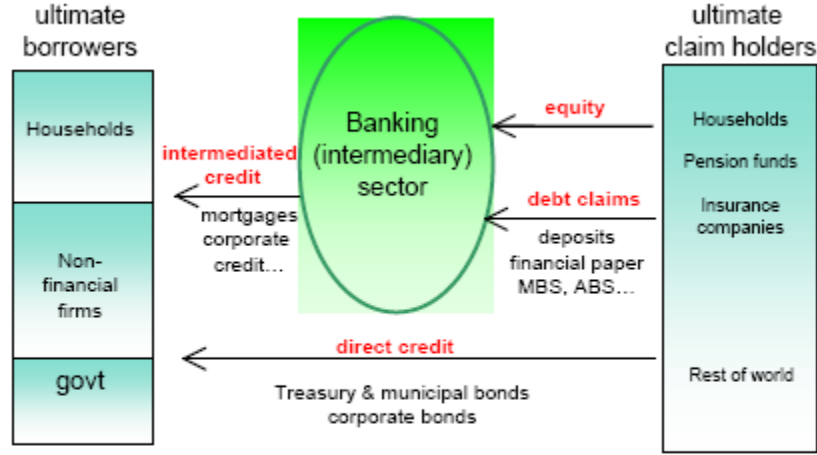


Figure 2.1: Stylized Financial System for Credit

debt - is almost always intermediated through the banking system, broadly defined. At the end of 2008, US household sector mortgage liabilities amounted to around \$10.6 trillion, and consumer debt accounts for another \$2.5 trillion.

The accounting framework presented here is based on the picture of credit flow given in Figure 2.1, and is drawn from Shin (2009). There are  $n$  financial intermediaries standing between the ultimate borrowers and the ultimate creditors. For convenience, we denote these intermediaries simply as "banks".

Denote by  $y_i$  the claim held by bank  $i$  on the ultimate borrowers, such as household mortgages or consumer loans. For our purposes in this paper, it does not matter much whether  $y_i$  is in face values or market values, since the purpose of this paper is to outline the underlying accounting relationships within the financial system. However, in what follows, it is useful to interpret all quantities as being in market values, since the comparative statics take on additional richness due to valuation effects.<sup>1</sup>

As well as claims on the ultimate borrowers, the banks hold claims against each other. Denote by  $x_i$  the total value of the liabilities of bank  $i$ , by  $x_{ij}$  the value of bank  $i$ 's liabilities held by bank  $j$  and by  $\pi_{ij}$  the share of bank  $i$ 's liabilities that are held by bank  $j$ . Denoting by  $e_i$  the value of equity of bank  $i$ , the balance sheet of bank  $i$  is

Assets	Liabilities
$y_i$	$e_i$
$\sum_{j=1}^n x_j \pi_{ji}$	$x_i$

(2.1)

<sup>1</sup> See Shin (2009) for more details on the relationship between book values and market values in an interconnected balance sheet network.

The balance sheet identity of bank  $i$  is:

$$y_i + \sum_j x_j \pi_{ji} = e_i + x_i \quad (2.2)$$

The left hand side is the value of assets and the right hand side is the sum of debt ( $x_i$ ) and equity ( $e_i$ ). The matrix of claims and obligations between banks can then be depicted as below. The  $(i, j)$ th entry in the table is the debt owed by bank  $i$  to bank  $j$ . Then, the  $i$ th row of the matrix can be summed to give the total value of debt of bank  $i$ , while the  $i$ th column of the matrix can be summed to give the total assets of bank  $i$ . We can give the index  $i+1$  to the outside creditor sector (households, pension funds, mutual funds etc.), so that  $x_{i,n+1}$  denotes bank  $i$ 's liabilities to the outside claimholders. Deposits would be the prime example of a liability that a bank has directly to outside creditors.

	bank 1	bank 2	...	bank $n$	outside	debt
bank 1	0	$x_{12}$	...	$x_{1n}$	$x_{1,n+1}$	$x_1$
bank 2	$x_{21}$	0		$x_{2n}$	$x_{2,n+1}$	$x_2$
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	
bank $n$	$x_{n1}$	$x_{n2}$	...	0	$x_{n,n+1}$	$x_n$
end-user loans	$y_1$	$y_2$	...	$y_n$		
total assets	$a_1$	$a_2$		$a_n$		

From the balance sheet identity (2.2), we can express the vector of debt values across the banks as follows, where  $\Pi$  is the  $n \times n$  matrix where the  $(i, j)$ th entry is  $\pi_{ij}$ .

$$[x_1, \dots, x_n] = [x_1, \dots, x_n] \begin{bmatrix} \Pi \end{bmatrix} + [y_1, \dots, y_n] - [e_1, \dots, e_n] \quad (2.3)$$

or more succinctly as

$$x = x\Pi + y - e \quad (2.4)$$

Solving for  $x$ ,

$$y = e + x(I - \Pi)$$

Define the leverage of bank  $i$  as the ratio of the total value of assets to the value of its equity. Denote leverage by  $\lambda_i$ . That is,

$$\lambda_i \equiv \frac{a_i}{e_i} \quad (2.5)$$

Since  $x_i/e_i = \lambda_i - 1$ , we have  $x = e(\Lambda - I)$ , where  $\Lambda$  is the diagonal matrix whose  $i$ th diagonal entry is  $\lambda_i$ . Thus

$$y = e + e(\Lambda - I)(I - \Pi) \quad (2.6)$$

Thus, the profile of total lending by the  $n$  banks to the end-user borrowers depends on the interaction of three features of the financial system - the distribution of equity  $e$  in the banking system, the profile of leverage  $\Lambda$  and the structure of the financial system given by  $\Pi$ . Total lending to end users is increasing in equity and in leverage, as one would expect. More subtle is the role of the financial system, as given by the matrix  $\Pi$ . Define the vector  $z$  as

$$z \equiv (I - \Pi)u \quad (2.7)$$

where

$$u \equiv \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

so that  $z_i = 1 - \sum_{j=1}^n \pi_{ij}$ . In other words,  $z_i$  is the proportion of bank  $i$ 's debt held by the outside claimholders - the sector  $n+1$ . Then, total lending to end-user borrowers  $\sum_i y_i$  can be obtained by post-multiplying equation (2.6) by  $u$  so that

$$\sum_{i=1}^n y_i = \sum_{i=1}^n e_i z_i (\lambda_i - 1) + \sum_{i=1}^n e_i \quad (2.8)$$

Equation (2.8) is the key balance sheet identity for the financial sector as a whole, where all the claims and obligations between banks have been netted out. The left hand side is the total lending to the end-user borrowers. The second term on the right hand side of (2.8) is the total equity of the banking system, and the first term is the total funding to the banking system provided by the outside claimholders (note that the second term can be written as  $\sum_{i=1}^n x_i z_i$ ). Thus, from equation (2.8) we see the importance of the structure of the financial system for the supply of credit. Ultimately, credit supply to end-users must come either from the equity of the banking system, or the funding provided by non-banks. Greenlaw, Hatzius, Kashyap and Shin (2008) uses this framework to calibrate the aggregate consequences of banking sector lending contraction that results from the combination of capital losses and deleveraging from subprime losses.



Assets	Liabilities
Loans to firms, households	Liabilities to non-banks (e.g. deposits)
Claims on other banks	Liabilities to other banks
	Equity

**Individual bank**

Figure 2.2: Balance Sheet of Individual Bank

The aggregate balance sheet identity of the financial intermediary sector given by (2.8) can be explained more informally as follows. Take the balance sheet of an individual bank, given by Figure 2.2. The bank has assets against ultimate borrowers (loans to firms and households), but it also has assets that are claims against other banks. On the liabilities side, the bank has obligations to outside creditors (such as retail depositors), but it also has obligations to other banks.

Now, consider the aggregate balance sheet of the banking sector as a whole, where the assets are summed across individual banks and the liabilities are summed across the banks, also. Every liability that a bank has to another bank is an asset when viewed from the point of view of the lending bank. One asset cancels out another equal and opposite liability. In aggregate, all the claims and obligations across banks cancel out. Thus, in aggregate, the assets of the banking sector as a whole against other sectors of the economy consists of the lending to non-bank borrowers. This lending must be met by two sources - the total equity of the banking system, and the liabilities that banks have to lenders outside the banking system. Figure 2.3 illustrates.

Assets	Liabilities
Total lending to ultimate borrowers (firms, households govt)	<b>Total debt liabilities to non-banks</b>
	Total equity

**Banking sector**

Figure 2.3: Aggregate Balance Sheet of Banking Sector

Equation 2.8 is a statement of the aggregate balance sheet identity. What is useful is the fact that equation 2.8 tells us how the leverage of the financial intermediary sector as a whole depends on the leverage of the individual institutions.

$$\sum_{i=1}^n y_i = \sum_{i=1}^n e_i z_i (\lambda_i - 1) + \sum_{i=1}^n e_i$$

Total lending to ultimate borrowers      Total debt liabilities To non-banks      Total equity of intermediaries

The total debt liabilities of the banking sector to the household creditors can be expected to be sticky, and would be related to total household assets. Thus, the expression in the red balloon above will be slow-moving, in line with shifts in the total household holding of debt claims on the banking sector. For the purposes of short-term comparative statics, we could treat it as a constant. If we treat the expression in the red balloon as a constant, we learn much about the impact of various shifts in the parameters on the configuration of the financial system. We now examine two scenarios.

## 1. Boom Scenario

Consider a boom scenario where the marked-to-market equity of the banks are healthy (that the profile of equity  $\{e_i\}$  is strong) and the decline in measured risks leads to an increase in leverage,  $\{\lambda_i\}$ . In order for the expression in the red balloon to remain constant, there must be an overall decline in  $\{z_i\}$ , the proportion of funding coming from outside claimholders. In other words, banks must lend more to each other in order to achieve their desired risk-taking profile and leverage, given their strong capital position. In such a scenario, banks take on more of each others' debts and the intertwining of claims and liabilities become more far-reaching. The image is of an increasingly elaborate edifice built on the same narrow foundation, so that the structure becomes more and more precarious. The systemic risks therefore increase during the boom scenario.

Figure 2.4 is the map of CoVaR measures for the conditional Value at Risk for US financial institutions (conditional on distress of another institution) (Adrian and Brunnermeier (2009), IMF (2009)). Andy Haldane (2009) has recently highlighted the highly interconnected nature of financial institutions in the run-up to the financial crisis.

Our accounting identity above shows why such closely interconnected balance sheets is a necessary feature of a boom scenario when banks have strong capital positions and measured risks are low. For any fixed pool of funding to be drawn from the household sector, any substantial increase in balance sheet size of the financial intermediaries can be achieved only by borrowing and lending from each other. The key variables are the  $\{z_i\}$ , which gives the proportion of funding obtained from outside the intermediary sector. In order to increase the profile of leverage  $\{\lambda_i\}$  within the intermediary sector, the banks must lower the funding profile  $\{z_i\}$ , since they are competing for the same limited pool of outside funding. The banks can raise their risk exposure to their desired level only by borrowing and lending between themselves, since outside funding is inadequate to meet their growing needs.

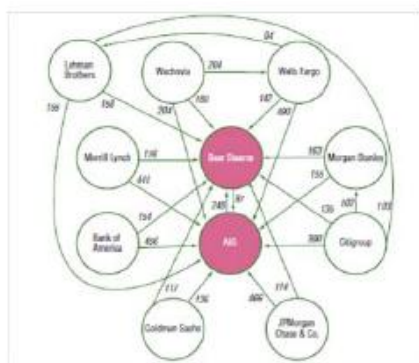


Figure 2.4: US Financial Institutions' Co-Risk Measure (source: IMF Global Financial Stability Report, April 2009)

An architectural analogy is appropriate. In order to build additional rooms into a house whose footprint is limited by shortage of land, the only way is to build upward - like a skyscraper in Manhattan. The lower is the funding profile  $\{z_i\}$ , the taller is the skyscraper. However, even this analogy is somewhat misleading in that the Manhattan skyscraper would be planned in advance and built as a coherent whole. An interconnected financial system that builds upward is much less coordinated, and hence is liable to result in greater unintended spillover effects. It would be as if additional floors are built on top of existing ones, where the architects of lower floors did not anticipate further building on top.<sup>2</sup>

Shortening of maturities would be a natural counterpart to the lengthening intermediation chains. In order for each link in the chain to be a profitable leveraged transaction, the funding leg of the transaction must be at a lower interest rate. When the yield curve is upward-sloping, this would entail funding with shorter and shorter maturities at each step in the chain. The prevalence of the overnight repo as the dominant funding choice for securities firms before the current crisis can be understood in this context. The use of ultra-short term debt is part and parcel of long intermediation chains.

The importance of the short-term interest rate in determining the size and fragility of the financial system can be seen from the above line of reasoning. A period of sustained short-term interest rates (with the assurance of continued low short rates by the central bank) is a highly favorable environment for the taking on of such short-term bets. Adrian and Shin (2008) shows that the Fed Funds rate is an important determinant of the growth of securities firms' balance sheets, which in turn has significant effects on the real economy. Thus, there is a monetary policy angle to the increasing length of intermediation chains.

<sup>2</sup> Architecturally, the closest example would be the Sutyagin house in Archangel, Russia, reported in the Daily Telegraph of March 7th, 2007. The 13 floor 144 feet wooden structure is described as "a jumble of planking" and the "eighth wonder of the world". A Google image search for "Sutyagin House" yields dozens of photos of the structure.

## 2. Bust Scenario

Now consider the reversal of the boom scenario whereby perceptions of heightened risk raise Value at Risk and induce deleveraging of the financial system, leading to lower  $\{\lambda_i\}$ . In addition, falls in asset prices and possible credit losses eat into the marked-to-market equity levels  $\{z_i\}$ . This is a double whammy for the financial system as a whole, since in order for the expression in the red balloon to stay roughly constant, there has to be substantial increases in  $\{z_i\}$ . The increase in  $\{z_i\}$  means that a greater proportion of the funding comes from outside claimholders - that is, the funding that banks had granted to each other must now be withdrawn. This is a classic run scenario where banks run on other banks. The runs on Northern Rock, Bear Stearns and Lehman Brothers are all instances of such a run.

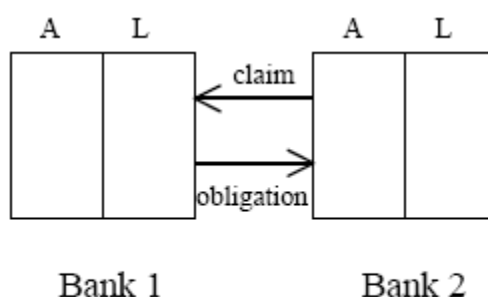


Figure 2.5: Financial Intermediary Run in the Bust Scenario

The direct manifestation of a run of this type can be given a simpler depiction in the following two bank example, taken from Morris and Shin (2008). Bank 1 has borrowed from Bank 2. Bank 2 has other assets, as well as its loans to Bank 1. Suppose that Bank 2 suffers credit losses on these other loans, but that the creditworthiness of Bank 1 remains unchanged. The loss suffered by Bank 2 depletes its equity capital. In the face of such a shock, a prudent course of action by Bank 2 is to reduce its overall exposure, so that its asset book is trimmed to a size that can be carried comfortably with the smaller equity capital.

From the point of view of Bank 2, the imperative is to reduce its overall lending, including its lending to Bank 1. By reducing its lending, Bank 2 achieves its micro-prudential objective of reducing its risk exposure. However, from Bank 1's perspective, the reduction of lending by Bank 2 is a withdrawal of funding. Unless Bank 1 can find alternative sources of funding, it will have to reduce its own asset holdings, either by curtailing its lending, or by selling marketable assets.

In the case where we have the combination of (i) Bank 1 not having alternative sources of funding, (ii) the reduction in Bank 2's lending being severe, and (iii) Bank 1's assets being so illiquid that they can only be sold at fire sale prices, then the withdrawal of lending by Bank 2 will feel like a run from the point of view of Bank 1. In other words, a prudent shedding of exposures from the point of view of Bank 2 is a run from the point of view of Bank 1. Arguably, this type of run is one element of what happened to Northern Rock, Bear Stearns and Lehman Brothers.

### III. Prescriptions

The prescriptions for moderating the fluctuations associated with the boom and bust scenarios can also be understood in terms of the aggregate balance sheet identity (2.8). We discuss three in particular - regulatory interventions, various forms of forward-looking provisioning, and the reform of the institutions involved in financial intermediation.

#### Approach 1. Regulatory Intervention.

The first approach is to moderate the fluctuations in leverage and balance sheet size through capital regulation with an explicit countercyclical element, such as the countercyclical capital targets advocated in the recent Geneva Report (Brunnermeier et al. (2009)) and the Squam Lake Working Group's memo on capital requirements (Squam Lake Working Group (2009)). The leverage cap introduced in Switzerland recently (Hildebrand (2008)) can also be understood in this connection.

$$\sum_{i=1}^n y_i = \sum_{i=1}^n e_i z_i (\lambda_i - 1) + \sum_{i=1}^n e_i$$

Leverage caps or countercyclical capital targets aim at restraining the growth of leverage  $\{\lambda_i\}$  in boom times so that the corresponding bust phase of the financial cycle is less damaging, or can be avoided altogether. In the above expression, moderating the fluctuations in  $\{\lambda_i\}$  implies that the marked-to-market equity values  $\{e_i\}$  and the outside financing proportions  $\{z_i\}$  can also be kept within moderate bounds, so as to prevent the rapid build-up of cross-exposures which are then subsequently unwound in a disorderly way as runs against other banks.

A closely related set of proposals are those that address the composition of assets, rather than the capital ratio. The idea is to impose liquidity requirements on the banks so as to limit the externalities in the bust phase of the cycle. Cifuentes, Ferrucci and Shin (2004) is an early statement of the proposal, subsequently incorporated in the Bank of England's RAMSI framework for systemic risk.<sup>3</sup>

Morris and Shin (2008, 2009) describe the rationale for liquidity requirements and provides an analysis of the mechanisms invoked. The idea is to take those elements that are responsible for the vicious circle of distress and self-reinforcing runs and then harness them to create a virtuous circle of beliefs leading to a stable outcome. Liquidity requirements mandate a cushion of cash assets over some interval of time, such as requiring banks to maintain reserves at the central bank over some fixed maintenance period. Such liquidity requirements can moderate the externalities involved in a run by influencing the risks of spillovers across financial intermediaries. When a borrower bank has a high level of liquidity, then the withdrawal of funding by its creditor banks can be met (at least partly) by its liquid resources, which makes the debtor bank less likely to run on other banks. For creditor banks, there are two effects. First, knowing that the debtor bank is less vulnerable to runs reduces the incentive to run that arises purely from a coordination motive. In addition, when each creditor bank realizes that other creditor

<sup>3</sup> The Bank of England's RAMSI framework is described in the recent issue of the IMF's Global Financial Stability Report (2009, chapter 2).

banks have higher liquidity levels, the coordination problem among the creditor banks becomes less sensitive to strategic risk - making them less jittery when faced with a run scenario. The more relaxed attitude of creditors and debtors are mutually reinforcing, just in the same way that distress and concerns about others' viability can be self-reinforcing. In this way, the same forces that lead to the vicious circle of run psychology can be harnessed and channeled to generate a virtuous circle of stability.

## Approach 2. Forward-Looking Provisioning.

A second way to moderate fluctuations of the boom bust cycle is to operate directly on the equity  $\{e_i\}$  of the banks. The forward-looking statistical provisioning scheme that has operated in Spain is a good example of such a method. By imposing a provisioning charge when new loans are made, there is a corresponding diminution of the equity level of the bank making the loan. For any given desired leverage of the bank, a lower equity level means lower total assets, hence restraining the rapid growth of balance sheets.

$$\sum_{i=1}^n y_i = \sum_{i=1}^n e_i z_i (\lambda_i - 1) + \sum_{i=1}^n e_i$$

The Spanish pre-provisioning scheme highlights one of the important lessons in a boom<sup>4</sup>. Under a boom scenario, the problem is that there is too much equity in the banking system. There is overcapacity in the sense that the level of aggregate capital is too high. Capital is higher than is consistent with only prudent loans being made. Overcapacity leads to the chasing of yields and the lowering of credit standards. Elsewhere (Shin (2009)), I have sketched a mechanism for the emergence of subprime lending based on this mechanism. Expanding balance sheets are like an expanding balloon. Just as an expanding balloon needs air to fill the balloon, expanding balance sheets need new asset creation. But when all prime mortgage borrowers are already catered for, lending standards must be lowered in order to generate new assets. Hence, subprime lending emerges as a result of the urge to expand balance sheets.

In the Geneva Report, we discuss the merits of a variant of the Spanish preprovisioning scheme called the Pigovian Tax. The idea is that rather than reducing equity through a provision, equity can also be lowered in a boom through an explicit centralized tax. The tax has the potential to enhance efficiency of the overall financial system in the same way that a congestion charge would improve traffic in a city. By counteracting an existing inefficiency through a tax, one can counteract the harmful externality. Just as with a traffic congestion charge, the revenue raised in the tax is not an essential component of the scheme. However, if the revenue raised through the Pigovian Tax could be put into a separate bank resolution fund, then the scheme would not imply a net transfer away from the banking sector.

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<sup>4</sup> For a description of the Spanish pre-provisioning system, see the Bank of Spain working paper by Fernandez, Pages and Saurina (2000).

### Approach 3. Structural Reform of Intermediation.

A third approach is more long term, and is aimed at influencing the market structure of the financial intermediary sector as a whole. The idea is to restrain the lengthening of intermediation chains, and encourage the formation of shorter intermediation chains.

$$\sum_{i=1}^n y_i = \sum_{i=1}^n e_i z_i (\lambda_i - 1) + \sum_{i=1}^n e_i$$

In terms of the aggregate balance sheet identity, the objective is to operate directly on the mode of financial intermediation so that the funding profile  $\{z_i\}$  is maintained at high levels, thereby limiting the number of intermediaries  $n$  and moderating the fluctuations in leverage and total assets. The idea is to induce a shortening of the financial intermediation chain by linking ultimate borrowers and ultimate lenders more directly.

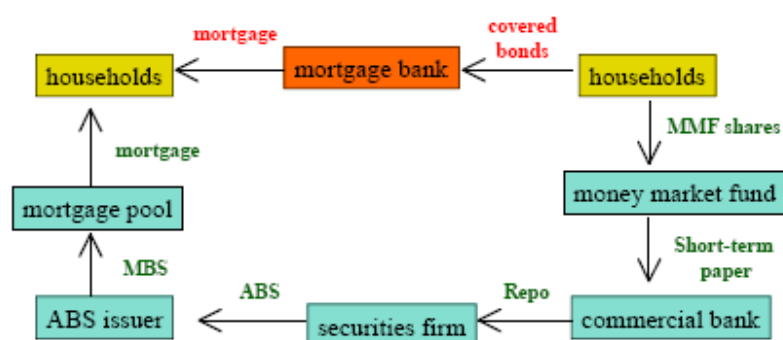


Figure 3.1: Shortening the Intermediation Chain through Covered Bonds

One potential way to induce such shortening of the intermediation chain would be through the encouragement of the issuance of covered bonds – bonds issued against segregated assets on a bank's balance sheet, with recourse against the issuing bank itself.

The intermediation chain associated with a covered bond is short, since the bank holds mortgage claims against ultimate borrowers, and issues covered bonds that could be sold directly to households or to long-only institutions such as mutual funds or pension funds. The bonds offer longer duration that match the duration of the assets. The longer duration of the liabilities have two advantages. First, the duration matching between assets and liabilities means that the issuing bank does not engage in maturity transformation in funding. Rigorous application of marking to market makes less sense when loans are segregated to back such liabilities. In the Geneva Report, we have argued that the accounting treatment of such assets can take account of what the banks are capable of holding, rather than simply appealing to their intentions, as is the rule under the current mark-to-market regime.

Second, the fact that liabilities have long duration means that the short-term funding that is prevalent in the long intermediation chains will be less likely to be employed provided that the covered bonds are held directly by households or by long-only

institutions such as pension funds and mutual funds. The long duration of such securities would be a natural source of sought-after duration for pension funds who wish to match the long duration of their pension liabilities. Household savers would also find such products a good substitute for government bond funds. The shortening of the intermediation chain in this way will have important benefits in terms of mitigating the fluctuations in leverage and balance sheet size in the financial boom bust cycle.

Covered bonds have been a familiar feature of many European countries, especially in Denmark (with its mortgage bonds) and Germany (with its *pfandbriefe*). But to date, over twenty countries in Europe have some form of covered bonds backed by laws that underpin their role in the financial system. Packer, Stever and Upper (2007) is a recent overview of the covered bond system, who report that as of mid-2007 the outstanding amount of covered bonds reached €1.7 trillion.

As already discussed, covered bonds are securities issued by a bank and backed by a dedicated, segregated group of loans known as a "cover pool". The bondholders have two safeguards in their holding of covered bonds. First, the bonds are backed by the cover pool over which the bondholders have senior claims in case of bankruptcy. Second, because the covered bonds are the obligations of the issuing bank, the bondholders have recourse to the bank if the cover pool is insufficient to meet the bond obligations. In this second sense, covered bonds differ from the U.S.-style mortgage backed security, which are obligations of the special purpose vehicle - a passive company whose sole purpose is to hold assets and issue liabilities against those assets. The loans backing the covered bonds stay on the balance sheet of the bank, eliminating one step in the intermediation chain, and also guarding against potential incentive problems in the "originate to distribute" model of securitization in which the originating bank can sell the loan and take it off its balance sheet altogether.

The double protection offered by covered bonds distinguishes them both from senior unsecured debt and asset-backed securities (ABSs). In contrast to ABSs, the cover pool serves mainly as credit enhancement and not as a means to obtain exposure to the underlying assets. Also, cover pools tend to be dynamic in the sense that issuers are allowed to replace assets that have either lost some quality or have been repaid early. These features imply that covered bonds are seen not so much as an instrument to obtain exposure to credit risk, but rather as a higher-yielding alternative to government securities.

These payoff attributes of covered bonds are reflected in the identity of the investors who hold them. The identity of the investors are critical in determining the funding profile  $\{z_i\}$  of the intermediation sector. The objective of achieving a higher funding profile is achieved if the investors are either household savers or non-bank institutions such as pension funds and mutual funds. A survey of the investors in covered bonds was released in May 2009 by the European Covered Bond Dealers Association (SIFMA (2009)), and is reproduced in Figure 3.2. We see that the bulk of the investors in covered bonds are non-banks, with the largest category being asset management firms. Leveraged institutions and intermediaries constitute only around one third of the total. Even within the intermediary sector, institutions such as private banks are closer to asset management firms in character than intermediaries such as broker dealers who lengthen the intermediation chain.



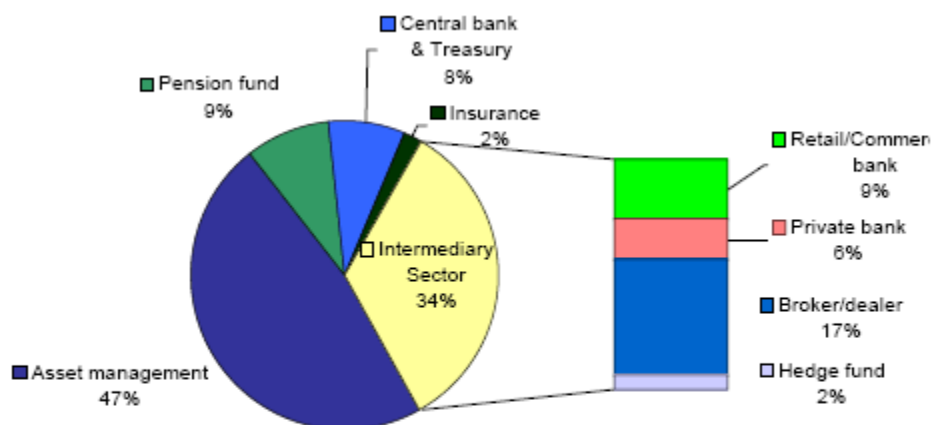


Figure 3.2: Investors in covered bonds (source: SIFMA (2009))

Even among covered bonds, the Danish system of mortgage bonds has attracted considerable attention recently as a resilient institutional framework for household mortgage finance due to the added feature that household mortgage borrowers can redeem their debt by purchasing the relevant issue of the mortgage bonds at the prevailing market price (see Boyce (2008)). By being able to extinguish debt obligations at market prices, household borrowers participate as purchasers in the market for mortgage debt, and prevent the type of collapse in mortgage-backed securities seen in the United States in the financial crisis of 2007 and 2008.

The legislation required to underpin the operation of a covered bond system is more developed in some regions than others. Europe leads the world in this respect. In the European Union, covered bonds are defined by the Capital Requirements Directive (CRD), which limits the range of accepted collateral maximum loan-to-value ratios. While the CRD only recognizes securities issued under special legislation as covered bonds, market participants tend to work with a more general definition that also includes bonds issued under private contractual arrangements using elements from structured finance. There have been a number of such “structured covered bonds”, primarily in countries without covered bond legislation (eg the United Kingdom, the Netherlands and the United States) (see Packer, Stever and Upper (2007)).

Indeed, one of the main hurdles against the widespread introduction of a covered bond system has been the legal hurdle of introducing a class of claimholders for the cover pool that are senior to the deposit insurance agency, and hence the general depositors of the bank. The larger is the cover pool for covered bonds, the smaller is the general pool of assets that are accessible to the deposit insurance agency. In the United States, the FDIC has issued a statement on the treatment of covered bonds, limiting the size of covered bonds to 4% of total liabilities after issuance.<sup>5</sup> Given the benefits associated with the shortening of the intermediation chain, there are legitimate questions on how much political will can be mustered in order to amend the relevant laws to allow the operation of the covered bond system.

<sup>5</sup> The FDIC's statement on covered bonds is at <http://www.fdic.gov/news/news/financial/2008/fil08073.html>

A possible alternative legal approach would be to permit specialist "narrow" banks whose liabilities are restricted to covered bonds only, and hence whose liabilities are not insured by the deposit insurance agency. Such narrow banks would be akin to Danish mortgage banks whose liabilities match the duration of the assets perfectly and whose equity provides a cushion for bond holders.

#### IV. Implications for Korea

Korea has been vulnerable to "twin crises" in which a banking crisis and currency crisis reinforce each other. Such crises are particularly potent due to the mutually reinforcing nature of the two crises, and the rapid deterioration of economic fundamentals caused by the amplification of the crisis. Although twin crises show many different forms across countries and across time, the common thread that links all of them is the balance sheet mismatch at the aggregate country level arising from excessive short-term debt denominated in foreign currency.

There are three potential ways to address the vulnerability to twin crises:

- maintain larger holding of foreign exchange reserves
- curb the growth of banking sector assets
- diversify the funding sources for the banking sector.

However, the first two methods have many undesirable economic consequences and are unsuitable as a long-term strategy for financial sector resilience. The best way to improve the resilience of the Korean financial sector is through the third method – to diversify the funding sources for the banking sector. US-style securitization has been shown to be flawed in the current crisis. Instead, the adoption of "covered bonds" (used in Europe for over two hundred years) is a more promising long-term strategy to diversify the funding of the banking sector while maintaining the stability of the system.

Foreign exchange reserves held by Korea rose to \$227 billion in May, up substantially from last autumn in the midst of the liquidity crisis caused by the failure of Lehman Brothers. There is an active debate on the appropriate size of foreign exchange reserves, with some voices arguing for a continued accumulation of foreign exchange reserves. Although larger foreign exchange reserves may be desirable in the short-term, maintaining large foreign exchange reserves is not a feasible or desirable option for Korea in the long-term.

Maintaining large reserves is costly – it is tantamount to lending to foreigners at a very low interest rate. Given the large and growing US budget deficit and the potential for a rapid fall in the value of the US dollar, there is the potential for large capital losses on such holdings. Large reserves hinder the smooth functioning of domestic monetary policy pursued by the Bank of Korea, as capital inflows have to be sterilized by issuing domestic claims. Capital inflows present challenges for maintaining domestic liquid reserves at prudent levels. Finally, there are international political economy issues. Large foreign exchange reserves expose Korea to political pressures from US politicians who may misinterpret Korea's intentions, and accuse it of artificially maintaining a weak currency.

For these reasons, maintaining large foreign exchange reserves is not a desirable long-term strategy. Much better would be to reduce the vulnerability of the Korean financial sector, so that there is less need to hold large foreign exchange reserves.

One potential way to reduce the vulnerability of the Korean financial sector is by curbing the rapid growth of lending in booms. Restricting the rapid growth of assets would mitigate the building up of such vulnerabilities, but such a policy also carries large costs. By restricting the growth of assets, lending would be limited to the same rate as the

growth of retail deposits. However, for a rapidly growing economy, such restrictions would impose inefficiently tight restrictions on loans.

There is also the danger that banks would focus excessively on the availability of collateral, so that lending is skewed toward residential real-estate based lending, at the expense of financing for firms. Although large companies can tap the capital markets, the same is not true of the small and medium sized enterprises (SMEs) who rely heavily on bank lending. Therefore, restricting the growth of assets will have potentially undesirable side-effects of choking off lending to SME firms.

These concerns are magnified by the institutional development in which banks have to compete to keep their retail deposits in the face of competition from other providers of deposit-like savings instruments, such as money market funds (MMFs) provided by securities firms. Restricting the excessive growth of bank lending should form part of the overall strategy for the Korean financial sector, but relying on it exclusively will entail undesirable costs. Combining such a policy with a long-term policy for the diversification of bank funding is important. I turn to this issue now.

US-style securitization in which loans are sold off to special purpose vehicles has been shown to be flawed by the current crisis. Securitization was meant to disperse risks associated with bank lending so that deep-pocketed investors who were better able to absorb losses would share the risks. But as argued already, in reality, securitization had the perverse effect of concentrating all the risks in the banking system itself. The severity of the global financial crisis, especially in the United States, highlights the shortcomings of US-style securitization and the excessive growth of the securities industry relative to the real economy.

One promising alternative to US-style securitization is the institution of covered bonds. Covered bonds offer two main benefits. First, by providing a long term domestic source of funding for the banking system, the liability structure of the banking sector is made more resilient. The funding becomes (i) long-term and (ii) denominated in the domestic currency. For both reasons, covered bonds guard against twin crises of liquidity crisis and currency crisis. Second, covered bonds provide a long-term savings vehicle for households that (in contrast to bank deposits) allow them to hedge against fluctuations in interest rates. The legislation required to underpin the operation of a covered bond system is most developed in the European Union. Outside Europe, the main hurdle against the widespread introduction of a covered bond system is the legal hurdle of introducing a class of claimholders for the cover pool that are senior to the deposit insurance agency, and hence the general depositors of the bank. However, given the large benefits from providing a stable source of domestic funding and providing a long-term savings vehicle, the development of the covered bond system deserves greater attention from policy makers.

A possible way to overcome the issue of seniority of depositors is to establish specialist "narrow" banks whose liabilities are restricted to covered bonds only, and hence whose liabilities are not insured by the deposit insurance agency. Danish mortgage banks operate in this way. Indeed, Denmark provides a good illustration of how resilience of the financial sector can be combined with active lending for domestic mortgage borrowers. Denmark's housing boom was almost as large as that of the United States. However, Denmark has not seen a similar financial crisis as in the United States. This contrast is largely due to the difference in the financial structure and the operation of the covered bond system.

For Korea, the covered bond system in Denmark (but also in Germany, France, Spain and others) would bring the twin advantages of providing a stable source of long-term domestic funding, and the provision of a long-term savings vehicle for households.

## V. Concluding Remarks

The organizing theme of this paper has been the overall systemic impact of long versus short intermediation chains. Long intermediation chains have been associated with the rapid development of the securitized, market-based financial system in the United States. I have argued that long intermediation chains carry costs in terms of greater amplitude of fluctuations in the boom bust cycle of leverage and balance sheet size. Shorter intermediation chains carry benefits for stability of the financial system.

For the financial industry, the key question is to what extent the rapid development of securitization and the market-based system can be regarded as the norm, or a long, but ultimately temporary stage

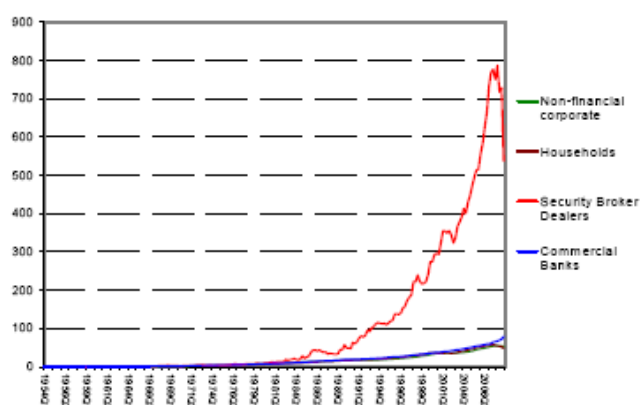


Figure 5.1: Growth of Four US Sectors (1954Q1 = 1) (source: Flow of Funds, Federal Reserve)

in the development of a more sustainable financial system. Figures 5.1 and 5.2 show the growth of four sectors in the United States (non-financial corporate sector, household sector, commercial banking sector and the security broker-dealer sector) taken from the Federal Reserve's Flow of Funds accounts. The series are normalized so that the size in Q1 1954 is set equal to 1. Most sectors grew to roughly 80 times its size in 1954, but the broker dealer sector grew to around 800 times its 1954 level, before collapsing in the current crisis. Figure 5.2 is the same chart, but in log scale. The greater detail afforded by the chart in log scale reveals that the securities sector kept pace with the rest of the economy until around 1980, but then started a growth spurt that outstripped the other sectors. On the eve of the crisis, the securities sector had grown to around ten times its size relative to the other sectors in the economy. Clearly, such a pace of growth could not go on forever. Even on an optimistic scenario, the growth of the securities sector would have tapered off to a more sustainable pace to keep in step with the rest of the economy.

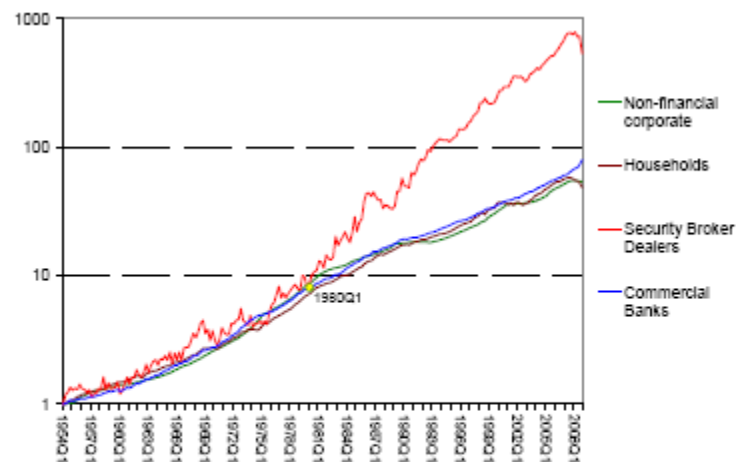


Figure 5.2: Growth of Four US Sectors (1954Q1 = 1) (in log scale)

The relative size of the securities sector can be seen as a mirror of the lengthening intermediation chains in the market-based system of financial intermediation. One could reasonably conclude that some of the baroque flourishes that appeared in the Indian summer of the expansion of the securities sector (such as the growth of exotic asset-backed securities such as CDO-squared) have gone for good, and are unlikely to feature in a steady state of the securities sector.

Overall, it would be reasonable to speculate that the securities sector that emerges from the current crisis in sustainable form will be smaller, with shorter intermediation chains, perhaps less profitable in aggregate, and with less maturity transformation. The backdrop to this development will be the regulatory checks and balances that are aimed at moderating the fluctuations in leverage and balance sheet size that were instrumental in making the current financial crisis the most severe since the Great Depression.

## References

- Adrian, Tobias and Markus Brunnermeier (2009) "CoVaR" working paper, Federal Reserve Bank of New York and Princeton University
- Adrian, Tobias and Hyun Song Shin (2007) "Liquidity and Leverage" forthcoming in the Journal of Financial Intermediation
- Adrian, Tobias and Hyun Song Shin (2008) "Financial Intermediaries, Financial Stability and Monetary Policy" Proceedings of the Federal Reserve Bank of Kansas City Symposium at Jackson Hole, 2008.
- Adrian, Tobias and Hyun Song Shin (2009) "Money, Liquidity and Monetary Policy" forthcoming in American Economic Review, Papers and Proceedings
- Boyce, Alan (2008) "Covered Bonds vs. Securitization Transparency vs. Opacity Which is the Right Question" working paper, Absalon  
<https://www.ibm.com/developerworks/blogs/resources/adler/200903251.pdf>
- Brunnermeier, Markus (2009) "De-Ciphering the Credit Crisis of 2007" Journal of Economic Perspectives, 23(1), 77-100
- Brunnermeier, Markus, Andrew Crockett, Charles Goodhart, Avi Persaud and Hyun Song Shin (2009) "The Fundamental Principles of Financial Regulation" Geneva Report on the World Economy 11.
- Calomiris, Charles and Charles Kahn (1991) "The Role of Demandable Debt in Structuring Optimal Banking Arrangements" American Economic Review, 81, 497-513
- Cifuentes, Rodrigo, Gianluigi Ferrucci and Hyun Song Shin (2004) "Liquidity Risk and Contagion" Bank of England working paper 264, short version published in Journal of the European Economic Association, 3, 556-566 (2005)  
<http://www.bankofengland.co.uk/publications/workingpapers/wp264.pdf>
- Diamond Douglas and Raghuram Rajan (2001) "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking" Journal of Political Economy, 109, 287-327.
- Fernandez, S., J. Pages and J. Saurina (2000) "Credit Growth, Problem Loans and Credit Risk Provisioning in Spain" Bank of Spain working paper 18,  
<http://www.bde.es/informes/be/docs/dt0018e.pdf>
- Greenlaw, D., J. Hatzius, A. Kashyap and H. S. Shin (2008) "Leveraged Losses: Lessons from the Mortgage Market Meltdown" US Monetary Policy Forum Report 2,  
<http://www.chicagogsb.edu/usmpf/docs/usmpf2008confdraft.pdf>
- Haldane, Andrew (2009) "Rethinking Financial Networks" Speech delivered at Financial Student Association in Amsterdam 28 April 2009  
<http://www.bankofengland.co.uk/publications/speeches/2009/speech386.pdf>

- Hildebrand, Philipp (2008) "Is Basel II enough? The benefits of a leverage ratio" Financial Markets Group Lecture, [www.bis.org/review/r081216d.pdf](http://www.bis.org/review/r081216d.pdf)
- International Monetary Fund, (2009), Global Financial Stability Report, April, Washington DC
- Morris, Stephen and Hyun Song Shin (2008) "Financial Regulation in a System Context," Brookings Papers on Economic Activity, Fall 2008, 229-274.
- Morris, Stephen and Hyun Song Shin (2009) "Illiquidity Component of Credit Risk" working paper, Princeton University.
- Packer, F., R. Stever and C. Upper (2007) "The Covered Bond Market" BIS Quarterly Review, September 2007, 43-55.
- Shin, Hyun Song (2009) "Securitisation and Financial Stability" Economic Journal, 119, 309 – 332.
- SIFMA (2009) First European Covered Bond Investors' Survey, European Covered Bond Dealers Association, May 2009, <http://europe.sifma.org/ecbda.shtml>
- Squam Lake Working Group (2009) "Reforming Capital Requirements for Financial Institutions" policy memo, <http://www.squamlakeworkinggroup.org/>

CHAPTER 1-3

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**Sovereign Wealth Meets Market Failure:  
Government Participation vs Government intervention In Markets**

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## I. Introduction

Two crises afflict the global economy: one financial, the other environmental. Economists analyze both issues in terms of the appropriate roles for markets and governments. But this dichotomy is inadequate, given the globalization of financial markets and environmental issues: we should consider all the ways in which governments and markets can interact at the global level. This can provide a better understanding, both of how the crises arose and of how to deal with them. The obvious way to deal with global financial and environmental crises is for national governments to join together to replicate the role of a global government, i.e., to negotiate agreements on global financial regulation and global emission standards. Such efforts have not gone very far. This paper suggests that business-style partnerships between governments can provide another useful path forward by harnessing national self-interest to alleviate market failures.

Section 2 argues that the financial crisis arose, not just because regulation failed, but also because national governments entered markets in a un-business-like manner. Section 3 proposes a mechanism that would allow governments to interact in a business-like way: by forming consortia of Sovereign Wealth Funds (SWF), which we call “mutual wealth funds” (MWF). Section 4 suggests how the governance of a MWF can be designed to alleviate some market failures in finance. Section 5 argues that MWF can play a useful role in alleviating market failures in environmental issues. Section 6 concludes.

## II. Origins of The Financial Crisis

### 1. Un-businesslike Decisions by Deficit and Surplus Countries

Globalization means that goods and capital flow freely between countries and have a significant impact on their internal economies. Since governments are interacting via markets, just like private businesses, they ought to manage their deficits and surpluses in a business-like manner, if they are to avoid adverse market reactions. By that standard, how have the major surplus and deficit countries performed?

Suppose a corporation enjoys a massive surplus. No responsible management would lend most of that surplus to a single borrower via the simplest financial instrument, i.e., a bond with a fixed coupon that allows no flexibility in repayment and no claim on assets in the event of default. And no responsible management would keep lending to the same borrower when past loans had already driven yields close to zero. But that was how China, Japan, and other surplus countries lent to the US.

Suppose a corporation is already highly leveraged, but needs a lot more capital. No responsible management would raise that capital only via bonds with a fixed coupon: it would build in some flexibility in repayment by issuing some equity. And no responsible management would borrow more without a business plan to pay back the new loans, or at least a plan to balance the increased loan outgoings with increased earnings. But that was how the US borrowed.

When the largest corporate entities — sovereign governments — depart so radically from business-like decisions, that distorts prices and markets all over the globe. Consider this analogy. Suppose that the US auto industry has grown so large in so many congressional districts that it always gets bailed out with (newly-printed) money because it is “too big to fail”; the auto industry maintains employment by selling its surplus

output to auto rental companies at big discounts, which encourage the rental companies to sell off last year's fleet at even bigger discounts. Then distortions would surely spread to other markets: petroleum and steel prices would skyrocket, bus and motor-cycle production would collapse, an industry would arise to dismantle one-year-old cars into components for sale back to the auto industry, etc.

Distortions in finance were likewise spread far and wide by the un-businesslike decisions of sovereign governments that poured trillions of dollars of current account surpluses into US agency and Treasury securities. This depressed the yield on all low-risk assets and created excess demand for assets that seemed of low risk, but promised a higher yield. The new funds from the surplus countries had to find new borrowers. Inevitably, these were riskier: the sub-prime borrowers in the US housing market. So global banks switched from the intermediation of savings into productive investments, to the more profitable repackaging of high-risk assets into pseudo-riskless assets, such as the higher tranches of Collateralized Debt Obligations. This repackaging was carried out offshore, beyond the purview of demoralized US regulators and was risky, unstable and opaque.

Had surplus countries invested like responsible corporate managers, they would have diversified across many countries and instruments, equity as well as debt — instruments that would have been offered by deficit countries, had they raised capital like responsible corporate managers. The yield on low-risk assets would not have been driven down relative to risky assets; there would have been little profit in repackaging risky assets as pseudo-riskless assets, and perhaps no financial crisis.

## 2. Politics Deadlocks Economic Policy

Governments have difficulty behaving like business corporations, given their different relationships to their 'shareholders'. For example, a government might refrain from policies that maximize long-term GDP because it fears to antagonize a public that is short sighted and nationalistic, or because it fears overthrow by a political coalition that would be angered by short term consequences.

The policy of export-led growth under an exchange rate pegged to the US dollar had proved successful for Japan and the smaller East Asian economies, both in economic terms and in promoting the legitimacy of their governments; China adopted the same policy. However, China is much larger and its exports grew much faster; its surpluses piled onto ongoing surpluses from the rest of East Asia and surpluses from the Gulf (that were the result of China's growth, which raised energy prices). When such a massive country naively followed the economic policies that had worked for smaller countries, there resulted a massive distortion of financial markets around the globe.

Why did China not change its policies? Firstly, because its surpluses grew so fast that they outran its capacity to re-appraise and re-orient policy. Secondly, because the success of export-led growth built up a strong political constituency in the coastal provinces for more of the same. However, the current crisis is dramatic enough to force a policy reappraisal and to disrupt the political constituency for export-led growth. It should bring home that the country as a whole would gain nothing from more surpluses and must re-appraise what to do with those that it has accumulated so far. This is also true for the other surplus countries.

The deficits of the US likewise grew so fast that they outran its capacity to re-appraise and re-orient earlier policies. These policies were likewise locked into place by the

political constituencies that earlier success had built up. Globalization had expanded the opportunities of US multinational corporations and banks, hence the wealth of their owners and managers. Lower-income groups had been sedated by the low prices of imported goods and by home ownership that had been funded ultimately by surplus countries. Big budget deficits sedated both rich and poor, by shifting the burden of government onto future generations, who cannot yet vote. Thus, an unlikely coalition of rich campaign donors and poor voters locked high-deficit policies in place.

But now the rich have lost their capital gains and their bonuses; the poor are losing their houses; this generation of voters is losing jobs and pensions. All parties would have been better off had the US borrowed abroad like a responsible business, i.e., by issuing a diversified range of financial instruments within a sustainable business plan. That is what it needs to do today. But US policymakers are busy throwing money at the internal credit crisis and are unlikely to address the international consequences in business-like terms. So surplus countries can best help themselves by using their surpluses to help the US manage its credit crisis.

### 3. International Impasse

As things now stand, the trillions of dollars of politically-driven international loans have left only a ghastly shadow: a hole of the same magnitude in the balance sheets of US banks, into which their capital has disappeared. Private banks without capital have neither the inclination nor the ability to lend, so sound US corporations cannot get funding, leaving the US economy in recession. The US government is staving off financial and economic collapse by guaranteeing money markets, commercial paper and bank deposits. It has followed the US\$700 billion bailout of banks, carmakers, etc., with a US\$787 billion stimulus package, with more bank bailouts and more fiscal stimuli almost sure to follow. But these policies add massive liabilities onto the US government's balance sheet — already US\$11.5 trillion or 80 percent of GDP.<sup>1</sup> Interest payments in 2008 cost US\$451 billion, the largest item in the US budget after Social Security, Medicare and Defense.<sup>2</sup> Will the US ever have the political will to levy the taxes to pay off the mounting liabilities, or even to get them down to a sustainable level? Or will it inflate them away? Rising fear has led foreign creditors to switch their holdings even from government-guaranteed agency securities to the direct debt of the US government, especially short-term debt.

Inflating away the debt has a high long-term cost: the end of the US dollar's reserve currency status, hence of US autonomy in international markets. But the US is drifting toward that solution anyway, as its internal deficit rises from US\$1 trillion so far this year toward US\$2 trillion in the autumn.<sup>3</sup> The Federal Reserve has begun buying up US Treasuries because there is no prospect of covering the deficit with tax increases. Foreign owners of US Treasuries therefore face expropriation through inflation and currency depreciation. By now, none of the countries that hold large blocks — China, Japan, Saudi Arabia, Kuwait, etc. — can avoid that outcome by selling out, for that would trigger panic sales by the others, which would collapse the US dollar, global trade and their own economies. The surplus countries find themselves arranged in a circular firing squad around Helicopter Ben in a Mexican standoff — exactly the complex business relationship that they had sought to avoid by buying only the simplest securities: bonds issued or guaranteed by the US government.

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<sup>1</sup> <http://zfacts.com/p/461.html>

<sup>2</sup> [http://www.treasurydirect.gov/govt/reports/ir/ir\\_expense.htm](http://www.treasurydirect.gov/govt/reports/ir/ir_expense.htm)

<sup>3</sup> <http://www.voanews.com/english/2009-07-13-voa49.cfm>

### III. A Way Forward: Mutual Wealth Funds

When corporations lock into business relationships that are too complex to be governed by contracts (because the costs of negotiating and enforcing the contracts would be too high), then they try to make the relationships govern themselves. This they can achieve by re-structuring their financial relationships to share the risk, align the incentives and bridge the information asymmetries. For example, companies in Germany or Japan that are locked into complex supply relationships often hold each other's shares. These cross-holdings mitigate the conflicts of interest that might otherwise emerge as they co-develop and install complex technologies.<sup>4</sup>

The international counterpart to such cross-holdings could be achieved in today's circumstances by converting the foreign claims on the US government into equity in its economy, especially its banks. This would provide the foreigners with real claims on the US economy, protect them against expropriation through inflation, and reduce the US incentive to attempt such expropriation. It would also reduce the capital that the US government has to inject into its banks, hence the liabilities that it would have to pile onto its already overburdened balance sheet, hence the danger of a run on the US dollar. Recognition of these dangers is already leading the US Treasury to propose partnerships with private capital.

Many private players holding big blocks of capital are on the sidelines, but each hesitates to be the first to move; none is big enough to be sure that its own actions would make a difference; there are too many to co-ordinate joint action. But the major surplus countries hold the biggest blocks of capital of all; they are certainly big enough to make a difference; their small numbers facilitate joint action. Why not trigger private activity by forming public partnerships with the major surplus countries, currently trapped holding trillions of US dollar securities waiting to be expropriated through inflation?

Because foreign equity holdings are politically sensitive, as shown by the US reaction to CNOOC's attempt to buy a small US oil company and Dubai World's attempt to buy into US port management. China is trying to switch its surpluses into claims on natural resources, but the perception that Chinese companies are ultimately state-controlled derailed Chinalco's recent attempt to buy into Australia's Rio Tinto. Meantime, foreign governments' enthusiasm for equity investment in the US has evaporated, along with their recent investments in US financial institutions. How to swap foreign-held debt for US equity to address all these concerns?

Surplus countries should inject funds into US corporations via a number of competing mutual funds, called "mutual wealth funds" (MWF) that would invest in a range of corporations. Foreign countries bruised by big investments in particular corporations would welcome this diversification. Each MWF would receive funds from a variety of foreign governments, which would get voting rights in proportion to their contributions; no country would hold a controlling block of shares. Each country could manage its contributions via a Sovereign Wealth Fund (SWF), perhaps set up for the purpose.

The US could itself set up a SWF that would participate in each MWF, and get voting rights in proportion to its contribution. Such a SWF has been proposed for the US government by Michael Metcalfe<sup>5</sup> to channel the capital that it is injecting into banks

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<sup>4</sup> La Porta *et al.* 1999, Franks and Mayer, 2002

<sup>5</sup> *Financial Times*, 1/15/09

toward long-term objectives, such as funding Social Security. Such objectives would be consistent with those of foreign SWF, facilitating their partnership in MWF.

In line with the Santiago Principles for Sovereign Wealth Funds<sup>6</sup>, the MWF should have transparent governance, mutually agreed investment objectives and professional management. The diversity of foreign participants and the participation of their own SWF would reassure US citizens that the MWF would operate on market principles, rather than pursuing any foreign government's agenda. For that matter, foreign participation would constrain US politicians from manipulating the investment policies of a MWF to favour their pet corporations (as happened with Troubled Assets Recovery Program) and from pursuing narrow political objectives.

#### IV. Governance Structure of Mutual Wealth Funds

How should a consortium of SWF manage a MWF? To alleviate host country concerns about foreign governments' interference in its economy, the SWF should only set the broad investment strategy, which it discloses, but should delegate implementation to professional managers. How should the managers be selected, monitored and rewarded? Private investors do so on the basis of investment performance, e.g., the returns achieved relative to some benchmark. This approach evolved to allocate the funds of millions of savers amongst thousands of investment managers. Its flaws have been highlighted by the mass exit of investors from hedge funds, which use an extreme version of this approach. Given their scale and long-term investment horizons, SWF can design a better approach.

The performance of an investment fund depends on the manager's skill, but also on unforeseeable shocks: economic, political and natural. Only the skill is under the manager's control; only the skill should be rewarded. All investors should choose investment managers by assessing their skill and the soundness of their investment strategies. But there is no way for millions of busy private investors to assess thousands of investment managers. So managers end up being rewarded according to their investment performance relative to a benchmark; private investors end up allocating their savings on this basis. If an investment fund performs poorly in any quarter, then private investors exit; the fund managers lose performance bonuses, and perhaps their jobs. This prospect induces short-term investment horizons and herd behaviour by the fund managers.<sup>7</sup>

This market failure can be traced to the asymmetry of information between private investors and their investment managers: the investors cannot observe investment skill, so they reward managers according to observable investment performance. Sovereign wealth funds can bypass this market failure. Unlike pension funds and mutual funds, they do not have to compete every quarter for the loyalty of skittish private investors; governments typically enjoin their SWF to invest for the long term. The scale and long-term investment horizon of the SWF allows them to employ full time officials to monitor the management of their funds.

The MWF should invite teams of investment managers to propose long-term investment strategies; all teams who submit substantial proposals should receive payment commensurate with their efforts. Each SWF should appoint expert officials to

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<sup>6</sup> <http://www.iwg-swf.org/pubs/gaplist.htm>

<sup>7</sup> Cipriani and Guarino, 2008

interrogate the management teams to assess their knowledge and competence, as well as the soundness of their investment strategies. Once a strategy has been chosen and the management team selected, the SWF officials should monitor implementation through monthly reports and should continue the strategic dialogue with the management team in quarterly meetings. The team should be assessed and rewarded primarily on the quality of their analysis and recommendations, and the effectiveness of their implementation. Since the MWF would focus on long-term investments, only long-term investment performance should be rewarded.

To address the political concerns of host countries, investment strategies should be disclosed with an appropriate lag; so should the minutes of the debate amongst the national delegates on MWF investment strategy. In any case, host country citizens can be reassured by the participation of their own government in the MWF.

Since the MWF would be seeking long-term returns by analyzing long-term trends, they should be able to exploit investment opportunities that are not attractive to the mutual fund industry. The long-term investment horizon should also help MWF stabilize financial markets. They can add their voices and votes to other institutional shareholders to improve corporate governance.<sup>8</sup> In sum, MWF can earn high long-term returns, even as they help improve long-term resource allocation

## V. Rescuing the Global Environment

The MWF concept is especially suitable for investment in green projects. Markets can fail to address environmental problems for two well-known reasons. Firstly, research/investment in renewable energy and cleaner technologies requires long-term commitments to projects with uncertain payoffs. They are unlikely to attract funds from institutional investors, whose managers focus on quarterly returns to keep their jobs and bonuses. Similarly, investment analysts tend to focus on short-term returns, intent on discovering investment opportunities just ahead of others in order to capture capital gains. Secondly, firms tend to consider their environmental impact only insofar as it hits their bottom lines, ignoring other social costs. Conversely, they tend to under-invest in green technology and innovation, since they cannot appropriate all the social benefits. Insofar as they succeed via patents and licensing, they impede adoption.

The SWF set up by surplus countries have mandates to promote national welfare, so they ought to address the global environment. They can overcome the above market failures by investing for the long term and taking account of the social benefits to their nation. But the international spillover of environmental problems suggests that SWF should act via an international consortium, which we might call a Mutual Green Fund (MGF).

The difficulties of coping with international spillovers are illustrated by the Amazon Fund that Brazil set up in August, 2008 to solicit international donations to save the Amazon forest.<sup>9</sup> Norway committed \$1 billion; other surplus countries were conspicuous by their absence, presumably fearing domestic criticism of donations that would benefit mostly non-citizens. Overcoming such selfishness requires joint international action, so

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<sup>8</sup> Gillan and Starks 2003

<sup>9</sup> "Paying for the forest", *Economist*, Aug 7th 2008

that each country can reassure its citizens that other countries are also contributing. But the Kyoto precedent is unpromising: a vast negotiation yielded mostly grand statements of principle and national commitments that were largely unfulfilled.

How to do better? A neighborhood group trying to improve its environment is typically launched by those with the most motivation and resources. They typically attract others by securing additional benefits for members (such as discounts at local shops).<sup>10</sup> Similarly, international collective action on the environment needs a core group with exceptional resources and motivation — that can offer additional benefits to its members. Countries with large reserves can contribute the most. But why should they, when all countries would suffer from global warming or resource depletion?

Because countries with large reserves are especially exposed. They are trying to transfer purchasing power to the future by holding financial claims on other countries. They have the most to lose in financial terms, were the future to be impoverished by environmental catastrophe or resource depletion. Any large-scale environmental disruption would require forceful government actions — and expenditures. Piling these onto the deficits already necessitated by the current financial crisis might create irresistible pressure to monetize the deficits — with especially unfortunate consequences for those holding the most assets denominated in money.

Surplus countries might take the lead via a joint project that promises them specific commercial benefits, as well as general environmental benefits. The US has earmarked \$16.8 billion for renewable energy projects in its Recovery Act. It could leverage these funds by injecting some into an MGF, then invite SWF to contribute. Other countries with promising projects could likewise launch MGF with national funds and invite SWF to contribute. Each MGF could build up expertise in evaluating and commercializing green technologies; its members could channel the technologies developed into their own countries via licensing.

A variety of MGF designs are possible. The host nation could inject equity and invite SWF to contribute more, in return for a pro-rata share in the resulting intellectual property and profits from commercialization. The equity could be leveraged by a loan from the host country's national pension fund. Or, the MGF could sell convertible bonds, which would offer SWF a base return, plus upside participation. The global initiative could be coordinated by a supranational body, such as the UN. Its main political task would be to persuade each SWF to contribute, on the basis that other SWF are participating in a global effort that would yield commercial as well as environmental benefits — and help safeguard the long-term value of their foreign exchange reserves.

By contributing to a variety of MGF, each SWF could diversify across many risky projects. The various MGF would be competing for SWF funds by offering attractive terms for sharing risk and reward and good governance mechanisms, yet consortia of SWF would be cooperating within each MGF. Such international "co-opetition"<sup>11</sup> might be the most realistic way forward on the global environment. The Kyoto attempt by all countries to negotiate all environmental matters at once yielded rather grand but unenforceable commitments. By contrast, a consortium of SWF in an MGF would only be

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<sup>10</sup> Mancur Olson, 1971

<sup>11</sup> Nalebuff and Brandenburger, 1997

seeking mutual benefits as they negotiate a narrow set of commercial issues in a business-like setting. Yet in the aggregate, the MGF could greatly expand research and commercialization of renewable energy, and salvage the global environment.

There are wider political benefits. Global imbalances have provoked political grandstanding that demonizes surplus countries, and foreshadows protectionism. A joint commitment by surplus countries to green projects would diffuse tensions by signaling responsible global citizenship. Participation by the biggest polluters, China and the US, in consortia dedicated to green projects would show joint global leadership, which should encourage other countries to take responsibility for the global environment. Collaboration on green projects would also provide a useful precedent for collaboration by SWF in other inflation-protected investments that use current account surpluses constructively. It would clear the air in more ways than one.

## VI. Conclusions

A basic theme of microeconomics is the interplay of markets and governments. Under this standard dichotomy, the revelation of a market failure leads economists to debate whether governments can do better by intervention in markets. But globalization requires us to think at three levels: markets, national governments and the global community. In particular, it requires us to consider national government participation in markets. This paper has analyzed today's financial crisis in terms of the failure of national governments to participate in markets in a business-like manner. It has analyzed the environmental crisis in terms of the difficulty of national governments joining together in globally responsible actions, given that they are politically accountable only to their own citizens. It has also argued that some market failures in finance and the environment can be alleviated if governments participate in markets by joining together in business ventures whose ownership and control is structured to address the political concerns of host countries.

SWF have been enjoined to behave as good global citizens; the organizational structure proposed above for MWF should induce them to do so out of collective self-interest. By overcoming the market failure in the private sector due to information asymmetry and the under-pricing of the public benefits of long-term investment, the MWF can strengthen the global economy, while earning high long-term returns. They can do well by doing good.



## References

- La Porta R, Florencio Lopez de Silanes and Andrei Shleifer, 1999, "Corporate ownership around the world", *Journal of Finance* 54 471 - 517
- Franks J, and Colin Mayer, "Ownership and control of German corporations", *Review of Financial Studies* 2002
- Cipriani, Marco and Antonio Guarino "Herd Behavior and Contagion in Financial Markets," *The BE Journal of Theoretical Economics*, 2008
- Gillan, Stuart and Laura T. Starks "Corporate Governance, Corporate Ownership, and the Role of Institutional Investors: A Global Perspective" *Journal of Applied Finance*, 2003
- Olson, Mancur, *The Logic of Collective Action: Public Goods and the Theory of Groups*, Harvard University Press, Revised edition ed. 1971
- Nalebuff, Barry J. and Adam M. Brandenburger "Co-opetition: Competitive and Cooperative Business Strategies for the Digital Economy", *Strategy & Leadership*, 1997

## **Comments on "Sovereign Wealth Meets Market Failure: Government Participation versus Government Intervention in Markets"**

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This paper provides an interesting political-economy perspective on how official capital can be mobilized and managed internationally to play a catalytic role in raising private capital for global public investment that is needed but under-financed due to market failures. The basic mechanism proposed by the paper is the business-like partnership between governments that operates through shared interests and aligned incentives. As a useful vehicle to facilitate such partnership, the paper proposes mutual wealth funds (MWFs) which can be created in the form of an international consortium of individual sovereign wealth funds. The governance structure of MWFs can be designed to ensure long-term investment horizon of the fund, transparency of investment strategy, and equitable voice of each participating government while avoiding sensitive political issues. For useful application of MWFs, the paper highlights two global investment needs: recapitalization of US banks which is crucial for the resolution of the current global crisis and long-term development of green technology.

### **I. Mutual Green Funds (MGFs)**

The proposal could be useful to address global underinvestment in green technology for which international cooperation has thus far been disappointingly inadequate. It is worth noting that by design MGFs help internalize only positive externality by rewarding green technology development with financial returns while an international trade of CO2 emission rights works on both positive and negative externalities by rewarding over-performance and penalizing under-performance in emission controls. For this reason, the working mechanism of MGFs should in principle be less powerful than that of the international trade of emission rights. However, MGFs may be politically more viable than agreeing on the (zero-sum) allocation of emission rights across countries. In this respect, MGFs could be a realistic second-best solution.

### **II. Mutual Wealth Funds (MWFs)**

Unlike MGFs that will have to be mandated to invest in green projects that would otherwise be under-financed, MWFs will have no such specific mandate in investment strategy because its main objective is to make long-term financial investment in a wide array of assets including equities. This feature of MWFs may make international cooperation more difficult to achieve than in case of MGFs. It is also unclear whether MWFs could dominate other available options in terms of cost and benefit.

#### **1. Incentive to participate in MWFs**

It is less convincing that MWFs can be a useful solution for overcoming market failures in international finance and political interference. Macroeconomic theories suggest that global imbalances might have been avoided if the US monetary and fiscal

policies had been more prudent and/or if China had allowed greater exchange rate flexibility and further liberalized the capital account. Despite clear understanding by policymakers of the risk of catastrophic consequences of unsustainable global imbalances, global imbalances did materialize followed by a global crisis. The paper turns to political constraints and incentives to explain why macroeconomic policies had been misaligned on both sides of the Pacific Ocean for so long until global imbalances reached at unsustainable levels. If the explanation is valid, it is hard to understand how MWFs under government controls can overcome the same political constraints and incentives.

Once it is assumed that the Santiago Principles are in full operation and equally applied to MWFs and individual SWFs, it is not easy to see what additional benefit MWFs can yield to participating countries relative to the case where sovereign wealth funds invest individually. Indeed, the existing SWFs are managed for quite different purposes and under different mandates. Therefore, it may be very difficult, if not impossible, for MWFs to align the objectives of participating SWFs in determining the desirable diversification.

A simple example might help in this regard. Since SWF is a vehicle to invest savings in tradable goods, a plausible assumption would be that SWFs will determine the optimal currency composition in such a way as to stabilize the real purchasing power of the fund in terms of imported goods. Suppose that the US and the Europe accounts for 60 percent and 40 percent of Saudi Arabia's imports, respectively. Then a Saudi Arabia SWF would likely hedge against currency risks by investing 60 percent of the fund in dollar assets and 40 percent in Euro assets. Within each currency exposure, the SWF may also want to short in assets whose return is positively correlated with oil prices while taking a long position in assets with negatively correlated returns. How about SWFs of China? They would seek quite different currency composition because China's import structure differs from that of Saudi Arabia. Within each currency exposure, they would also take the opposite position from that of Saudi Arabia because China is one of the largest oil importers. Consequently, neither China nor Saudi Arabia would have an incentive to participate in MWFs even if MWFs can achieve better asset diversification (within each currency exposure) than individual SWFs for reasons suggested in the paper. Both can do better by managing SWFs individually.

## **2. Long-run benefit of MWFs and short-run cost of inaction or alternative options**

The long-run benefit of MWFs in terms of enhanced global financial stability may be better achieved by other available means and perhaps at lower economic and political costs. Recently, the G-20 took the initiative to reform the international financial architecture with a view to strengthen surveillance and financial regulation at a global level, for which international cooperation is within reach. While the longer-term investment horizon of mutual wealth funds might help stabilize international capital flows, the recent study by the IMF also points out the risk of SWFs being a source of inefficiency and market volatility.

The short-run cost of inaction (i.e., no MWFs) or alternative options (e.g., financial sector bailout by official resources) seems to take larger weight in the argument of the paper. But the short-run cost may be overstated. The following questions might help clarify several misconceptions in the paper.

(1) Would the world economy have looked much different from now if China had invested in a diversified portfolio instead of putting all eggs in the same basket?

- This question is critical for the argument for MWFs because the main purpose of MWFs is to provide official creditors with right (business-like) incentives to invest in a diversified portfolio. Note that MWFs have no bearing on how much China would or should save or the United States dissave.

- Consider first the diversification across different types of assets. For simplicity, suppose that there exist two types of assets—bonds and equities. The government (or central bank) of China holds a portfolio unduly concentrated in bonds. But the private sector of China holds a portfolio unduly concentrated in equities which are backed by domestic capital stock. For the country as a whole, therefore, China holds a far more diversified portfolio. If the return on domestic capital is positively correlated with the return on US equities (e.g., through trade linkage), the Chinese government or central banks may have a good reason—other than possibly limited capacity to manage investment risks—to hold a portfolio concentrated in bonds which provide additional benefit of liquidity. Likewise, the gross asset/liability position of the United States is far better diversified than implied by Chinese or other surplus countries' holdings of the US Treasury bonds. Despite the largest negative net investment position, the US has earned positive net return on its portfolio. If the US has superior risk management technology, it may be optimal to borrow in low-yield bonds and invest the proceeds in risky but high-yield assets like equities. Indeed, this is what the US has been doing.

- Consider now the geographic diversification. China invested most of its savings in the United States rather than in a geographically diversified portfolio. Several factors might help explain why China did so. First, the US economy has been more productive than other advanced countries in Europe or Japan with more vibrant investment. Second, the US current account deficits generate large and sustained borrowing needs which were absent in Europe or Japan. Third, the de facto peg to the US dollar eliminates the currency risk in holding dollar assets. Last but not the least, China might have had political incentives to invest in the US in order to avoid trade frictions that might arise in relation to large and sustained trade surpluses with the US, or for strategic reasons suggested by Dooley et al (2003).

- Of course, this is not saying that China could not have done better in terms of diversifying investment or borrowing. China could have earned higher return without compromising its liquidity position if it had invested excess reserves into higher-yielding dollar assets.

- What is important for the argument is, however, that such effort by China or other surplus countries is unlikely to have helped in any important way prevent the current global crisis. Macroeconomic theories provide no compelling reasons to believe that the US long-term interest rates or fiscal/external deficits would have behaved quite differently if the US monetary policy had remained as lax as it was but China had invested the same amount of surpluses in US private equities or other high-yield assets. It is equally unlikely that the housing boom fueled by risky sub-prime mortgage loans would have been avoided under the same regulatory failure of the US if China had invested in a diversified portfolio. As such, a better portfolio diversification by China is unlikely to have changed the course of the world economy insofar as the underlying reasons of global imbalances were left unaddressed.

(2) Will the financial sector bailout put the US public debt on an unsustainable path and pose the expropriation risk?

- By questioning the post-crisis sustainability of US public debt, the paper argues that foreign claims on the US government are subject to the risk of expropriation through inflation or currency depreciation. To mitigate the risk and contain the danger of a run on the dollar, the paper suggests that those foreign claims could be converted into equity claims on private corporations—especially US banks. Such action could also help prevent US public debt from rising to unsustainable levels. The paper then proposes that MWFs can be a useful vehicle to manage the converted equity claims.

- In the United States, the headline support committed for financial sector stabilization is as large as 81 percent of GDP. But this number grossly overstates the potential fiscal cost of bailout—which is what matters ultimately for public debt sustainability—as it includes general liquidity support by the Fed to stabilize the financial markets. A more careful accounting suggests that the committed support that would incur fiscal liabilities once implemented is about 40 percent of GDP. Thus far, only 15 percent of the committed support (or, about 6 percent of GDP) has been actually used. Moreover, not all support measures will incur fiscal costs or increase public debt in net terms. Official resources used for bank recapitalization, asset purchases or direct lending are backed by acquired assets or collateralized and thus could be recovered later at least partially if not in full once the economy is normalized. Despite large uncertainty about the future course of the economy, net fiscal costs of financial sector bailout are expected to be no larger than 5 percent of GDP even if the committed support is fully utilized.

- While the expected net fiscal cost of financial sector bailout is modest, US public debt is anyway on the rising path in gross terms because of large spending for stimulus and revenue losses from economic recession. The recent projections by the IMF indicate that US public debt could become as large as GDP by 2019. But this projected figure is still low if compared to Japan or Italy today.

- There is no indication in financial market data that investors might flee from the US government debt for fear of expropriation. In fact, market reactions were the opposite driving the US Treasury bond yield to near zero. The historical behavior of the US primary balance also suggests that the US public debt can be stabilized before creating any significant risk of expropriation.

- In addition, there are alternative ways to minimize or avoid the risk of expropriation if it is a real concern. China and other surplus countries could rebalance their claims on the US government toward shorter maturities by selling long-term bonds and purchasing short-term bills. The US may issue inflation-indexed bonds if the expropriation risk is a serious concern. Currency depreciation may still be a source of the expropriation risk. But all dollar assets—not just US government bonds—are exposed to the same currency risk implying that MWFs that invest in US equities cannot do better in this regard. If the currency risk is the major concern of surplus countries, the US government could also issue foreign liabilities denominated in the SDR or other foreign currencies.

(3) Could surplus countries avoid or reduce the risk of expropriation if their claims on the US government are converted into US bank equities?

- If US public debt rises to unsustainable levels posing an expropriation risk, it should be not because of fiscal costs of financial sector bailout but because of large fiscal stimulus and automatic stabilizer (see the discussion above).

- If China sells US treasury bonds in the market and use the proceeds to buy US bank equities, the most likely buyers of treasury bonds would be US banks who need to rebalance their balance sheet toward less risky and more liquid assets. Then, the acquired equity claims on those banks will continue to be subject to the same expropriation risk.

- As correctly pointed out in the paper, there will be greater danger of a run on the dollar if China or other surplus countries simultaneously pull out from the US government debt markets, which is self-defeating for both China and the United States. In this light, China is one of the largest stake holders and thus might have strong interest in helping the US get out of the current financial mess and back on the recovery path.

## Between Two Whales: Korea's Choice in the Post-Crisis Era\*

*Joon-Kyung Kim and Chung H. Lee*

### Abstract

This paper examines the impact of the current global financial meltdown and China's rising power on the South Korean economy and South Korea's external relations with China and the U.S.

#### Main Argument

Since 1945 South Korea has had a close relationship with the U.S., who has both been the country's largest trade partner and guaranteed its security. This relationship has been changing, however, ever since China's emergence as a global economic power. As the Korean economy grows, it will inevitably become more closely linked with China through trade, investment, and production networks. How close these links become will depend on the economic relations that evolve between South Korea and the U.S. following the current crisis.

#### Policy Implications

- If the U.S. economy recovers quickly and does not grow protectionist, Washington's relationship with Seoul will remain strong.
- The U.S.-South Korean relationship will be strengthened if the Korea-U.S. Free Trade Agreement is ratified. A peaceful coexistence between the U.S. and China is the only way for South Korea to avoid being faced with the difficult choice of aligning with one or the other of these major powers.

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The current financial and economic crisis that has emanated from the United States has had, and will continue to have, a serious impact on the economy of South Korea (Korea henceforth). Not only have the Korean financial markets been adversely affected by the failures of the U.S. financial system, but as the world economy has suffered a contraction of global demand, Korea's real economy has been forced into a recession—although there are now some signs of recovery since the early months of 2009. This chapter examines the impact of the current global financial meltdown and resultant economic recession both on Korea's economy and on the country's external relations with China and the United States.

Since liberation from Japanese colonial rule in 1945, Korea has had a close relationship with the United States, which has been Korea's largest trade partner and security guarantor. Yet this relationship has gradually been changing following China's emergence as a major global economic power and trading nation. As China develops further, the Korean economy will inevitably become more closely linked with the Chinese economy through trade, investment, and production networks, especially given the two countries' cultural and geographical proximity. How close they become will, however, depend on the economic relations that evolve between Korea and the United States. If the current crisis does not turn the United States toward protectionism, the Korean economy will remain closely linked with that of the United States, countering growing dependence on the Chinese economy. In sum, how the economic relationship between Korea and China evolves in the near future will depend critically on the impact that the current crisis has on the relationship between Korea and the United States.

The current crisis is thus expected to have a profound effect on Korea's relations with the United States and China. First, China has already surpassed the United States as Korea's most important trade partner, and the current crisis is likely to enhance China's supremacy as the country's trade partner unless the U.S. economy recovers within a few years. Second, the crisis will diminish whatever confidence that Korean policy elites may have had in the version of capitalism that has been practiced in the United States in the past few decades. Many of the economic reforms undertaken in Korea since the early 1980s and especially in the aftermath of the Asian crisis of 1997 were modeled, at least in theory, after the institutions in Anglo-American countries. This crisis may discredit some of those institutions in the eyes of policy elites, causing them to rethink the attractiveness of those institutions as a model to emulate. In other words, the crisis may increase the economic interdependence between Korea and China while diminishing the value of the U.S. capitalist model and thus reduce U.S. influence on Korea's economic policymaking.

The chapter is organized as follows. The first section briefly examines some of the institutional reforms that Korea undertook in the aftermath of the 1997 crisis, arguing that it helped the Korean corporate and financial sectors better respond to the current crisis. The second section discusses the impact of the current crisis on Korea's financial and real sectors, as well as the impact of some of the government measures that have been adopted or proposed in response to the crisis, concluding that the current crisis is unlikely to have much impact on the country's political stability. The third section examines how China's rise over the past few decades has affected the Korean economy and how the current crisis may affect Seoul's economic relationship with Beijing. The fourth section concludes the chapter by overviewing the effect that the crisis has had on Korea's economic relations and strategic alignment with both the United States and China. Finally, it should be noted here that this chapter does not look into the possible effects of the current crisis on the Democratic People's Republic of Korea (DPRK, or North Korea). The North Korean economy is almost completely isolated from the rest of the world and is thus little affected by disruptions in the global export and financial markets.



## The 1997 Asian Financial Crisis and Institutional Reform in Korea

Although the current crisis has clearly had an adverse impact on the Korean economy, other industrialized countries have been more severely affected. In particular, Korea appears to have suffered less than the United States and some European countries in terms of delinquency ratios, bankruptcies, and unemployment.<sup>1</sup>

Korea's comparatively good performance may be due in part to the institutional reforms taken by the country in the aftermath of the 1997 crisis that led to changes in the financial structure of its corporations and in risk management of its banks. Large corporations managed to actually reduce their debt leverage ratios and improve their debt service capacity. It is not surprising then that the Korean economy has been able to withstand the current global crisis better than other industrialized economies.

Whether the post-crisis reforms—specifically, in macroeconomic policies, financial institutions, corporate governance, and labor market institutions—have had an overall salutary effect on the Korean economy is still being debated, as there are issues relating to the appropriateness of transplanted institutions to specific local conditions and the effectiveness of such reform.<sup>2</sup> Some have even argued that the severity of the current crisis in Korea is partly due to the “undisciplined” capital account liberalization that took place after 1997, which allowed Korean financial institutions to acquire large foreign currency liabilities and to invest heavily in foreign securities.<sup>3</sup> One thing that is certain, however, is that corporations and financial institutions in Korea had undergone a series of reforms before the current crisis. How Korea has responded to the current crisis cannot be understood without first understanding these post-1997 reforms.

### *Corporate Sector Restructuring*

The 1997 crisis prompted the Korean government to carry out a restructuring of the corporate sector, particularly chaebols, in order to restore the health and competitiveness of the economy.<sup>4</sup> The reforms included various measures for promoting competitiveness and improving corporate governance, capital structure, and profitability. In particular, in order to improve the capital structure, the government required corporations to reduce debt levels, strengthen their equity position, and eliminate chaebols' cross-subsidization of weaker affiliates.<sup>5</sup>

Recognizing a close link between the profitability of the corporate sector and the health of the financial sector, the government simultaneously pursued reforms in both areas. The restructuring of chaebols began, however, as a key element in the reform because insolvency of these conglomerates played a major part in the 1997 crisis and after

<sup>1</sup> Federal Deposit Insurance Corporation (FDIC), *Quarterly Banking Profile*, First Quarter 2009; and International Monetary Fund (IMF), *World Economic Outlook: Crisis and Recovery* (Washington, D.C.: IMF, 2009), 65.

<sup>2</sup> Keun Lee and Chung H. Lee, “The Miracle to Crisis and the Mirage of the Postcrisis Reform in Korea: Assessment after Ten Years,” *Journal of Asian Economics* 19, no. 5–6 (November–December 2008): 425–37; and James Crotty and Kang-kook Lee, “The Effects of Neoliberal ‘Reforms’ on the Post-Crisis Korean Economy,” Political Economy Research Institute, Working Paper Series, no. 111, September 2005.

<sup>3</sup> Yung Chul Park, “Global Economic Recession and East Asia: How Has Korea Managed the Crisis and What Has It Learned?” (mimeograph, Korea University, April 2009). Park argues that “undisciplined” liberalization led to large foreign currency liabilities in the banking sector, which jumped from \$83,429 million at the end of 2005 to \$194,045 million at the end of 2007.

<sup>4</sup> A *chaebol* is a large, usually family-owned conglomerate in Korea. Examples include Hyundai and Samsung.

<sup>5</sup> For a brief review of the post-crisis reform in Korea, see Chung H. Lee, “The Political Economy of Institutional Reform in Korea,” *Journal of the Asia Pacific Economy* 10, no. 3 (August 2005): 257–77.

that crisis the number of insolvent chaebols only increased. Out of 63 of the largest chaebols, 30 were forced to undergo some form of insolvency rehabilitation procedures – 15 chaebols for in-court procedures and another 15 for informal workout programs.

Realizing the potentially serious negative impact that a massive wave of bankruptcies could cause, the government mobilized public funds to bring about the restructuring of the troubled firms. From 1998 to 2001, a total of 168 trillion won (25% of Korea's GDP in 2002) was mobilized, with a considerable portion being injected into the financial sector – both banks and non-banking financial institutions (NBFI). With these funds, the government cleaned up non-performing loans (NPL) through the Korea Asset Management Corporation (KAMCO) and strengthened the capital base of banks through the Korea Deposit Insurance Corporation (KDIC). In particular, KAMCO played a significant role in facilitating the rehabilitation of distressed chaebols, notably by reducing these businesses' level of debt: Between 1998 and 2002 KAMCO purchased NPLs valued at 48.3 trillion won (in book value) associated with the 30 troubled chaebols out of 63 largest chaebols for 17.4 trillion won.<sup>6</sup> Once the government strengthened the soundness of the financial sector with public funds, financial institutions were in the position to implement creditor-led corporate restructuring, which began in 2001.

As part of the restructuring process, formal insolvency procedures were used in dealing with troubled chaebols.<sup>7</sup> Informal workout programs, however, played a more important role in restructuring and thus preventing corporate bankruptcies and restoring a rapid economic recovery. One such case involved Daewoo, the second-largest Korean business group at that time, which faced serious financial troubles and was technically insolvent by June 1999. Burdened with a massive non-performing debt of around \$72 billion, twelve affiliates of Daewoo entered into informal workout programs in August 1999. Implementing the workout programs was not easy, however, given that they involved a large number of domestic and foreign creditors with conflicting interests. Eventually, public funds were used in early 2000 to purchase \$3.9 billion of loans from more than three hundred foreign creditors.

Since the 1997 crisis, Korea's corporate sector has made significant progress in financial soundness and efficiency. The extreme high debt-equity ratios of over 500% in the years preceding the crisis were brought down to 200% by the end of 2000, and the intra-group debt guarantees of the 30 largest chaebols have also been reduced to a significant degree.<sup>8</sup> More importantly, many large-scale spin-offs have resulted in both the significant reduction in the number of poorly performing affiliates and the streamlining of financially weak chaebols.

To assess the degree of improvement in the corporate sector since the crisis, the present authors have examined the debt service capacity, operating profitability, and debt leverage of firms for 1991–2008 using the financial data for more than 18,000 externally

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<sup>6</sup> Joon-Kyung Kim, "Public Funds and Post-Crisis Corporate and Financial Restructuring in Korea," (paper presented at the symposium "International Forum on Non-performing Asset Fund," KAMCO, April 3, 2007)

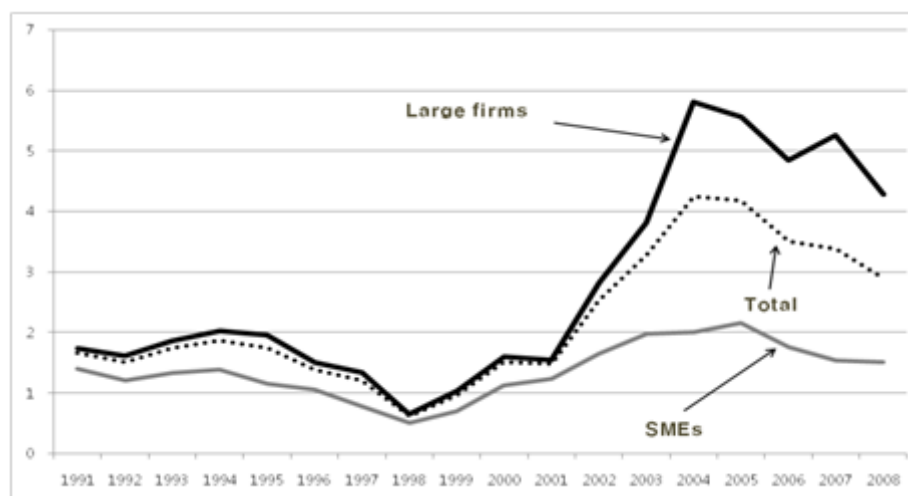
<sup>7</sup> The 1997 crisis prompted a number of changes in laws relating to corporate restructuring. The Corporate Reorganization Act was amended in 1998 and 1999 to improve insolvency laws with the following changes. First, an economic efficiency criterion was established, specifying the qualification for judicial insolvency procedures: the court now disqualifies a candidate firm whose going concern value is less than its liquidation value. Second, to speed up proceedings, time limits were introduced for the critical steps in the proceedings, including the decision to stay, the report of debts and equities, and the approval of a reorganization plan. In addition the Composition Act was amended in 1998 to prohibit large firms with complicated capital structures from [applying for](#) composition and thus prevent the abuse of the composition procedures. This appears to have had a salutary effect, as shown by the fact that the firms that entered both corporate reorganization and composition outperformed their 1997 counterparts. Joon-Kyung Kim, "Assessment of Progress in Corporate Restructuring in Korea since the 1997–98 Crisis," *Journal of Restructuring Finance* 1, no. 2 (September 2004): 289–310.

<sup>8</sup> Fair Trade Commission.

audited firms. For the debt service capacity we have used the interest payment coverage ratio (IPCR)—the ratio of operating profits to interest expenses. This definition implies that the firms with an IPCR less than one are unable to even cover their interest payments, let alone the principal, with their current earnings. The IPCR for the entire group of sample firms has been rising since the crisis, albeit with some fluctuations (**Figure 1**). Reduction in debt, combined with lower interest rates, led to this upward trend. Another feature relating to the IPCR is that the large firms have been improving their performance, albeit with some fluctuation, since the 1997 crisis, whereas small and medium-sized enterprises (SMEs) have been doing less well. Between 1997 and 2008 the IPCR of large firms rose from 1.3 to 4.3, more than a three-fold increase, while that of SMEs rose from 0.8 to 1.5, barely a two-fold increase.

There are at least a couple of reasons for the weaker debt service capacity of SMEs, one being these firms' stagnant profitability (**Figure 2**) and the other being their higher debt leverage than is the case for large firms (**Figure 3**). In particular, little improvement occurred in the operating profitability of SMEs compared to their pre-crisis performance.<sup>9</sup> Large firms were, however, able to reduce debt leverage at a more rapid rate than SMEs: the ratio of total borrowings to total assets for large firms decreased from 49.9% in 1997 to 22.9% in 2008. Although initially decreasing after the crisis, the level of SME's debt leverage began to rebound in 2003 and reached 42.8% in 2008, almost the same level as before the crisis.

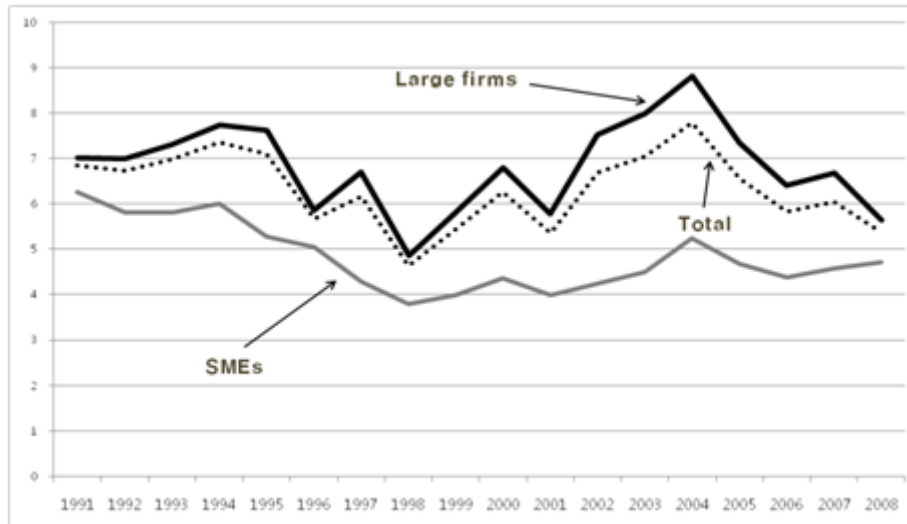
Figure 1. Interest payment coverage ratio (IPCR)



Data Source: Database from Korea Investors Service, Inc. Note: The ratios are a weighted average across firms.

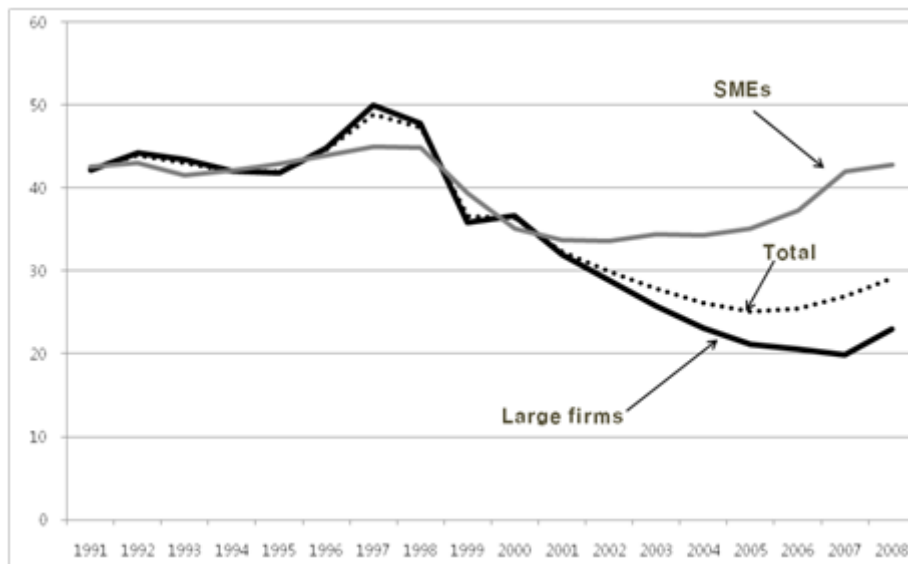
<sup>9</sup> Due to the global financial crisis in 2008, the operating profitability of large firms decreased substantially, from 6.7% in 2007 to 5.6% in 2008, whereas that of SMEs increased from 4.6% in 2007 to 4.7% in 2008. The increase in operating profitability for SMEs is mainly caused by the implementation of temporary changes in the accounting rule for non-listed SMEs: (1) applying the won-dollar exchange rate of June 30, 2008, instead of the traditional rate of December 31, 2008, to foreign currency-denominated assets and liabilities and (2) allowing a one-year deferment for reporting on losses that arise from holding derivatives with foreign exchange risk.

Figure 2. Ratio of operating profits to total sales (%)



Data Source: Database from Korea Investors Service, Inc. Note: The ratios are a weighted average across firms.

Figure 3. Ratio of total borrowings to total assets (%)



Data Source: Database from Korea Investors Service, Inc. Note: The ratios are a weighted average across firms

In contrast to the considerable progress made in the restructuring of chaebols, there remain a vast number of financially weak firms in the SME group, as measured in IPCR. In 2008 the number of firms with an IPCR less than one was 7,470, accounting for 40.6% of

the sample firms. Particularly worth noting is that the proportion of such firms was higher for SMEs than for large firms. Among the total number of troubled firms, 6,995 were SMEs, accounting for 42.6% of the total SMEs, whereas 515 were large firms, equivalent to 30.1% of the group. Though an IPCR of less than one for a single year may reflect only a short-term liquidity problem, a longer time horizon—for instance, three consecutive years—may point to severe credit risks and signal a “distressed” firm. In 2006–08, 2,662 firms recorded an IPCR of less than one for three consecutive years, accounting for 14.8% of the total sample firms. The amount of borrowings by these firms exceeded 101 trillion won, accounting for 17.3% of the total borrowings by all the sample firms.<sup>10</sup>

### *Restructuring of Financial Institutions*

The 1997 financial crisis forced the government to carry out a number of reforms in the financial sector. These included the restructuring of financial institutions, liberalization of the financial intermediation industry, and reform of governance and regulatory institutions.

On the eve of the crisis, many banks in Korea were significantly undercapitalized, and the crisis only worsened the situation by further weakening their capital base. The government's top priority was to dispose of their NPLs and recapitalize the troubled banks. As a first step toward this end, the government set out to identify insolvent financial institutions and resolve their problems through either “purchase and assumption” or liquidation. By October 2006, 893 financial institutions had been either suspended or closed. A total of sixteen banks, twenty merchant banking corporations, fifteen securities companies, and twenty insurance companies were made to close through the mechanisms of either exits or mergers.

As mentioned above, the government created KAMCO and KDIC to clean up the NPLs and strengthen the banks' capital base. The funds expended by these corporations reached 168 trillion won, and the recovery ratio of total public funds was 55.7% as of February 2009. From inception through 2002, KAMCO purchased 111 trillion won of NPLs from financial institutions for 38.8 trillion won (an average of 36% of the face value) and so far has recovered 42.4 trillion won from the sale of the acquired NPLs, which amounts to 110% of the injected fiscal money.

As to be expected, the restructuring of the financial sector led to a drastic reduction in employment in that sector. By the end of 1999 the total employment in banks decreased from 128,503 employees on the eve of the crisis to slightly over 90,000—a significant drop of approximately 30%. Employment in that sector has since increased somewhat, yet still reached only about 100,000 in 2006.

The soundness of Korean banks improved markedly, thanks to the injection of public funds as well as strengthened prudential regulation and improved efficiency and internal risk management. Indeed, the BIS (Bank for International Settlement) ratio improved from 7.0% in 1997 to 12.3% in December 2007 while the NPL ratio decreased from 9.2% in 1999 to 0.6% in December 2007.

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<sup>10</sup> Joon-Kyung Kim, “Global Financial Crisis and the Direction for the Korean Economy” (paper presented at the symposium “What are the problems in Korea's Financial System?” Seoul National University Institute for Research in Finance and Economics, May 21, 2009).

### *Liberalization of the Financial Intermediation Industry and the Capital Market*

Another financial reform undertaken by the Korean government after the crisis was to fully open the financial intermediation industry by completely eliminating restrictions on foreign equity ownership. In August 1998 the Foreign Investment Promotion Act was enacted for the purpose of attracting FDI by fully liberalizing hostile mergers and acquisitions (M&A) by foreign investors. Foreign portfolio investments in the stock and bond as well as the short-term money markets were also completely liberalized. As a result, foreign investments in the financial intermediation industry steadily increased after 1999, with the total accumulated amount reaching \$26.4 billion by 2008. These liberalization measures have led to an increase in the share of foreign ownership in Korean banks and, in some cases, the acquisition by foreign investors. For example, Korea Exchange Bank was acquired by Lone Star in 2003, KorAm Bank by Citi Bank in 2004, and Korea First Bank by Standard Chartered Bank in 2005. One exception to this general trend is the Woori Financial Group, which is mostly government-owned.

The removal of restrictions on capital inflow was accompanied by the liberalization of foreign exchange transactions. In particular, the Foreign Exchange Management Law that had been maintained for over 50 years was abolished in 1999 and replaced with the Foreign Exchange Transaction Law. The old law constituted a positive list system in capital account transactions, which prohibited all capital account transactions that were not on the list. The new law introduced a negative list system that allows all capital account transactions except those on the list. Under the old law, foreign exchange transactions had to be accompanied with bona fide demand for foreign exchange, thereby preventing speculative transactions; under the new law, no such requirement is needed.

Beginning in 2006 the Korean economy continuously recorded surpluses in the current account, and the government encouraged capital outflows by, for instance, partly removing restrictions on overseas securities investment and real estate acquisition by individuals (**Table 1**). With these changes in laws and regulations relating to capital account transactions, Korea has now joined the ranks of the most advanced countries in the world in terms of the country's degree of capital market liberalization. In fact, Korea's liberalization index increased from 65.0 in 1997 to 85.1 in 2006, a level comparable to that of Japan or the United Kingdom.

Foreign investments in the Korean equity market have also shown an upward trend since 1998 when ceiling restrictions on foreign ownership were abolished. Consequently, foreign investors' share of equities increased from 13% in 1996 and peaked at 42% in 2004 before falling to roughly 32% in 2007. During 2003–07, gross capital inflows to Korea averaged \$43.5 billion a year, led largely by foreign portfolio investments and foreign currency borrowings by financial institutions, which accounted for 50.1% and 45.3% of total capital inflows, respectively. In 2003–04, foreign investments in equity were greater than in debt securities, but in 2006–07 foreign investment in equity turned negative while investment in debt securities exploded. The share of FDI in total capital flows in 2003–07 was 15.5%.<sup>11</sup>

Overall, the institutional reform undertaken by the Korean government in the aftermath of the 1997 crisis has put chaebols and financial institutions on more solid footing, helping them to better withstand the external shocks of a global financial meltdown and recession. One may debate the wisdom of the government's approach to liberalizing the capital account, but as far as the restructuring of large corporations and

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<sup>11</sup> "Economic Statistics System," Bank of Korea website, <http://ecos.bok.or.kr>.

financial institutions is concerned, there appears to be little dispute about the appropriateness of the reform.

Table 1. Key measures for capital account liberalization in Korea

Dates	Measures
Dec 1997	Full liberalization of corporate and government bond markets
Apr 1998	Establishment of foreign subsidiaries allowed
May 1998	Opening of all money market instruments (CP, CDs, RPs, etc.) Removal of ceilings on foreigners' stock market investment (with the exception of investment in some state-owned enterprises)
Apr 1999	First phase of foreign exchange liberalization: capital account transaction regulation changed from positive to negative list system
Jan 2001	Second phase of foreign exchange liberalization: abolishment of ceilings on overseas payments for overseas expenses for travel, stay, education, and emigration
Dec 2005	Abolition of capital transaction licensing system, replaced by an <i>ex post</i> reporting system
Jan, Mar 2006	Removal both of ceilings on outbound FDI by individuals (Jan) and of restrictions limiting the types and items of overseas securities investment by individuals (Mar)
May 2006	Early implementation of foreign exchange liberalization plan: (1) advancing schedule of plan from 2009 to 2011, and (2) allowing acquisition of overseas real estate up to \$1 million Reduction of tax rates from 25% to 14% on interest income from domestic bonds held by foreigners
Jan 2007	Raising of limit on acquisition of overseas real estate by Korean nationals for investment purposes from \$1 million to \$3 million
Dec 2007	(1) full completion of first phase of foreign exchange liberalization plan, as schedule, and (2) abolishment of reporting requirement for capital transactions up to \$50,000 and reduction of documents required for reporting

Source: Ministry of Strategy and Finance, cited from Kyungsoo Kim, Byoung-ki Kim, and Young Kyung Suh, "Opening to Capital Flows and Implications from Korea," Institute for Monetary and Economic Research, Bank of Korea, Working Paper, no. 363, February 2009.

## The Current Crisis's Economic Impact and Government Response

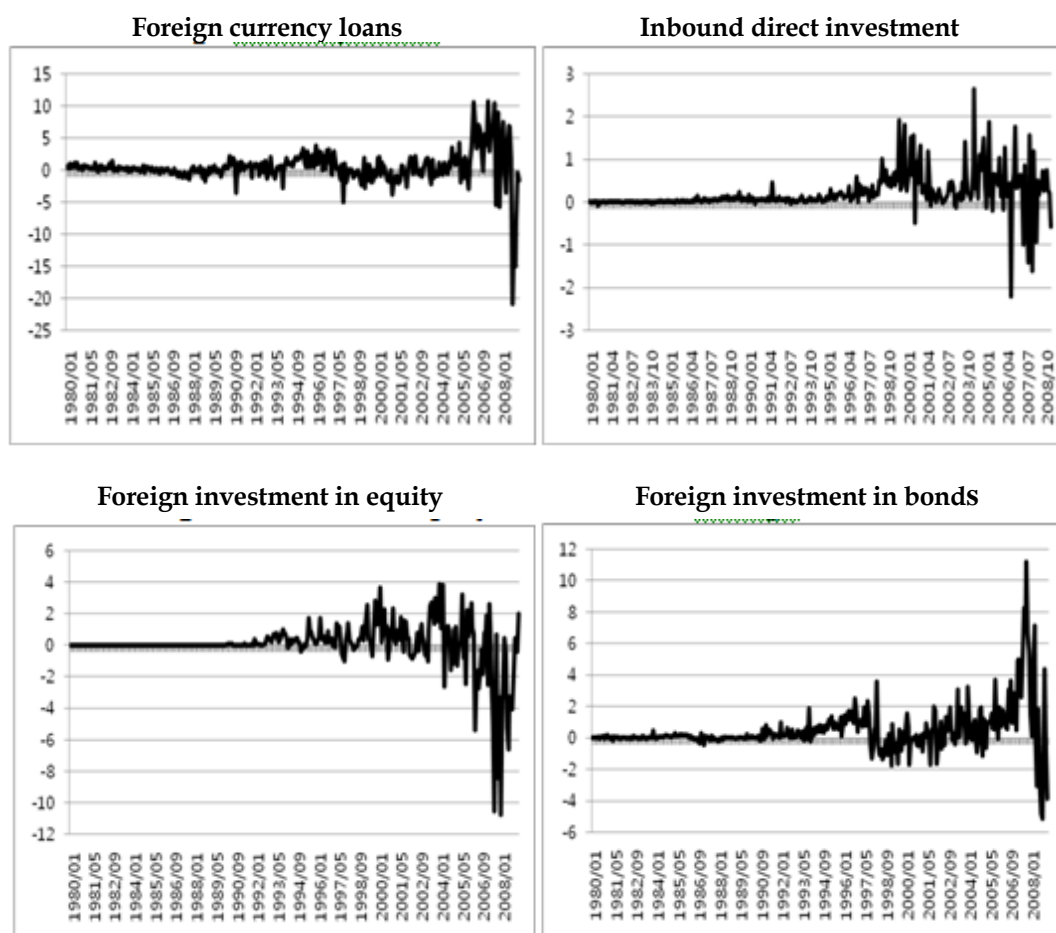
### *Impact on the Financial Sector*

The Korean financial market has suffered from the current crisis but not as severely as the financial markets in some countries. Stock prices certainly declined, with the KOSPI (Korea Composite Stock Price Index) falling by 40.7% between year-end 2007 and year-end 2008 and by 5.5% between year-end 2008 and February 2009. The decline was largely due to a surge in capital outflow, with a net outflow of \$46.2 billion between September and year-end 2008. This capital outflow was largely due to a massive withdrawal of foreign debt by financial institutions (**Figure 4**) and was a key factor in bringing about a

rapid credit squeeze in the financial market. As a consequence, the won-dollar exchange rate fell, with the won depreciating by 40.8% between October 2007 and February 2009.

Since March 2009, stock prices and foreign exchange rates have gradually stabilized, due to the increased current account surplus as well as to the expansionary policy by central banks under the global policy coordination. The KOSPI increased by 28.8% between the end of February and the end of April 2009, and the won appreciated by 16.4% over the same period.

Figure 4. Capital inflows by category (unit: US\$ billion)



Source: Bank of Korea, Economic Statistics System, <http://ecos.bok.or.kr>.

Korea did not have as large a housing bubble as occurred in the United States.<sup>12</sup> During 1996–2007 housing prices in Korea rose only by an annual average of 3.6%, in

<sup>12</sup> Korea suffered from serious financial instability, however, due to credit card defaults in 2003 when there were 3.7 million credit defaulters (one-sixth of Korea's economically active population) with total household credit amounting to \$389.2 billion. See Hong-bum Kim and Chung H. Lee, "Financial Reform, Institutional



contrast to an increase of 9.1% in the United States, and in 2008 prices in Korea rose by 3.1% versus the 16.8% drop in U.S. home prices (**Table 2**). Two factors accounted for this moderate increase in Korea: one was the deflationary effect of economic restructuring after the 1997 crisis (over the period of 1996–2000), and the other was the restrictive mortgage-loan regulations that the government introduced a few years before the current crisis.

Table 2. Change in housing prices

	YOY growth rate, 1996–2000 (%)	YOY growth rate, 2001–07 (%)	YOY growth rate, 1996–2007 (%)	YOY growth rate, 2008 (%)
United Kingdom	9.4	12.5	11.2	-6.7
Norway	11.3	8.1	9.4	-7.5
Spain	6.7	11.3	9.4	1.1
United States	7.0	10.7	9.1	-16.8
Sweden	7.5	8.9	8.3	3.0
Netherland	12.1	4.4	7.6	-0.3
Finland	9.9	5.8	7.5	1.2
Italy	1.4	8.3	5.4	2.6
Germany	-0.8	0.4	-0.1	1.4
Korea	-1.0	7.0	3.6	3.1

Source: Data for the European countries is derived from Financial Time European Housing Price Index, *Financial Times*, April 2009, [http://www.ft.com/cms/s/0/4fda2cc8-525a-11dd-9ba7-000077b07658.html?nckick\\_check=1](http://www.ft.com/cms/s/0/4fda2cc8-525a-11dd-9ba7-000077b07658.html?nckick_check=1); for the United States, Case-Shiller Housing Price Index (Composite-10 cities), [http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices\\_csmahp/0,0,0,0,0,0,0,0,0,1,1,0,0,0,0,0.html](http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_csmahp/0,0,0,0,0,0,0,0,0,1,1,0,0,0,0,0.html); and for Korea, Kookmin Bank, National Housing Price Survey [http://land.kbstar.com/quics?asfilecode=5023&\\_nextPage=page=land&weblog=l\\_gnb\\_C0](http://land.kbstar.com/quics?asfilecode=5023&_nextPage=page=land&weblog=l_gnb_C0).

Until 1997, when the Korean Housing Bank (KHB) was privatized, a ceiling on the housing loan per household was typically set at less than 30% of the value of the property, and loans were granted only for newly built houses. As the mortgage market became more market-based and competitive, however, and as more diverse financial products were introduced as a result of the post-crisis reform, housing loans increased, fueling a boom in the market. From 2001 to 2006 housing prices in Seoul rose on average by 11% per year.

In September 2002, to help control the bubble in the housing market, the government began tightening the loan-to-value (LTV) ratio on apartments in “speculative areas” priced over 600 million won. For banks and insurance companies, the ratio was set at the maximum of 60% on most housing loans but at a more restrictive 40%–60% on condominium apartments in the speculative areas. Some adjustments allowed for difference in the length of loan maturity and the value of the collateral. For non-bank financial institutions, such as mutual finance and savings banks, the ceiling was set at 50%–70%, with the difference depending on the type of housing and location. These ratios are more restrictive than in other OECD (Organisation for Economic Co-operation and Development) countries, where ratios generally range between 55% and 90% or in some cases between 80% and 115%.<sup>13</sup>

Interdependency, and Supervisory Failure in Postcrisis Korea,” *Journal of East Asian Studies* 6, no. 3 (September–December 2006): 409–31.

<sup>13</sup> Organisation for Economic Co-operation and Development (OECD), *OECD Economic Surveys: Korea 2007* (Paris: OECD, 2007), chap. 3.

Beginning on August 30, 2005, a regulation on DTI (debt-to-income ratio, which is the principle and interest payments on total loan to income) was also introduced to reduce the default risk on housing loans. The government began to apply a 40% DTI ratio to borrowers who it suspected might use the loans to invest in apartments in the speculative area.

Measures such as LTV and DTI ratios had the effect of curbing the credit boom in mortgage loans and thus holding down the demand in the housing market. As of September 2008, the LTV ratio in Korea was 45.5%, a figure far lower than in the United States, where the ratio on subprime mortgages was 90% at the end of 2008.<sup>14</sup>

Since year-end 2006 the delinquency ratio of mortgage loans in Korea has remained low and was only 0.54% in April 2009. In contrast, the delinquency ratio for SME loans, which had ranged from 1.0 to 1.8% during 2008, shot up to 2.59% in April 2009.<sup>15</sup> These numbers suggest that the housing market in Korea is in a much healthier condition than that of the United States, although some financial institutions may still suffer a higher-than-average number of loan defaults given a general contraction in the real economy. So far, however, no bank has gone bankrupt in Korea.

### *Impact on the Real Sector*

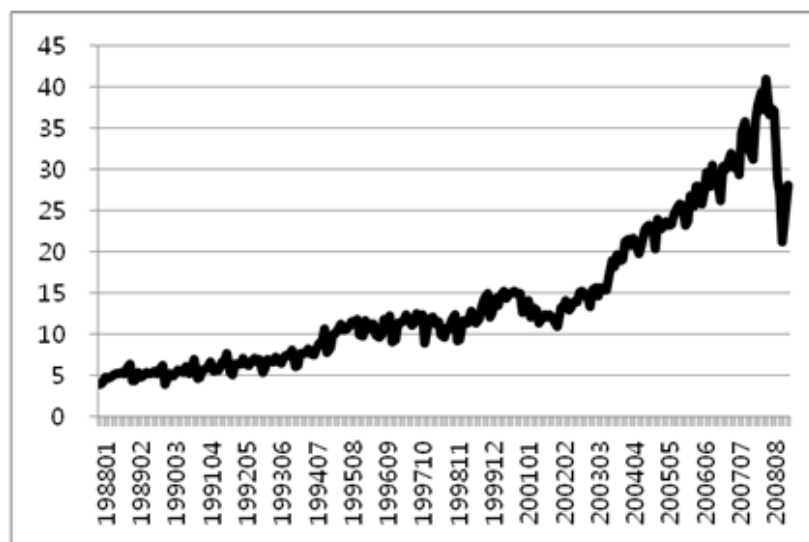
In spite of this relative stability in the financial market, the current global recession has brought about a severe contraction in Korea's exports, thus hurting Korea's real economy. As a matter of fact, Korea's monthly exports recorded an unprecedented decline from \$41.0 billion in July 2008 to \$25.5 billion in January 2009 (**Figure 5**). Between October 2008 and March 2009 exports to China, the United States, Japan, the European Union, and the rest of the world ("others") decreased by 24.4%, 15.4%, 22.6%, 25.0%, and 11.9%, respectively. The severity of these contractions is especially stark when compared with the high-growth rates in exports to these areas in the preceding seven years (**Table 3**). Beginning in March 2009, however, exports improved somewhat, though, with the exception of the shipbuilding industry, exports still remain weak overall.

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<sup>14</sup> After the collapse of Lehman Brothers in September 2008, the Korean government relaxed almost all restrictions on the housing market in fear of a rapid fall in housing prices. That action has led to a slight rebound in housing prices in certain areas since early March 2009.

<sup>15</sup> Financial Supervisory Service Delinquency Ratios for Loan Portfolios by Domestic Banks at the end of April, 2009 (May 27, 2009); [http://www.fss.or.kr/kr/nws/nbd/bodobbs\\_1.jsp](http://www.fss.or.kr/kr/nws/nbd/bodobbs_1.jsp)

Figure 5. Korea's exports (unit : US\$ billion)



Source: The Korea International Trade Association,  
[http://stat.kita.net/top/state/n\\_submain\\_stat\\_kita.jsp?menuId=01&subUrl=n\\_default-test\\_kita.jsp?lang\\_gbn=kor^statid=kts&top\\_menu\\_id=db11&lang\\_gbn=kor](http://stat.kita.net/top/state/n_submain_stat_kita.jsp?menuId=01&subUrl=n_default-test_kita.jsp?lang_gbn=kor^statid=kts&top_menu_id=db11&lang_gbn=kor)

Table 3. Growth rate of Korea's monthly exports by destination (YOY growth, %)

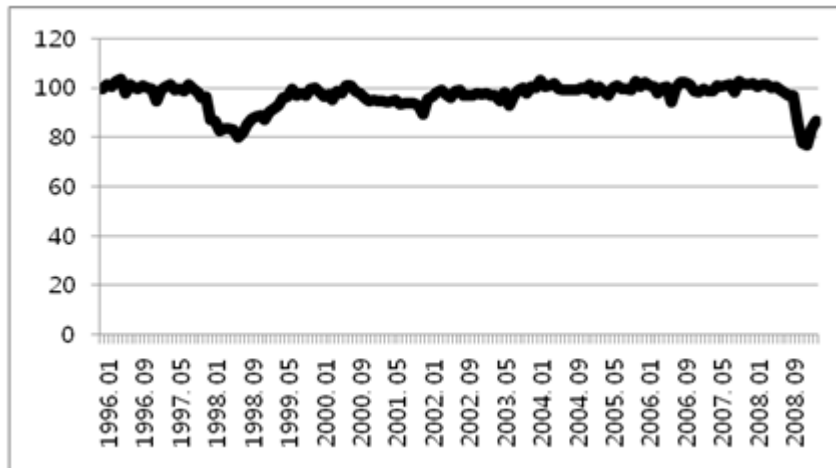
	China	United States	Japan	EU	Others
Jan 2002 - Sep 2008	29.3	7.1	9.8	14.5	19.9
Oct 2008 -Mar 2009	-24.4	-15.4	-22.6	-25.0	-11.9

Source: The Korea International Trade Association  
[http://stat.kita.net/top/state/n\\_submain\\_stat\\_kita.jsp?menuId=01&subUrl=n\\_default-test\\_kita.jsp?lang\\_gbn=kor^statid=kts&top\\_menu\\_id=db11&lang\\_gbn=kor](http://stat.kita.net/top/state/n_submain_stat_kita.jsp?menuId=01&subUrl=n_default-test_kita.jsp?lang_gbn=kor^statid=kts&top_menu_id=db11&lang_gbn=kor)

As to be expected, this decline in exports has had a negative impact on Korea's manufacturing sector: the manufacturing production index fell significantly since November 2008 and its year-on-year growth rate recorded a 17% decrease between November 2008 and February 2009 (**Figure 6**). This negative impact was widely spread throughout the entire manufacturing sector, although the automobile industry appears to have suffered the most. Beginning in March, manufacturing production saw some improvement.

As indicated by the manufacturing production index, production activities have declined for large firms as well as for SMEs. Yet unlike during the 1997 crisis, when SMEs suffered more than large firms, the contraction in large firms has been more pronounced than that in SMEs (**Figure 7**). The severity of the impact of the current crisis on manufacturing can also be seen in the sharp decline in the capacity utilization index to 77 for January 2009, which is even lower than during the 1997 crisis (**Figure 8**). The capacity utilization index rose somewhat to 83.9 in February and further to 86.9 in March.

Figure 8. Manufacturing capacity utilization index (2005=100)

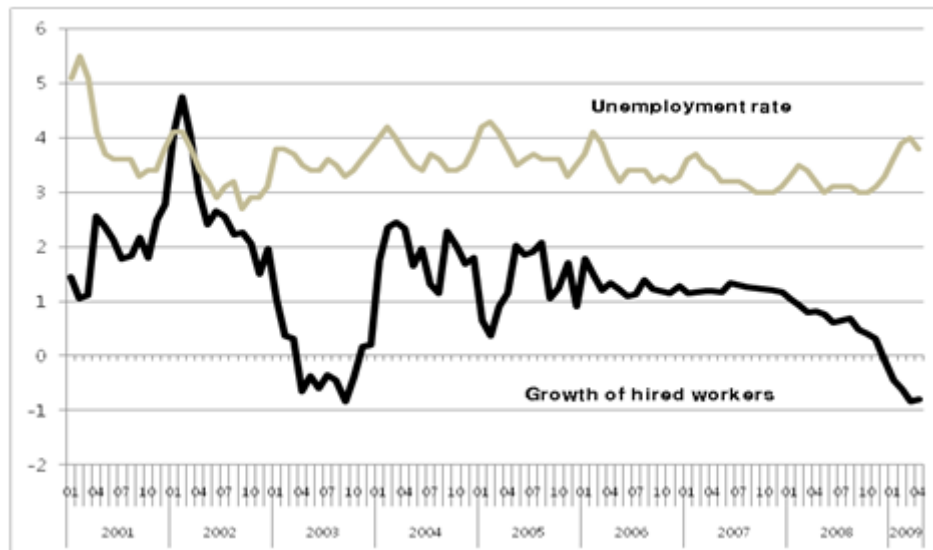


Source: Korea National Statistical Office, <http://www.kosis.kr/>

Consumption-related indicators also show a continuing slowdown, particularly in durable goods, which suffered a 17.7% drop between November 2008 and January 2009, the largest dip since the 1997 crisis. In February and March 2009, sales of consumer durables fell by 9.4%. Equipment investment likewise decreased sharply during the same period (-22% YOY growth). The value of completed construction projects continued a sluggish pace between November 2008 and January 2009 (-3.4% YOY growth) but improved somewhat in February and March (8.4% YOY growth), owing to a massive increase in public sector spending.

The contraction in manufacturing has caused the unemployment rate to rise from 3.0% in January 2008 to 3.9% in February 2009. The number of new workers hired has continued to fall since December 2008, and in February this number fell by 0.6% (142,000 workers), the largest drop since the 1997 crisis (**Figure 9**). The nominal wage rate decreased by 2.1% in the fourth quarter of 2008, which is the first drop since the 1997 crisis. The impact was much greater for temporary/non-regular employees, whose wages declined by 9.0% as compared to the 1.7% drop in the wages of permanent/regular employees. This change has had the effect of increasing the wage gap between the two groups of workers, especially in large companies with more than 300 employees.

Figure 9. Rate of unemployment and YOY growth rate of hired workers (%)



Source: Korea National Statistical Office, <http://www.kosis.kr/>

### *Government Response*

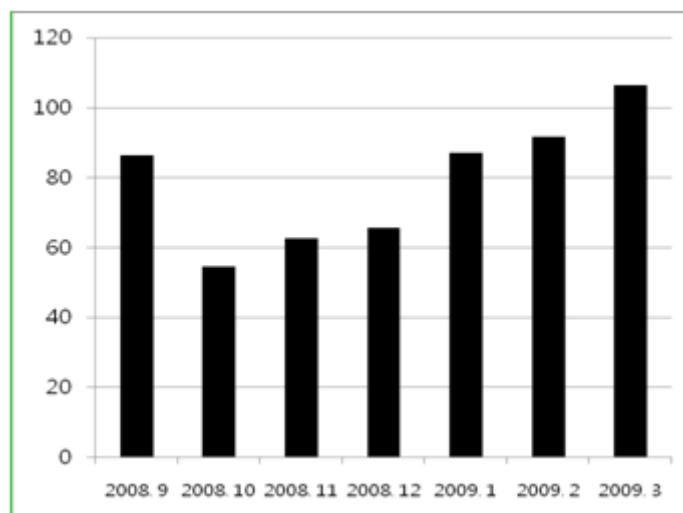
The Korean government has taken a number of comprehensive and preemptive measures designed to address the actual or potentially adverse impacts of the crisis. These measures are briefly discussed below, being cognizant that it is too early yet to tell whether these measures will be successful.

**Foreign currency liquidity provision.** The massive outflows of capital have exceeded those that occurred during the 1997 financial crisis; in response, the Korean government and the Bank of Korea have set aside \$55 billion for the October 2008–February 2009 period in order to provide foreign currency liquidity (\$21 billion for trade finance and \$34 billion for liquidity provision). In addition, in October 2008 the government set up a three-year \$100 billion payment guarantee for foreign currency borrowing by domestic banks. During November and December 2008 Korea also made currency swap agreements of \$30 billion each with the United States, Japan, and China. As an additional measure for stabilizing the foreign exchange market, the government now grants to foreign investors an income tax exemption on interest from government bonds.

These measures have significantly alleviated the credit squeeze. Although the short-term external debts of domestic banks fell by \$46.7 billion in the fourth quarter of 2008, the term-loan rollover ratio increased to around 90% at the end of 2008 from 50%–60% in September (**Figure 10**). In March 2009 the rollover ratio further increased to 106%, mainly due to the current account surplus, which rebounded to \$3.68 billion from a deficit of \$1.64 billion in the previous month. The banks have secured enough funding to pay off the loans maturing in January and February of 2009 while obtaining roughly \$5 billion in long-term funds by issuing bonds and through private equity funds.<sup>16</sup>

<sup>16</sup> Korea's foreign exchange reserves, down to \$200.5 billion in November 2008, increased to \$212.5 billion in April 2009, the sixth-largest in the world.

Figure 10. Short-term loan rollover ratio (%)



Source: Financial Supervisory Service.

### *Policy rate cut and liquidity provision.*

To prevent the Lehman Brothers bankruptcy in September 2008 from resulting in a credit crunch, the Bank of Korea reduced the policy rate by 325 base points – from 5.25 to 2.0%. To assure liquidity the bank also pumped 23.3 trillion won into the banking system through a Repurchase Agreement (RP) (16.8 trillion won) and treasury bonds (1.7 trillion won) and the buyback of the Monetary Stabilization Bond (0.7 trillion won).<sup>17</sup>

### *Large-scale fiscal stimulus package.*

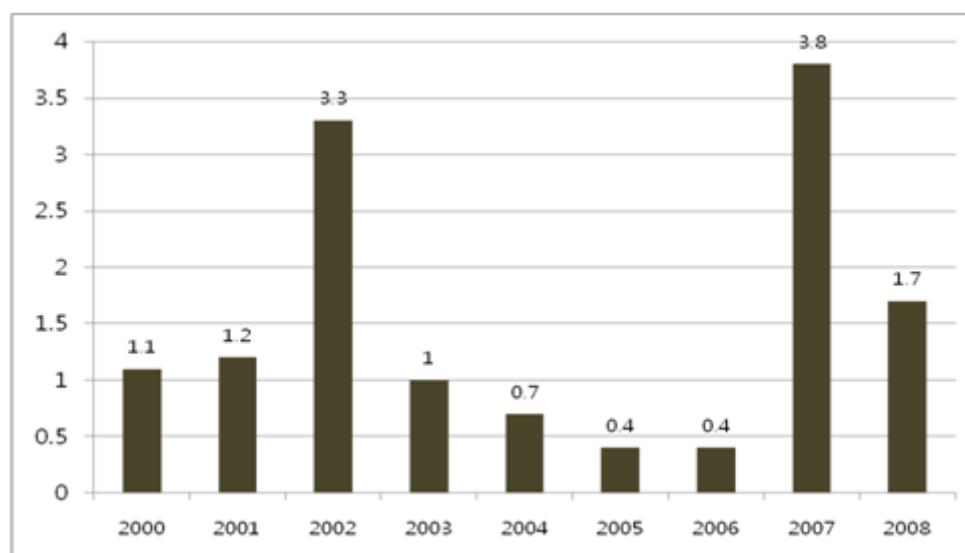
In response to the fall in aggregate demand, the Korean government has adopted expansionary fiscal measures. Specifically, the government has earmarked 51.3 trillion won (5.7% of GDP) for a stimulus package, which includes investment in infrastructure, provision for the social safety net (16 trillion won), and a reduction in corporate and personal income tax rates (35.3 trillion won). The government may consider additional fiscal stimulus if economic conditions deteriorate further. In addition to spending on investments to strengthen the growth potential of the economy, the supplementary budget will focus on job creation, especially for low-income groups, the unemployed, SMEs, and the self-employed.

These expansionary fiscal measures may lead to a deterioration of fiscal balance and an increase in the national debt. The Korean economy is, however, unlikely to suffer much from these consequences of expansionary fiscal measures. The government has

<sup>17</sup> The Bank of Korea's cut in the policy rate has pulled down the short-term interest rate, but the expectation of fiscal pump priming (such as a large-scale supplementary budget) raised the treasury bond yield rate in February 2009, thereby widening the spread between short- and long-term interest rates. AA-corporate bond yields decreased whereas BBB-corporate bond yields increased to widen the credit spread, indicating that the Korean financial market is experiencing some degree of credit crunch.

been running surpluses in the budget for the past several years, and the national debt is well below the average for the OECD countries (Figure 11) .

Figure 11 Government surplus (% of GDP)



Source: Bank of Korea, <http://ecos.bok.or.kr/>.

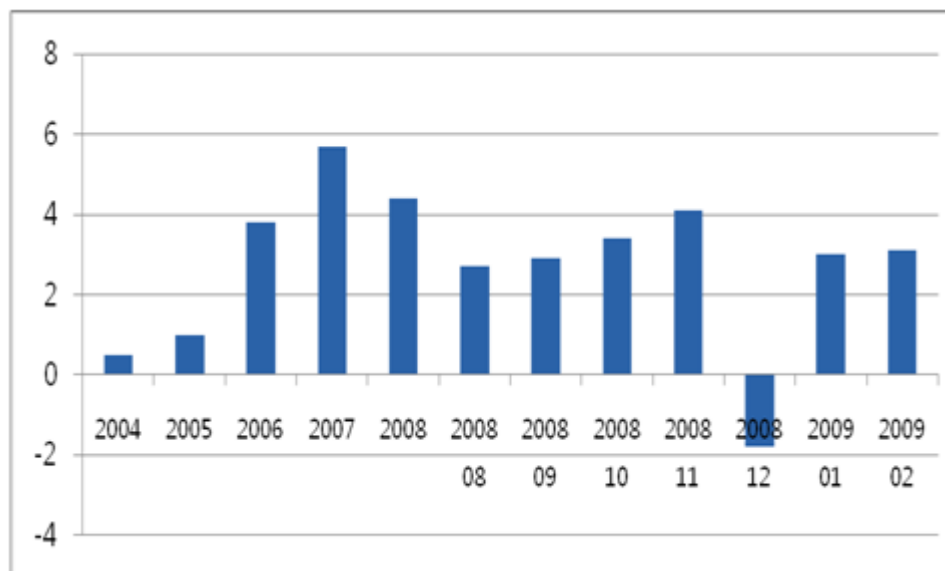
### *Enhanced support for SMEs.*

Government credit guarantees to SMEs through KODIT (Korea Credit Guarantee Fund) and KIBO (Korea Technology Credit Guarantee Fund) will increase to 62.6 trillion won at year-end 2009 from 48.9 trillion won at year-end 2008. An extension will be granted to credit guarantees maturing in 2009, which amount to 32.5 trillion won, and the criteria for credit guarantees will be relaxed. Moreover, the guarantees that have an upper limit of one-fourth or one-third of the sales revenue of a firm will be raised to one-half. In particular, the guarantees for exporting firms, "green-growth" firms, high tech firms, and start-up companies will increase from the current level of 85% to 100%. In addition, other SME loans maturing in 2009 will be rolled over.<sup>18</sup>

Since the global financial crisis began, the demand for SME loans has decreased while the credit risk has increased, creating a precipitous drop in the amount of SME loans made by the banks (in December 2008 alone the supply of SME loans decreased by 1.8 trillion won). After the implementation of the credit guarantee policy in January and February 2009, however, SME loans increased to 3.1 trillion won (**Figure 12**). Excluding the KDB loans, 97% of the increased SME loans by commercial banks were estimated to have been supported by credit guarantees.

<sup>18</sup> These measures may have the effect of keeping unviable "Zombie" firms alive, imposing a drag on rapid economic recovery. See Gonzalo Fernández de Córdoba and Timothy J. Kehoe, "The Current Financial Crisis: What Should We Learn from the Great Depression of the Twentieth Century," Federal Reserve Bank of Minneapolis, Research Paper Staff Report, no. 421, February 2009.

Figure 12 Monthly average of net increase in SME loans by banks (Trillion won)



Source: Financial Supervisory Service, Actual results of SME loans. <http://www.fss.or.kr>

### *Enhancing the soundness of the banking system.*

The government is implementing various measures, including the Bank Recapitalization Fund, to expand the credit-supply capacity of banks. The fund will have 20 trillion won, of which 10 trillion will be from the Bank of Korea, 2 trillion from the Korea Development Bank, and 8 trillion from institutional and retail investors. The fund will purchase subordinated bonds, hybrid loans, and redeemable preferred stocks upon bank request. It will also provide support to commercial banks, the Industrial Bank of Korea, the NACF (National Agricultural Cooperative Federation), and NFFC (National Federation of Fisheries Cooperative) on a limited basis.

The government also plans to establish a corporate restructuring fund of 40 trillion won in KAMCO in order to purchase bad debts and support restructuring. This fund will conduct a role similar to the Non-performing Loan Resolution Fund, which was created during the 1997 financial crisis.<sup>19</sup> As of year-end 2008, key soundness indicators of Korean banks, including the BIS ratio (12.2%), the NPL ratio (1.11%), and the coverage ratio (147.1%), are all in good standing.

### *Support for household loan/mortgage holders.*

Several measures have been introduced to lessen household burdens. They include guaranteeing collateral supplementation up to 100 million won for the depreciated value of housing, extending the maturity and grace period of mortgage loans up to ten years, and exempting the early repayment fees on the transfer from floating to fixed-rate loans.

<sup>19</sup> From its inception up until the end of 2006, KAMCO purchased 111 trillion won (in book value) in non-performing assets from financial institutions for 38.8 trillion won. By the end of 2008, it recovered 42.4 trillion won from such sales, which is 110% of the injected fiscal money.



### *Job sharing.*

In order to create new jobs and retain employment the government will spend 60% of its budget in the first half of 2009 and launch the Green New Deal Project, which will invest 50 trillion won for the purpose of securing future economic growth and employment.

Youth unemployment is a serious problem in Korea and has spurred the government to initiate the Youth Internship Program in order to train unemployed youth for employment in an economy that is becoming more technologically sophisticated. The government also plans to revise labor laws and institutions to make the labor market more flexible and to promote job creation. Specifically, the government will offer tax credits and financial incentives to companies that are devising ways to bring about cooperation between labor and management for job-sharing and improved industrial relations. Also, to address the inequities between regular and non-regular workers, the government is revising the relevant labor laws and institutions—for example, by extending the employment of non-regular workers from two to four years.

### *Implications for Political Stability and Strategic Alignment*

What effect the current economic crisis has on Korea's political stability will depend very much on whether the various measures currently being undertaken by the government will succeed in ameliorating the impact of the crisis. If the government succeeds in mitigating the credit and liquidity crunch, in moderating the demand fall and increases in unemployment with expansionary fiscal measures, and in providing an adequate social safety net to the more vulnerable groups in society, the economy will recover quickly. If this recovery occurs, there will be little danger of the current crisis weakening political support for the government and endangering the country's political stability.<sup>20</sup>

An additional factor for the likelihood of the current crisis having little effect on political stability is that the crisis is seen to have its origin in the failures of the U.S. financial system rather than in political corruption or "crony capitalism" in Korea itself, which some blamed for the 1997 crisis. Consequently, there is little or no demand—either domestically or from abroad—for institutional reform and thus no potential opposition from the entrenched domestic powers (e.g., chaebols and bureaucrats) that such reform may engender.

It is, of course, too early to tell how successful the macroeconomic and social safety net measures will prove. If, however, the Korean government does not succeed in solving the problems created by the crisis or at least in lessening the negative economic and social impacts, the government will need to devise and implement other measures, even including state ownership of some of the banks, as occurred in Sweden during that

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<sup>20</sup> Since the 1997 crisis, Korea has experienced deterioration in income distribution as well as wealth distribution. According to the Korea National Statistics Office, the Gini coefficient for income distribution increased from 0.295 in 1998 to 0.325 in 2008. This increase was due to the restructuring in the corporate and financial sectors. According to an article by Joon-Kyung Kim, the Gini coefficient for total assets also increased from 0.60 in 2000 to 0.64 in 2006. The worsening of wealth distribution was mainly due to the fact that mortgage loans were relatively concentrated among the high-income class and that the price of real estate steadily increased during 2001–06, adding to the wealth of the well-off. Given this state of income and wealth distribution, unless the current social safety and income redistribution policy are strengthened, Korea may face social instability should the current crisis further deteriorate income distribution. See Joon-Kyung Kim, "Recent Changes in Korean Households' Indebtedness and Debt Service Capacity," Working Paper, no. 08-23, KDI School of Public Policy and Management, 2008.

country's financial crisis. There is historical precedent in Korea for such a government intervention: in the early 1960s the government nationalized the commercial banks and used them as an instrument in launching the Korean economy on the path of rapid economic growth.<sup>21</sup> The Korean people may realize that the exigencies of the current crisis could call for such a pragmatic, less ideologically bound role of government.

How will the current crisis affect Korea's external relations and strategic alignments? According to Jonathan Pollack, Korea has three primary strategies: it can pursue a U.S.-centered, an autonomous, or a diversified (hedged) strategy.<sup>22</sup> The first strategy was preferred and chosen by the current president Lee Myung-bak, the second by Park Chung-hee (1961-79) and Roh Moo-hyun (2003-08), and the third by Kim Dae-jung (1998-2003) and to a lesser extent by Roh Moo-hyun. This association of strategy with the incumbent of the presidential office seems to be determined by the political and strategic views of the president and the internal political alignments that led to his election to the presidency. There is, however, one geopolitical-economic change that has occurred in the past few decades that must be taken into account in discussing the direction of Korea's strategic alignments in the near future: the emergence of China as a major economic power in the world and the effect on the Korean economy.

Korea's strategic alignment depends, as Pollack has pointed out, on factors such as the ideology of political leaders, the strength of the economy and military, and historical relationships. To this list, this chapter adds the extent of economic integration or interdependence between Korea and its counterparts. Especially for an economy such as Korea's that depends heavily on external trade for economic growth, the choice of strategic alignment is critically dependent on how close economic relations are with the counterpart country. The following section shows that China has not only replaced the United States as Korea's biggest trade partner but has also incorporated Korea in region-wide production networks. This growing economic interdependence will challenge the long-standing close relationship between Korea and the United States. What effect the current crisis will have on this interdependence is thus a key determining factor in how Korea's relations with the United States may evolve in the near future.

## Yet Another Variable: The Emergence of China

China's rapid economic growth since the late 1970s has brought the economies of China and Korea closer together through expanding bilateral trade and production networks while at the same time making the two states competitors for market share in the rest of the world.

In 1989, Korea exported to China \$437 million worth of merchandise and imported \$1.7 billion, while Korean merchandise exports to and imports from the United States amounted to \$20.6 billion and \$15.9 billion, respectively. By 2008, Korea's merchandise exports to and imports from China grew to \$91.4 and \$76.9 billion, respectively, while merchandise exports to and imports from the United States reached \$46.4 billion and \$38.4 billion, respectively. Thus, in less than twenty years China has surpassed the United States as Korea's largest trade partner. It has also become a major host country for Korea's overseas investment: in 2007 alone Korea invested \$5.3 billion in China and by year-end

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<sup>21</sup> See Chung H. Lee, "The Government, Financial System, and Large Private Enterprises in the Economic Development of South Korea," *World Development* 20, no. 2 (February 1992): 187-97.

<sup>22</sup> Jonathan D. Pollack, "The Korean Peninsula in U.S. Strategy: Policy Issues for the Next President," in *Strategic Asia 2008-09: Challenges and Choices*, ed. Ashley J. Tellis, Mercy Kuo, and Andrew Marble (Seattle: The National Bureau of Asian Research, 2008): 135-66.

2008 its total cumulative stock of investment in China stood at \$26.5 billion (compared to an investment of \$25.5 billion in the United States).

### *Competition*

Although now Korea's major trade and investment partner, China has also become a major competitor in the realm of exports by gaining a comparative advantage in many manufacturing industries, especially those that are labor-intensive. China's gain of comparative advantage in such industries is seen by some observers in Korea to have put its economy in a position of being caught between two "neighboring whales": price-competitive China and technologically more-advanced Japan. Further complicating the economic relationship between the two states is the fact that Korea is now a major supplier of parts and components used in the manufacture of China's exports and thus indirectly benefits from the growth of these exports.

Over the past few decades China has successfully changed its export structure from low to more high tech products. In 1992, for instance, more than a half of China's manufacturing exports were low tech products such as textiles, apparel, and footwear, whereas the exports of medium-high and high tech products accounted for only 12.4% and 10.9%, respectively. By 2006, however, the share of low tech exports declined to 28.6% while the share of medium-high tech and high tech exports rose to 20.4% and 35.3%, respectively. The high tech product group, computers, office products, and radio, television, and communication equipment increased the most in terms of export share between 1992 and 2006—from less than 6% in 1992 to 27% in 2006.<sup>23</sup>

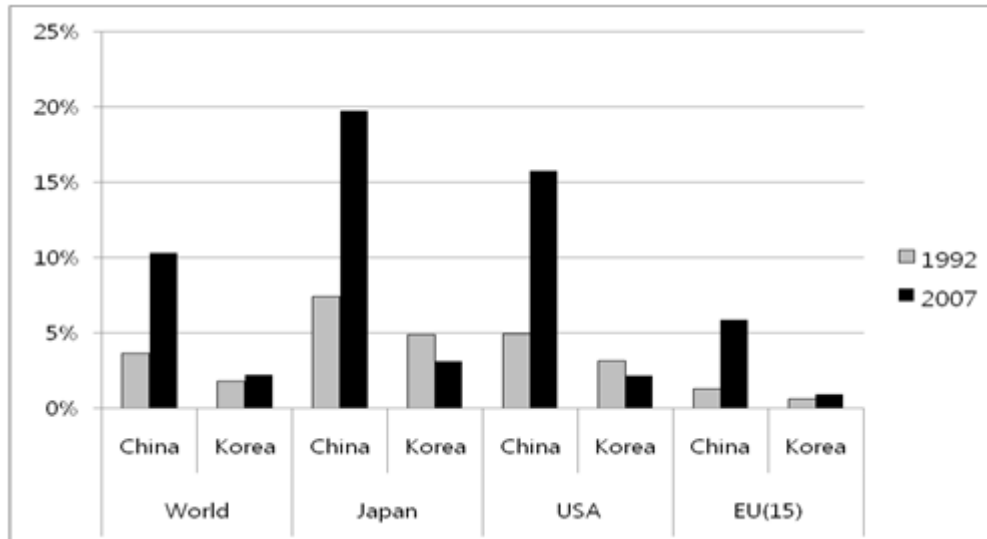
With China's export structure catching up to Korea's, a convergence would be expected in the two countries' export structure and increased competition in their export markets. To see how the two have fared in this competition, **Figure 13** compares the shares of imports from China and Korea for 1992 and 2007 in four markets—Japan, the United States, the EU, and the rest of the world. It is clear that China made significant gains in market share for all products in Japan and the United States, whereas Korea's share shrank in those markets.

It is difficult to know how much of the loss in Korea's market share was due to the growth of exports from China and how much stemmed from cost increases in Korea and other factors unrelated to China's emergence. One thing that is certain, however, is that while becoming a major competitor with Korea for world market share, China has also become an important destination for certain Korean exports. Although suffering a market loss to China in low and medium-low tech products Korea has increased, between 1992 and 2006, its world market shares in high and medium-high tech products from 2.6% and 1.2% to 5.4% and 3.2%, respectively. This growth is partly due to an increase in Korean exports to China, as will be discussed below.

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<sup>23</sup> For a more detailed discussion, see Joon-Kyung Kim and Chung H. Lee, "Emergence of China and the Economy of South Korea," in *Korea Yearbook*, ed. Rüdiger Frank et al. (Leiden: Brill, 2008), 139–64.

Figure 13 Import share of China and Korea in major markets (%)



Source: UN Comtrade database, 2009, <http://comtrade.un.org>.

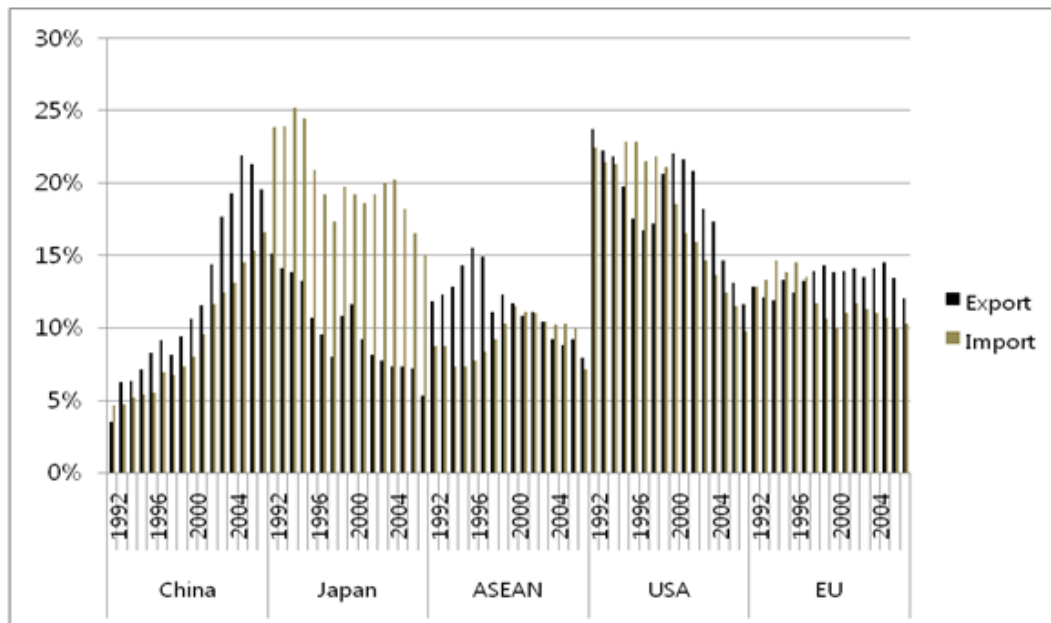
### *Complementary: Expanding Bilateral Trade*

Although Korea competes with China in the rest of the world for market share for a number of products, its relationship with China has been complementary in that bilateral trade between the two countries has been growing at a rapid rate. In fact, China's share of Korean exports rose from 3.5% in 1992 to 19.5% in 2007 (see **Figure 14**), and this growth largely accounts for the increase in Korea's total exports over the past fifteen years. The increase is certainly phenomenal, but to confirm whether the bilateral trade has grown more rapidly than Korea's overall trade **Figure 15** shows the export- and import-intensity indices with respect to China for 1992–2007.<sup>24</sup>

Not surprisingly, export intensity with respect to China rose from 1.6 to 4.3 during this period, whereas the import intensity remained almost the same, suggesting that Korea has become relatively more dependent on China for exports but not for imports. During the same period Korea's export intensity with respect to the United States fell from 1.7 to 0.9 while import intensity decreased from 1.9 to 1.2.

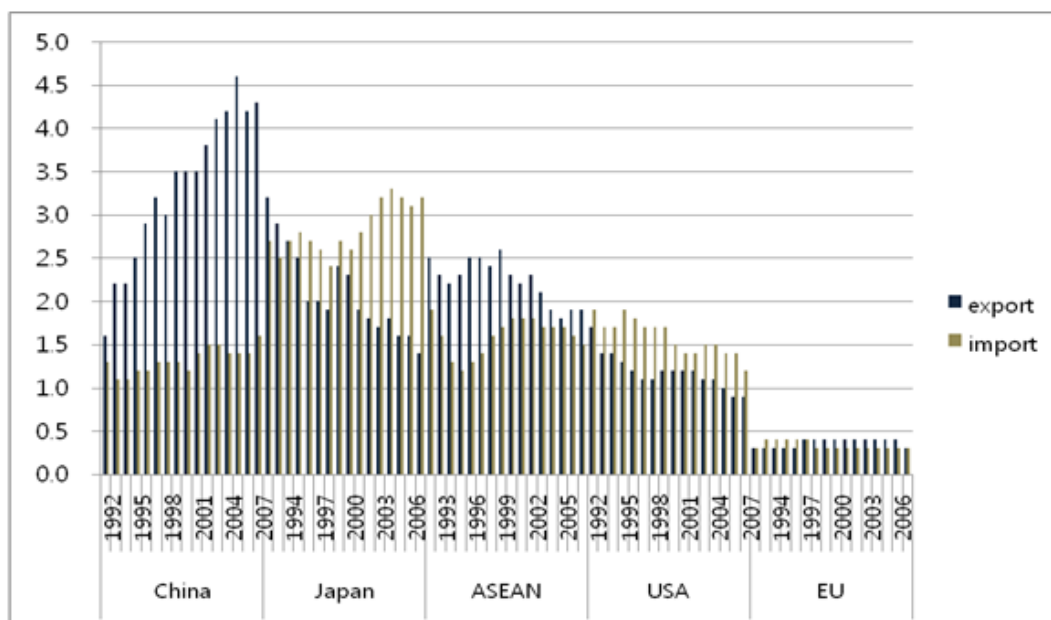
<sup>24</sup> The export intensity of country A with respect to country B is the ratio of B's share of A's total exports to B's share of world total imports. An export intensity greater than one suggests that A is more closely tied with B in trade than the latter is with the rest of the world. The import intensity index is similarly calculated and has the same implication.

Figure 14 Direction of Trade as Share of Korea's Total Trade (%)



Source: UN Comtrade.

Figure 15 Korea's export and import intensity with trade partners



Source: UN Comtrade.

The various statistics presented so far point to a growing economic interdependence between Korea and China, the latter having surpassed the United States as Korea's largest trade partner and as a market for Korean exports. In addition, the nature of Korea's relationship with its primary trade partner has also changed: China has become closely linked with Korea through production networks. That is, interdependence between the two states is not only through trade linkages but is also based on networks that bring together production units across national boundaries. A sign of these networks is the trade in parts and components, which, as shown below, makes up much of the bilateral trade between Korea and China. Because these parts and components are used in the manufacture of goods exported from China, Korean exports are closely linked to China's exports to the rest of the world, especially to the United States. Thus, the Korean economy may appear to have become decoupled from the U.S. economy in that in terms of gross trade volume China has now replaced the United States as Korea's most important trade partner. In reality, though, this has not actually occurred. Korea remains indirectly linked with the United States through China because its exports of parts and components to China depend crucially on the latter's exports to the United States.<sup>25</sup> This situation may not last long, however, if China begins to domestically produce these parts and components or imports them from sources other than Korea. In that eventuality the Korean economy may truly become decoupled from the U.S. economy.

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<sup>25</sup> Joshua Aizenman and Yothin Jinjark, "The US as the 'Demander of Last Resort' and Its Implications on China's Current Account," National Bureau of Economic Research, Working Paper, no. 14453, October 2008. Yung Chul Park and Kwanho Shin have claimed that East Asia has become decoupled from the U.S. economy due to the growth of East Asian trade with China. In comments published in the same journal, however, Premachandra Athukorala has pointed out that intraregional trade with China is mostly in parts and components and that the bulk of China's exports are for extraregional markets. The decoupling is thus a statistical artifact. See Yung Chul Park and Kwanho Shin, "Economic Integration and Changes in the Business Cycle in East Asia: Is the Region Decoupling from the Rest of the World?" *Asian Economic Papers* 8, no.1 (Winter 2009): 107–40; and Premachandra Athukorala "Comments," in *Ibid.*, 141–45.

## Trade in Parts and Cross-Border Production Networks between Korea and China

This section examines trade in parts and components, which is a good indicator of the extent of cross-border production networks. Such trade takes place either between separate production units that belong to the same firm or between two independent firms and is a consequence of the international fragmentation of production processes.<sup>26</sup>

**Table 4** reports the destinations and sources of parts trade for Korea in 1992 and 2006 for the industries in which much parts trade takes place. Between 1992 and 2006 exports to China of parts for computers and office products; radio, television, and communication equipment; precision, medical and optical instruments; and electrical machinery all increased from less than 2% to more than 30%. Even in motor vehicles and trailers the increase was from 0.9% in 1992 to 25.6% in 2006. This increase in parts trade is much greater than the increase in Korea's total exports to China from 3.5% to 21.3% during the same period and is a sign of the growing importance of parts exports from Korea to China. This trend is certainly an indication that China has become a major assembler of parts and components manufactured in Korea for many high and medium-high tech products and that Korea has become an indirect beneficiary of China's growing exports to world markets.

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<sup>26</sup> Mitsuyo Ando and Fukinari Kimura, "The Formation of International Production and Distribution Networks in East Asia," National Bureau of Economic Research, Working Paper, no. 10167, December 2003.

Table 4 Korea's trade in parts with major partners (%)

		China		Japan		ASEAN		United States		EU 15	
		1992	2006	1992	2006	1992	2006	1992	2006	1992	2006
Total Trade	Exports	3.5	21.3	15.1	7.2	11.8	9.2	23.7	13.1	12.8	13.4
	Imports	4.6	15.3	23.8	16.5	8.7	9.9	22.4	11.5	12.8	9.9
Total parts trade	Exports	0.9	30.0	10.5	6.5	21.4	12.0	31.4	12.3	12.7	7.1
	Imports	0.4	19.2	40.3	22.3	8.6	13.2	29.8	17.7	12.0	11.8
Parts for computers and office products	Exports	1.5	34.6	11.2	3.0	13.8	11.0	41.8	19.4	26.6	14.4
	Imports	2.7	58.0	46.5	10.3	3.0	9.5	34.0	6.7	3.7	2.9
Parts for radio, television, and communication equipment	Exports	1.0	35.6	17.4	1.7	14.0	5.4	22.1	5.6	16.9	4.1
	Imports	1.1	38.6	65.4	17.5	3.7	12.3	12.2	9.4	9.6	10.4
Parts for precision, medical, and optical instruments	Exports	0.9	82.2	18.4	4.2	4.0	1.3	58.8	3.8	9.0	1.9
	Imports	0.2	7.9	39.8	33.3	0.9	2.5	38.2	23.8	17.9	21.6
Parts for electrical machinery	Exports	1.8	48.5	16.8	6.4	11.4	6.0	19.6	10.2	13.8	5.0
	Imports	0.5	34.4	53.2	36.5	2.6	3.3	22.5	8.2	15.4	12.5
Parts for motor vehicles and trailers	Exports	0.9	25.6	20.2	4.6	5.8	2.9	27.9	25.3	18.2	7.3
	Imports	0.3	9.2	62.9	31.4	0.2	1.1	15.9	30.9	15.9	30.7
Parts for home appliances and machinery equipment	Exports	1.9	23.4	15.7	13.9	14.5	8.2	26.5	14.2	16.0	13.6
	Imports	0.4	11.6	39.4	31.4	1.1	1.6	16.0	13.6	22.9	28.1

Source: UN Comtrade

In 1992, Korea imported parts and components mostly from Japan, the United States, and Europe (a total of 82.1%) while importing only a miniscule amount (0.4%) from China. By 2006, however, imports from the former decreased to 51.8% while those from the latter increased to 19.2%. The most dramatic change took place in computers and office products; radio, television, and communication equipment; and electrical machinery. Their respective shares of imports from China increased from 2.7% to 58.0%, 1.1% to 38.6%, and 0.5% to 34.4%. The fact that these increases took place while the share of parts imports in those groups from Japan, the United States and the EU decreased is a sign both of growing cross-border production networks between China and Korea and of the growing relative importance of China for Korea's manufacturing sector.

It is clear that China has become Korea's major trade partner, importing many parts and components from Korea for the manufacture of its own exports and then supplying Korea with inexpensive consumer goods. Furthermore, the expansion of the economic relationship between Korea and China is more than a growth in the volume and variety of goods traded: numerous production networks now span the two countries, bringing them



closer together. This expansion does not, however, mean that the Korean economy has become less dependent on the U.S. economy. To the contrary, the Korean economy remains closely linked with the latter not only indirectly through cross-border production networks with China but also directly through U.S.-Korean trade. Thus, the effect of the current crisis on the U.S. economy has a profound impact on the Korean economy. At the same time, how Korea will react will depend on the effect of the crisis on China's economy, economic policy, and relationship with Korea.

## The Effect of the Crisis on Korea's External Economic and Strategic Relations

What effect the current crisis will have on the realignment of Korea's external economic relations will depend on a number of factors. First, any effects will depend on the speed at which the U.S. economy recovers. The sooner and more quickly the United States recovers from the crisis, the less likely it is that there will be a long-lasting change in economic relations between Korea and its two major trading partners. Spending nearly \$600 billion for economic stimulus and growing at 8% (or 6.5%, as recently revised by the World Bank) in spite of the crisis, China's importance for the Korean economy will only grow, strengthening the country's status as Korea's biggest trade partner. The slower the recovery of the U.S. economy, however, the stronger will economic relations between Korea and China become.

Second, if the United States grows protectionist, Korea may have no option but to turn to China for market access. Because Beijing is changing its growth strategy from export orientation to domestic demand, China is thus potentially an expanding market for Korean exports. Korea's direct investment in China and the cross-border production networks that had been established before the crisis should be a positive factor in this expansion—especially if China's stimulus package boosts local demand for consumer durables such as television sets and home appliances.

Even if the United States does not turn protectionist in its overall trade policy stance, Washington may take certain specific measures that are likely to have an adverse effect on the U.S.-Korea economic relationship. One such measure would be the failure to ratify the Korea-U.S. Free Trade Agreement (FTA).<sup>27</sup> The ratification of the agreement is crucial for Korea because the FTA would have both a salutary effect on Korea-U.S. economic relations and a counterbalancing effect on Korea's increasing economic dependence on China.

If the United States either turns protectionist or grows slowly in the next few years, East Asian countries may search for a regional solution to ensure their own economic survival and prosperity. Such regionalization would mean that, given its size and economic strength, China would likely become the locomotive for the region's economic growth. If this were to occur, the East Asian economies could become more decoupled from the U.S. economy and more dependent on China.

One of the profound consequences of the 1997 crisis for Korea was that it brought about reforms leading to the adoption of many institutions of the Anglo-American capitalist tradition. Korea was pressured by the IMF to adopt its prescription of institutional reform. At the same time, having diagnosed some domestic policies and institutions as the cause of the crisis, Korea was a willing student of the tutorage offered by the multilateral organization.<sup>28</sup> This more recent crisis is a different situation, however, because the causes of the crisis are not seen as internal to Korea but as having originated in the United States, a paragon of free-market capitalism. The crisis has probably made many in Korea to question the wisdom of following the Anglo-American model as practiced in the past few decades with such a heedless emphasis on deregulation.

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<sup>27</sup> *Chosun Ilbo*, a South Korean newspaper, reported that Ron Kirk, the U.S. trade representative-designate, spoke out against the Korea-U.S. FTA in its present form. Korea already has an FTA with Chile and some of the ASEAN countries and is in the process of negotiating FTAs with Australia and the EU. See "FTA with Seoul Unacceptable, Says U.S. Nominee," *Chosun Ilbo*, March 11, 2009, [http://english.chosun.com/site/data/html\\_dir/2009/03/11/2009031161001.html](http://english.chosun.com/site/data/html_dir/2009/03/11/2009031161001.html).

<sup>28</sup> Chung H. Lee, ed., *Financial Liberalization and the Economic Crisis in Asia* (London: Routledge, 2003).

A fundamental change could take place in what Korea's policy elites regard as the appropriate role of government in a capitalist market economy. The current crisis and failure of the U.S. economy to recover quickly may lead both to the loss of credibility in certain features of Anglo-American free-market capitalism, especially those practiced in the past few decades, and to the strengthening of the effort to reinterpret East Asia's spectacular success in industrial development over the past 50 years. A successful reinterpretation of the development experiences of the East Asian countries will highlight common development strategies and lead to the establishment of a competing economic ideology.

The mainstream view of East Asia's economic development, which began in post-World War II Japan, continued in Korea and Taiwan in the 1960s, and finally spread to China since the late 1970s, is the "Washington consensus." This consensus is basically the Anglo-American version of the capitalist market economy, promoting free trade and financial liberalization in addition to stable macroeconomic policies as a prescription for economic development. This view is being challenged by the "Beijing-Seoul-Tokyo consensus" (Best consensus), which includes a greater role for government than that prescribed in the Washington consensus. According to the BeST consensus, East Asian governments have been actively engaged in creating and strengthening domestic enterprises, establishing pilot state agencies that coordinate and guide industrialization, and sequentially upgrading the leading sectors and activities to secure dynamic comparative advantage.<sup>29</sup> These are government activities that are proscribed in the Washington consensus, as they are presumed to lead to inefficiencies and rent-seeking. One likely consequence of the current crisis is increased credence to the BeST consensus and the way East Asian countries have managed their economies.

The current crisis may further increase the interdependence between the economies of Korea and China. If China is successful with its new policy of relying on domestic demand for economic growth, Korea will be well poised to find markets for its consumer durables in China. China may turn into a market of final destination for Korean exports rather than merely a way station for parts and components made in Korea, thereby making Korea more dependent on China for economic growth. This possible eventuality, however, may not be what Korea would like to see as its future, as this would put the country in a strategically subordinate position to China<sup>30</sup>. To hedge against this possibility, Korea will want to maintain strong economic and security ties with the United States. Ratification of the Korea-U.S. FTA would have the symbolic effect of affirming such ties.

In the end, what will determine the future relationship between Korea and China will depend on the Sino-U.S. relationship, given that Beijing may have a long-term interest in seeing the growth of Chinese influence and a reduction of Washington's influence in Korea. According to China scholar Robert Sutter, China has been careful not to be seen as directly challenging the U.S. leadership in Korean affairs, and if the United States follows a "firm and effective policy toward China, avoiding challenge to core Chinese interests while making clear boundaries China should not cross," China is less likely to take a more assertive and disruptive stance in Asian affairs.<sup>31</sup> The metaphor of Korea being positioned between the two whales of Japan and China may have been appropriate to Korea's economic situation a decade or two ago. In the sphere of strategic alignments that Korea will be faced with in the post-crisis era, however, the two whales are China and the United States. Only when these two behemoths co-exist in peaceful harmony will Korea not have to make a difficult choice between the two.

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<sup>29</sup> Keun Lee and John A. Mathews, "From the Washington Consensus to the BeST Consensus: A New Path to Sustained Economic Growth?" Macquarie Graduate School of Management, Macquarie University, Working Paper, August 25, 2008.

<sup>30</sup> This would be a view of "realists" in international relations, whereas "neoliberal institutionalists" would argue that close economic interdependence would mitigate the likelihood of political conflict. For a brief but succinct discussion of different theories on the relationship between economic interdependence and political relations in the context of Korea, see Scott Snyder, *China's Rise and the Two Koreas* (Boulder: Lynn Rienner, 2009).

<sup>31</sup> Robert G. Sutter, *China's Rise in Asia: Promises and Perils* (Lanham: Rowman and Littlefield, 2005), 6.

## **Economic Crisis and Intergenerational Economy: Lessons from Korea's 1997-98 Economic Crisis**

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### **Abstract**

This paper provides insight into some important features of the intergenerational resource allocation in Korea, before and after the financial crisis in 1997-98. Data sets of three periods before and after the financial crisis (1996, 2000, and 2005) were used to compare the results. This research particularly addresses two related issues: i) the generational effects of economic crisis, and ii) the capacity of age reallocation systems to spread economic risks across generations. The results show tremendous consumption smoothing and resource reallocation by age, during and after the financial crisis. Private education and private health consumption decreased for children between 1996 and 2000. However, the decrease in private education and private health consumption was mitigated by the increase in public consumption. It appears that the public sector did not only mitigate the adverse impact of the economic crisis on consumption, but it also reduced the widening disparity amongst generations. Within transfers, the public transfers for the elderly increased substantially as the private transfers decreased rapidly. Finally, there was a big increase in the asset-based reallocation of the elderly. The increase in asset-based reallocation was mainly due to an increase in asset income between 1996 and 2000, but it was almost entirely due to a decrease in saving (i.e. an increase in dis-saving) between 2000 and 2005. This suggests that Korean elderly seemed to have some degree of supporting system during the crisis, even without sufficient pension benefits. The increased reliance on asset accumulation will be critical in the long-run in Korea, as public pension funds diminish due to population aging.

Keywords: intergenerational economy, transfers, economic crisis, population aging.  
JEL Classification: J18, H53, I35.

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## I. Introduction

Korea survived the brunt of the crisis in 1997-98, but it was faced with numerous socioeconomic problems that emerged during and following the crisis. The most serious problems included the rising numbers of disadvantaged people, employment instability, the widening gap between the rich and the poor, and rapid deterioration of familial support for the elderly. Even long after the affected economies recovered, social impacts continue to be felt.

During and after the crisis, there has been great change in the Korean economy and economic support system. There has been substantial fluctuation in the value of assets due to changes in the price of housing and equities. A lot of middle aged workers were forced to retire, and many of them were not able to re-enter the labor market even when the economic crisis was over. The reduction in new jobs made it difficult for young workers to find a regular job after graduating. On the other hand, there has been a great increase in social expenditure, mainly due to changes in the economic and social environments, as well as some political factors. Increasing social demands for welfare are recognized, especially since the economic crisis devastated the Korean economy. The expenditure is often age targeted, regardless of whether the Korean government intended this or not.

At the same time, a rapid decline in fertility during and after the crisis appeared to be a new threat to the economy that accelerates the aging process of the society. The unprecedentedly fast population aging imposed a burden of old age support. Traditionally, the burden was borne by the income transferred from their grown-up children living with the elderly. But as the traditional familial support system has deteriorated, the number of families living with their aged parents has been declining. During the crisis, lots of families suffered from the economic difficulties, and, as a result, private transfers substantially diminished. However, the Korean government has increased the welfare budget in order to settle the problems of unemployment and poverty since the financial crisis.

The origins of the Korean economic crisis in 1997-98 are complex. Many researchers pointed out several domestic, regional, and global elements, all of which contributed to generating it. The impact of the Korean economic crisis seems at least as complex as the origins are. In this paper, we focus on two related issues: Korea's intergenerational economy before and after the crisis and the capacity of age reallocation systems to spread economic and financial risks across generations. The analysis makes use of the National Transfer Accounts (NTA) which provides comprehensive estimates of intergenerational economic flows. The analysis emphasizes the effects of the crisis on consumption and key components of consumption by age. A second level of analysis focuses on the economic flows that fund consumption. Value of assets and labor income are directly affected. Transfers and savings are indirectly influenced and may serve to mitigate the effects of economic crises.

We use three periods of data, 1996, 2000, and 2005. The year 1996 is chosen because it was soon before the financial crisis and it was also the year before entering the aging society. The year 2005 is the year after entering the aging society and it is the one showing the effect of the increased social policies. We try to compare them with the year 2000, which seems to be the year that unemployment rates began to recover and per capita income recovered to the level before the economic crisis. Thus, this study sets the years of 1996 and 2005 as comparison years to grasp the effect of population aging and the change of the intergenerational resource allocation due to the economic crisis.

It should be mentioned that the methodology of comparing outcomes before and after the crisis has its own limitation because it is very difficult to identify the pure effect

of any time-series event on an economy. This is in large part because there is no counterfactual event, and, hence, it is difficult to net out the effect of other economic events, policies, and trends from that of the crisis. On the other hand, some of these events, policies, and trends are outcomes of the financial crisis, which might have affected the following changes in intergenerational economy. Thus, although it is difficult to identify the net effect of the economic crisis, the crisis might have played the broader role of a catalyst, which might have had an effect on intergenerational resource reallocation.

We also focus only on the short run impact of the economic crisis. The impact may have a persistent effect and the lifetime behavior of an individual at each generation might be governed by a lifetime budget constraint. The long run impact of a crisis can be analyzed by calculating the lifetime wealth effect of the economic crisis, for example by constructing a synthetic cohort measure.<sup>2</sup> The lifetime impact of the economic crisis on each age/cohort group, however, is discussed elsewhere, in collaboration with other project country teams. On the other hand, the Korean economic crisis has been marked by sharp declines of very short duration, which might distinguish it from a long lasting economic recession.

The paper is organized as follows. Section II briefly reviews the economic crisis and methodology. Section III discusses results. The last section concludes.

## II. Background

### 1. Korea's 1997-98 Economic Crisis

Korea has had an extraordinary development experience until the mid 1990s. Between 1962 and 1996, real GDP per capita grew at an annual rate of 6.6 percent, and per capita income soared from only \$87 in 1962 to \$12,197 in 1996. During the process of economic development, the investment and saving rate remained over 30 percent. The rate of total savings in Korea increased continuously from 10 percent of GNP in the 1960s to 40.4 percent in 1988. Despite such high economic growth, inflation remained relatively low, at around 4 percent throughout the mid 1990s. However, late in 1997, shortly after Korea had become a member of the OECD, the Korean economy experienced a severe economic crisis. Combined with a substantial depreciation in the exchange rate, per capita income plunged to US \$7,355 in 1998.

The changes in key macroeconomic indicators between the first quarter of 1993 and the first quarter of 2009 are shown in Figure 1. The real per capita GDP growth rate ranged from 4.4 percent to 10.3 percent until the third quarter of 1997, but it decreased to 2.8 percent in the fourth quarter of 1997. The real growth rate fell to -5.3 percent in the first quarter of 1998, which was the lowest growth rate in Korea since the political turmoil of the early 1980's. The growth rate plunged to -8.1 percent in the third quarter of 1998. The GDP growth rate rebounded in 1999 and fully recovered to the pre-crisis level by the third quarter of 2000.

Market interest rates, measured as the nominal interest rate for the 3-year corporate bond, soared to over 20 percent during the crisis. The interest rates sharply declined to below 10 percent in 1999 and maintained a decreasing trend until 2004. The decline in asset prices was also substantial during the crisis. The nominal value of land and housing respectively decreased by 9.5 percent and 11.4 percent in the second quarter of 1998, compared with the second quarter of 1997. For only one year in 1998, the average price of

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<sup>2</sup> We would like to thank John M. Kim for his valuable comment on this.

land and housing declined 14 percent and 12.4 percent respectively. Land and housing prices began to rise again in 1999. Interestingly, the housing price rose very rapidly after the crisis, much faster than the land prices. Between 2000-2003, the housing price increased over 35 percent, or 10 percent per annum. It rose again by 20 percent between 2004 and 2007. Unemployment rates increased from 2.2 percent in the third quarter of 1997 to 7.5 percent in the same quarter of 1998. Unemployment rates began to recover later; they started to recover in the second quarter of 2000, almost three years after the crisis.

Figure 1. Key Macroeconomic Indicators: Quarterly, 1993 ¼ to 2009 ¼

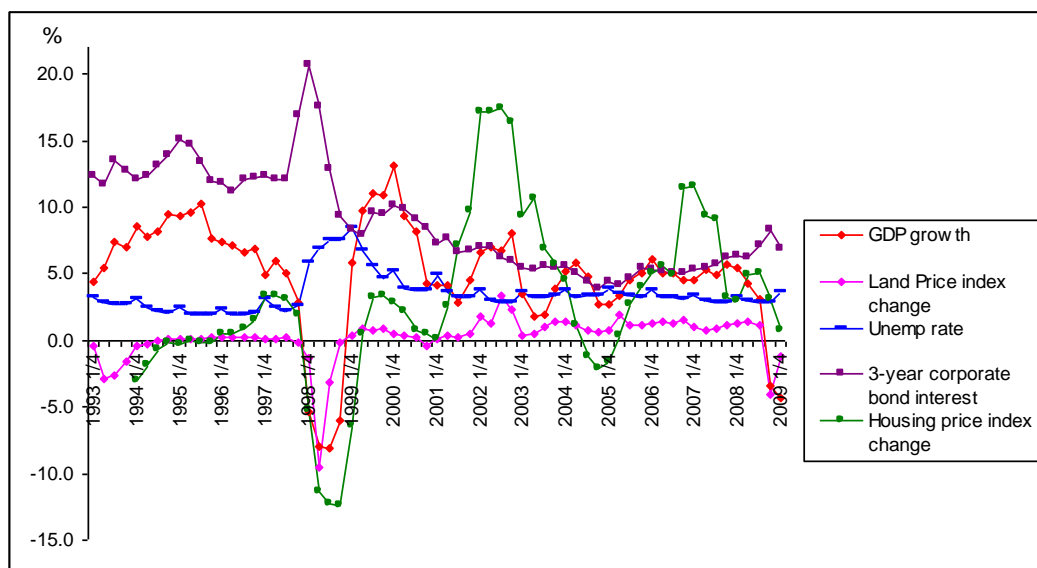
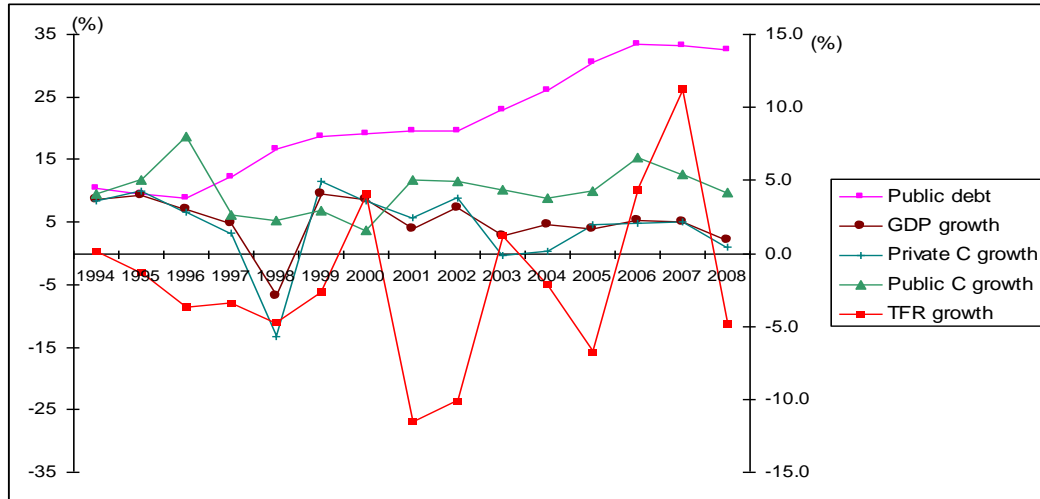


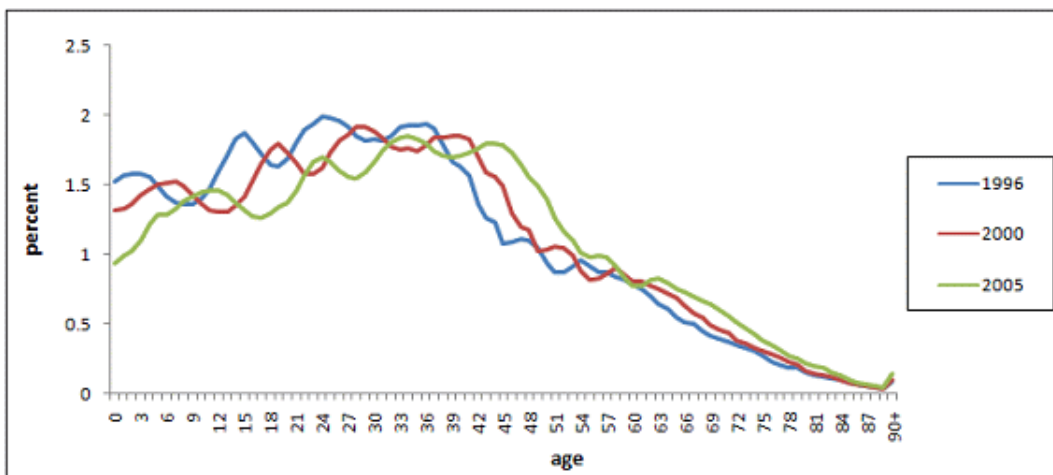
Figure 2 shows the changes in more key socio-economic indicators, by year, which bear direct or indirect implications for the intergenerational economy. Most of all, the government debt has increased very rapidly since 1997. The government debt as a percentage of GDP increased from 8.8 percent in 1996 to 16.6 percent in 1998. It further increased to 22.9 percent in 2003 and reached to 33.4 percent of GDP in 2006. The rise in government debt during the crisis may not be surprising because public debt increases as governments attempt to maintain public spending in the face of declining revenues, and to employ fiscal policy in response to the economic crisis. In Korea, the government debt kept increasing after the crisis, especially between 2002 and 2005, mainly due to the large increase in the exchange stabilization fund (ESF). ESF accounted for only 15 percent of all government debts in 2002, but the share increased to 40 percent as of 2005. Interestingly, public consumption has not declined, while private consumption sharply declined during the crisis, making a marked contrast. Again, this might suggest that the Korean government played a role in smoothing consumption during the crisis. The total fertility ratio (TFR) went down slightly from 1.58 in 1996 to 1.47 in 2000, but it plunged further, to 1.08, in 2005. The life expectancy (not shown in the figure) increased from 74.0 in 1996 to 76.0 in 2000, and it further increased to 78.6 in 2005.

Figure 2. Other Socio-Economic Indicators, Annually, 1994-2008



There were also substantial changes in population age structure before and after the crisis. Figure 3 shows the population distribution by age in Korea between 1996 and 2005. The youth dependency ratio decreased from 22.9 percent in 1996 to 21.1 percent in 2000, and dropped to 19.1 percent in 2005. On the other hand, the old age dependency ratio increased from 6.1 percent in 1996 to 7.2 percent in 2000, and increased again to 9.1 percent in 2005, entering the aging society. As a result, the population age structure in Korea has changed substantially during a short period of time.

Figure 3. Population Age Structure: 1996, 2000, and 2005





## 2. Application of National Transfers Accounts (NTA) in Korea

The purpose of National Transfer Accounts (NTA) is to measure at the aggregate level, in a manner consistent with National Income and Product Accounts (NIPA), the reallocations across age of economic resources. The methodological details are not discussed here, but some important aspects for constructing estimates are as follows.

The young and the old have a lifecycle deficit because they produce less through their labor than they consume. Working-age adults have a lifecycle surplus because they produce far more through their labor than they consume. Age reallocations occur because of this; at some ages individuals consume more than they produce, while at other ages individuals produce more than they consume. The reallocation system consists of a set of complex institutions and practices by which the young and the old, those with lifecycle deficits, draw on the surplus resources generated during the prime working ages (Lee 1994a, 1994b).

The economic mechanisms used for age reallocations fall into two broad categories: transfers and asset-based reallocations. A defining feature of transfers is that they involve no explicit *quid pro quo*, or exchange of money for goods or services. Resources flow from one party to another either voluntarily, in the case of private transfers, or as public transfers. Asset-based reallocations realize inter-age flows through inter-temporal exchange. For example, an asset such as gold can be acquired in one period generating an outflow at that age, and disposed of in a subsequent period generating an inflow at an older age. More generally asset-based reallocations involve two kinds of flows – asset income and saving. When individuals accumulate pension funds or personal saving during their working years and rely on asset income and dis-saving of those assets during their non-working years, they are relying on asset-based reallocations. Or when individuals borrow to finance their education, they are relying on asset-based reallocations to shift resources to young ages, when they are in need, from older ages. Readers interested in methodological details might benefit by reading Lee, Lee, and Mason (2008), Mason et al. (2009), <http://www.ntaccounts.org/>. Readers interested in Korea's public sector generational accounting may also benefit by reading Chun (forthcoming).

A variety of micro data sets are required to construct the age profiles of NTA. To construct the age profiles for our study, income and expenditure surveys, such as the National Survey of Household Income and Expenditure (NSHIE), Household Income and Expenditure Survey (HIES), Korean Household Panel Study (KHPS) and Korean Labor and Income Panel Study (KLIPS), are used. It is important to understand that the numbers estimated from the micro data sets are used to construct the age profiles, but the numbers are adjusted by aggregate macro controls. For this purpose, we use NIPA and the records of public institutions, including but not limited to National Pension Statistical Yearbook, National Health Insurance Statistical Yearbook, National Tax Statistical Yearbook, Yearly Statistics of Employment Insurance, Statistical Yearbook of Health and Welfare, and Statistical Yearbook of Teachers Pension.

A brief explanation for primary micro data sets is as follows. NSHIE started in 1991 and has been released every five years. This survey provides information on yearly income and expenditures, durable goods, assets, and liabilities of households in detail from the nationally representative household sample. The sample size is about 27,000 households. The Household Income and Expenditure Survey (HIES) has been conducted with non-farm households excluding one person households in cities during the past sixty or so years, and in 2003 it was expanded to include rural non-farm households. Beginning in 2005, one person households are also included. Hence, it should be mentioned that the changing consumption pattern between 2000 and 2005 could be due to

the changing coverage of households between the two surveys. The purpose of HIES is to collect up-to-date information on household income and expenditures and to analyze variations in the levels of living and the disparities among different socio-economic groups, and to obtain weights for the consumer price index.

KHPS is the first panel data in Korea. The sixth wave has been released from the first study in 1993. It covers minutely the income and expenditures of the whole household, and the income and taxes of all over 18 years of age, except for the residents of Cheju Island. KLIPS, started in 1998, is the longitudinal survey of households and individuals residing in urban areas, on their labor market and income activities. The KLIPS sample had been selected from households that lived in the 7 metropolitan cities as well as urban areas in 8 provinces, again excluding Cheju Island. The sample size was originally 5000 households and 13,321 individuals, and has diminished since then. The primary data sets and methods used by items of NTA are summarized in Table 1.

Table 1. Estimation Methods and Data Sources

NTA	Estimation methods	Data Sources
Education, private	Regress on enrollment and age	NSHIE, HIES
Health, private	Regress on age	NSHIE, HIES
Imputed-rent, Others, private	Equivalence scale	NSHIE, HIES
Education, public	Age- & education level- specific enrollment rate	OECD
Health, public	Age distribution of benefits	NHISY
Others, public	Per capita basis	NIPA
Compensation of employees	Wage of wage workers	KLIPS, KHPS
Entrepreneurial income	Income of non-wage workers	KLIPS, KHPS
Asset income, private	Net property income of households	NSHIE, HIES
Savings, private	Residuals	Calculation
Asset income & financial asset Accumulation, public	Age distribution of tax burden	NIPA
Capital and land accumulation, public	Age distribution of population	NIPA
Social insurance & tax	Generational accounting	NIPA
Inter-household transfers	Private subsidy and remittance of households	NSHIE, HIES
Intra-household transfers	Net transfers=consumption - disposable income	KHPS

### III. Results

#### 1. Economic Lifecycle

The age profiles of consumption and labor income – the economic lifecycle – reflect many factors (Lee, Lee, and Mason 2008). One of the most important factors is population age structure. Reallocations to children are much more important than reallocations to the elderly in current-day Korea because there are many more children than elderly. But Korea is aging rapidly and therefore reallocations to the elderly, as compared with reallocations to children, will increase substantially over the coming decades. The economic lifecycle also reflects behavior and the factors that influence behavior – prices, taxes, tastes, etc. Consumption profiles, for example, are influenced by the importance of education as compared to health care – and the institutional framework that governs these important sectors. Labor income profiles vary with the wage system, the returns to education, educational attainment, the ages at which children leave school and adults retire, and the labor force decisions made by women – to mention a few obvious factors.

Figure 4 shows the lifecycle profile of per capita labor income and consumption in Korea for 1996, 2000, and 2005. The labor income peaked at age 38 in 1996, but it declined to 35 in 2000. It bounced back slightly, to 37, in 2005.<sup>3</sup> The mean age of labor income and median age of labor income showed a similar pattern. The mean age of labor income declined from 42.2 in 1996 to 41.3 in 2000. It increased slightly, back to 42.0, in 2005. The median age of labor income declined from 40 to 39 between 1996 and 2000, but recovered to the pre-crisis level, 40, in 2005. The share of labor income for elderly ages 65 and older declined substantially from 4.1 percent in 1996 to 2.3 percent in 2000, and slightly increased to 2.7 percent in 2005. This consistent pattern means that the share of labor income for the prime age adults or elderly population must have declined compared with the share for young people. This is also consistent with the notion that the unique seniority-based wage system in Korea has been rapidly deteriorating during the 1990s, especially after the 1997 economic crisis.

The figure also shows that consumption peaks in the late teens and decreases until the 40s. Such a decline in consumption was also found in other countries as a result of decreasing expenditure on education. However, the decline seems to come earlier in Korea, immediately after high school graduation. This result may be related to the extremely high level of private education consumption among high school students in Korea, which is supported by the data. The peak of consumption at senior high is much more prominent in 2005.

As is clear from the figure, while the labor income profile has shifted little between 1996 and 2000, it increased substantially between 2000 and 2005. However, consumption has modestly increased between 1996 and 2000, and again substantially between 2000 and 2005. Both results are interesting because this suggests that the impact of the economic crisis on consumption might have been mitigated. The combined effect of the change in age profiles of labor income and consumption changed the lifecycle deficit years. It indicates that the lifecycle surplus decreased from 33 years in 1996 (age 23 to 55) to 31 years in 2000 (age 24 to 54), and remained the same in 2005 (age 25 to 55).

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<sup>3</sup> Labor income peaks much earlier in Korea than in many other advanced countries, and it was excelled during the economic crisis. This in part reflects that the labor income peaks quite early for women in Korea. Note that the shape of the figure is dependent upon various components of labor income as well.

Figure 4. Lifecycle Profiles of Per Capita Labor Income and Consumption: 1996, 2000, and 2005.

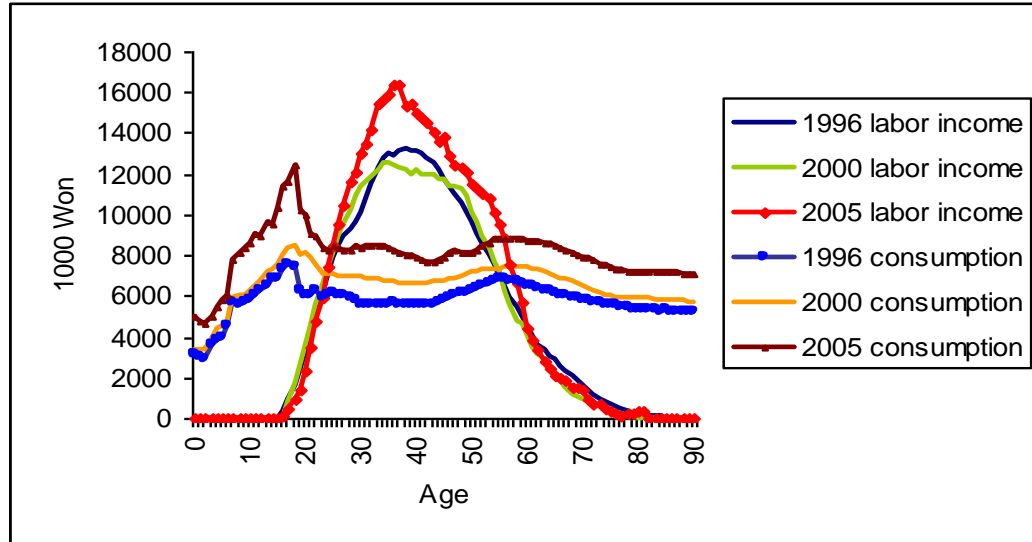
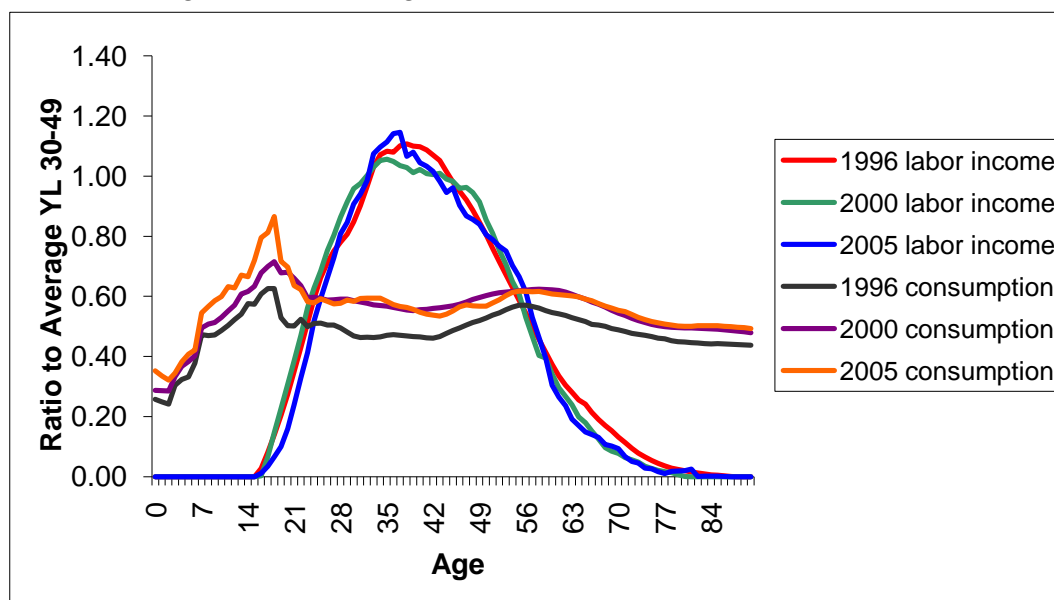


Figure 5 charts the age profile of labor income and consumption relative to average labor income for adults aged 30-49 each year. That is, Figure 5 was drawn in a way that Figure 4 was rescaled by dividing by the simple average of per capita production between ages 30-49. This normalization makes the estimated profiles more easily comparable by age and also by time period. We divided each age schedule by the un-weighted average of per capita labor income of each age over the range 30 to 49. Thus, for example, a value of 0.5 at some age in consumption implies that a person at that age consumes half the annual amount of production averaged over the prime ages of her life. So it can present the changing pattern of age profiles or age targeting of government programs more clearly. The figure suggests that the labor income of elderly aged 65 and older declined substantially between 1996 and 2000, while it was stagnant between 2000 and 2005, compared to that of ages 30-49. In addition, the labor income of prime age adults appears to have declined between 1996 and 2000. The figure also shows that the normalized per capita consumption increased for almost all ages between 1996 and 2000, while it was stagnant between 2000 and 2005. The only notable difference between 2000 and 2005 is that the consumption of children under 20 years, normalized by the average labor income ages 30 to 49, has increased substantially. On the other hand, the normalized consumption increased for all ages between 1996 and 2000, suggesting a potential consumption smoothing during the period.

Figure 5. Lifecycle Profiles of Per Capita Labor Income and Consumption: Ratio to the Average Labor Income Ages 30-49, 1996, 2000, and 2005



A further investigation of the consumption by component shows some interesting features. Table 2 presents real annual growth rates of each consumption component and labor income by broad age group. While per capita labor income increased by only 0.7 percent per annum between 1996 and 2000, per capita labor income for ages 65 and older decreased by 10.7 percent per annum during the same period. On the other hand, total consumption rose by 3.7 percent per annum, exceeding the increase in labor income. Interestingly, the private consumption for ages 0-24 and ages 65 and older increased much less than the average, by 3 percent and 1.6 percent per annum, respectively. As a result, the consumption gap between prime age adults and the older people and between prime age adults and the younger people in Korea has been widened after the financial crisis. The results for private education and private health consumption are most striking because both of them respectively decreased by 3.8 percent and 2.9 percent per annum for ages 0-19.<sup>4</sup> However, the decrease in private education and private health consumption was mitigated by the increase in public consumption. The public health consumption, in particular, grew very rapidly for all age groups, recording 10.6 percent per annum. Thus, it appears that the public sector did not only mitigate the adverse impact of the economic crisis on consumption, but it reduced the widening disparity amongst generations due to changing patterns of private consumption.

<sup>4</sup>Another interesting result is that, while private consumption for ages 0-19 declined, that for 0-24 increased for the same period, suggesting that the education expenditure for college students increased substantially. It might be because of the substantial increase in college tuition during the period.

Table 2. Annual Growth Rate of Consumption and Labor Income: By Broad Age Groups

%	Annual growth between 1996-2000				Annual growth between 2000-2005			
	0-19	20-64	65+	per capita	0-19	20-64	65+	per capita
Total Consumption	2.6	4.2	2.7	3.7	6.4	3.6	4.0	4.4
Public Consumption	3.7	4.4	6.6	4.0	9.0	6.9	7.1	7.4
Public Education	3.4				12.2			
Public Health	9.4	9.1	14.5	10.6	8.2	10.6	8.9	10.6
Public Others	3.2	3.2	3.2	3.2	6.0	6.0	6.0	6.0
Private Consumption	2.1	4.1	1.6	3.6	5.0	2.8	3.0	3.4
Private Education	-3.8	..	..	..	10.6	..	..	..
Private Health	-2.9	-1.2	1.4	-0.3	22.5	6.3	8.3	9.2
Housing	-1.4	1.6	5.6	1.9	4.1	1.3	-1.0	2.0
Other Consumption	5.1	4.0	0.9	4.3	2.2	2.7	2.9	2.9
Labor Income	2.7	0.3	-10.7	0.7	-13.4	3.3	3.2	3.7
Compensation	2.6	0.0	-14.1	0.4	-13.5	4.6	6.9	5.0
Self-Employed Income	46.2	2.1	-2.8	2.5	4.8	-6.0	-4.9	-5.4

Public consumption further increased between 2000 and 2005, especially for public education consumption. Public education consumption for ages 0-19 increased by 12.2 percent per annum during the period, which is in stark contrast with the substantial decrease in the labor income for the same age group. Public health consumption also kept growing during the period. Private education consumption and health consumption increased very rapidly during the recovery, too. The private health consumption for children ages 0-19 grew 22.5 percent per annum during the period. For ages 0-24, it increased by 20.2 percent per annum.

## 2. Reallocation System

Reallocation systems, which is the way of funding to fill the gap between consumption and labor income, vary along two important dimensions: the governing or mediating institution and the economic form of the reallocation (Lee, 1994a; 1994b). The public sector reallocates resources relying on social mandates embodied in law and regulation and implemented by local, regional, and national governments. Education, public pensions, and health care programs are important examples of public reallocation programs. Private sector reallocations are governed by voluntary contracts, social conventions, etc. that are mediated by households, families, charitable organizations, and other private institutions. Important examples of private reallocations are private saving and credit transactions and familial support to children and the elderly. The results are explained in turn using the following figures.

It is not surprising that transfers dominate the reallocation of wealth to children in any economy, because asset reallocation is not the usual mechanism for supporting consumption by young children. Although Korea is no exception, familial transfer to children in Korea is particularly prominent, given the high level of private education consumption by high school students. Public transfers to children are getting more

important, especially since the recovery from economic crisis, due to the rapid increase in public education consumption. Familial transfers for the elderly trend upward with age too, but net familial transfers for the elderly decreased dramatically between 2000 and 2005 (figures 6 and 7). The drastic decrease in familial transfers during the period is largely due to the difference in growth rate between inflows and outflows. That is, the outflows grew much faster than inflows for elderly, which might be also related with the change in asset-based reallocation for the elderly, as described below.

Figure 6. Per Capita Net Public Transfers Profiles: 1996, 2000, and 2005

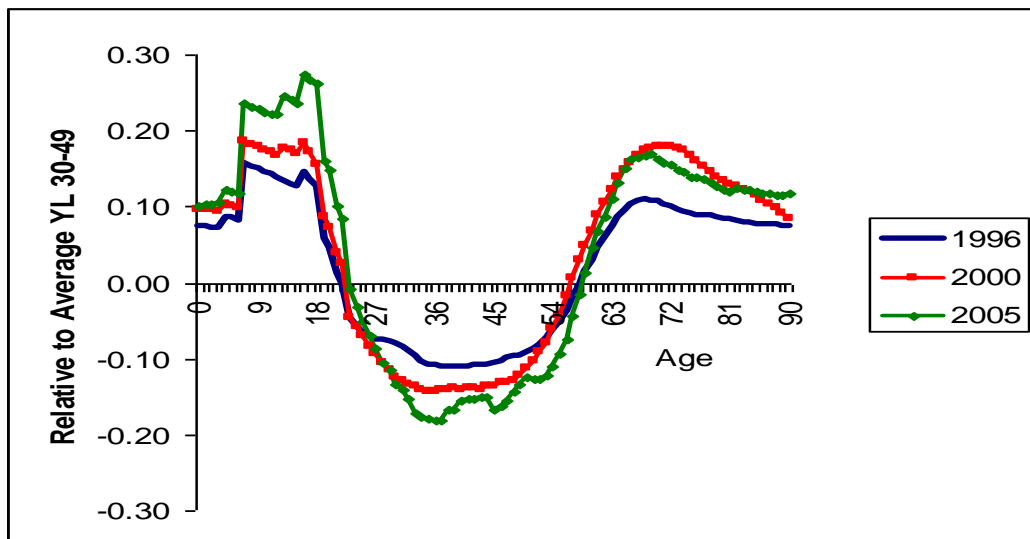
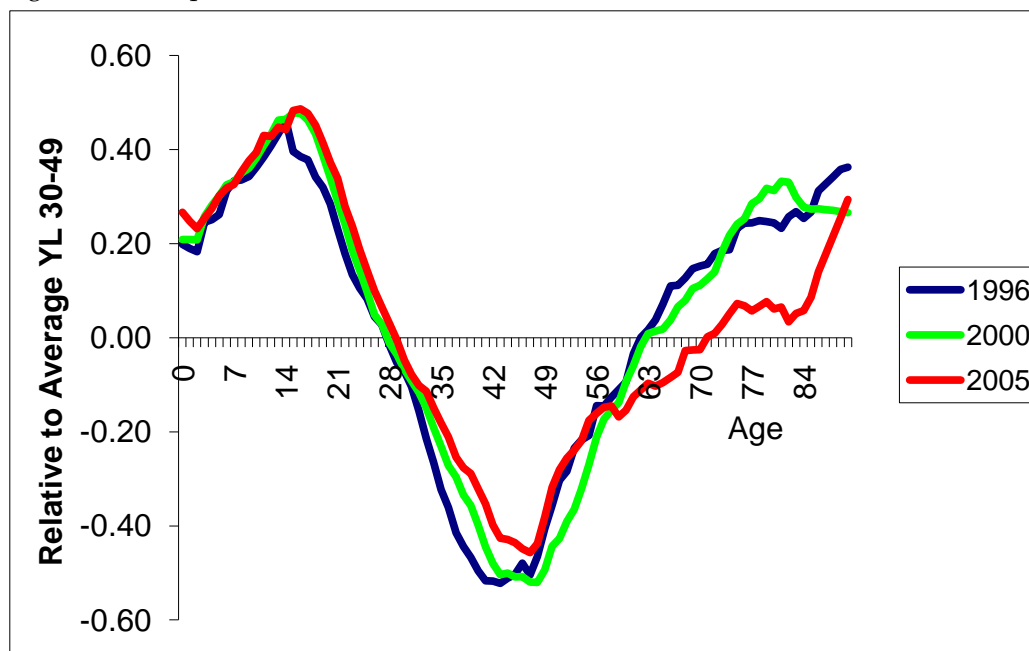


Figure 7. Per Capita Net Private Transfers Profiles: 1996, 2000, and 2005



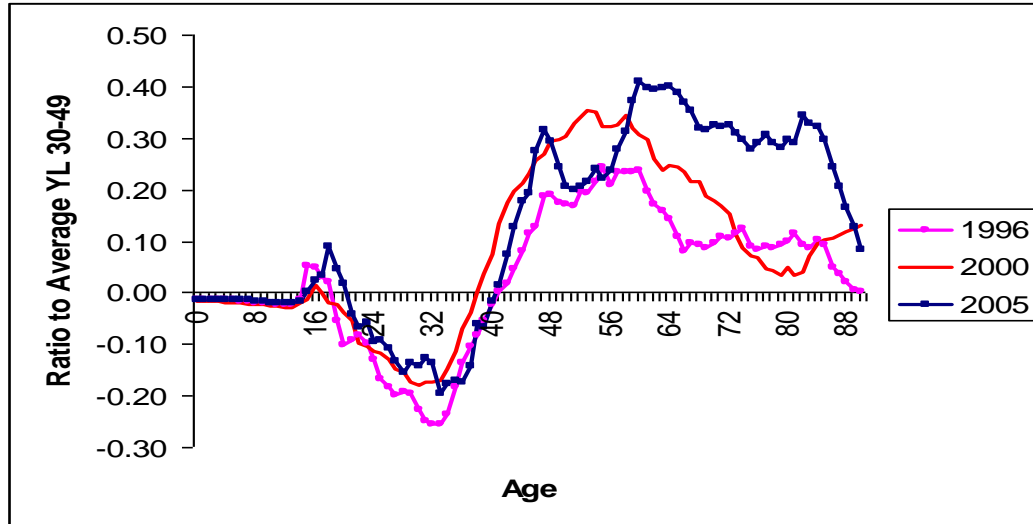
The most striking feature of the change in transfers was the rapid increase in social welfare expenditure (Not shown in the figure). In addition to public health expenditure, social assistance benefits increased for all age groups, amounting to 18.9 percent per annum between 1996 and 2000, and 13.3 percent per annum between 2000 and 2005, in real terms. It might be because of the expansion of the National Basic Livelihood Security System (NBLSS) benefits system in 2000, which consists of cash and in-kind benefits to households with incomes below the poverty line. Social security related expenditure also grew rapidly, especially for the elderly. Social security inflows grew by 7 percent per annum between 1996 and 2000, and it further increased by 16.3 percent per annum between 2000 and 2005.

Private asset-based reallocations were positive at most ages, except for ages in the 20s and 30s in Korea over the period (Figure 8). At those ages, asset income was equal to or smaller than saving. Younger people, those aged 15–20, were dis-saving, but at a trivial level. Private asset income was rising steeply among people in their 40s and 50s. But their private savings were always quite low compared with their asset income. Perhaps the reason for their low savings is that people in this age group were financing much of the consumption of children and the elderly.<sup>5</sup>

<sup>5</sup> Or it could be simply due to the fact that our results are based on cross-sectional rather than longitudinal data. See Mason et al. (2009) regarding this issue.



Figure 8. Per Capita Asset-based Reallocation Profiles: 1996, 2000, and 2005



A striking result is the huge increase in asset-based reallocation (asset income minus saving) for the elderly between 1996 and 2000, and again between 2000 and 2005. Quite surprisingly, the increase in asset-based reallocation is mainly due to an increase in asset income between 1996 and 2000, while it was entirely due to a decrease in saving (an increase in dis-saving) between 2000 and 2005 (figures 9 and 10). The increase in asset income among older people between 1996 and 2000 was largely due to an increase in net inflow of interest and other property income for those age groups, while capital income was still a most important source of asset income for Koreans of all age groups.

Figure 9. Per Capita Private Asset Income Profiles: 1996, 2000, and 2005

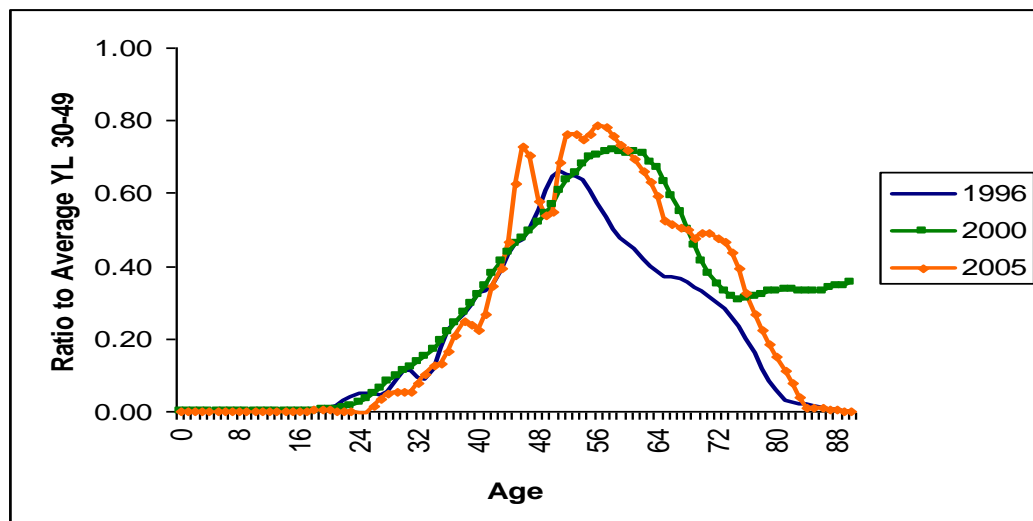
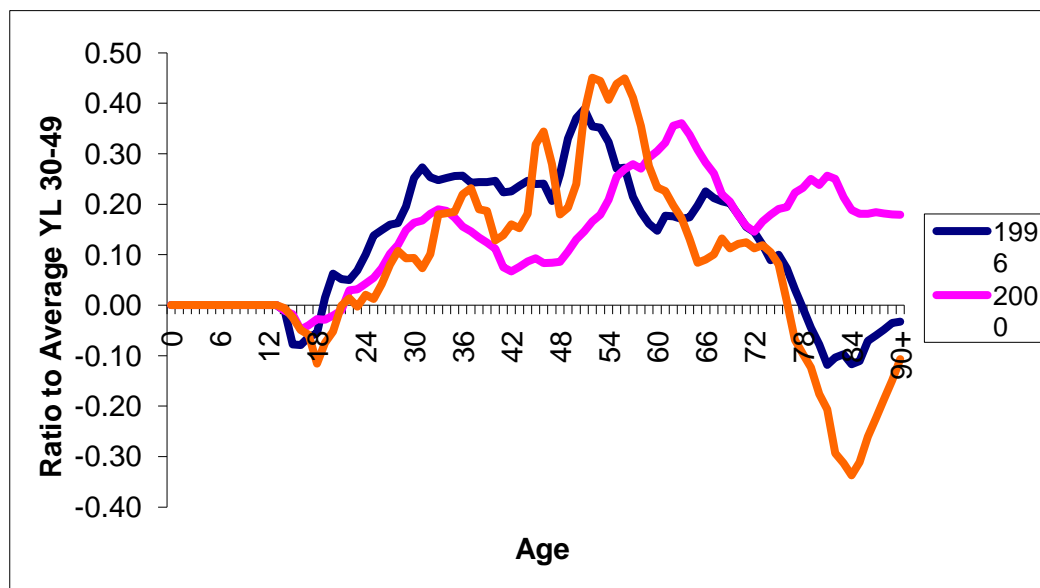


Figure 10. Per Capita Private Saving Profiles: 1996, 2000, and 2005



What are the major sources of the large swings in asset income and saving during the financial crisis and after the recovery? It is premature to speculate at this moment, and it is well beyond the scope of this paper. However, it is worthwhile to mention that it must be related to the speculation in real estate which became a serious social issue in Korea right after the financial crisis. The lowering interest rate between 2000 and 2005 may have affected the huge decline in saving behavior for the elderly during the period, which in turn might have affected the asset-based reallocation. Also the asset-based reallocation system in Korea after the crisis should be understood in conjunction with several unusual features of Korea, such as the *chonse* (key-money) housing system, that may have had a significant effect on the private sector through private transfers and private asset-based reallocations.

### 3. Sources of Financing Consumption

Table 3 presents the national transfer flow account for Korea in a highly summarized form, reporting aggregate lifecycle deficits and aggregate age reallocations by age in billions of won. Total age reallocations and their major components are shown in the bottom panel, with positive values representing net inflows and negative values representing net outflows. The lifecycle deficit for people ages 65 and older, for example, was 12 trillion won in 1996. The lifecycle deficit for this age group was substantially increased, to 19 trillion won, in 2000. The lifecycle deficit further increased to 30 trillion won in 2005 for this age group. Clearly, the lifecycle deficit has become large as the population ages and labor income decreases for this age group.

Table 3. National Transfer Accounts, Aggregate Values by Broad Age Groups: 1996, 2000, and 2005. Billion won.

1996	Total	0-19	20-64	65+
Life Cycle Deficit	(12,590)	74,873	(99,717)	12,254
Total Consumption	263,878	78,979	168,848	16,050
Public Consumption	58,089	24,914	29,902	3,273
Private Consumption	205,789	54,066	138,946	12,777
Labor Income (Less)	276,467	4,106	268,565	3,796
Age Reallocations	(12,590)	74,873	(99,717)	12,254
Transfers	(161)	76,174	(85,453)	9,118
Net Public Transfers	0	19,671	(22,917)	3,246
Public Transfer Inflows	78,261	28,273	43,202	6,787
Public Transfer Outflows	(78,261)	(8,602)	(66,119)	(3,541)
Private Transfers, net	(161)	56,503	(62,537)	5,872
Asset-Based Reallocations	(12,428)	(1,301)	(14,263)	3,136
Public Asset Based Reallocation	(36,379)	(3,998)	(30,735)	(1,646)
Public asset income	4,832	531	4,082	219
Less: Public Saving	41,210	4,529	34,817	1,865
Private Asset Based Reallocation	23,951	2,697	16,472	4,782
Private asset income	96,256	54	87,572	8,631
Less: Private Saving	72,306	(2,644)	71,100	3,849
2000	Total	0-19	20-64	65+
Life Cycle Deficit	21,299	79,505	(76,930)	18,725
Total Consumption	314,706	83,887	209,161	21,658
Public Consumption	70,098	27,608	37,358	5,133
Private Consumption	244,609	56,280	171,804	16,525
Labor Income (Less)	293,407			

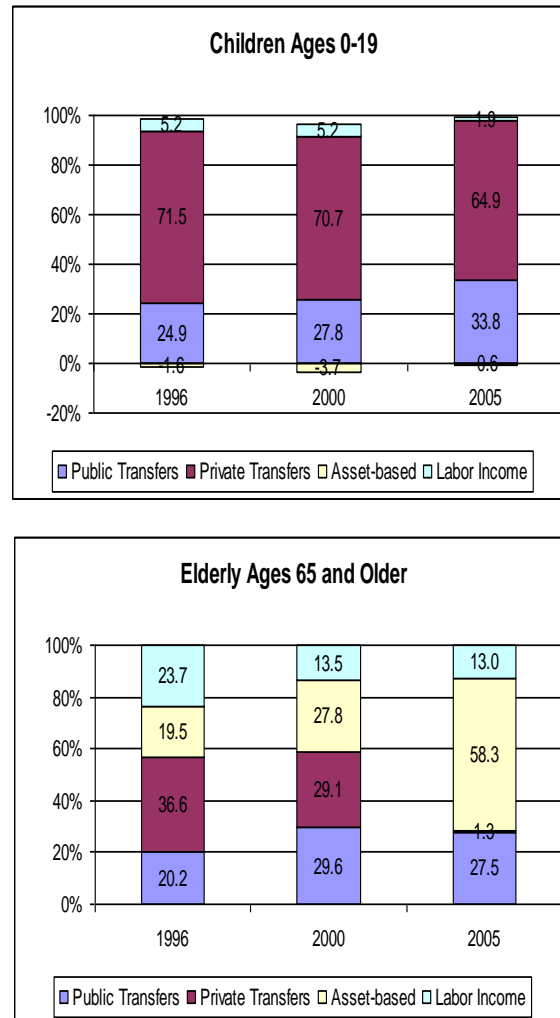
		4,382	286,092	2,933
		-	-	-
Age Reallocations	21,299	79,505	(76,930)	18,725
Transfers	644	82,629	(94,698)	12,713
Net Public Transfers	-	23,326	(29,746)	6,420
Public Transfer Inflows	102,278	33,052	57,915	11,310
Public Transfer Outflows	(102,278)	(9,726)	(87,661)	(4,891)
Private Transfers, net	644	59,303	(64,952)	6,294
Asset-Based Reallocation	20,655	(3,124)	17,768	6,012
Public Asset Based Reallocation	(49,731)	(4,729)	(42,624)	(2,378)
Public asset income	9,047	860	7,754	433
Less: Public Saving	58,777	5,589	50,378	2,810
Private Asset Based Reallocation	70,386	1,605	60,392	8,389
Private asset income	125,337	30	108,075	17,231
Less: Private Saving	54,951	(1,575)	47,684	8,842
2005	Total	0-19	20-64	65+
Life Cycle Deficit	38,405	101,112	(92,255)	29,549
Total Consumption	399,109	103,036	262,116	33,958
Public Consumption	102,452	38,315	54,843	9,294
Private Consumption	296,657	64,720	207,273	24,664
Labor Income (Less)	360,704	1,924	354,371	4,409
		-	-	-
Age Reallocations	38,405	101,112	(92,255)	29,549
Transfers	(2,267)	101,684	(113,699)	9,747
Net Public Transfers	(0)	34,795	(44,116)	9,321
Public Transfer Inflows	157,144	46,036	93,729	17,379

Public Transfer Outflows	(157,144)	(11,242)	(137,845)	(8,057)
Private Transfers, net	(2,267)	66,890	(69,583)	426
Asset-Based Reallocation	40,672	(573)	21,444	19,801
Public Asset Based Reallocation	(50,380)	(3,604)	(44,192)	(2,583)
Public asset income	8,661	620	7,597	444
Less: Public Saving	59,040	4,224	51,790	3,027
Private Asset Based Reallocation	91,051	3,031	65,636	22,384
Private asset income	171,600	69	147,179	24,352
Less: Private Saving	80,549	(2,963)	81,543	1,968

Table 3 enables us to measure the source of financing consumption for each age group. Figure 11 shows how consumption by children and the elderly was funded for the three periods. In the case of children, earnings were a negligible source for all years; virtually all their consumption was financed by transfers in all three periods. Private transfers dominated, accounting for more than 70 percent for 1996 and 2000. Private transfers decreased to about 65 percent, as a source of consumption for this group, in 2005. The remainder consisted of public transfers, and its importance has been substantially increased over the periods.

For the elderly, work contributed about 24 percent of consumption in 1996, but it declined to about 13 percent in 2000 and 2005. Public transfers accounted for only 20 percent of consumption by the elderly in 1996, but jumped to about 30 percent in 2000 and decreased slightly until 2005. Private transfers were the most important source of consumption for the elderly in 1996, accounting for about 37 percent. But these decreased to 29 percent in 2000, and further decreased, dramatically, to 1.3 percent in 2005. The results should be interpreted with caution, however, because, as we pointed out above, the 2000 and 2005 data sets are not exactly comparable due to the changing coverage of households between two surveys, NSHIE and HIES. However, the results are still quite informative in terms of the direction of changes. For the elderly, only the importance of asset-based reallocation rose consistently.

Figure 11. Sources of Financing Consumption: 1996, 2000, and 2005



#### IV. Conclusion

The challenges resulting from the rapid aging and extremely low fertility level are of great concern to Korea, simply because no other society has faced so dramatic a demographic transition. This paper provides insight into some important features of the intergenerational resource allocation in the nation before and after the financial crisis in 1997-98.

The summary and implications of the study are as follows. The results show a tremendous consumption smoothing and resource reallocation by age during and after the financial crisis. Although labor income was sluggish between 1996 and 2000, consumption showed a modest increase, mostly due to the increase in public consumption. Private education and private health consumption decreased for ages 0-19 between 1996 and 2000. However, the decrease in private education and private health consumption was mitigated by the increase in the public sector consumption. It appears that the public sector did not only mitigate the adverse impact of economic crisis on consumption, but it also reduced the widening disparity amongst generations. Within transfers, the results suggest the public transfers increased substantially, while the private transfers substantially decreased for the elderly during and after the crisis. It also appears that social assistance benefits increased rapidly for all age groups.

Perhaps the most important and striking result is that the asset-based reallocation of the elderly increased remarkably after the financial crisis. The increase in asset-based reallocation was mainly due to an increase in asset income between 1996 and 2000, but it was almost entirely due to a decrease in saving (an increase in dis-saving) between 2000 and 2005. It means that the elderly in Korea have some degree of autonomy in spite of the economic crisis, rapid population aging, and the deterioration of the familial support system. This is good news for Korea, because it means that less public resources will be required by the elderly, and that in turn will mitigate the financial burden caused by rapid population aging or economic downturn. However, the increased reliance on dis-saving will lead to a decrease in saving rates, which could be an obstacle for economic growth in the future. The sharp increase in the reliance on asset-based reallocation could be diminished for a while, as the old-age pension of the National Pension Scheme has begun to be fully implemented, starting in 2008. However, without further reforms, public pension funds will be exhausted around 2035. Thus, increased reliance on asset accumulation will be critical in the future. Exactly how all these changes will play out remains to be seen.

## References

- Chun, Y. forthcoming. "Population aging, fiscal policies, and national saving: Prediction for Korean economy," In T. Ito and A. Rose, eds., *Fiscal policy and management: East Asia Seminar on Economics*, Vol. 16. Chicago: University of Chicago Press. Also NBER Working Paper 12265.
- Lee, R. 1994a. "The formal demography of population aging, transfers, and the economic life cycle," In L. G. Martin and S. H. Preston, eds., *Demography of Aging*, pp. 8–49. Washington, D.C.: National Academy Press.
- — —. 1994b. "Population, age structure, intergenerational transfers, and wealth: A new approach, with applications to the US" In *The family and intergenerational relations*, edited by P. Gertler, special issue of *Journal of Human Resources* 24: 1027–63.
- Lee, R., S.-H. Lee, and A. Mason. 2008. "Charting the economic life cycle". *Population aging, human capital accumulation, and productivity growth*, edited by A. Prskawetz, D. Bloom, and W. Lutz, supplement to *Population and Development Review* 33. Also NBER Working Paper 12379.
- Mason, A., R. Lee, A.-C. Tung, M.-S. Lai, and T. Miller. 2009. "Population aging and intergenerational transfers: Introducing age into national accounts," In David Wise ed., *Economics of Aging Series*, Chicago: National Bureau of Economic Research and University of Chicago Press.

<http://www.ntaccounts.org/>



## Comments on "Financial Crisis and Intergenerational Economy: Lessons for Korea's 1997 Financial Crisis"

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Investigating intergenerational transfers and intergenerational resource allocation at an aggregate level is essential to understand the macroeconomic impacts of population aging. To this purpose, the National Transfer Account (NTA) system is a useful and intuitive tool. As Korean pioneers of the NTA studies, the authors show us interesting pictures drawn by the NTA, focusing on the effects of Korea's 1997 financial crisis on intergenerational economy.

### 1. Identification of the Crisis Effects

It might not be easy to identify the effects of the crisis just by comparing periods before and after the crisis. Counter-cyclical policies or structural trend make things complicated.

For example, on page 3 it reads: "One group of flows (labor and asset income) are directly affected by economic crises. A second group of flows (public and private transfers and dis-saving) are indirectly influenced and may serve to mitigate the effects of economic crises."

But as in Figure 9, at least for mid-50s and over, asset income actually *increased* in 2000 compared to 1996. This is because of housing market boom induced by deregulation policies under Kim Dae-Joong government, low interest rates, and abundant liquidity supply from export boom.

In addition, private transfers did not play an expected role in mitigating the economic hardship of the crisis for the elderly. It is because traditional familial support system had been deteriorating and also partly because the expansion of public transfers during and after the crisis might crowd out private transfers at least to some extent.

Therefore, simple comparison of the pictures taken with the NTA framework before and after the crisis might not be successful in the identification of the impacts of the crisis *per se*.

### 2. A Few Results Seem Less Plausible

"The peak of labor income was the middle and late thirties - with the peak age at 38 in 1996, at 34 in 2000, and at 39 in 2005" (p.9).

Is that true? These estimated peak ages in terms of labor income seem too young. I'm not sufficiently convinced of these peak points considering usual age-earning profiles where the peaks lie somewhat later and the fact that the employment rate (=the number of employees/population) of those in their 30s is generally lower than that of those in their 40s.

In Figure 3, the bi-modal shape ('M-shape') of labor income by age appears only for the year of 2000 (and arguably for 2005).

Didn't the career breaks on the working lives of women exist in 1996?

According to Table 6, per capita private transfers to Korean elderly (65+) were 50,244,000 won, and then they plunged to 9,189,000 won in 2005.

Isn't the amount for 1996 too big? And is it plausible that private transfers to the elderly have decreased that much only in a decade?

### 3. Asset-Based Reallocation

The authors suggest that Korean elderly seemed to have some degree of supporting system during the crisis even without sufficient pension benefits owing to their asset income. I admit that Korean elderly homeowners could have benefited from housing market boom beginning in 2000. But I also suspect that the importance of asset-based reallocation as a source of funding elderly consumption of 2005 is overestimated in the NTA framework.

In fact, Figure 12 reports a striking result that suggests 70% of elderly consumption is funded through asset-based reallocation at least in 2005. This is quite provocative because asset income occupies only a small portion of Korean elderly income according to recent studies using nationally representative household data. For instance, the proportion of property income in total income of Korean elderly (65+) in 2005 is not more than 10% regardless of their income quintile (see Appendix Table 1).

Finally, as to policy implications for asset-based reallocation as an important source of elderly income, the liquidation of housing assets as well as the future prospect of their prices should be mentioned. If reverse mortgage program become more popular, elderly people who are often "house-rich but cash-poor" can have a stable source of retirement income even without housing market boom as in the early 2000s.

### 4. Usages of the NTA Framework and Its Linkages with Micro Analyses

The NTA system is expected to be used to study the implications of population aging for both familial and public transfers, how changes in familial support systems influence the economic circumstances of different generations, the interaction between public and familial transfer systems among others. The authors have been conducting comparative studies across countries and across periods using the NTA framework, which also proves the usefulness of the NTA system.

To interpret the findings from the NTA studies, however, we need micro analyses related to the issues. Put differently, macro-level findings that the NTA provides facilitate micro-level studies, and the author surely give us many interesting topics that wait for micro analyses. Therefore, it might be recommendable to cite NTA findings in micro studies and vice versa, i.e., to cite stylized facts from micro studies in the future NTA studies.

### 5. Small edits

p.5, line 4 from the bottom: "National Transfers (NTA) Accounts"

→ National Transfers Accounts (NTA)

p.5, line 2 from the bottom: "National Income and Product Accounts"

→ National Income and Product Accounts (NIPA)

p.9, the second paragraph:

→ Where is Figure 2?

p.9, the second paragraph: "They were divided into the *surplus* ages of 0-24, the *deficit* ages of 25-54, and *surplus* ages of 55 and older in 1996. This was changed the *surplus* ages of 0-27, the *deficit* ages of 28-55 and the *surplus* ages of 56 and older in 2000. This again changed to the *surplus* ages of 0-25, the *deficit* ages of 26-54, and the *surplus* ages of 55 and older in 2005."

→ The '*surplus*' and '*deficit*' should be exchanged for each other.

Appendix Table. Average Income and Wealth of Korean Elderly Aged 65 or Older and Having Some Income by Income Quintile

(10,000 won)						
Income quintile [Income range]	All (N=3212)	Lowest [1, 52)	Second fifth [52, 160)	Middle fifth [160, 372)	Fourth fifth [372, 870)	Highest 870&over
<b>Total annual income (in 2005)</b>	<b>712</b>	<b>21</b>	<b>99</b>	<b>259</b>	<b>573</b>	<b>2661</b>
1 Wage	67	0	1	7	58	274
2 Own business	46	0	0	2	21	211
3 Agricultural and fisheries	207	0	4	25	99	926
4 Side job	4	0	1	5	5	7
(1-4) Earnings (%)	45.4	2.1	5.9	15.2	32.0	53.3
5 Rent	10	0	1	2	8	40
6 Interest	53	1	9	13	29	217
(5-6) Property incomes (%)	8.9	2.8	10.4	5.9	6.6	9.7
7 National pension benefit	33	0	7	32	44	82
8 Occupational pension benefit	54	0	1	2	7	267
9 Private pension benefit	4	0	1	3	2	13
(7-9) Pensions (%)	12.7	0.8	9.2	14.1	9.3	13.6
10 Unemployment compensation	0	0	0	0	1	0
11 Workers' compensation	2	0	0	0	0	8
12 National Basic Livelihood Security	18	0	1	30	52	4
13 Veteran benefit	9	0	1	4	5	35
14 Other welfare benefit	10	8	10	12	11	7
(10-14) Public transfers (%)	5.3	39.7	11.8	17.8	12.1	2.0
15 Financial help received from children	183	11	62	120	225	502
(15) Private transfers (%)	25.7	53.9	62.6	46.6	39.3	18.8
16 Other income	14	0	0	1	4	69
<b>Total assets (A)</b>	<b>11584</b>	<b>8297</b>	<b>9729</b>	<b>9982</b>	<b>10505</b>	<b>19618</b>
1 Cash and checking account balance	258	88	119	178	239	678
2 Saving account balance	82	6	61	69	76	198
(1-2) Deposits (%)	2.9	1.1	1.8	2.5	3.0	4.5
3 Term life insurance ever paid	14	1	0	4	18	46
4 Whole life insurance ever paid	1	0	0	0	0	4
5 Annuity insurance ever paid	1	0	0	3	0	0
(3-4) Insurances (%)	0.1	0.0	0.0	0.1	0.2	0.3
6 Stocks and mutual funds	36	0	0	0	143	37
7 Bonds	0	0	0	0	0	0
8 GYE money owed by others	1	0	0	0	1	6
9 Personal loans made to others	17	2	7	25	25	23
10 Other financial assets	0	0	0	0	0	0
11 JEON-SE security deposit paid	738	466	2038	410	437	331
12 WOL-SE security deposit paid	48	54	38	43	48	55
(11-12) Housing security deposit paid	6.8	6.3	21.3	4.5	4.6	2.0
13 Home	8764	7129	6866	7993	7811	14170
14 Real estate other than home	1540	518	550	1170	1641	3877
15 Farm	31	17	26	53	21	41
(13-15) Real estates	89.2	92.4	76.5	92.3	90.2	92.2

16	Vehicles	51	16	24	22	43	151
17	Other assets	3	1	0	11	0	1
<b>Total debts (B)</b>		<b>668</b>	<b>679</b>	<b>487</b>	<b>431</b>	<b>837</b>	<b>914</b>
1	Loans from financial institutions	247	223	111	169	372	361
2	Loans from relatives and friends	44	40	107	38	12	22
3	Other debts	3	0	0	0	16	0
4	GYE money owing others	0	0	0	0	0	0
5	JEON-SE security deposit received	235	265	213	145	279	278
6	WOL-SE security deposit received	50	65	20	45	44	76
7	Other security deposit received	89	86	36	34	113	177
<b>Net worth (A-B)</b>		<b>10916</b>	<b>7618</b>	<b>9241</b>	<b>9551</b>	<b>9668</b>	<b>18704</b>

Note: Data are from Korean Longitudinal Study of Ageing.

Source: Kim, Hisam, "Intergenerational Transfers and Old-Age Security in Korea," in T. Ito and A. Rose (eds.), *The Demographic Transition in the Pacific Rim*, NBER-EASE Volume 19, University of Chicago Press, forthcoming.

## **Growth of Felonies after the 1997 Financial Crisis in Korea**

*Duol Kim and Jee Eun Kim*

### **Abstract**

Ever since the financial crisis in 1997, South Korea has witnessed a sharp increase in felonies (heinous crimes: homicides, robbery, rape, and arson), crimes which directly threatens human body or life. In this paper, we assume that the structural socioeconomic transformation led by the financial crisis increased crimes in this society, and assess the effectiveness of criminal deterrence policy by the Korean government. Our analysis on criminal deterrence policies- policing, sentencing, and corrections – proves that the efforts of Korean government were insufficient to ameliorate the rising trends in crime. For the past ten years, the investment of human resource and budget in the police has been virtually stagnant, as well as in prosecutors' investigation activities, causing a huge decline in arrest rates and prosecution rates. Comparing the pre- and the post-financial crisis period, the average length of prison sentence by the courts has declined. We also found that the increase in the number of repeat offenders convicted of more than a third offense pushed felonies upward, although the government hired more officers and allocated larger budget into prison and probation. In order to curve down the rising crime and prevent possible aggravation of social safety by the current global economic turmoil, it is crucial to invest more resources into criminal deterrence and improve policy effectiveness.

## I. Introduction

Ever since the Asian financial crisis in 1997, the Korean economy has undergone serious economic shifts, such as declining economic growth rate, a rising unemployment rate, widening income disparity, and growing poverty. Due to extensive socio-cultural changes brought about by these structural transformations of the Korean economy, South Korea has witnessed a sharp increase in felonies (heinous crimes), crimes which directly threatens human body or life.<sup>1</sup>

Considering it is a nation's basic function to ensure people's safety, it is crucial that the government identifies the causes of rising crime and formulates effective policies to combat it. Furthermore, the countermeasures employed against crimes are vital for building a foundation of long-term economic growth. An increase in crime not only harms individual victims, but also creates an enormous economic loss to society as a whole, because the deterioration of community security impedes free economic activity. In other words, achieving reductions in crime is necessary for both economic growth and social safety.

There have been a number of past studies on crime analysis or its policies, which have emphasized the rising trends of crimes since the economic turmoil in 1997.<sup>2</sup> However, these studies have mainly focused on the causes of rising crime (e.g. that the worsening economic condition accelerated certain push factors of crime, or that society as a whole had become more violent). Yet, these studies neglected how the government responded to ameliorate the situation.

In this paper, we assess the effectiveness of criminal deterrence policy by the Korean government, while assuming that the structural socioeconomic transformation induced more crimes in the society swept by the 1997 Asian financial crisis. When a country experiences deteriorating macroeconomic performance, its government either reduces resources for deterring crime or changes policy priorities for distributing a given amount of resource. This eventually leads to insufficient resource investment in criminal deterrence. Moreover, when ministries and offices in charge of criminal deterrence fail to succeed in policy coordination regarding changes in policy conditions, it is likely that the effectiveness of criminal policy will be weakened.

If the policy measures of the Korean government were less appropriate to deter crime, then the rise in crime, after the financial crisis, stems more from the failure of government policy rather than socioeconomic conditions vulnerable to crimes. That would suggest that rising crime could have been less severe than current levels if appropriate government policies had been implemented. Hence, this study attempts to clarify the issue, whether crime skyrocketed as the result of policy failures, rather than an inevitable outcome of socio-economic structural changes. We compare criminal policies in the pre- and post- Asian financial crisis period, and suggest significant policy implications.

The deterrence policy of crime can be categorized into three operations: the prevention of crime, the arrest and punishment of criminals, and correction activities. The National Police, Prosecutor's Office, the Supreme Court, and the Ministry of Justice are in charge of these activities. The evaluation of crime-related policies can be carried out by examining the followings criteria: first, whether sufficient resources were invested in order to implement these three criminal deterrence policies; second, whether the resources were effectively used; third, whether the policy regarding criminal deterrence

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<sup>1</sup> The definition of heinous crime or felony (homicide, robbery, arson, and rape) is described in Section 3.

<sup>2</sup> Park (2008), Kim et al. (2007), Chang (2008), Choi (2002)

was coordinated and managed in a coherent manner; fourth, whether the government was successful in tackling crime.

This paper is organized as follows. In section 2 we provide a theoretical framework for the analysis of criminal deterrence policy. In section 3 this study reviews the rising trend of index crime as a proxy for public security. We will also examine problems with crime statistics - whether or not the increase in reported cases reflects the rise in the actual amount of crime, since the number of actual crime differs from the size of reported case. Section 4 examines policy effectiveness of policing, investigation and prosecution, sentencing, and correction activities. In section 5 we conclude with the summary of analysis and policy implications.

## II. Theoretical Framework of Criminal Deterrence Policy

In general the establishment and implementation of government policy begins with defining an objective of the policy. After setting an objective, it must be clear how one can measure the objective's accomplishment, what policy instruments can be used to attain that goal, and through what channel must policy instruments influence said goal. These four elements of policy requirement also apply to designing criminal policy.

The objective of criminal policy, or criminal deterrence policy, is to provide public security and to protect people's life and property by deterring the occurrence of crime. In order to assess the extent to which an authority attains this policy objective, it is useful to use a quantitative index. The most popular proxy is crime rate; namely, the amount of crime per population.<sup>3</sup> We can gauge how well the government achieves criminal deterrence and the quality of our public safety by comparing the level of crime in Korea with other countries and examining the long-run trend.

Among several policy measures, Gary Becker categorizes criminal policy instruments into deterrence and punishment, and claims that one can substitute the other.<sup>4</sup> As many of the policy instruments targeting crime deterrence contain both crime prevention and ex-post measures, the framework suggested by Becker may not be so helpful in analyzing criminal deterrence policies. For instance, we can say that it is an ex-post measure if an offender is incarcerated after crime is committed. However, imprisonment can be also seen as preventive, since the increased threat of punishment induces potential criminals not to commit crimes. Therefore, we suggest that criminal policy can best be systemically analyzed when a policy is examined with respect to the government organizations and their mandates: policing, sentencing, and correction activities.

First, policing refers to a physical initiative to prevent potential victimization, and the police are in charge of this procedure. We use three proxies for measuring the amount of resources spent to support policing: the number of police officers; the amount of expenditure on police; and the equipment capacity per police officer. Apprehension refers to the procedure to investigate and take custody of criminals, which is carried out by both the prosecutor's office and the police. The level of resource inputs devoted to arrest activities can be also measured by indices such as annual expenditures and workforce. Though policing and apprehension conceptually differ from each other, it is difficult to tell how much of the police workforce or budgets are spent on each activities. Therefore, two procedures are analyzed together for our convenience. The optimal level of resource

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<sup>3</sup> Crime rate is usually computed per 100,000 people in Korea. In this paper, the rate is estimated by dividing the amount of crime by 100,000 people, unless specified otherwise.

<sup>4</sup> Becker (1968)

input in policing and apprehension, and the effectiveness of policy are evaluated with intermediate variables such as crime rate and the probability of being prosecuted.

Second, sentencing is determined by a prosecutor's conviction of the accused, followed by a judge's ruling. In principle, it is also influenced by how the National Assembly establishes and amends penal laws and ordinances. There usually exists a positive correlation between the severity of punishment and criminal deterrence effect. Namely, the higher the level of penalty, the lower the probability of potential criminals committing crimes, and the repeat offence rate decreases for those who finish their sentence.<sup>5</sup> The level of punishment intensity can be examined by computing average sentencing length.

Third, correction is carried out by the Ministry of Justice. Their main job is to physically implement sentencing by the court and educate offenders in order to prevent future crimes. There are two ways to examine correctional activity: correction in prison and social correctional treatment, such as probation. The amount of resources invested in the correctional policy is usually explained through figures such as annual expenditures on correction, the number of prison and probation officers. While the effectiveness of the policy is evaluated by initially examining the management condition of prisoners and probationers, the primary criteria for successful correction policy is to see whether those who received correctional education commit repeat offenses or not. In this sense, the repeat offense rate of prisoners and probationers is a significant variable for judging a policy's effectiveness.

The three policy instruments examined above influence criminal deterrence through different channels, and cost differently in their implementation. The government decides the optimal combination of these policies to successfully deter crimes. Yet, possibilities for coordination failure arise from decentralized decision-making procedures hindering effective and coherent criminal policy formulation. This is because those policies are exercised by the Police, the Prosecutor's Office, the Supreme Court, and the Ministry of Justice; whereas the amount of budget, the most critical factor in policy implementation, is planned by the National Assembly and the Ministry of Strategy and Finance. For example, when the government finds the current sentencing practices excessively severe and decides to alleviate the intensity of punishment for the purpose of protecting human rights, more policemen must be hired to suppress a predictable jump in crime, led by shortened sentence length. Given this inflexible decision-making procedure and organizational structure of the Korean government, it is important to empirically examine possible policy coordination failure. In the next section, we explore the current level of crime in Korean society and its long-term trend.

### III. Trend of Felony

The most widely used benchmark of public safety is the number of crimes occurring in a certain period of time. Crime, the breach of one or more rules or laws for which some governing authority or force must ultimately prescribe punishment, varies by its type of violations. Crime involves the breach to human life and property (e.g. homicides or robbery), white-collar crimes (e.g. the violation of the Securities and Exchange Act and malfeasance in office), and minor offenses like traffic offense and noise pollution.

This paper focuses on felonies, instead of all crimes, for the purpose of examining public security in Korea. Prosecutors and the Police tend to list homicides, robbery, arson and rape as

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<sup>5</sup> Cooter and Ulen (2008)



‘violent crime’ (a heinous crime or felony). Since felonies are serious threats to human body and life, they provide useful indicators to show how safe the Korean society is.<sup>6</sup>

According to the *Criminal Analysis* published by the Prosecutor’s Office, about 21,000 cases of felony were committed in 2007 (Table3.1). Felonies account for 1.1% of all criminal cases, and 2.5% of penal law cases. Homicide, robbery, arson, and rape account for 5.4 %, 21.4%, 8.1%, and 65.1% respectively. Comparing 2007 to the late 1960s, felonies increased more than six times (Figure3.1).<sup>7</sup> During the same period, the population had increased by about 70 percent, which implies that felonies increased at a faster rate than population growth. The felony rate, defined as the number of felonies per 100,000 people, increased from 10 per 100,000 in the late 1960s to 43 per 100,000 in 2007, showing a four fold increase.

The notable feature regarding this rise in felonies has been its non-linear increasing trend. From the late 1960’s to the mid-1970’s, felonies were recorded around 3000-5,000, at which point they started rising to about 10,000 in the early 1980’s. While the number had been relatively steady at about 10,000 cases from the early 1980 to the mid-1990’s (about 15 years), it began accelerating in 1997 and has now doubled to 21,000 by 2007. The structural shift shown between the Asian Financial Crisis to the present can also be detected in the felony rates.<sup>8</sup>

The structural change observed for heinous crimes is also present for its every component: homicide, robbery, arson, and rape. From the late 1960’s to 2007, homicide, robbery, arson, and rape surged twice, 4.5 times, 8 times, and 10 times respectively, making the year 1997 as a watershed (Figure3-2). Table3.2 indicates to what degree each crime had contributed to the overall increase of felonies from 1977 to 2007. One notices the soaring increase in arson and rape during the post-financial crisis period.

There are two issues to be addressed before analyzing the causes of this inexorable rise in felonies. First, did heinous crimes increase to the point that crime ranks as a major social and economic issue? We raise the question because the rise in crime rates since 1997 might be considered negligible if the absolute amount of increase is not high.

To answer this question, we compare the crime statistics with those of other nations. As each nation has different rules and laws, and aggregation standards for statistics of crime, a mere comparison would not be helpful. Instead of analyzing all crimes, we choose homicide rates in OECD countries. Intentional homicide rates from 2000 to 2005, reported by UNDP, show that the homicide rates in Korea were higher than average for OECD countries ([Table3-3]).<sup>9</sup>

Second, does the long-term rise in heinous crime statistics reliably reflect real shifts in crime? It may not be the case when considering the reporting effect. In general, empirical studies use the reported crime rather than actual crime, due to the lack of availability of true measures. For example, the number of rapes usually increases when reporting rates rise. The increase in reporting rates stems from many factors: victims are more willing to accuse offenders; a rise in police officers increases the probability of criminal arrest; and technological innovation, such as the DNA testing, improves the overall investigation. Therefore, when reported cases increase, rape seems to be on the rise despite the fact that

<sup>6</sup> The Prosecution divides crime into penal offense and special law offense. Penal offense is classified into ‘violent crime (heinousness)’, ‘violent crime (violence)’, ‘property crime’ and so on. This paper calls ‘violent crime (heinousness)’ as either heinous crime or felony.

<sup>7</sup> Although the *Criminal Analysis* is published since 1964, we use data from 1967 for statistical stability and consistency.

<sup>8</sup> The rise in the late 1970s is also noteworthy. However, we focus on the surge in the post-financial crisis and reserve the 1970s rise for other chance.

<sup>9</sup> UNDP has published *Human Development Report* almost annually since 1990, and crime statistics has been on the report from the very beginning. While crime statistics were limited to few nations until 2006, the report includes all member state from the 2007/2008 issue.

the actual numbers are not increasing. If the rise in heinous crime is mainly attributed to the growing reporting rate, it would be misleading to interpret that felonies are increasing based on statistics shown in this section. Unless we have statistics on the number of actual crimes, not reported ones, it is very difficult to answer, in principle, the question of whether or not reported cases rightfully reflect real changes in the number of crimes.

However, some evidence implies that the dramatic rise in heinous crime statistics in Korea cannot be attributed to the alleged increase of crime due to reporting. First, homicides and arson have less incongruence between reported cases and occurred incidents. Homicides are the most accurately measured, because it is known to have relatively high ratio of reported case to actually committed cases. Arson statistics also have high reporting rates compared to others; people mostly report arson to police to put out fires; a thorough investigation is generally carried out regarding the causes of arson for damage compensation and insurance payment. Over the last forty years, homicides have quadrupled and arsons have risen by eight times, and this surge has mainly taken place since 1997. The increase in the amount of crime since 1997 was so large that the rising reporting rates can explain only a fraction of it. It is hard to refute the fact that heinous crimes have accelerated from the late 1990's, even excluding rape and robbery statistics, which are difficult to accurately estimate.

Moreover, the fact that reporting bias is less present for felonies than other crimes minimizes the alleged incongruence between our dataset and reality. For example, the elasticity for reporting rates with respect to the changes in police numbers (victims' tendency to report the offense to the police) is higher for theft than robbery. More generally speaking, the number of heinous crimes is not as elastic as other crimes in terms of the responsiveness in the reporting rates of a crime result of changes in size of policemen. This is because the difference between the number of committed crimes and reported crimes are relatively small for heinous crimes.

Drawing from this inference, Figure 3-4 indicates an interesting implication. Taking the average of 1970's - 1980's value indexed as 1, the overall crime and violent crime increased 3.5 times and about 3 times respectively, whereas heinous crime increased more than four times. The fact that heinous crime shows a more dramatic rise than other criminal cases demonstrates that the soaring heinous crime can not be simply overlooked as an exaggerated trend stemming from the rise in reporting rates.

Furthermore, the trend of police staffing suggests that the rise in reporting rates is not the main cause of the rising heinous crime. In general, reporting rates may rise if the police presence increases, as the perceived likelihood of a crime being solved increases. The police force must show a dramatic increase since 1997, or the growth rate of police number should be higher than the previous years if we attribute the acceleration of crime to the reporting effect associated with the increasing number of police. If the changes in the number of police since 1997 do not coincide with our expectation, we can refute the argument that the rise in crime is due to a reporting effect. In the next section, we explore the trend of police forces, which is important not only in terms of the main purpose of this paper, but also as a starting point for understanding what the basic trend is.

## IV. Criminal Deterrence Policy of the Korean Government

### 1. Policing and Apprehension

The main job of police officers is to prevent and investigate crime, and arrest criminals.<sup>10</sup> The prosecutors direct and supervise the work of police, and have a duty and right to investigate crimes.<sup>11</sup> How successful police and prosecutors have been in preventing crimes and arresting criminals can be evaluated in terms of resource inputs and outputs: the number of police and prosecutors, their respective budgets; and crime rates and arrest rates.

First, let's examine changes in the size of police forces. From the mid-1970's to the mid-1990's, the police force increased from about 57,000 to 160,000, but started to decline in 1996, and has since become stable at around 147,000 (Figure 4-1 (A)). The number of police forces per 100,000 populations also shows structural changes: the number doubled from 16 in 1975 to 34 in 1995, later decreasing to 30 per 100,000 people by 2007.

For a more thorough analysis, we broke down the police forces into police officers, combat police, and an administrative workforce. The number of police officers tripled from 33,000 in 1960 to 96,324 in 2007 (Figure 4-1 (B)). This 90 percent increase (an extra 63,000 police officers), namely 57,000, was hired between 1960 and 1997. Since the 1997 financial crisis, only 6,695 police officers - 10 percent of that total increase - have been newly recruited.<sup>12</sup> As for combat police, the number has seen the rapid increase from the 1970s to the 1990s, hitting roughly 60,000. Since 1996, however, it declined to 50,000, at which point the figure went below 50,000 in the mid-2000's. The size of administrative workers also showed a steady drop, from 8,000 to 4,000 by 2007, half of the size in 1995. In sum, the size of police forces has been de facto frozen, while the proportion of police officers in the total police force has gone up.

The capacity of police forces must be also analyzed not only with the size of forces, but also with the available resources which is distributed per police officer. More specifically, police cars, electronic devices, and equipment for scientific investigation are also an important criteria to evaluate the effectiveness of thwarting crime. The budget expenditures for police, in real terms, surged ten times between 1975 and 2006, with real expenditures per police officer also increasing five times during the same period (Figure 4-2). Unlike the police workforce, the annual expenditure in police shows a linear increase during the entire period. This implies that there could be an increase in resource inputs available per police officer for policing and arrest.

However, the proportion of labor cost in the total spending and its trend directly oppose the presumption we made above (Figure 4-2 (B)). While 50 percent of total police budget was spent for labor costs between the early 1980's and the mid-1990's, the proportion of labor cost increased to 65 percent in the mid-2000's, which is 15%p greater than the initial level. The increase in the proportion of labor costs, despite the stable police size, implies that the expenditure increase was mostly used for raising wages instead of improving the police department's ability to tackle crime. In order to support this claim, this paper estimated  $E$ , which denotes the annual expenditure per police population in the non-labor sector, which is the amount of expenditure one police workforce uses for policing activities.

<sup>10</sup> The Police Law of Korea, Article 2 and 3.

<sup>11</sup> The Law on the Prosecution Office of Korea, Article 3

<sup>12</sup> Since 1998, however, the number of police officers per 100,000 populations has stopped growing at 20 for the past ten years

$$E = \frac{\text{Total Expenditure} - \text{Labor Cost}}{\text{Total Police Employees}} \text{-----} (1)$$

Figure 4-2 (B) shows the long-term trend of  $E$ . One can see that non-labor expenditures increased from the early 1980's to the mid-1990's, but halted after the financial crisis. This suggests that the expenditure increase during the post-financial crisis was mainly spent on increasing wages of police officers, not for increasing the number of police or improving policing capability of each police officer.

Let's examine the level of prosecution resources. The number of prosecutors has shown a steady rise from 700 in the late 1980's to 1,700 in 2007. Employees in the Prosecutor's Office, excluding prosecutors, doubled from 4,000 in 1988 to 8,000 in 2007 (Figure 4-3), with prosecution expenditures in real term increased 4.5 times from 1988 to 2007.

However, it is premature to conclude that prosecution resources show a steady growth. The number of the assistant/ancillary workforce per prosecutor has declined from 8 to 6 people since the 1990's. The amount of expenditure per prosecutor also stopped growing since 1997 (Figure 4-3).<sup>13</sup> Therefore, despite the increase in the number of prosecutors, assistant employees, and annual expenditures, the decline in the resource input per prosecutor suggests that the investment has not been sufficient enough to improve investigation capability.

The indicators of criminal deterrence prove that the government's resource investment in crime sanction and prosecution has been running short to curb the spread of crimes during the past ten years. The first evidence is the arrest rates of heinous crime, which is a proxy of crime investigation capability. The arrest rates were consistently around 96 percent from 1977 through 1997, whereas the rates declined to 90 percent by 2007 (Figure 4-4).

Other evidence to backup this argument is the number of prosecuted offenders and the prosecution rates, which also shows a drop after the financial crisis. These two figures explain how successful the prosecution office is in filing charges against the arrested. The number of the prosecuted individuals decreased, despite the increase of crime since the economic turmoil of the 90's. Prosecution rates, indicating roughly 50 percent before the financial crisis, also started to decrease and stabilized around 30 percent in the mid-2000s (Figure 4-5(A)). When we broke down the prosecution rates by crime category, the rates of homicide and rape had not changed much, while robbery and arson demonstrated a dramatic decline, leading to a fall of overall prosecution rates for heinous crimes (Figure 4-5 (B)).

The heavy fall of arrest and prosecution rates is significant in two ways. First, the investigation capability of police and the prosecution has not been improved to deal with the social environment that pushes crime upward. Second, the failure in preventing repeat offense poses a potential danger to increase heinous crime. In addition to the two indicators, which assess the level of the police and prosecution officer's abilities to fight crime, crime rates, already discussed in Section 3, also have increased at great level.

From our analysis in this section, we conclude that the stagnated investment in resources for the police and prosecutors was significantly detrimental to tackling the rising crime levels since the Asian financial crisis in 1997-1998.

One additional issue regarding police forces is whether felonies increase due to the reporting bias effect, which might drive from the growing size of police forces. As mentioned in the previous section, one of the strongest arguments for attributing the

<sup>13</sup> We do not rule out the possibilities that the decline in the assistant workforce per prosecutor is the consequence of office computerization and increased efficiencies, reducing the number of administrative employees

increase in crime statistics to reporting effect, instead of the rise in actual crime, was that the hiring of more police pushed the reporting rates upward. To back up this claim, there should be a greater increase in police growth rate after 1997, which is not the case when we consider the stagnant level of police.

## 2. Sentencing

The sentencing in criminal trials is determined by the seriousness of the crime, the penal laws in question, and the way a judge interprets and applies the laws to the case at hand. Among the factors that influence sentencing, the penal law on heinous crime has shown almost no changes since the establishment of the criminal law in 1953. There was a small amendment to the criminal law in 1995. It was intended to change the unit of fine from “hwan” from “won” but the actual sentence has not been changed. Therefore, when the severity of punishment changes, it must be mainly explained by the sentencing practices of the court.

We can examine shifts in the sentenced length in-between the financial crisis and now by computing the average length sentenced for each crime. We denote  $AS_t$  as the average length of a sentence at the first trial for heinous crime in year  $t$ .

$$AS_t = \frac{\sum_{i=1}^{N_t} \delta_{it}}{N_t} \quad \text{--- (2)}$$

$N_t$  : The number of defendants at the first trial at year  $t$

$\delta_{it}$  : The length of sentence for defendant  $i$

However, there are a few obstacles to be addressed before calculating the average sentencing and tracing a pattern. First, due to a difference regarding crime categories in two primary sources for our dataset, we were unable to use Formula 2. The information on the sentenced length for a defendant was included in the “*Yearbook of Judicature*”. This book provided statistics according to the name of an offense in the criminal law, categorizing “homicide,” “theft and robbery,” “rape and harassment,” and “arson and accidental fire”, unlike the “*Criminal Analysis*”, published by the Supreme Public Prosecutor’s Office, which lists crime statistics by each name of an offense, such as “homicide”, “robbery”, “rape”, and “arson”.<sup>14</sup>

To solve this problem, we defined semi-heinous crime, as a proxy for felonies, which followed the category of crime in “*Yearbook of Judicature*”. By defining “homicide,” “rape and harassment,” and “arson and accidental fire” as semi-heinous crimes, we were able to analyze how the decisions of the courts changed the length of sentencing. Compared to heinous crimes, semi-heinous crimes exclude robbery, but include accidental fire and adultery. We exclude “theft and robbery” because the size of theft is substantially large that the number was greater than the total for all categories of heinous crimes. Since theft is not normally listed as a heinous crime, if we were to include it in our analysis, the number of theft cases might mislead the real trend in sentencing regarding heinous crimes (Table 3-1).

<sup>14</sup> The Yearbook of Judicature published arson and accidental fire as a separate crime category, as well as robbery and theft until 2001. Rape and harassment has been classified as one single category even before 2001. Homicide has been also reported as single category.

In semi-heinous crime, "rape and harassment," and "arson and accidental fire" also contains name of offenses that are not in the scope of heinous crime. As the size of number included in our analysis is relatively small, and we conclude that it does not cause a serious distortion on our estimation. Therefore, we first estimate the average sentencing of heinous crime by quantifying the average length of semi-heinous crime, and determine factors that might give misleading patterns, drawn from definitional differences, in order to gauge the reliability of our estimation.

Second, we need to use weighting for computing average sentencing lengths. The data source in the *Yearbook of Judicature* provided categories of sentencing and the number of criminals sentenced with some range of length, not the actual length of each sentencing.

For example, data on penal servitude for a definite term was classified by "less than one year," "more than three years," "more than five years," and "more than then ten years." In other words, the information given in the book is how many criminals are imprisoned for a certain range of term. Therefore, it is required to give weights to each sentencing range in order to calculate the average length of sentence for semi-heinous crime.

$$AS_t = \frac{\sum_{j=1}^{N_t} \alpha_j d_{jt}}{N_t} \quad \text{-----} (3)$$

$d_{jt}$  : The number of defendants at each range of sentence

$\alpha_j$  : The average length of sentence or weight of each range of sentence

Third, punishment can take several forms: confinement to prison for definite terms or for life, capital punishment, monetary penalty, or suspended sentencing. It is difficult to quantify the court's decision and to calculate the average length of imprisonment. If the ratio of each sentence to all sorts of crime has been uniformly maintained, we can use Formula 2 to calculate the sentence length and to see the long-term pattern. Unfortunately, the ratio of each sentence to category of crimes has been changing for the past thirty years. In the late 1970's, forty percent of those convicted were sentenced either to capital punishment or imprisonment, while the number declined to twenty percent in the mid-2000's (Figure 4-6 (A)). In case of semi-heinous crime, since the quality of crime is comparably serious, the average prison sentence remained at a high level compared to other criminal cases, yet the ratio has shown a drop from approximately 60 percent in the late 1970's to nearly 40 percent in the mid-2000's (Figure -6 (B)).

To minimize misleading outcomes from the variety and the changing proportion of sentencing types, this paper estimates the average prison sentence by setting two rules.

We first compute the average period of sentence  $AS_t$  only for penal servitude for a definite term. Table 4-1 describes the range of prison sentence in the *Yearbook of Judicature*, with weight  $\alpha_j$  for each range section. Although the most of sentence range section states its minimum and maximum, it is not a good idea to set a median value for

$\alpha_j$  because the sentence range of “more than ten years” does not have a maximum value.

Therefore, as shown in Table 4-1, we weigh 15 years for “more than ten years” section, and review the possibility of overestimation and underestimation of the average sentence.

We use the Yearbook of Judicial Affairs from 2005 instead of the Yearbook of Judicature for the calculating of average sentence length for definite imprisonment. The Yearbook of Judicature does not publish the number of defendant in each sentence section from 2000 beyond. Fortunately, the Yearbook of Judicial Affairs reports the number of defendants by sentencing range since 2005, in a same way as the Yearbook of Judicature did until 2000.

In addition, we estimate a new average that also covers non-numeric sentencing such as imprisonment for life, monetary penalty, and suspended sentencing. We set monetary penalty and suspended sentencing as zero, and imprisonment for life as 30 years for the

value of  $\alpha_j$ . This paper will also check the appropriateness of weighting values in many ways in the later section.

Fourth, we needed an assumption regarding the quality of crimes for the period of our analysis in order to evaluate the severity of sentencing. It is impossible to conclude that the courts favored weaker sentencing than from previous years merely because the average value had decreased. For instance, even if it falls into the same category of homicide, there might be more homicides cases which offenders twenty years ago have committed murder, chopped the body into pieces, and threw it into river than recent years. Neither can we claim harsh sentencing is more favored by the court based on increasing length of average sentence, because there are possibilities that offenders today might murder victims with greater cruelty. Therefore, without any information on the quality of crime, changes in the average of prison sentence would not play as an evidence to assess the courts' decision.

In our analysis, we assume that the quality of crime after the financial crisis has become more serious compared to that of the pre-financial crisis time. Our assumption coincides with the general public perception that the push factors of crimes have increased due to deteriorated socio-economic conditions and the growing violence in the

society. We formulate an inequality as below, setting  $QC_t$  as the average quality of crime.

$$QC_{before1997} < QC_{after1997} \quad \text{-----} \quad (4)$$

Presuming that the level of punishment intensity is the same, the average length of imprisonment must increase corresponding to the deteriorating trend of the seriousness of crime. Furthermore, if the Korean government is aware of the substitute relationship

between the number of police and the severity of sentencing, it must increase the prison sentence length in order to cope with the effect of the non-increasing number of police during the post-financial crisis.

Therefore, we make a null hypothesis whether the sentencing policy responds coherently to socioeconomic transformation or policing policies. Our null hypothesis is that average sentence before 1997 is longer than the average after 1997. If the measured length of sentencing before 1997 is greater than after 1997, it is impossible to reject the null hypothesis. This implies that not only the decision by the court on sentencing period has not become stricter. Instead, the decreasing intensity of punishment underestimates the actual length of the decline given that the quality of crime has become more serious.

$$AS_{before1997} \geq AS_{after1997} \quad \text{-----} \quad (5)$$

Combining all four factors, the outcome of our estimation on the prison sentence is shown in Figure 4-7. Figure 4-7 shows us that the average length of prison sentence during the post-financial crisis increases roughly one year longer than the pre-financial crisis. This might lead us to reject the null hypothesis that the sentencing becomes more severe.

However, our analysis on the genesis of the decline supports the null hypothesis and concludes that the average term of sentencing after 1997 shortened compared to the previous period. The rise in sentencing length stems from two factors: the decline in the proportion of defendant sentenced to "less than 3 years" in prison and the increase in the proportion of "5 to 10 years", and "more than 10 years" (Figure 4-8). The drop in the proportion of defendant sentenced to "less than 3 years" in prison is accompanied by the rise in the proportion of monetary penalty and suspended sentencing and the decrease in the proportion of defendants sentenced for imprisonment. In other words, the violation of criminal laws mostly sentenced to less than three years in prison is now likely to be sentenced by court to monetary penalty or suspended sentencing.

The enlarged size of people sentenced to "more than 10 years" must be interpreted to be the sign of less severe sentencing when we take account of the number of defendants with life-time sentencing and death penalty. Figure 4-9 demonstrates that the number of people with life-time sentencing and death penalty has been decreasing or stagnant. Furthermore, capital punishment is considered to be de facto life sentence as it has not been implemented since 1998.<sup>15</sup> Therefore, the increase in defendants sentenced to 'more than 10 years' can be interpreted that less severe term are sentenced to the people, who must have sentenced to life or to death penalty in the past. Suggesting another evidence of the weakened sentencing practices, we can not again reject the null hypothesis.

After considering all these factors, we reach a conclusion that the probability of receiving a suspended sentence or monetary penalty increases in the less severe crimes whereas the probability of being sentenced to death penalty or to imprisonment for life decreases compared to the pre-financial crisis period. Simply put, the real severity of sentencing has not become greater. Figure 4-6 which shows the average sentencing proves our reasoning. The average sentencing, including imprisonment, monetary penalty, suspended sentencing, life-time imprisonment, and death penalty, does not differ much

<sup>15</sup> The total number of people executed is 902 (19 people per year) from 1948 to 1998. From 1989 to 1998, the execution had shown a decline. There has been no execution beyond 1998.



when we compare the pre- and post-financial crisis time.<sup>16</sup> In conclusion, the outcome implies that we cannot reject the null hypothesis (Formula 5), and that the ruling of the courts changed in a way to water down the effect of criminal deterrence, considering the average seriousness of crime has worsened and the number of crime cases has increased.

### 3. Correction

The primary role of the correctional system is to execute the court's decision of sentence to the criminal, ultimately guide and educate criminals, and rehabilitate and reintegrate them as healthy members of a society.<sup>17</sup> The correction of criminals is mainly classified into two parts: correction in official facilities, such as prisons; namely, incarceration, and social correctional treatment. Social correctional treatments include probation and parole, social welfare service command, and so on. Among these forms of social corrections, the probation and parole system is the most relevant system for preventing repeat offenses. Probation refers to a sentence which may be imposed by a court in lieu of incarceration. An offender on probation is ordered to follow certain conditions set forth by the court, under the supervision of a probation officer for the purpose of rehabilitation.<sup>18</sup> Traditionally, correction programs have focused on incarceration, but the emphasis on social correctional treatment programs, which supervise and guide suspended offenders and the released in society, is increasing in recent years.<sup>19</sup>

Correctional facilities and probation systems are in need of human resources and physical investment for their activities. Trends of resource inputs in the correctional activities are as follows. The number of prisoners per prison officer decreased from 7 in the early 1980's to 3 in the mid-2000's (Figure 4-10 (A)). The real expenditure per prisoner quadrupled from 1981 through 2007.

As shown in Figure 4-10, resource input in prisoners has been increasing since the 1980's. But the increasing trend in the pre- and post-financial crisis can be explained by different reasons. During the pre-financial crisis, while both prison population and expenditures (factor inputs) increased, spending in prison has grown faster than the prison population, ultimately increasing expenditures per prison population. During the post-financial crisis, however, the resource input per prisoner precipitated because the prison population decreased whereas the expenditures either increased or at least maintained their previous level (Figure 4-10 (B), (C), (D)).

The probation system was first introduced for juvenile delinquency in 1989, and later extended to all ages. This implies that the government's effort to prevent repeated crimes has shown improvements in quality in between financial crisis and the present. The number of probationers per probation officer sharply increased since 1997, when adult offenders also became eligible for probation. But the number has shown a steady downturn at 150 people per probation officer because probation officers have increased (Figure 4-11). In sum, the size of government workforce in incarceration and probation proves that the government raised its labor inputs since the financial crisis.

<sup>16</sup> Even if we give higher weight to death penalty than imprisonment for life, there is no chance that the declining trends in death penalty render Figure 4-7 invalid. Same reasoning applies to the likelihood when the weight given to imprisonment for life is overestimated.

<sup>17</sup> The Law on Sentencing and Treatment for Prison Inmates, Article 1.

<sup>18</sup> Hyunamsa, (2007), p.1088

<sup>19</sup> The Criminal Law, Article 59-2, 62-2, 73-2, The Juveniles Law, Article 32, The Law on Probation and Parole, Article 3.

However, it is difficult to conclude that the increased level of resources in correctional programs have been effective in preventing released prisoner from committing future crimes. The proportion of repeat offenders among felony criminals has increased. In the early 1980's, the number of first time offenders, who committed felonies, was about 9,000, occupying about 70 to 80 percent of all felony criminals. Yet, the number of first offenders decreased to 4,000 in 2005, whereas the size of offenders convicted of more than a third crime was pushed to more than 6,000 by 2007, demonstrating the biggest share. (Figure 4-12).

Although we are cautious to claim that the failed investment in correctional policy programs increased the number of heinous crimes committed by the repeat offenders, the growth in repeat offenders implies that invested resources in correctional programs needs greater effective allocations. More in-depth discussions and empirical analysis on how effective correctional facilities and probation system are used in preventing repeat offenses must be followed to examine this issue. The correctional system needs coordinated action with sentencing by the courts. And once the probation and parole system turns out to be ineffective in correctional education for certain crimes, it is desirable that offenders with those crimes be incarcerated on a more long-term basis.

## V. Conclusion

The Korean economy successfully overcame the macroeconomic downturns driven from the Asian financial crisis in a very short period of time. The economic shock, however, generated a variety of social problems, one of which was the increase in felonies, or degradation of public safety. This paper examined the possibility that the Korean government has not implemented criminal policies in the best manner to solve this problem, assuming that the financial crisis generated socio-economic changes more favorable for criminality. In other words, we reviewed whether or not the government changed its policy priorities to address the extremely vulnerable social conditions to criminality, stemming from the economic recession. We also examined whether the government organizations failed to respond respectively or to make coordinated actions, eventually causing a dramatic increase in crimes which was more than uncontrollable.

In this paper, we examined criminal deterrence policies - policing, prosecution, sentencing, and correction system - by checking resource inputs and policy effects. We concluded that the government's policy measures were far more inappropriate to cope with the socio-economic transformations during the post-financial crisis. Human and physical resource inputs into the police have virtually stopped, as have similar resources for the improving of investigative capabilities for prosecutors. Therefore, arrest and prosecution rates have dropped since 1997. With respect to sentencing, the Korean judicial system has not increased the severity of punishment. Given the degrading in the quality of crime and the decreasing amount of inputs into the policing and prosecution, the government should have increased the severity of punishment to deter crime. Lastly, felonies increased due to the rise in the number of repeat offenders with more than a third offense though resource inputs in correctional system have shown a huge growth for imprisonment and probation. In sum, the insufficient efforts in respective policies and the coordination failure of these criminal policies have given substantial impact on doubling felonies since the economic downturn.

This research brings explicit policy implications. In order to prevent possible additional degradation of public safety, stemming from the socioeconomic transformation after the financial crisis and the current global economic woes, the government must put more efforts into increasing the effectiveness of policy and to investing more resources into said policies. To achieve this goal, it is necessary to review the policy priorities of the

government at the root. Furthermore, extensive empirical research on the effect of resources available should be carried out so as to systemically support the improvement of policy effectiveness. Lastly, this paper emphasizes cooperation and the institutional mechanisms that foster policy coordination among the Police, the Prosecutor's Office, the Ministry of Justice, and other relating government organizations.

## References

- The National Police Agency, The Whitepaper of Police,  
The National Police Agency, Statistical Yearbook of Police, Each year  
The Supreme Public Prosecutor's Office, Criminal Analysis , Each year  
Ministry of Justice, Yearbook of Judicature,  
Ministry of Justice, Yearbook of Judicial Affairs
- Choi, Insup, Analysis on Crime Trends in Korea, Korean Institute of Criminology Research Series , 2003  
\_\_\_\_\_, Comparative Analysis on Violent Crime Trends, Korean Institute of Criminology Research Series 04-23, 2004  
Hyunamsa, Legal Dictionary, 2007  
Kim, Jisun, Lee Chunhyun et al., The Korean Criminal Policy and Crime Trends, Korean Institute of Criminology Research series 07-01, 2007  
Park, Chulhyun, "Age-crime curve in Korea", Korean Journal of Demography 24, 2001  
\_\_\_\_\_, Development of crime career and rationality, 2006.  
Roh, Horae, "Correlation between police and crime prevention", Korea Public Security Journal Issue 25, 2006  
Becker, Gary, "Crime and Punishment: An Economic Approach", Journal of Political Economy 169 (March/April 1968), pp.169-217.  
Cooter, Robert, and Thomas Ulen, Law and Economics, 5th ed., (Boston: Pearson Education, Inc., 2008)  
UNDP, Human Development Report 2007/2008

Table 2-1. Theoretical framework of criminal deterrence policy

## (A) Policy measures and goals of criminal deterrence

Policy Measures	Policy Instruments	Intermediate Variables	Policy Goal
Policing	Police Forces and Expenditure	Arrest Rates	Control the number of crime and crime rate
	Prosecutor Workforce and Expenditure		
Sentencing	Prosecutor's demanded sentence		
	Sentence by the courts		
Correction	Workforce in Correctional Activities	Repeat Offense Rates	
	Expenditure in Correctional Activities		

## (B) Government organizations in charge of policy instruments

		Government Organizations			
		The Police	The Prosecution	The Court	The Ministry of Justice
Criminal Deterrence Policy	Policing	○			
	Apprehension	○	○		
	Sentencing		○	○	
	Correction				○

Table 3-1. The number of crimes and trial cases in 2007

Crime Occurrence and Treatment ( <i>Criminal Analysis</i> )				The first criminal trial ( <i>Yearbook of Judicature</i> )	
Name of Offense	Reported case	The Prosecuted	Cases in Trial	Name of Offense	Received case
Criminal Offense	845,311	269,521	63,695	Criminal Offense	110,388
Homicide	1,124	674	674	Homicide	762
Robbery	4,470	1,394	1,397	Robbery and	14,044
Theft	212,530	22,353	10,736	Theft	
Arson	1,694	402	392	Arson and	803
Accidental Fire	1,908	405	27	Accidental Fire	
Rape	13,634	4,052	2,017	Rape and	2,153
Adultery	613	41	36	Adultery	
Others	609,338	240,197	48,416	Others	92,626
Special Law Offense	1,120,666	772,952	53,134	Special Law Offense	139,784
Total	1,965,977	1,042,473	116,829	Total	250,172
Heinous Crime	20,922	6,525	4,480		
Semi-Heinous Crime	18,973	5,574	3,146	Semi-Heinous Crime	3,718

Notes: Heinous crime includes homicide, robbery, arson, and rape. Semi-heinous crime includes homicide, robbery and theft, arson and accidental fire, rape and adultery. Refer to section 4 (2) for the discussion on crime definition.

Source: *Criminal Analysis* 2008, pp.50-55, 343-345,  
*Yearbook of Judicature* 2008, pp.864-873.

Table 3-2. Proportion of felonies and growth rate

	1977	1987	1997	2007	1977-2007
Number of crimes					
Heinous Crime	5229	9135	11914	20964	
Homicide	516	631	815	1094	
Robbery	1204	3023	4425	4577	
Arson	330	558	885	1690	
Rape	3179	4923	5790	13604	
Proportion (%)					
Heinous Crime	100.0	100.0	100.0	100.0	
Homicide	9.9	6.9	6.8	5.2	
Robbery	23.0	33.1	37.1	21.8	
Arson	6.3	6.1	7.4	8.1	
Rape	60.8	53.9	48.6	64.9	
Average annual growth rate (%)					
Heinous Crime	6.2	2.9	6.5	5.2	
Homicide	3.4	2.4	3.9	3.2	
Robbery	12.1	6.4	1.5	6.7	
Arson	4.9	5.9	9.3	6.7	
Rape	5.0	2.0	9.6	5.5	

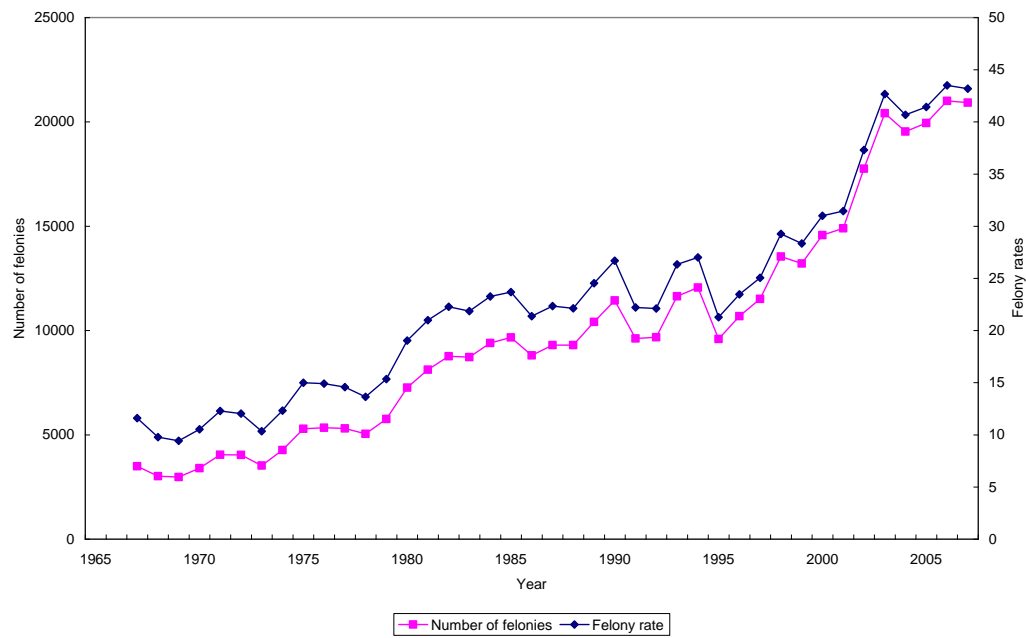
Notes: The number of cases is the three-year average before and after the year. The average for 2007 is the average of 2006 and 2007. The average annual growth is computed by first estimating a growth rate for a year, and computing the average of 10 years.

Source: *Criminal Analysis*

Table 4-1. Weight given to a sentence range for computation of the average prison sentence

	Suspended Sentencing	Fines	Imprisonment for definite terms					Imprisonment for life	Death Penalty
			Less than a year	1-3 years	3-5 years	5-10 years	More than 10 years		
Weight	0	0	0.5	1.5	4	7.5	15	30	30

Figure 3-1. The number of Felonies and felony rates, 1967-2007



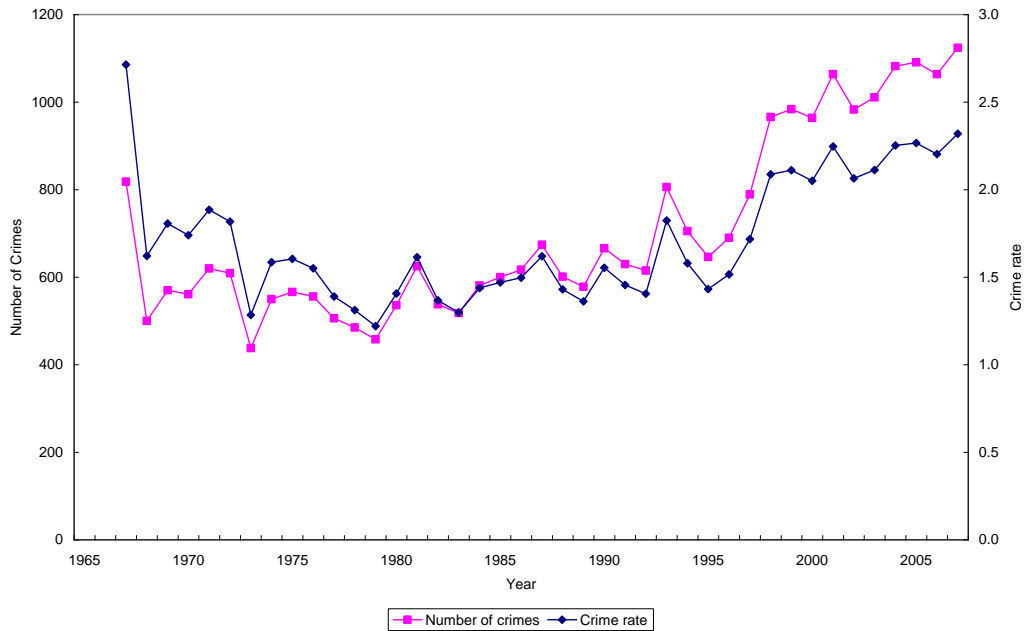
Notes: Crime rate is computed per 100,000 people.

Source: *Criminal Analysis, Korea Statistical Yearbook*

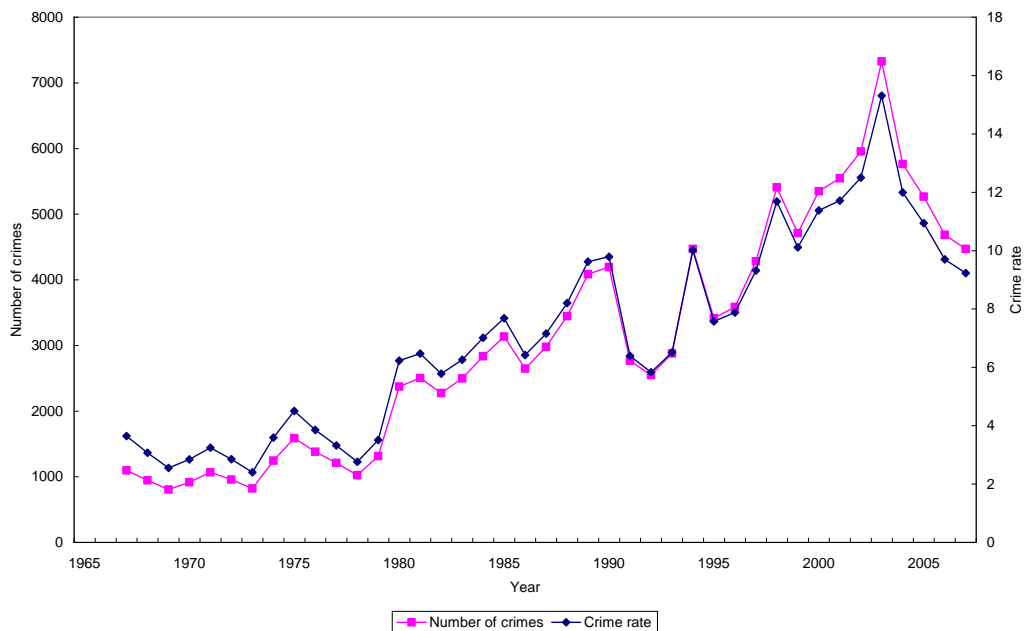


Figure 3-2. The number of heinous crimes and crime rate by category, 1967-2007

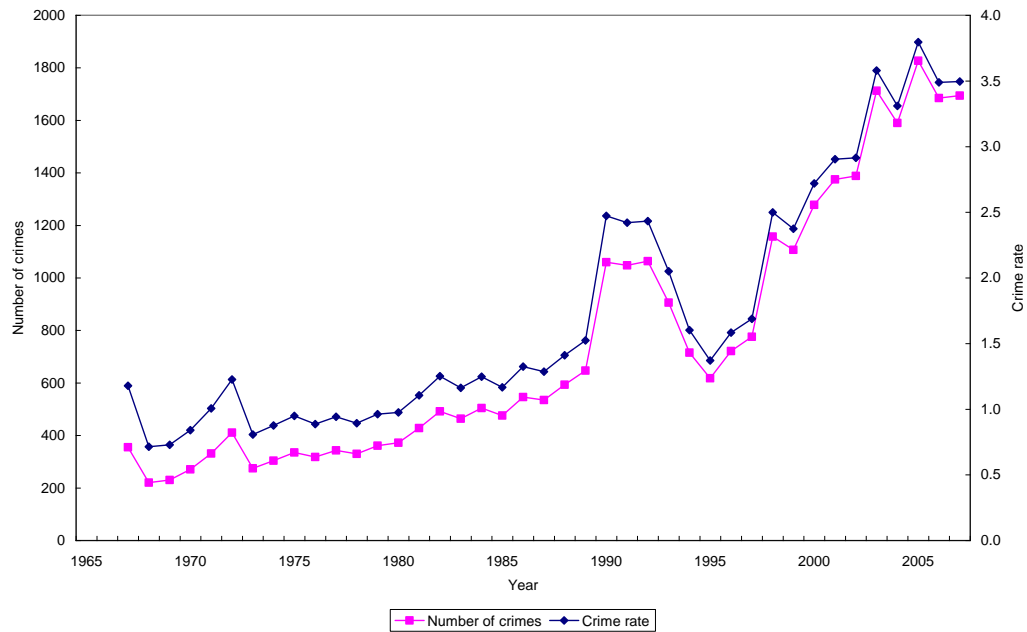
## (A) Homicides



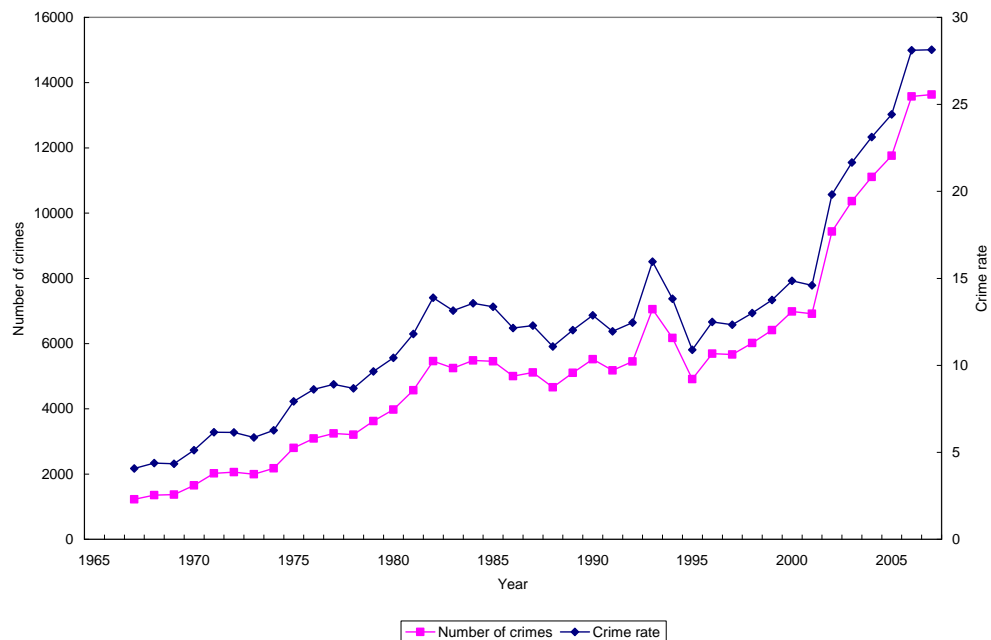
## (B) Robbery



## (C) Arson



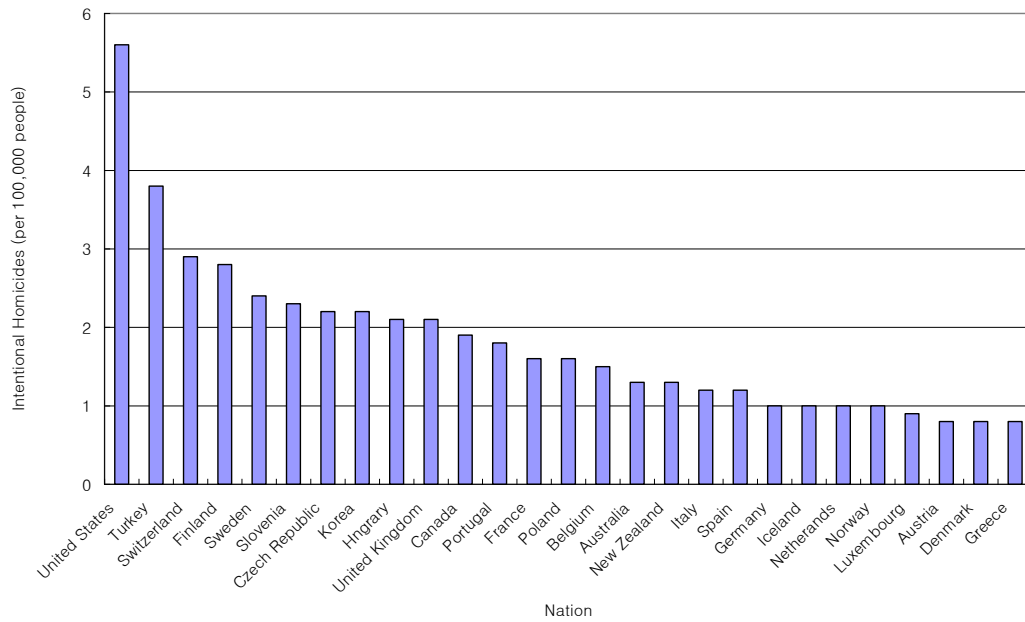
## (D) Rape



Notes: Crime rate is computed per 100,000 people

Source: Criminal Analysis, Korea Statistical Yearbook

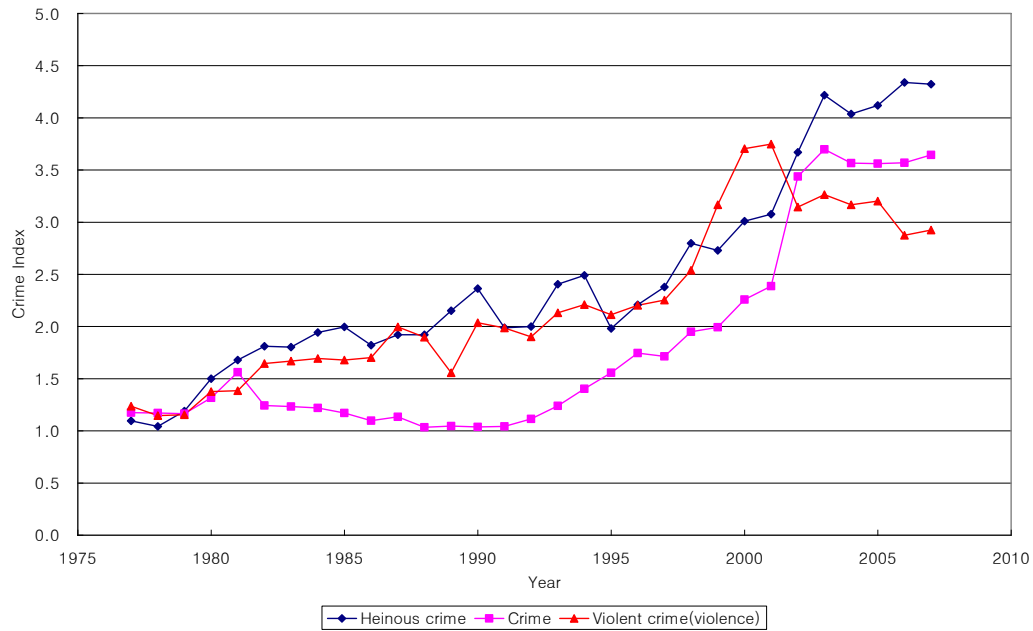
Figure 3-3.. Intentional crime rates of the OECD nations, 2000-2004



Notes: Crime rate is computed per 100,000 people. The homicide rates of Mexico marks 13 per 100,000 people, the highest among the OECD nations, but excluded in this figure. The average of homicide rates in the OECD countries is 2.16 (1.77 excluding Mexico), median is 1.6.

Source: UNDP, *Human Development Report 2007/2008*, pp. 322-325

Figure 3-4. Heinous crime, violent crime (violence), and all crimes, 1977-2007

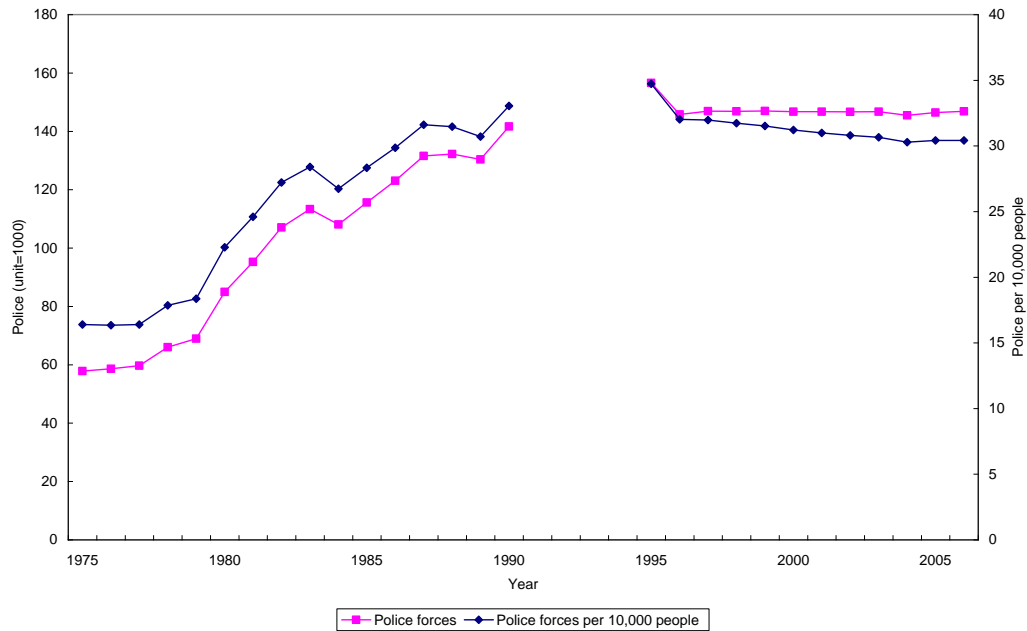


Notes: The average of crimes occurred in 1970 - 80s is indexed as 1.

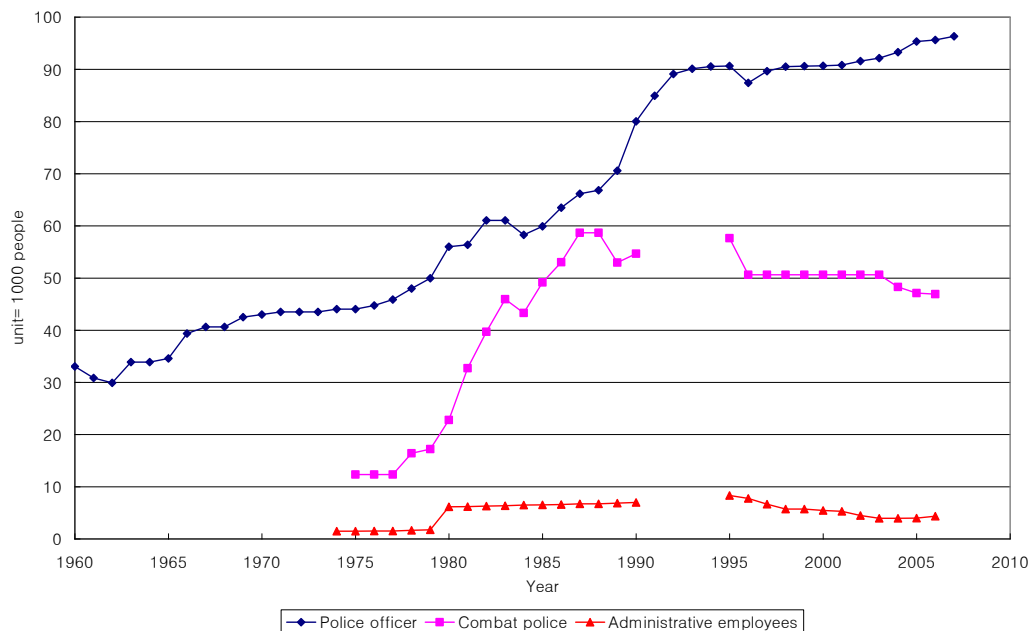
Source: *Criminal Analysis*

Figure 4-1. Trends in Police

## (A) Police, 1975-2006

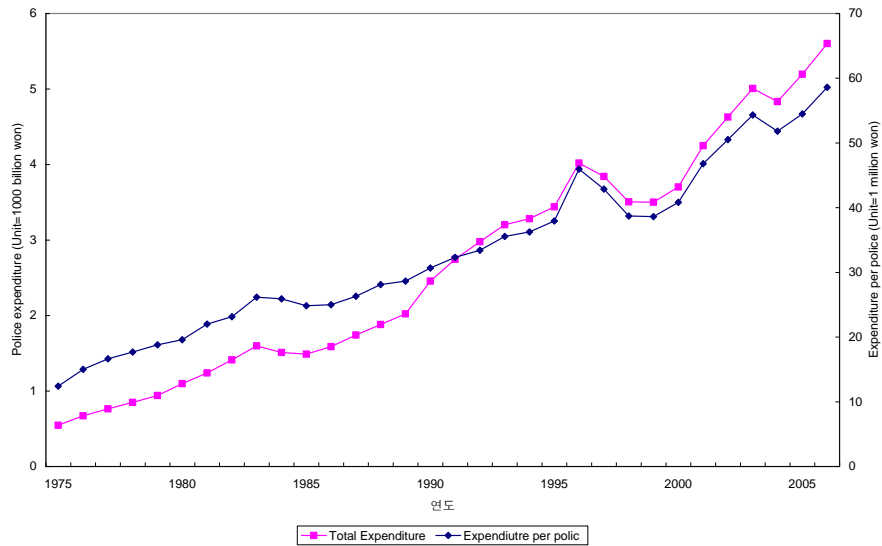


## (B) Police officers, combat police, administrative employees, 1960-2007



Source: The Whitepaper of police, Statistical Yearbook of Police, KOSIS

Figure 4-2. Trends in Police expenditure (real term, 2000=1)  
 (A) Police expenditure, 1975-2006



(B) Proportion of labor cost in police expenditure and expenditure on non-labor cost per police, 1982-2007



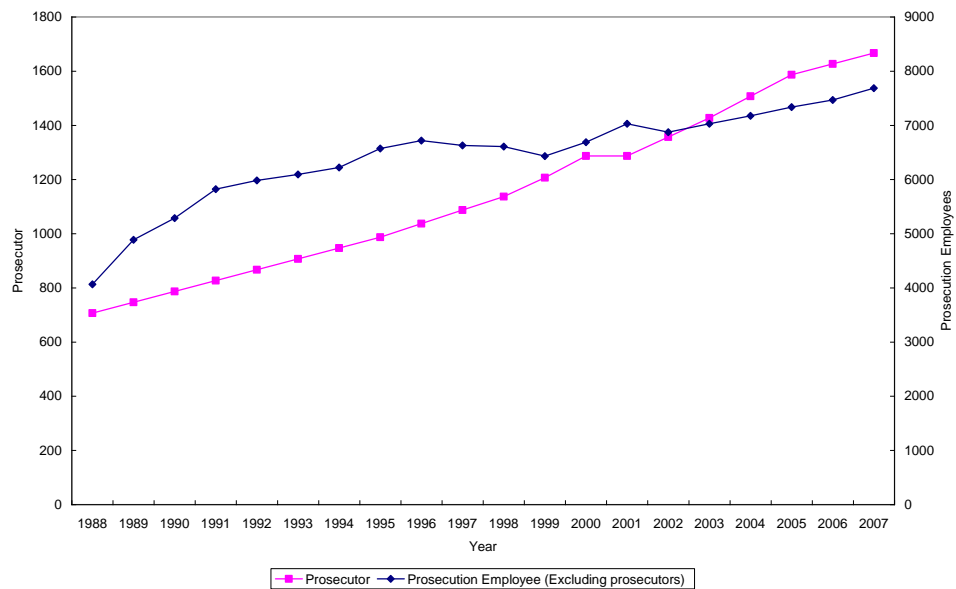
Notes: We divided total police expenditure by the number of police officers because there are many years that the number of total police employees is not available.

$$\text{Ratio of labor cost} = \frac{\text{Labor cost}}{\text{Total Police Expenditure}}$$

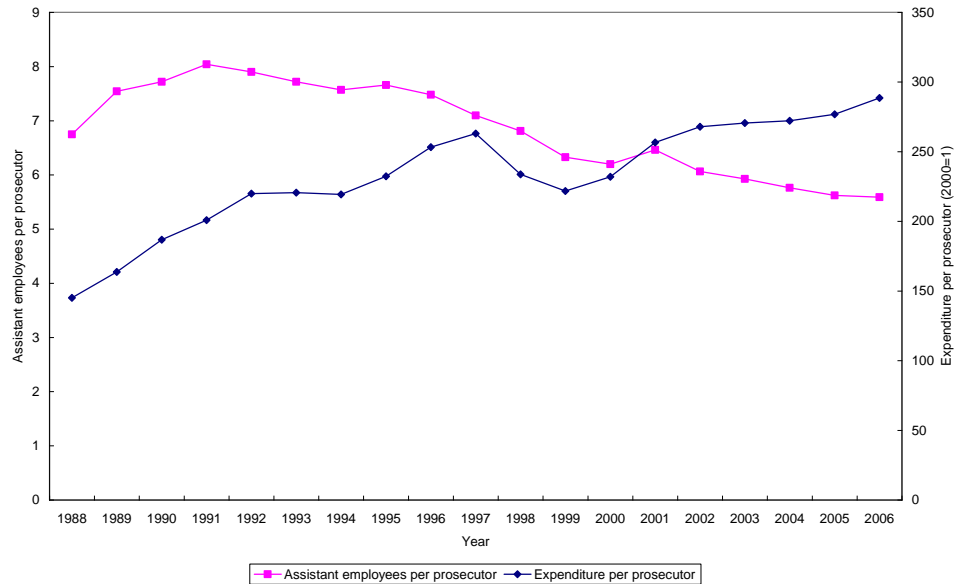
Source: The Whitepaper of police, Statistical Yearbook of Police

Figure 4-3. Trends in workforce in the Prosecution and expenditure

## (A) Workforce in the Prosecution



## (B) Assistant employees per prosecutor and real expenditure

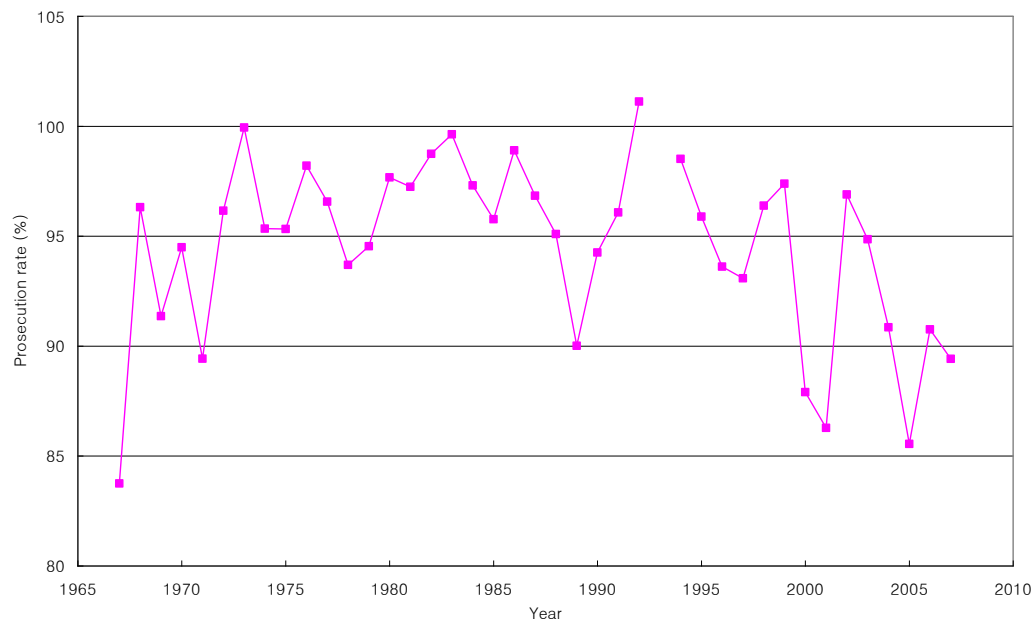


Note:

$$\text{Assistants per prosecutor} = \frac{\text{Total Prosecution employees} - \text{Prosecutors}}{\text{Prosecutors}}$$

Source: The Law on Prosecutors, Yearbook of Judicial Affairs

Figure 4-4. Arrest rate of offenders, 1967-2007



Note: 1977-1997 - the average: 97.1 %, median 96.6%,  
 1998-2007 - the average: 91.1 %, median 90.8%.

$$\text{Arrest Rates} = \frac{\text{Arrested cases}}{\text{Re ported cases}}$$

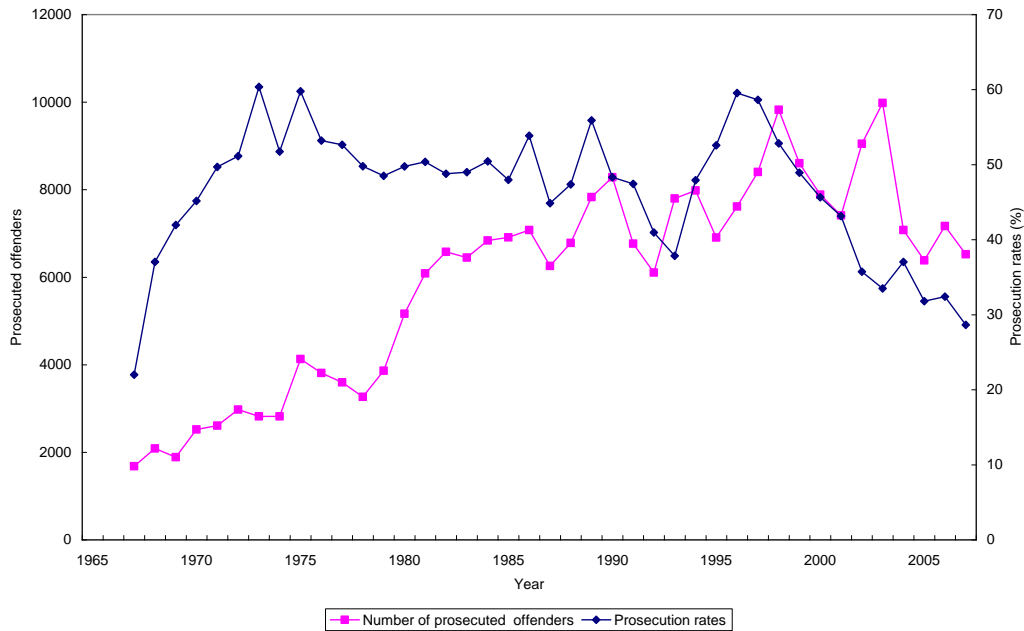
We excluded the arrest rate in 1993 because the number is 115%

Source: *Criminal Analysis*

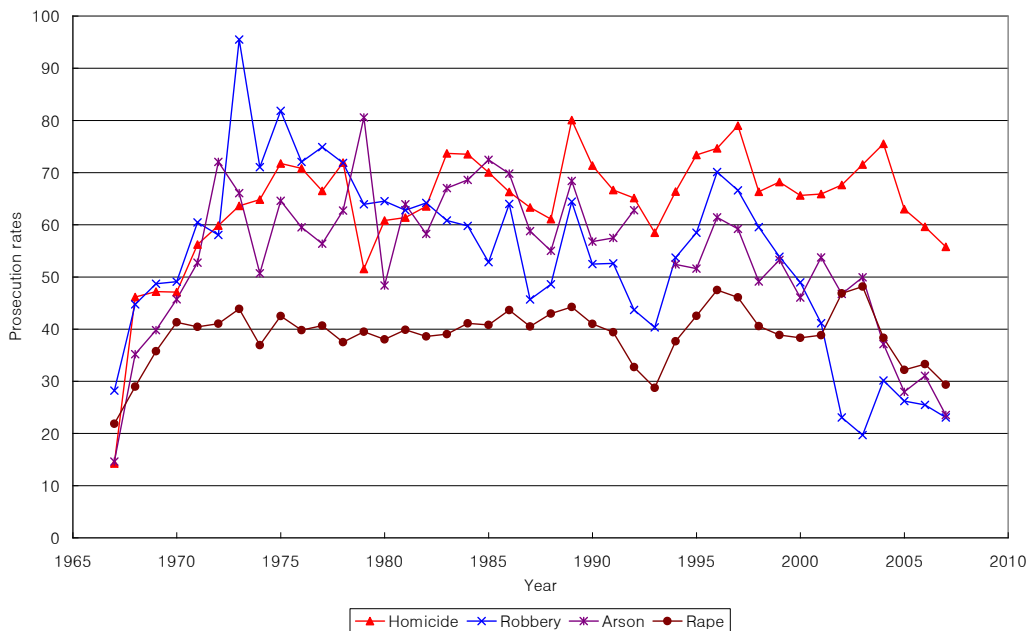


Figure 4-5. Prosecution rates and the number of people who are prosecuted, 1967-2007

## (A) All crimes



## (B) Prosecution rates by crime category

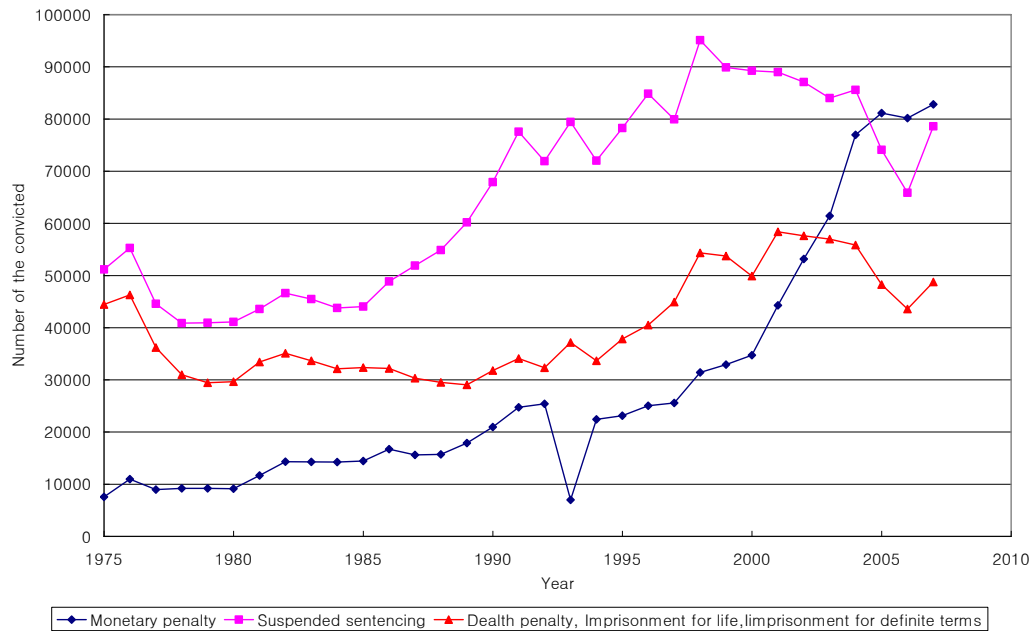


Notes: Prosecution rate = Number of prosecuted offenders / Number of arrested offenders

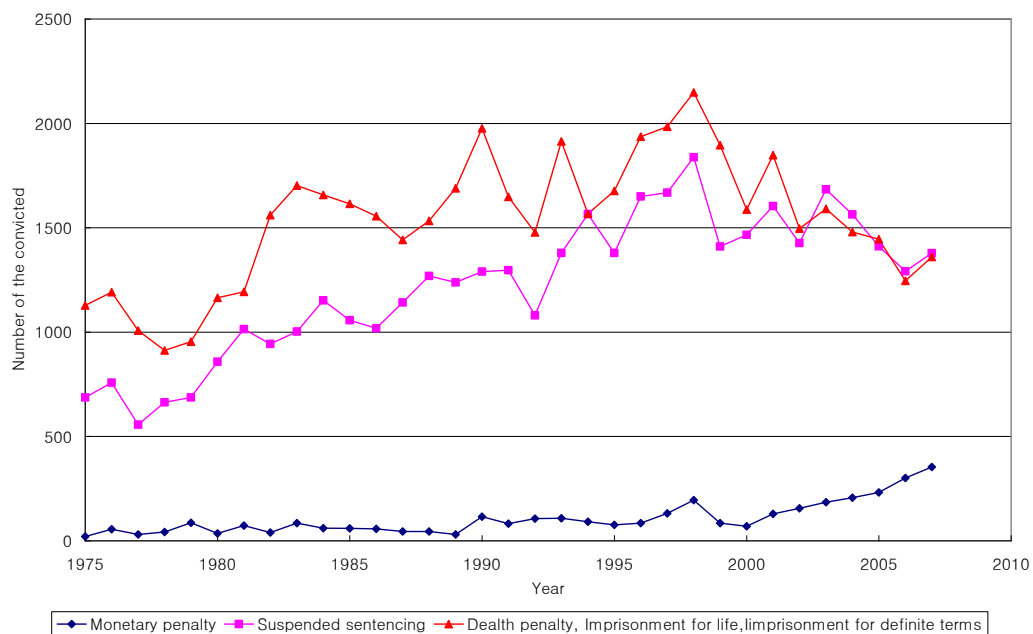
Source: *Criminal Analysis*

Figure 4-6. Sentencing: imprisonment, suspended sentencing, monetary penalty

## (A) Criminal offense

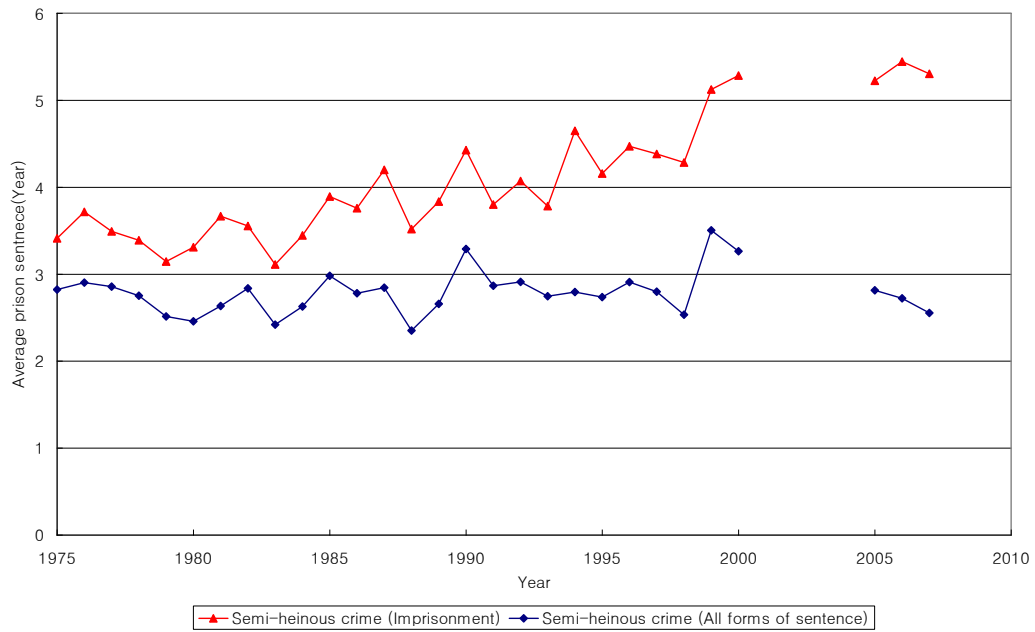


## (B) Semi-heinous crimes



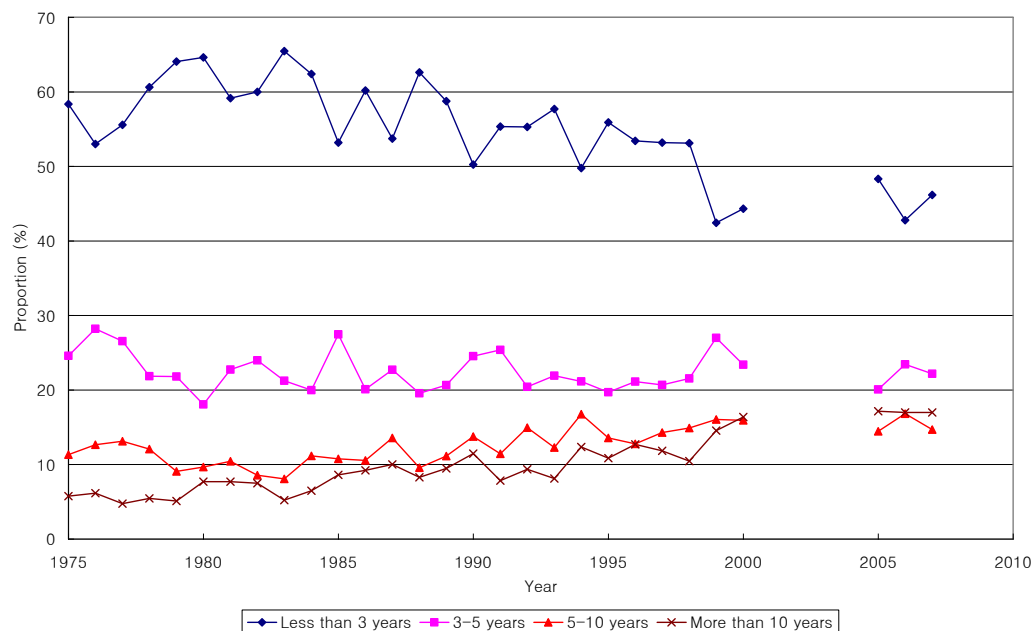
Source: Criminal Analysis

Figure 4-7. Sentencing of semi-heinous crimes



Source: Yearbook of Judicial Affairs, Yearbook of Judicature

Figure 4-8. Proportion of each sentence length at the first criminal trials

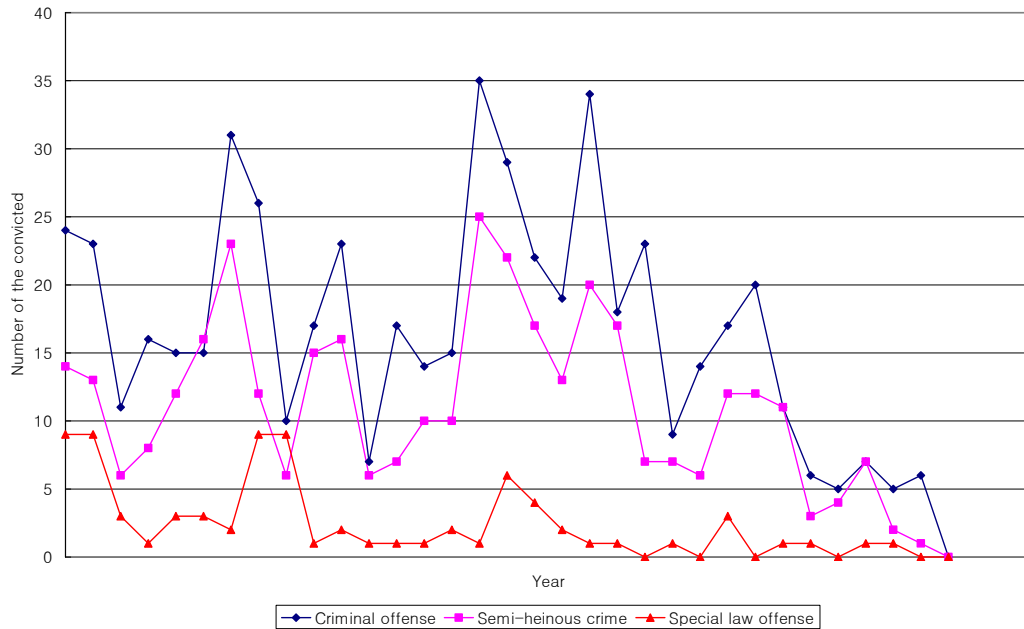


Notes: Number of cases sentenced to "Less than 3 years" is the sum of "Less than 1 year" and "Less than 3 years"

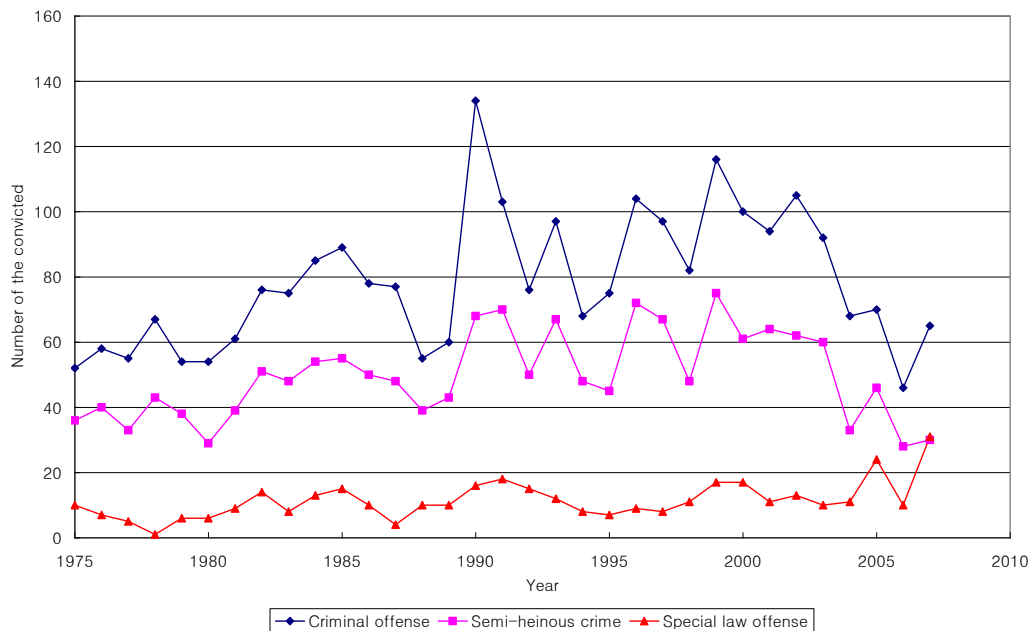
Source: *Yearbook of Judicature*

Figure 4-9. Number of cases sentenced to imprisonment for life and death penalty, 1975-2007

## (A) Death penalty



## (B) Imprisonment for life



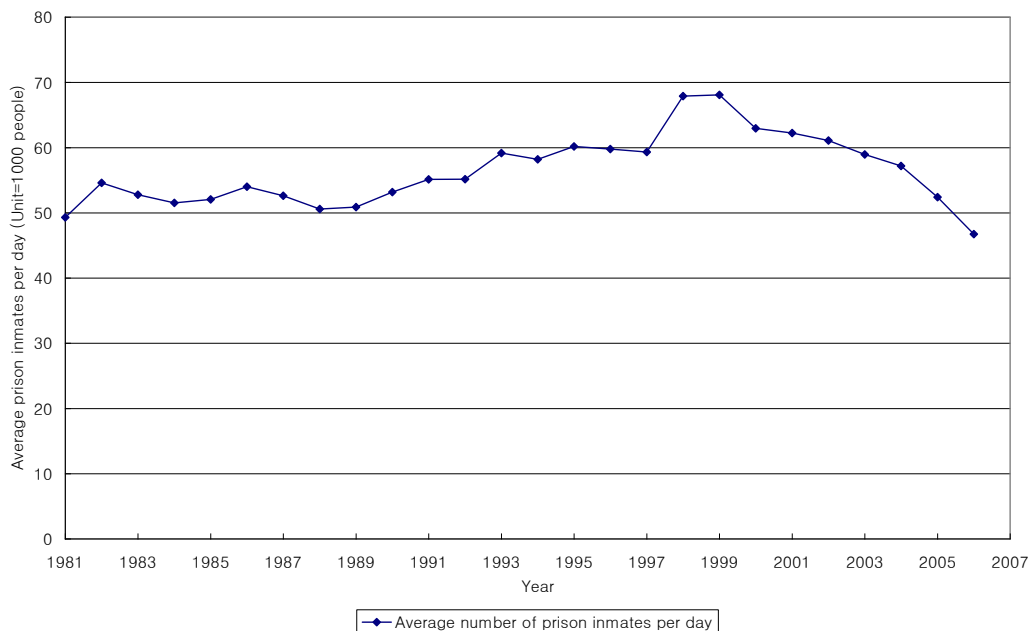
Source: Yearbook of Judicial Affairs, Yearbook of Judicature

Figure 4-10. The number of prisoners and resource input, 1981-2006

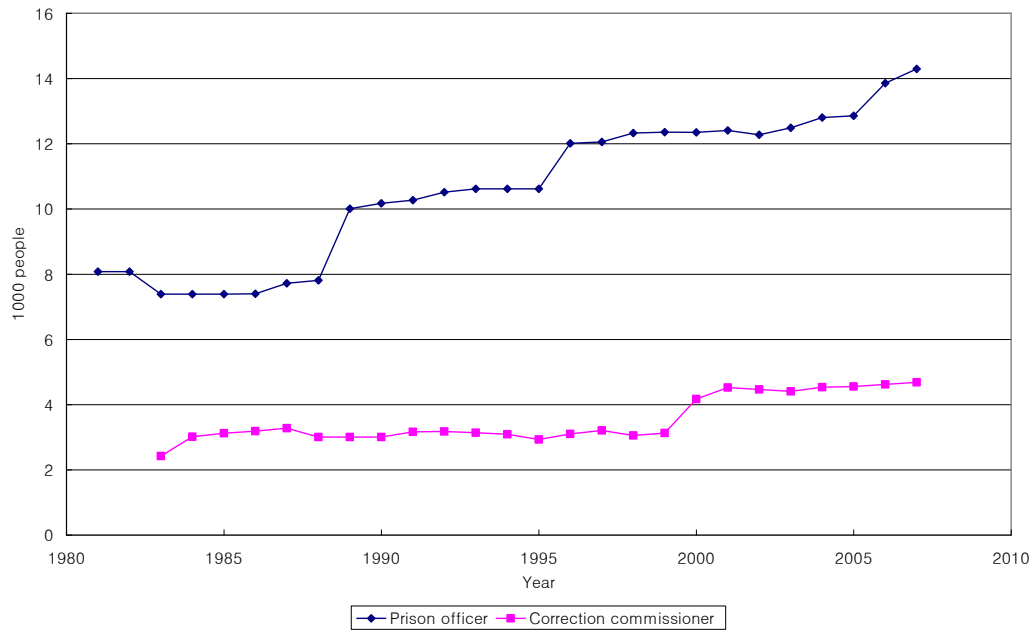
(A) The number of prisoners per prison officer and the real expenditure per prisoner



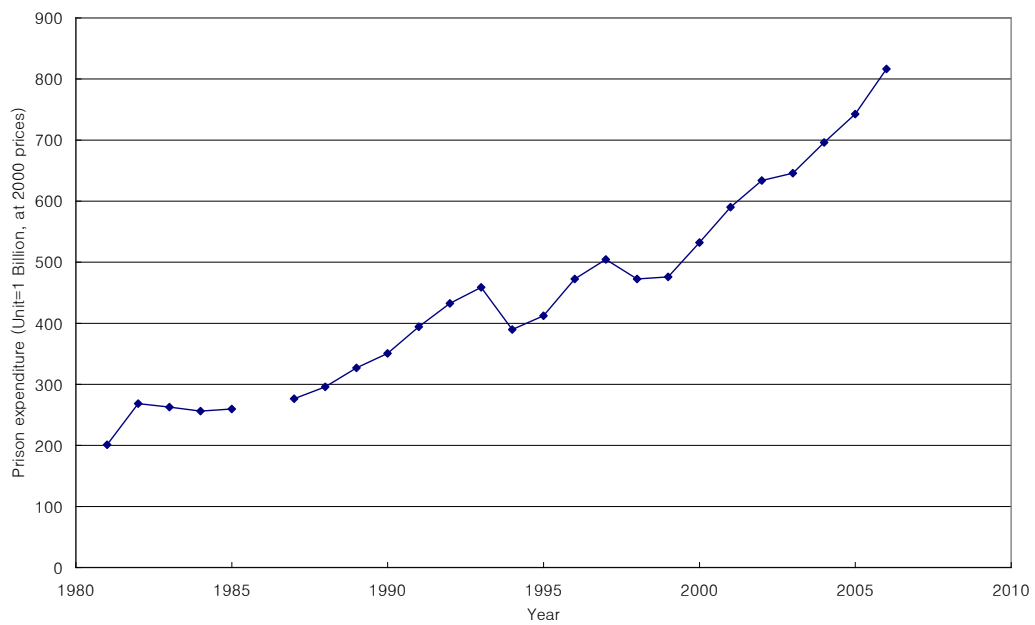
(B) Average number of prison inmates per day



## (C) The number of human resource



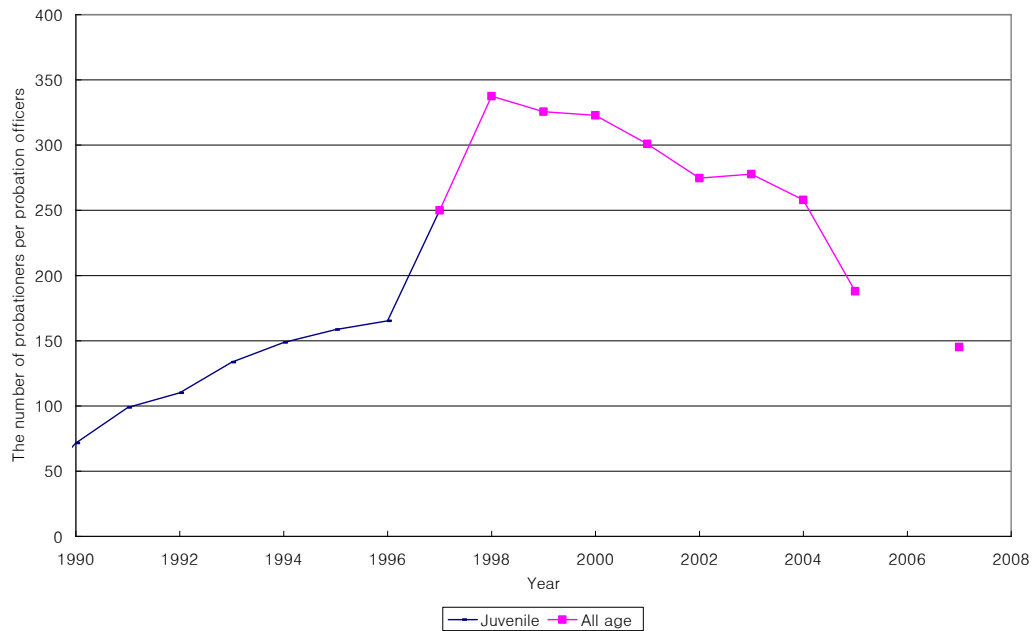
## (D) Prison expenditure (At 2000 prices)



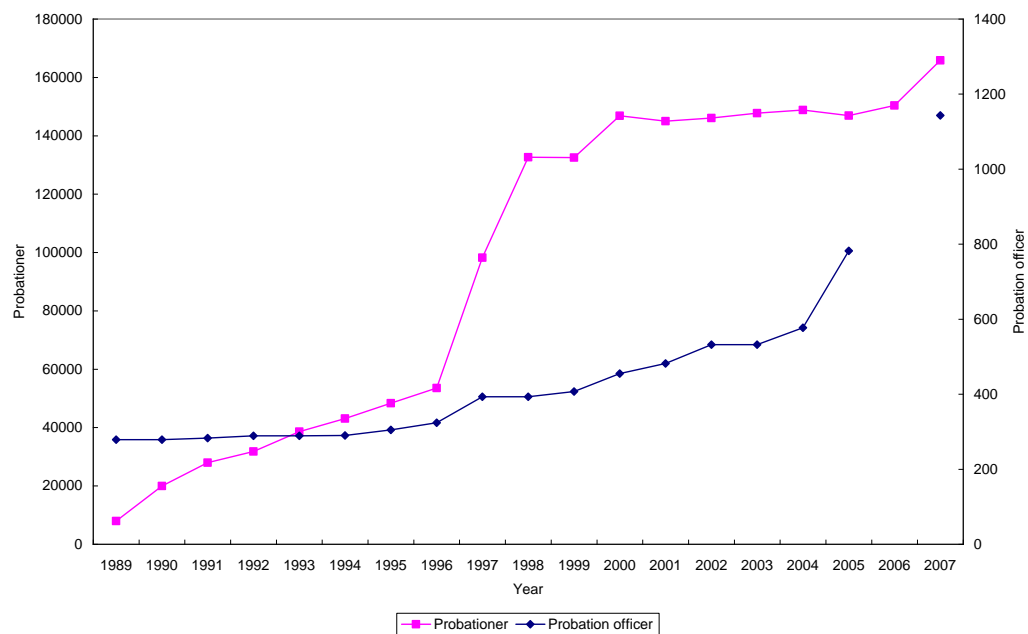
Source: Yearbook of Judicial Affairs

Figure 4-11. The number of probationers and resource input

## (A) The number of probationers per probation officers



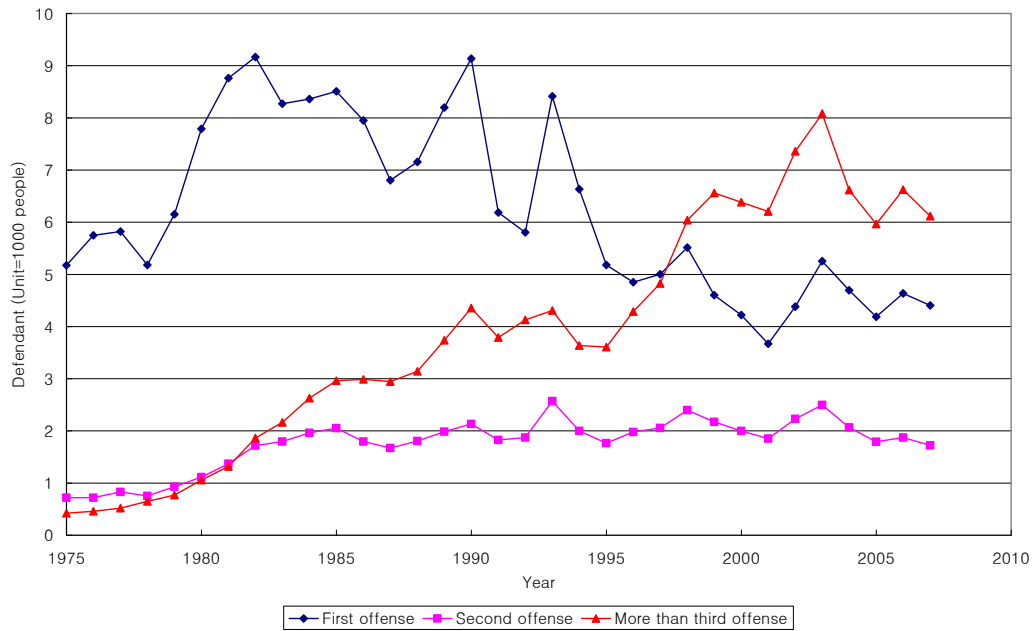
## (B) Government workforce in probation and probationers



Source: Yearbook of Judicial Affairs



Figure 4-12. Repeat offenders among felony criminals, 1975-2007



Source: *Criminal Analysis*

## Comments on "Growth of Felonies after the 1997 Financial Crisis in Korea"

John M. Kim  
Korea Institute of Public Finance

The paper's central finding is that serious crimes have been increasing rapidly as a consequence of the socioeconomic changes after the Asian financial crisis, but that government spending in this area has been quite inadequate to deal with the rising trend of crimes. The paper develops this thesis by considering crime-related statistics in various phases of a crime: occurrence, investigation and apprehension, prosecution, sentencing, correction and recurrence.

Through the use of creative and sometimes bold arguments, the authors manage to build up a persuasive case for themselves, which in itself is an impressive feat in this area, considering that the available data in Korea is of far more meager quality than what we are used to. Therefore my overall assessment of the paper is very positive. However, I do have some remarks that I hope the authors will reflect on and could hopefully incorporate into the paper.

First, a cursory look at the diagrams suggests that the long-term trend of crimes can be interpreted differently from the authors. Namely, instead of a trajectory which rises sharply after the financial crisis as the paper asserts, one can just as easily observe a steadily increasing long-term trend since the early 1970s throughout the entire period observed, with a temporary decline in the early to mid 1990s, in which case one might argue that the dramatic increase after the financial crisis is just things returning to normal. If we admit that as a plausible interpretation, that would mean that the focus of the investigation should be placed on the abnormally low 1990s instead of the post-financial-crisis years. I think the authors need to deal with this alternative interpretation before stressing that crimes have been accelerating after the financial crisis.

Next, I cannot help observing that the paper, despite the rather simple thesis and arguments employed in support of that thesis, is quite difficult to read.

In large part I think this is because the authors employ arguments and methodology that are somewhat different from what economists are used to. In some sense, the evidence and arguments are not as rigorous as those found in the usual economics paper, which will probably leave most readers vaguely uncomfortable. For instance, usually one expects to see evidence derived from micro data or at least from two- or three-way tabulations of aggregated variables to make the sort of arguments that we see in this paper. Instead the paper relies mainly on one-way analyses of a single variable in time series. In such cases, it is almost impossible to derive the kind of conclusive, airtight results that economists usually look for. Instead, at best one derives a very persuasive result. Considering the kind of data on crime that is available for research in Korea, I think the use of the latter approach by the authors is entirely appropriate and it is to the authors' credit that they have been able to tease out as much evidence as they have through this approach. Probably this is where the principal author's training as a cliometrician shows – the approach used in this paper is to accumulate a chain of persuasive arguments to convince the reader, rather than build a case from airtight, conclusive results rigorously derived from rich data.

But, there are also other factors that make this a difficult paper to read, and here I think the authors would do well to try to improve things.

First, concerning terminology, there are expressions that are non-idiomatic or those that demand clear and explicit definitions. Crime stories are very popular and therefore crime-related terminology is very much a part of everyday English – non-idiomatic expressions therefore make the narration that much more difficult to follow, and I hope the authors will avail themselves of the services of a good editor. There are also some terms that appear to be used by the authors in a specific, precisely defined sense in the paper – such as felonies, heinous crimes, semi-heinous crimes, etc. – but I feel that the authors need to: a) provide very clear, explicit definitions at the outset, including how this differs from general usage; and b) make it very clear in the text when these same terms are being used in their general, rather than specially defined, sense.

Second, there are a few instances where the authors over-state their case, in statements such as “... this proves ...” or “... shows that ...” or the like. Quite often the evidence provided in the paper is not strong enough to warrant such a definitive conclusion from the authors, and I kept finding myself objecting to, rather than agreeing with, the authors’ assertions as I read the paper. In such cases, expressions such as “this strongly suggests” or “the evidence implies” would have sufficed without detracting from the arguments that the authors wished to advance, which are usually of a persuasive nature rather than conclusive, as I explained above. I understand that the same statement in Korean would probably not provoke the same kind of objection from the reader – again, this seems to be a problem that a good editor can help with.

Third, it would help a lot if the authors first try to outline what they intend to do and what problems they will be dealing with at the head of each section or major division in the text. There are some stretches where the paper simply jumps into one argument or explication after another without informing the reader how the discussion at hand is relevant. This can make it very difficult for the reader to keep track of the thread of narration.

Fourth, there are a couple of places where the authors promise to investigate how different assumptions would affect the result, such as what kind of weights are assigned to fines or life sentences, etc. I may have missed them, but I haven’t been able to find where the results of the promised sensitivity analyses were shown.

To recapitulate, the paper by Kim and Kim is a very interesting attempt to assess government policy against crime in the last decade. I might add that it is also a very bold attempt, especially in view of the sweeping conclusions it tries to draw from the available data, which are of meager quality. My overall assessment is very positive, but with some caveats. The problems I’ve indicated will probably not affect the substantive core of the authors’ arguments, so I hope that the authors will be able to clear them up.

## **Walking after the Elephant of Financial Crisis**

*Yong J. Yoon\**

### **Abstract**

Speculative booms and busts are part of the free enterprise economy. Usually booms burst without much effect in the economy. The current financial crisis looks severer, however. What is noticeable about the procession is the eerie kind of Knightian uncertainty. The elephant of current turmoil tells about the economics profession as much as the economic condition. Economists walk after the elephants in the procession of financial crisis and economic recession. Economists do not seem to provide evidence of expert opinion. Their complaints may not be heard but they must speak with economic logic, and the logic I use in this paper is a public choice analysis. The paper provides a story of the financial crisis from the perspective of risk illusion and politicized mortgage making.

Key words: financial crisis, public choice, politicized mortgages, risk illusion, securitization of mortgages JEL categories: D72, D81, G

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## I. Introduction

Episodes of speculative booms and busts have been part of the free market economies. The objects of speculation are inelastic in supply, and booms usually burst without much damage to the economy. The current financial crisis looks a lot severer, however. And the recession is not typical business cycle recession traceable to tight money. In fact, interest rate is basically zero, thus monetary policy is not working. What was/were the cause(s) and what are the cures? Economists are, and will be, busy with these questions. Certainly economist's job is to explain the phenomenon, predict the pattern, and proffer policy alternatives. In attempting to answer this question, economists follow the standard method in hard sciences. They try to identify the factors that caused the phenomenon. The crisis started with subprime lending and the mortgage industry in general. The major factors economists recognize are low global interest rate, the Fed's monetary policy of low interest rate. In addition, the contributing factors are government's encouragement of subprime loans, securitization and derivatives, and rating agency are the contributing factors. These factors together have caused the crisis.

However, I follow a different approach. My approach is based on the premise that institutions matter by influencing our perceptions as well as incentives. To find better rules, or institutions for financial system, we may ask the following question. What kinds of institutions would mitigate the financial crisis? This will be done by comparing the old banking system and the new banking system of universal banking. I argue that the turmoil would be much more tolerable if we had old banking system in which commercial banks specialize in loan making. The financial crisis could be stopped if the Fed announced and stuck to the policy of the lender of last resort. Instead, government and the Fed exercise discretionary policies of bail outs and stimulus programs.

Our financial system and the government played major roles in the financial crisis that brought recession. In Section II I provide the story of the 2000-2008 subprime mortgage and financial crisis. The logic of bailout is provided in section III. Section IV analyzes the risk arithmetic of securitized assets based on subprime mortgage portfolios. Ultimately risk is judgment not calculus. Risk externality and risk illusions are discussed. The risk externalities may lead to the tragedy of risk commons, and the risk illusion is just as real as money illusion and fiscal illusion. The conclusion section V discusses banking reforms that will prevent financial crisis and the role of economic science and politics in policy making. Also discussed is the implication of the results in this paper to the Korean economy.

## II. The story

The credit crunch is caused by bad housing loans. Thus the financial crisis will end when the housing market stabilizes, i.e. prices of house settles down.

Here is some relevant statistics: There are 25 million subprime and Alt-A -- in other words, nonprime -- mortgages. They are worth \$4 trillion, 40 percent of all outstanding mortgages today (\$10tr). Outstanding subprime mortgage in July 2007 was a total of \$1.5 trillion. Subprime mortgages rose from virtually nothing to \$1.5tr in three years, helped by open market securitization. In 2001 54% of subprime mortgages were securitized and this rose to 75% in 2006. Fannie Mae and Freddie Mac were the major securitizers of home mortgages. Forty percent of their total single-family exposure is subprime mortgages. During the financial crisis of 2007-08, the share prices of these financial institutions fell from near \$70 per share to below \$10 within a year. See Figure 1.

## 1. Animal spirit

The S&P/Case-Shiller home price indices (Fig 2.2 in Shiller, 2008) show that there was housing boom during 2000-2007. Low international interest rate and the low Fed Funds rate between 2002 and 2005 (Greenspan's Fed chairmanship) are considered as the important contributing factor to the bubble. The Fed's intention was to prevent recession and deflation. Bubbles used to be local, like 1925 Florida land bubble and California bubble in 1880s. Speculations are involved in both stock market and the housing market bubble, but stock price move like random walk while housing market move in the same direction year after year for a while.

Mortgage portfolios in the current crisis were geographically diverse. Such diversity, investors thought, could protect the investors of securitized assets and derivatives based on subprime mortgage portfolios. It turned out to be not the case. Mortgage defaults are highly correlated. The pattern of the high correlation was dubbed irrational exuberance (by Greenspan).

Economists like Allen Greenspan (2008), Akerlof and Shiller (2009) and others revive the Keynes's idea and argue that the housing boom is caused by socially contagious animal spirit. They argue that what drives people's thinking is purely social in nature. Indeed, psychology and ethics matter a lot. The current discussions agree that, for economic recovery, confidence and trust in the stability of the system is crucial. Should economists give in to the animal spirit explanation? Before doing so, we have to look at the institutions that affect our perceptions of risks. Social contagion or not, the crisis would not happen or less severe if we had a financial system in which commercial banks concentrate on loan making and politicized mortgage lending is not allowed through Fannie Mae and Freddie Mac.

## 2. Double runs – up and down

The supply of housing is inelastic and most homeowners cannot respond to price rise. As a result of political favor, subprime creditors start to buy homes. Home price rises and expectation of price rise is formed. Because housing is a durable asset, price rise invites further demand and further price rise until the expectation stops somehow. The mechanism is similar to the bank run argument by Diamond and Dybvig (1988), in which the probability of bank failure increases as more people expect bank default and the run seems to justify the expectation. The same logic applies to housing market bubble and bust, run for bubble and run for bust.

Once price rise expectation is formed, just like in bank run, they run to buy house before price rises further and this run causes rapid price rise. When price is too high and construction starts to meet the demand, price starts to fall and expectation is formed that price will fall. Then, the collateral is insufficient and home buyers must pay the difference. The homeowner may believe it is not worth to keep the house because the asset has negative value. They want to move out before the price falls further. This quickens price fall. More houses will default because the collateral is insufficient for the loan.

## 3. Politicized mortgage lending – lax lending

Politicians passed acts to boost the house ownership of the low income people. There was politicization of mortgage lending through the paternalistic policies that made the loan requirement easier more than economic consideration would dictate. You can call this government encouragement of home ownership. During the nine year trend of price rise, subprime borrowers with no documentation loans became common.

During the 2000 – 2007 housing boom, mortgage lenders underestimated the risk because the value of the collateral was rising. The politicized mortgage lending could have started the boom by reducing the lending criteria. The new entrants were the subprime borrowers, who created demand and pushed up prices. As the housing bubble started, mortgage lenders attracted new entrants to the market. Lenders made it easier for borrowers to obtain subprime loans. Mian and Sufi (2008) provides evidences of a relaxation of mortgage lending criteria during this period. As the bubble burst in 2007, many mortgage holders could not afford mortgages and foreclosure increased. House price declined. Other mortgage holders who had borrowed close to 100% of the house cost had negative equity. Some people simply walked away from the house for the lenders to foreclose, reinforcing the housing price decline.

The perception of risk has changed as the banking system moved from relationships to transactions. Securitization is responsible for the lax screening of mortgages. The arithmetic of securitization is discussed in section IV.

#### **4. Old banking and new banking – securitization and derivatives**

Glass-Steagall Act of 1933 was enacted to prevent the spread and contagion of bank run over the country. The loan making business was separated from investment banking. The act was repealed in 1999. As financial sector was liberalized, new financial instruments appeared, most prominent were securitization and derivatives. These instruments are actively used for risk diversification but also for speculation.

The new institutional conditions, repeal of Glass-Steagall Act, universal banking, Fannie and Freddie changed the financial structure in the economy from old finance to new finance. In the old finance, mortgage originator was mortgage holder. Banks exercise their expertise in screening loans. This production of information was indeed the bank's contribution to the national economy. In the new finance, commercial banks originated mortgages and collects fixed fee and sell to securitization. In this process, the originator is not final mortgage holder. The originator has less incentive to pay attention to the qualification of loan application. On the other hand, the final holder cannot analyze the mortgages in the pool. In this process, the potential economic value is lost, while diversification based on formula was practiced.

#### **5. Risk illusion and the tragedy of the commons**

Risk is ultimately judgment, not calculus. The new finance system made it easier to include low quality subprime mortgages into circulation. We can interpret this as investors had the illusion of lowered cost or price of risk. And lower price invites demand for risk. Judgment requires attention and the institution restricts the information and influences our perception of risk. During the credit crunch, investors relied on the AAA-rating level, and the rating agencies were much criticized for lenient rating. What should be noted is that rating measures default risk not liquidity risk, and credit crunch means liquidity risk. The politician's encouragement for homeownership and the changed incentive of bank loan making contribute to negative risk externality and the result is what is known as the tragedy of the commons. Section IV discusses on risk illusion.

### III. The logic of bail out

The US government and the Fed bailed out financial institutions and carmakers, General Motors and Chrysler. Bailing out financial institutions was discretionary policy based on the argument that banking has systemic risks. But I argue that the Fed could announce itself as the lender of last resort and stick to the policy. The Fed gives loans to troubled financial institutions and charge interest. Since the value of collateral can be uncertain the Fed should prohibit dividends and bonuses by these financial institutions. The logic of bailing out carmakers is different from that of financial institutions. Of course, political logic overwhelms economic analysis. I examine the logic of bailing out carmakers in a separate paper (Yoon, 2009b).

The logic I examine is based on 'option demand'. After subprime mortgages triggered a financial crisis and, as recession sets in, the talk of bailouts became daily parade on the news media. The popular argument was "Fannie Mae is too big to fail." Now, "General Motors is too big to fail." The question is why should taxpayers' money be spent to rescue a private enterprise in a free enterprise economy? What is the economic logic of bailout if there is any?

This section provides an economic idea that explains the intuitive notion about bailouts. Weisbrod (19xx) introduced the conception of option demand in which some of the consumption goods have public good's nature. This argument can apply to bailing out General Motors. Suppose average Americans give some value, including a sentimental value, for having GM around and for the option of purchasing a GM car, an American car. If GM is not there anymore, their welfare will be reduced as much as they value the option of having GM running.

This argument sounds innocent enough, yet is no different from protectionism when applied to bailouts. One can argue that this is a passive one and would not damage the open economy. However, even if these were no explicit policies to undermine the global economy, international trade will shrink because of the reduced extent of the market.

Economists all believe that trade encourage specialization. But mostly think in terms of Ricardian or Heckscher-Ohlin theory of trade. These models assume that the world specializations are the same before and after opening the economy. What happens through opening the economy is sorting out, by comparative advantages, to determine which country specializes in production of which good. However, these neoclassical models cannot address the world recession properly. Stay with Ricardian or H-O theory, then trade encourages specialization according to comparative advantages which are determined by the relative configuration of each country's technologies. Now, in recession, each country has bad technological or demand shocks. So each country produces less and trades less. But specializations of each country will remain the same. However, according to the trade model by Yoon (2008) based on Smith's extent of the market, recession will cause some specializations disappear in some of the countries. This will have a lasting effect, because there will 'forgetting by not doing' a symmetric phenomenon to 'learning by doing'. When recession is over countries will pick up new specializations different from the lost ones. In this way, the list of specialization of each country will change over credit cycles, especially over the severe ones.



## IV. Arithmetic of Securitization: Risk Illusion

The overexpansion of credit in the US housing market caused huge losses by financial institutions and tightening of credit. We explain the products that were used to securitize mortgages and why those products performed so badly.

### 1. Securitization.

The core of the financial crisis is the subprime mortgages in the housing market. In the new financial system of universal banking that developed during the last thirty years, financial institutions may not retain the mortgages they originated on their books. Subprime mortgages are securitized and sold to investors as ABS (asset based securities). Securitization and derivatives are financial contracts that are useful tools in financial market by sharing risks and providing liquidity. However, they can be used for speculation too as in the case of housing booms. Securitization is also linked to the lax screening of mortgages.

Here is a brief statistics on subprime mortgages. There are 25 million subprime and Alt-A -- in other words, nonprime -- mortgages. They are worth \$4 trillion. In 2001 54% of subprime mortgages were securitized and this rose to 75% in 2006.

The process of securitization is expositied by using a simplified ABS model by Hull (2009). A portfolio of subprime mortgages (Asset 1 through asset N) is created. See Figure 2. The portfolio generates cash flows. In our numerical example in Figure 2, the principal of the portfolio is \$100 million. The credit risks of the portfolio are sliced (tranchied) out into three pieces with different risk characteristics. The three pieces are senior (III), mezz (II), and equity (I) tranches. The 'senior' is least risky and the 'equity' is most risky. This structure determines the order of cash flows to each piece and who bears the losses of principal on the underlying portfolio.

In the numerical example of figure 1, the 'equity' has 5% of principal and bears the first 5% of losses in the principal. 'Equity' tranche is wiped out when losses exceed 5%. In returns for this, its compensation is 30% on its part of principal (5% or less of the total principal). In fact, after senior and Mezz receive promised cash flows, 'equity' receives anything remaining. Mezz tranche is wiped out when the loss is more than 25% and earns 10% of outstanding principal (20% or less of the total principal). Losses in excess of 25% are borne by the senior tranche. The principal for senior tranche is 75% of the principal underlying the mortgage portfolio. The promised return is 6% of its principal. Securitization is structured so that the 'senior' slice is AAA-rated. The 'equity' slice is either retained by the originator or sold to a hedge fund. As the structure indicates, the values of slices depend on the default rate and correlation with the portfolio.

To find a market for the Mezz slice, a structure known as ABS CDO (collateralized debt obligation) is designed by financial engineers. The idea is to slice out the risks from a portfolio of mezz in the same way as an ABS portfolio slices out the risks from a portfolio of subprime mortgages. The structure is illustrated in Figure 3. CDO is structured so that the senior slice (m-senior) is rated AAA. It turns out that derivatives of this type are the most troublesome and at the core of the financial crisis. The numerical example is instructive. Even the AAA- rated security, the CDO senior tranche (m-senior), can be wiped out when the original portfolio loses 25% of its principal. If the portfolio loses 20%, the AAA-rated CDO senior tranche is worth 33% of the original value. More specifically, the value ( $v$ ) is related to the loss of the portfolio:

The range of the portfolio loss ( $L$ ) is  $0 < L < 100$  and the value of the portfolio is  $100 - L$ . Until ABS 'equity' and CDO 'equity' and 'mezz' are wiped out, the principal of m-senior is secure,

$$V = 100(0.2)(0.75) = 15 \text{ when } L < 10;$$

$v = 15 - (L-10) = 25 - L$  for  $10 < L < 25$ ; when the loss is more than 25 m-senior is wiped out,

$$v = 0 \text{ when } L > 25.$$

As the Exhibition 1 indicates, in July 2008 Merrill Lynch agreed to sell its senior ABS CDO, once valued at \$30.6 billion and rated AAA, to Lone Star Funds for 22 cents on the dollar. In our numerical example, this is equivalent to 21.7% loss of the portfolio principal: The portfolio principal is \$200 billion. Then portfolio of m-senior is \$40 billion, and  $v = 30 - (L-20) = 50 - L = (0.22)(30)$ . Solving for  $L$  and obtain  $L = \$41.2$  billion. Furthermore, Merrill Lynch agreed to finance 75% of the purchase price. Merrill Lynch lent Lone Star Funds about \$5 billion to complete the sale. This could be the private model that solves the problem the Treasury wanted by bailing out 'too big to fail' banks. Note that Lone Star Funds is a private equity fund, who can make profit by waiting until the toxic mortgages mature because it is unconstrained by capital requirements, unlike a publicly-traded firm.

As the simple CDO model suggests, securitization influences incentive of the mortgage originators. In the old banking system, the mortgage originators examine thoroughly lending opportunities. The risk was based on the relationship between borrowers and lenders. Commercial banks contribute to the national product by producing information in the process of screening loan proposals. In the new banking system, the majority of the loans would be securitized. The incentive was to make profit by selling a mortgage to an investor. The original economic contribution of banking has been reduced and moved to transactions, risk management and speculation. Originators would be more careful about the loans they make when they knew the loans might not be securitized. The interest of a loan originator is not aligned to those of an investor in the loan. For instance, when the equity slice for most ABS that the originator holds, is worth zero, the originator has no financial interest in the portfolio.

On the other hand, if the originator securitizes part (say, 80%) of its portfolio, investors might suspect that the better loans have been retained and that screening was lax on the rest. The complexity and lack of information flow causes the risk illusion. Most investors, when they bought AAA-rated slices, do not read the legal document that is several hundred pages long. Instead, they rely on the "AAA" label. The rating measures credit quality not liquidity. Once the slices were perceived as risky it became almost impossible to trade them. This is because potential investors did not understand enough about the underlying portfolio. These derivatives are difficult to price, and even with financial engineering models would not have mitigated the subprime crisis. The risk measurement is based on historical experience, but risk is ultimately human judgment. (See Hull, 2009, for discussions of other related issues.)

## 2. Risk Illusion

The current debates raises question about economist's role in society. The question could be stated as follows. Can we learn enough about risk through positive economic method and come up with the correct policy? Or, when knowledge is insufficient, how are we going to agree on rules about controlling risk in society?

Risk or uncertainty is usually treated as given exogenously and analyzed from the perspective of individual decision making. The financial risk may be endogenously determined in the whole financial system, but this fact has been ignored in the profession. Risk can be an external bad introduced by individual action against perceived risk. Such risks are wasteful without introducing any risk-return trade offs, and create the tragedy of the 'risk commons'. The behavioral response to risk can cause real effect such as moral hazard. Furthermore, risk commons will cause more uncertainty on individual decision making. The tragedy of the risk commons is the Knightian uncertainty and catastrophic freeze by individual decision makers. The management of risk commons requires rules beyond individual risk management, because the risk illusion is just as real as the money illusion and fiscal illusion.

To put the risk question in simple terms, consider a model economy,  $Y = F(K, L) + \varepsilon$  where  $Y$  is output,  $F$  is a production function,  $K$  and  $L$  are capital and labor inputs, and  $\varepsilon$  is a random variable. Suppose  $F$ ,  $K$ , and  $L$  are public knowledge. Now if you and I involve in a betting on  $Y$ , the outcome of the economy which depends on the random variable  $\varepsilon$ . Does this gambling make the economy more risky? It should not. It only causes a change in income distribution by transfer. Neither an insurance contract between two persons will make the economy less risky. Subprime mortgage and financial crisis are all caused by speculation, betting on and insuring against uncertain events. Bubble or whatever, they cannot make the economy more risky. We can do nothing about it, and we do not have to do anything about it. This is the advice from the simple economic model to the current financial trauma.

However, the subprime trauma has real effects. This would make no sense if risk is treated like the 'epsilon' exogenously given in the production function above. We assume risk is priced by the market by investors whose attitude toward risk is independent of the probability distribution of risk. This dichotomy is the habit of mind of neoclassical economics. However, individuals may not treat expectation and attitude separately, and the institution may influence our perception of risk. A better model for the financial crisis might be the guessing game suggested by Keynes as beauty contest.

Risk is a judgment rather than statistical formula which gives the illusion of exogenous distribution of outcomes. But there are ways to live with our ignorance. Under insufficient knowledge, rules rather than discretion will reduce uncertainty and agreeing to rules will secure legitimacy, which is another way of reducing uncertainty in democracy. The institutions of minimum government intervention and natural liberty, free use of individual mind, body and property, could be understood from this perspective.

## V. Conclusion

I have argued that the severity of financial crisis and recession is closely related to the institution, our financial system and polity.

Financial sector has been liberalized as Glass-Steagall Act of 1933 was repealed in 1999 with the belief that the free market idea should be applied to the finance industry. Many financial instruments appeared to diversify risk as much as possible. Securitization and derivatives are the major ones. These instruments in new financial regime gave different perceptions of risk and incentives. Financial instruments can diversify risk because different assets move differently. Yet, when they move in the same direction, these

instruments are used for speculation and generate crisis by engrossing risks. What we need is the good old banks that are good at making loans.

The financial crisis is the difficulty of finding prices for the inventory of homes. The Fed should have constitutional restraint as the lender of last resort. Troubled banks can get loans from the Fed with interest. Since collateral value is uncertain, the banks will be required not to pay dividends and bonuses bonus.

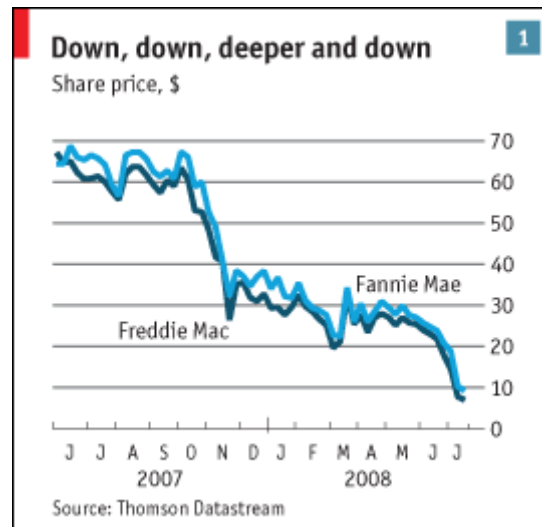
Instead of focusing on stopping housing price fall and protecting the homeowners, government concentrate on reducing the housing inventories. This could be done by giving tax benefits to those who purchase existing home with down payments. Another possibility is that the Fed gives loans to private firms that will buy up the inventories. What should economists do to claim evidence of expert opinion? I have no answer for this question. Yet, I believe that each economist can participate in the debate on the current experience, which is the empirical studies in the true sense for economic science, more informative than lab experiments and econometric studies.

Finally, we can find some lessons useful for the Korean economic situation. To reduce the uncertainty, transparency should be required both in the government policy and financial data from financial institutions. Voters should be careful about any paternalistic policies by politicians.

## References

- Akerlof, George and Robert Shiller, *Animal Spirit*, Princeton University Press, 2009.
- Diamond, Douglas and Phillip Divbig, "Bank runs, deposit insurance, and liquidity", *Journal of Political Economy*, vol. 91(3): 401-19, June 1983.
- Greenspan, Alan, "We will never have a perfect model of risk" *Financial Times*, March 16, 2008.
- Hull, John, "The credit crunch of 2007: What went wrong? Why? What lessons can be learned?" working paper, University of Toronto, 2008.
- Mian, A. and A. Sufi, "The consequences of mortgage credit expansion: Evidence from the 2007 mortgage default crisis," working paper, Graduate school of business, University of Chicago, 2008.
- Robert Shiller, *The Subprime Solution*, Princeton University Press, 2008.
- Simons, Henry Simons and John Taylor, "How the Government created the financial crisis" *Wall Street Journal*, February 10, 2009.
- Weisbrod, Burton, "Collective consumption services of individual consumption goods" *Quarterly Journal of Economics*, LXXVIII, p. 471-77, August 1964.
- Yoon, Yong J., "Stochastic Demand, Specialization, and Increasing Returns," *Journal of Division of Labor and Transaction Costs*, June 2008
- "A Note on Methodology of Economics" 2009a.  
\_\_\_\_\_. "An Economic Logic in Defence of Bailout" 2009.

Figure 1. Share prices of Fannie Mae and Freddie Mac during the Financial Crisis in 2007 - 2008



## Exhibit 1.

**New York Times**  
**Merrill's Bitter Pill May Be a Sweet Deal for Lone Star**  
July 29, 2008, 7:20 am



**Lone Star Funds** seems to have the pioneering spirit suggested by its name.

In the latest example of the Dallas-based private equity shop's desire to tackle tough terrain, **Merrill Lynch** announced Monday that it had sold Lone Star almost all of its troublesome **collateralized debt obligations**, once valued at nearly **\$31 billion**, for the fire-sale price of **22 cents on the dollar**.

For Merrill, the sale represents a steep loss and will cause the majority of the bank's expected \$5.7 billion write-down in the third quarter.

The United States super senior asset backed-security C.D.O.'s that Merrill sold were once valued at \$30.6 billion. As of the end of second-quarter, Merrill valued them at \$11.1 billion - or 36 cents on the dollar. And Merrill sold them for \$6.7 billion to Lone Star.

Furthermore, Merrill provided 75 percent financing to Lone Star Funds, which means Merrill lent the private equity fund about \$5 billion to complete the sale.

But Dow Jones notes that for Lone Star, the deal is almost a no-brainer. Unlike a publicly-traded firm, the private equity fund is unconstrained by capital requirements and freed from quarterly reporting obligations, allowing the buyout shop time to let the currently toxic mortgage-related investments to mature.

Thus, the news service says, if only a portion of the investments function the way they were intended to, Lone Star will pocket a handsome profit.

Furthermore, Dow Jones says, Merrill's C.D.O. portfolio isn't the only risky bet Lone Star has made recently. Other bets on investments hit by the current crisis include its \$1.5 billion [deal](#) for **CIT Group's** mortgage business and the acquisition of **Bear Stearns'** residential mortgage arm.

### Merrill Toxic Asset Sale May Present Model

[All Things Considered](#), February 10, 2009 · Last year, private-equity firm Lone Star Funds bought up nearly \$6.7 billion of Merrill Lynch's credit debt obligations at 22 cents on the dollar. Could that be the private model the Treasury Department wants others to duplicate? Simon Johnson, a professor at MIT and a former chief economist at the International Monetary Fund, offers his insight.

## Figure 2. Securitization (Asset Backed Security)

Portfolio: {Asset 1, Asset 2, ....., Asset N},  
principal \$100 million

III: Senior slice. Principal: \$75 million, Return: 6%

II: Mezz slice. Principal: \$20 million, Return: 10%

I: Equity slice. Principal: \$5 million, Return: 30%

The basic structure is

- (i). Principal (III) > Principal (II) > Principal (I)
- (ii). Return (III) < Return (II) < Return (I), and
- (iii). Cash flow goes to III (6%) first, then II (10)%, and I (30%).

(iv). Losses to portfolio (default) is born by the following rule:

Loss (x) is less than 5%,

I loses x in principal; earns 30% on principal, 100 (1-x).

Loss is more than 5%,

I is wiped out.

Loss is,  $5\% < x < 25\%$ ,

II loses x in principal; earns 25% on principal, 100(1-x).

Loss is more than 25%,

II is wiped out.



## Figure 3 ABS CDO

Losses x to subprime portfolio

X = 10%      Losses to Mezz =  $(10-5)/20 = 25\%$  loss principal  
                     Losses to Im = 100%  
                     Losses to IIm = 100%  
                     Losses to IIIm = 0%

X = 20% ->      losses to mezz =  $(20-5)/20 = 75\%$  loss  
                     losses to Im = 100%  
                             Losses to IIm = 100%  
                             Losses to IIIm =  $(15-5)/15 = 2/3$

X = 25%      losses of all items are 100%

## Comments on "Walking after the Elephants of Financial Crisis"

Kwang Choi  
Hankuk Univ. of Foreign Studies

I enjoyed reading Yoon's paper. Overall I cannot agree more with Professor Yoon in his diagnosis of the current financial crisis and economic recession and prescription to cure them.

Professor Yoon develops his own model based on the public choice approach and risk illusion. While unique, his explanation of why financial market collapsed and the economy sank is more or less that of Austrian school(cf. Thomas E. Woods Jr., *Meltdown*, 2009) Personally, I like Yoon's line of logic very much.

Why were there so many financial crises and economic recessions and booms? Almost all economists seem to agree that the factors that caused the current worldwide crisis are low global interest rate, central bank's monetary policy, politicized mortgages, securitization and derivatives, etc. What is surprising me and/or bothering me is that economists are so divided in policy prescriptions. In most cases, diagnoses of illness and cures for illness are so much different and inconsistent. Is economics a science?

There are so many quack doctors in the economics profession, who do not study economic history, letting the history repeat itself and people suffer from economic illness repeatedly. Reading of real world history and government policy histories leads me to conclude that other than economic downturn of 1970's due to oil shock all the economic crises in the 20th century were caused by the government and in due course the market cured itself.

The government is problem(trouble) shooter and is not problem solver. In short, current crisis was caused by government failure, not by market failure. Once again as in the past, most economist are prescribing more government intervention. I really do not understand repeated malprescriptions.

### Some questions:

1. I understand and agree to Professor Yoon's emphasis on rules and institutions. You suggest how to stop the financial crisis: old banking system, central bank as the lender of last resort, and no bail-outs. Could you be more specific about how to get out of financial crisis?

2. According to Joseph Heath[Filthy Lucre: Economics for People who Hate Capitalism, 2009] while there were economic bursts 2 or 3 times in every 10 year during the 19th century, we had economic crises 2 or 3 times for the last one century. How good and/or valid are Yoon's new model of risk illusion and the tragedy of the commons in explaining previous crises or recessions? How about Great Depression and Asian foreign exchange crisis in the late 1990s?

3. Can Yoon's model explain the recent economic recession of Korea?

CHAPTER 3-2

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**Was There an Explosive Bubble in U.S. Stock Prices before the  
Recent Stock Market Crash?**

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## Abstract

Existing studies on bubbles have been mainly concerned with investigating the stationarity properties of stock prices and dividends using unit-root and cointegration tests. However, the standard tests may not be able to detect an important class of bubbles. We develop a model that relates bubble measures to the Weibull distribution. In recent times there were at least three eruptions and subsequent collapses of seeming bubbles: 1987, 2000, and 2007. Using U.S. monthly data from 1980:1 to 2007:10, we have found that only the boom and crash of 2007 represented a bubble, although our stationarity tests fail to detect the bubble. Our results are in agreement with recent findings reported by Bohl (2003) and Nasseh and Strauss (2004).

Key Words: Intrinsic bubbles, extraneous bubbles, stationarity, unit roots, cointegration, Weibull distribution, bursting rate, hazard rate

JEL Classification Number: E44, G12

## I. Introduction

The U.S. stock market has been increasingly volatile in recent years. During one infamous week in October, 2008 (October 6 – 10), the Dow Jones lost more than 18 percent of its value, and the Dow's swing from high to low on October 10, 2008 was the biggest since the Dow Jones Index was created in 1896. There were several eruptions and subsequent collapses of seeming bubbles in the U.S. stock market in modern times. The U.S. stock market reached a peak in October 1987, which was followed by a sudden downturn commonly known as the Black Monday. The U.S. stock market reached another plateau in August 2000, but it plunged together with the burst of the IT bubble. The third peak point on the stock price series occurred in October 2007, but the stock market began to go into a tailspin, as the subprime mortgage crisis was on the horizon.

The drop of stock prices during the 1987 Black Monday was a temporary adjustment of the market. The boom of the stock market starting in the middle of the 1990s and lasting until August 2000 reflected productivity growth brought by the IT (information technology) Revolution in the latter half of the 1990s. However, the recent stock market crash has distinguished itself from the previous ones in that it has concomitantly occurred with the boom and the subsequent bust of the housing market. The stock market crash that triggered the Great Depression also coincided with the construction boom and bust in 1929. It has been generally accepted that the U.S. stock market before the outbreak of the Great Depression contained a speculative bubble. Thus, it is interesting to investigate whether the recent stock market boom and crash contained an explosive bubble, exhibiting different characteristics from the 1987 and 2000 market crashes.

If no bubble were present in stock prices, then there would be an adjustment of the stock market, and it would not take much time for stock prices to return to their appropriate levels even though stock prices seem to have risen too much. However, if stock prices contained an explosive bubble, the adjustment process would be much longer and costlier.

Earlier views on a bubble ascribe it to some psychological factors such as herd behavior, animal spirits or cognitive biases in which bubbles propagate themselves. A significant deviation of stock prices from the path predicted by market fundamentals may be due to waves of pessimistic or optimistic market psychology. Since this view attempts to link a bubble to some extraneous factors, this type of a bubble may be termed an extraneous bubble.

It has been widely believed that a bubble, especially an extraneous bubble does not lend easily itself to direct testing. Bubbles are recognized only when they burst. This nature of bubbles has led economists to acknowledge that it is difficult to test if there is a bubble or not. Evans (1991) maintains that it is difficult to test for the presence of a bubble when stock prices are too high but do not have the possibility of bursting. Flood and Hodrick (1990) have expressed a more pessimistic view :

"Whether the actual volatility of equity returns is due to time variation in the rational equity risk premium or to bubbles, fads, and market inefficiencies is an open issue. Bubble tests require a well-specified model of equilibrium expected returns that has yet to be developed, and this makes inference about bubbles quite tenuous."

For reasons of this difficulty, economists traditionally used indirect methods to test for bubbles. For instance, Shiller (1981) used variance bounds tests and interpreted excessive deviations from the bounds as a bubble. However, recent bubble models elaborated by Hamilton and Whiteman (1985), Diba and Grossman (1988a,b,c), Evans (1991), Froot and Obstfeld (1991) and others represent a significant departure from the

conventional view in that they reinterpret rational bubbles in terms of market fundamentals. These bubbles may be termed intrinsic bubbles, as opposed to extraneous bubbles. One attractive feature of the intrinsic bubble specification may be found in its ability to obtain testable implications for bubbles.

A number of recent studies have investigated the existence of intrinsic bubbles in stock markets by examining the stationarity properties of stock prices and dividends on the basis of unit-root and cointegration tests. These studies include Campbell and Shiller (1987, 1988), Diba and Grossman (1988), Crowder and Wohar (1988), Froot and Obstfeld (1991), Craine (1993), Charemza and Deadman (1995), Timmermann (1995), Lamont (1998), Bohl (2003), Sarno and Taylor (2003), Nasseh and Strauss (2004), Koustas and Serletis (2005), Cunado, Gil-Alana, and de Gracia (2005, 2007), among others.

However, the existing bubble models still remain unsatisfactory. The empirical relevance of these intrinsic bubble models has been seriously undermined by the results of Evans (1991) who has criticized that unit-root approaches are unable to detect an important class of rational bubbles. Evans has shown that even in the presence of bubbles, stock prices could be integrated and cointegrated with market fundamentals, so that standard unit-root and cointegration tests are not appropriate for detecting this class of rational bubbles. This view has been echoed by Charemza and Deadman (1995) and Ackert and Smith (1993). Ackert and Smith have noted that conventional measures of dividend payments to shareholders grossly underestimate the total cash flow to shareholders, and this underestimation of cash flows could have impacted conventional types of cointegration between dividends and prices, which may bias the tests to show no cointegration.

More interestingly, Rappoport and White (1991) have pursued a different strategy for testing for intrinsic bubbles. Their approach is notably distinguished from standard tests by directly extracting an estimate of the path of the bubble and its probability of bursting. Abreu and Brunnermeier (2003) also provide a setting in which new events can have a disproportionate impact relative to their intrinsic informational content without reference to the stationarity processes of stock prices and market fundamentals.

Another avenue of research on testing for speculative bubbles is provided by McQueen and Thorley (1994), Chan, McQueen, and Thorley (1998), and Harman and Zuehlke (2004) who have used hazard models to investigate duration dependence in stock prices. In particular, McQueen and Thorley have proposed that negative duration dependence in runs of positive abnormal returns is indicative of rational speculative bubbles. These studies pronouncedly distinguish themselves from stationarity tests by examining the question of whether stock prices tending toward cycle lengths can be framed as one of duration dependence. However, these duration dependence tests have some limitations in that they are in nature indirect tests for the presence of speculative bubbles.

The main purpose of this study is to develop a simple method of testing for rational bubbles that does not rely on stationarity properties of variables in asset pricing models, but directly relates explicit bubble measures to the probability of bursting in the context of the Weibull distribution. To this end, we directly derive a bubble measure from the information error model and test whether the bubble measure is explosive. Our model bears a parallel to that of Rappoport and White in that we explicitly extract a bubble measure and to that of Abreu and Brunnermeier in that bubbles can arise as a result of informational errors. One novel feature of our model is that unlike duration dependence tests proposed by McQueen and Thorley (1994) and Harman and Zuehlke (2004), we relate the bubble measures to the Weibull distribution. In this study we have shown that if the hazard function is estimated to be a weakly convex increasing function, the bubble is explosive, and vice versa.

We have tested for the existence of explosive bubbles in the U.S. stock market using monthly data from January 1980 to October 2007. We have divided the sample into three sub-samples: 1980:1 - 1987:10, 1987:11 - 2000:8, and 2000:9 - 2007:10. Our empirical results reveal that only the surge of stock prices peaking in October 2007 contained an explosive bubble. Thus, we can claim that an explosive bubble in the stock market is closely related to explosive increases in housing prices.

The paper is organized as follows. Chapter 2 briefly reviews the literature. In chapter 3, we develop a model that can be used to extract bubble measures. Chapter 4 presents empirical results and analyses. A summary and concluding remarks are provided in chapter 5.

## II. A Review of the Literature

Shiller (1981), using the present value (PV) model of stock prices, has demonstrated that stock prices are too volatile to be consistent with the present value of rationally expected future dividends discounted by a constant real interest rate. In particular, Shiller's variance bounds tests establish that the variance of the market price of a stock should not be greater than that of the present discounted value of future cash flows. Shiller has shown that the violation of this inequality is overwhelming for the U.S. data. The violation of the variance bounds is interpreted as rejection of the efficient markets hypothesis.

Hamilton and Whiteman (1985) have dealt with bubbles that can be dependent on market fundamental values for the first time. They have discussed bubbles from the perspective of the stationarity properties of stock prices and market fundamentals. Their argument is that it is not possible to test the proposition that bubbles are caused by self-fulfilling expectations from purely extraneous factors. The existence of bubbles is the output of rational reactions to market fundamentals by market participants. Their proposition implies that there exists a bubble if  $d$ -th differenced fundamental values are stationary, but  $d$ -th differenced stock prices are nonstationary. Put it differently, there exists a bubble if stock prices are more explosive than fundamental values such as dividends.

Diba and Grossman (1988) postulate that if there is no bubble premium in stock prices, then stock prices should be cointegrated with market fundamentals in a nonlinear fashion (nonlinear cointegration). However, they also suggest that the opposite is not true since non-cointegrated stock prices and dividends can occur from the nonstationarity of the unobservable variable which can be observed by market participants, but cannot be observed by researchers. Diba and Grossman have conducted cointegration tests for the U.S. data of the S&P 500 composite price index for the period 1871-1986 and found that the U.S. stock prices do not contain explosive rational bubbles.

Campbell and Shiller (1987) have tested for cointegration between stock prices and dividends using annual data for the S&P 500 index from 1871 to 1986, and found persistent deviations of stock prices from the present value model, which can be interpreted as evidence for the presence of rational bubbles in U.S. stock prices. In their subsequent paper, Campbell and Shiller (1989) have suggested that the dividend-price ratio ( $D/P$ ) can be explained by some market fundamentals. They have tested for the model using S&P data for 1871-1986 and 1926-1986 and found that the log dividend-price ratio has a significant relationship with the growth of dividends. Their results further indicate that there is also substantial unexplained variation in the log dividend-price ratio.

Evans (1991) has conducted the simulation of two hundred replications, each of 100 'years' of stock price and dividend data and shown that the cointegration of stock prices

with dividends cannot be viewed as evidence against the presence of bubbles. His Dickey-Fuller unit-root tests indicate that real dividends ( $d$ ) have a unit root and  $\Delta d$  is stationary. For stock prices ( $P$ ), the results are similar. Furthermore,  $P$  and  $d$  appear to be clearly cointegrated. This test procedure thus fails to find the presence of the bubble, since the existence of rational bubbles means that price series are 'less stationary' or 'more explosive' than dividend series. However, simulations show that over the sample, there appear to be four bubble eruptions, each followed by a collapse.

Froot and Obstfeld (1991) have maintained in line with Hamilton and Whiteman that since a bubble is the output of market participants' rational reaction to market fundamentals, bubbles are not extraneous. On the contrary, any self-fulfilling expectations of intrinsic bubbles are based on market fundamental values. They have tested for a unit root in the price-dividend ratio using the S&P 500 index for the period 1900-1988. Using the Phillips-Perron (1988) unit-root tests, they were unable to reject the unit root null hypothesis in five of six cases, which indicates the lack of cointegration between stock prices and dividends. Thus, they have concluded that deviations from the PV model are permanent – consistent with the presence of rational bubbles in stock prices.

Craine (1993) has argued that a unit root in the price-dividend ratio ( $P/D$ ) violates the no rational bubbles restrictions and applied the Augmented Dickey-Fuller (1981) unit-root test to the price-dividend ratio using annual S&P 500 data from 1876 to 1988. His test results show that either the price-dividend ratio contains a rational bubble or the discount factor must be stochastic and contain a large predictable component.

Yuhn (1997) has argued that Campbell and Shiller's (1987) linear cointegrating relation between stock prices and dividends is not appropriate for investigating stock price volatility and derived a dynamic form of cointegration between stock prices and dividends. His empirical results reveal that little evidence for linear cointegration is found, but the evidence of nonlinear cointegration is overwhelming for U.S. monthly data from 1959:1 to 1992:6, indicating no volatility in the U.S. stock market during the sample period.

More recently, Sarno and Taylor (2003) have examined the existence of rational bubbles in Latin American emerging markets – Brazil, Chile, Columbia, Mexico, and Venezuela. They fail to reject the null hypothesis of no cointegration – i.e., the hypothesis of the presence of bubbles at the 5% level for any of countries, providing strong evidence for the existence of bubbles in each of the Latin American stock markets.

Bohl (2003) has studied the presence of a bubble in annual (1871-1999) and monthly (1871-2001) U.S. stock prices using the momentum threshold autoregressive (MTAR) model developed by Enders and Granger (1998) and Enders and Siklos (2001). His empirical findings indicate the absence of periodically collapsing bubbles in the U.S. stock market over the 1871-1995 period. However, the evidence for the sample including the rapid share price increases since the middle of the 1990s (1871-2001) is interpretable in favor of the existence of periodically collapsing bubbles in U.S. stock prices.

Nasseh and Strauss (2004) have applied panel cointegration testing and estimation methods to quarterly data for 84 firms over the 1979-1999 period to examine the long-run relation between stock prices and dividends. Their results show that there is an approximately one-for-one long run relation (cointegrating relation) between stock prices and dividends for large established firms. However, their test results show that stock prices are overvalued by 43% during the late 1990s. They have found that real interest rates do not explain recent stock price overvaluations. Instead, declines in nominal interest rates explain approximately half of the overvaluations and a break in dividend payments in the mid-1990s can explain the remaining stock price overvaluation.

Koustas and Serletis (2005) have examined the behavior of the dividend-price ratio ( $D/P$ ) or the dividend yield to test for the existence of bubbles. They have maintained that the log dividend yield ( $dt - pt$ ) is a stationary stochastic process under the no rational



bubble restriction. On the contrary, the presence of a unit root in the log dividend yield is consistent with rational bubbles in stock prices. They have applied fractional integration techniques to the S&P 500 log dividend yield for the period 1871 to 2000. Their findings yield robust rejections of the null hypothesis of rational bubbles, strongly suggesting that the log dividend yield is mean reverting.

Cunado et.al. (2005) have investigated whether the NASDAQ composite index and its corresponding dividend yield satisfy the condition required for the absence of rational bubbles. They have used the dividend-price ratio (D/P) model and applied fractional integration methods to monthly, weekly, and daily data over the period 1994:06-2003:11. When monthly data are used, the unit root null hypothesis cannot be rejected. However, when they use daily and weekly data, the order of integration appears to be higher than 0 but smaller than 1, suggesting that a certain degree of fractional cointegration exists between the two variables. This finding leads them to reject the existence of rational bubbles.

Cunado et. al. (2007) have tested for the existence of bubbles in the S&P 500 index for the period 1871:1-2004:6. They have used fractional integration techniques, allowing for structural breaks and a nonlinear adjustment process of prices to dividends. They have found orders of integration for the log price-dividend ratio to be equal to or higher than 1 and concluded that there exists a stock market bubble in the S&P 500 index over the entire period.

Unlike the existing studies that are primarily concerned with the stationarity properties of stock prices and dividends, McQueen and Thorley (1994), Cochran and Defina (1995), and Harman and Zuehlke (2004) on one hand and Rappoport and White (1991) and Abreu and Brunnermeier (2003) on the other hand depart from the standard tests by focusing on the nature of bubble measures. First, McQueen and Thorley have adopted duration dependence tests to investigate the presence of speculative rational bubbles. They have argued that if bubbles are present, then the probability that a run (sequence of observations of the same sign) of positive abnormal returns ends declines with the length of the run (positive duration dependence or negative hazard function). The estimates reported by McQueen and Thorley are consistent with the presence of speculative bubbles in the New York Stock Exchange (NYSE). In contrast, Chan, McQueen, and Thorley (1998) have applied the same discrete hazard model to weekly returns on the S & P 500 Index and found no evidence of duration dependence.

On the other hand, Harman and Zuehlke question the efficacy of using measures of duration dependence to test for speculative bubbles. Using both equal-weighted and value-weighted portfolios of all NYSE stocks from 1927 through 1997 and equal-weighted and value-weighted NYSE-AMEX indices for the period 1963 through 1997, they have found that evidence of duration dependence is sensitive to the choice of sample period, the method of correcting for discrete observation of continuous duration, the use of value-weighted versus equally weighted portfolios, and the use of monthly versus weekly runs of abnormal returns.

Rappoport and White have argued that although standard tests find no bubbles in the stock price data for the last 100 years, historical accounts, focusing on briefer periods, point to the existence of a bubble during the Great Depression period of 1928-29. Their approach has used the behavior of the premia demanded on loans collateralized by the purchase of stocks as a bubble measure.

Abreu and Brunnermeier (2003) have developed a dynamic game model in which bubbles can persist even though all rational arbitrageurs know that the stock price is too high, and they jointly have the ability to correct the mispricing. There can be a large and long-lasting departure from fundamental values, because there is dispersion of opinions among rational arbitrageurs concerning the timing of the bubble. Their model provides a setting in which 'overreaction' and self-feeding price processes lead to full-fledged crashes.

Our model shares some common theme with Rappoport and White (1991) and Abreau and Brunnermeier (2003) in that our model extracts a bubble measure as market participants' overreaction to the new information on market fundamentals.

### III. The Theoretical Model

The present value (PV) model of stock prices implies that stock prices are equal to the present value of future cash flows such as dividends discounted by a constant real interest rate. Generally, the present value model takes the form of

$$(1) \quad P_t = \delta E_t(P_{t+1} + D_{t+1})$$

where  $P_t$  represents real stock prices at time  $t$  and  $D_{t+1}$  indicates real dividends between  $t$  and  $t+1$ , and  $\delta$  is a discount factor. The discount factor is equal to  $1/(1+r)$  with a constant real interest rate of  $r$ . The solution to equation (1) is given by

$$(2) \quad P_t = \sum_{k=1}^{\infty} \delta^k E_t(D_{t+k}) + \lim_{T \rightarrow \infty} E_t \delta^T P_{t+T}$$

If we impose a transversality condition on equation (2), then we obtain the unique solution to equation (1), which is given by

$$(3) \quad P_t = \sum_{k=1}^{\infty} \delta^k E_t(D_{t+k})$$

If the transversality condition fails to hold, we have a bubble part:

$$(4) \quad P_t = \sum_{k=1}^{\infty} \delta^k E_t(D_{t+k}) + B_t$$

where  $B_t = \lim_{T \rightarrow \infty} E_t \delta^T P_{t+T}$  measures the bubble term and satisfies the following process:

$$(5) \quad B_t = \delta E_t B_{t+1}$$

However, Hamilton (1986) and Diba and Grossman (1988a) reformulate the PV model in a different way from the conventional one such as equation (4). Hamilton (1986) has proposed the following PV model:

$$(6) \quad P_t = \delta(D_{t+1} + E_t P_{t+1} + \pi_t)$$

where  $\pi_t$  can be viewed as a catch-all random variable that is not observed by researchers, but can be observed only by market participants. The random variable includes the real interest rate, the risk premium, taxes on dividends, etc.  $\pi_t$  is assumed to be stationary, that is,  $I(0)$ .

Diba and Grossman (1988a) have conducted an empirical investigation of the Hamilton model using a slightly modified version.

$$(7) \quad P_t = \delta E_t(P_{t+1} + \alpha D_{t+1} + \pi_{t+1})$$

Diba and Grossman have proposed that if the unobserved  $\pi_t$  is stationary, and first differenced dividends and first-differenced stock prices are stationary, no bubble is present. That is, there is no bubble if  $\pi_t$  is  $I(0)$ , and stock prices and dividends are  $I(1)$ , and stock prices and dividends are cointegrated ( $CI(1,1)$ ). Diba and Grossman have

derived the following estimation equation:

$$(8) \quad P_{t+1} + \gamma D_{t+1} - (1/\delta)P_t = e_{t+1} - \pi_{t+1}$$

where  $e_{t+1} = P_{t+1} + \gamma D_{t+1} + \pi_{t+1} - E_t(P_{t+1} + \gamma D_{t+1} + \pi_{t+1})$ . The left-hand side becomes stationary if  $\pi_{t+1}$  is stationary, since  $e_{t+1}$  is not serially correlated.

In this study, we develop a rational bubble model in the spirit of Hamilton (1986) and Diba and Grossman (1988) but in a more straightforward manner. Our bubble model can be viewed as a significant improvement over the Hamilton and Diba-Grossman approaches. The obvious merit of our approach is that we derive the bubble measure without introducing unobservable random variables. Our model formulates a bubble measure as an overreaction to new information on market fundamentals by rational participants.

Since the present value relation must hold in period  $t-1$ , we have

$$(9) \quad P_{t-1} = \sum_{k=1}^{\infty} \delta^k E_{t-1}(D_{t+k-1})$$

Multiplying equation (3) by  $\delta$  and subtracting it from equation (9),

$$(10) \quad P_{t-1} - \delta P_t = E_{t-1} \delta D_t - \sum_{k=1}^{\infty} \delta^{k+1} [E_t - E_{t-1}] D_{t+k}$$

We can rearrange equation (10) to obtain

$$(11a) \quad \delta(P_t + D_t) - P_{t-1} = \sum_{k=0}^{\infty} \delta^{k+1} [E_t - E_{t-1}] D_{t+k}$$

$$(11b) \quad P_t + D_t = \frac{1}{\delta} P_{t-1} + \sum_{k=0}^{\infty} \delta^k [E_t - E_{t-1}] D_{t+k}$$

Equation (11b) can be further simplified as

$$(12) \quad P_t = (1+r)P_{t-1} - D_t + \nabla_t$$

where  $\nabla_t = \sum_{k=0}^{\infty} \delta^k [E_t - E_{t-1}] D_{t+k}$  denotes the present value of the sum of the forecast errors of market participants. That is, this is the rational response of participants to market fundamentals since  $[E_t - E_{t-1}] D_{t+k}$  is the difference between the  $k$ -period-ahead forecast of dividends in the previous period and the  $k$ -period-ahead forecast of dividends based on the arrival of new information in the current period. Since the bubble measure can be viewed as an information update by market fundamentals or a reaction to new information on market fundamentals, equation (12) will be called an information error model. The term  $\nabla_t$  is not the usual bubble measure defined in the literature. In essence it is similar to Hamilton's and Diba-Grossman's bubble formulation.

It can be demonstrated that  $\nabla_t$  is the same as the unobserved variable in the Hamilton-Whiteman and Diba-Grossman models. We can rewrite our information error model as follows:

$$(13) \quad P_{t+1} = \frac{1}{\delta} P_t - E_t D_{t+1} + v_{t+1}$$

where  $v_{t+1} = \sum_{k=1}^{\infty} \delta^k [E_t - E_{t-1}] D_{t+k+1}$ . Let  $E_{t+1} D_{t+1} - E_t D_{t+1} = e_{t+1}$

$$(14) \quad P_{t+1} + D_{t+1} - \frac{1}{\delta} P_t = e_{t+1} + v_{t+1}$$

This expression is the same as the Diba-Grossman model when  $\gamma = 1$  in their model. We note that  $\bar{V}_{t+1} = e_{t+1} + v_{t+1}$  ( $\bar{V}_{t+1} = e_{t+1} + \pi_{t+1}$  in the Diba-Grossman model). Thus, we can extract bubbles from  $P_t + D_t - (1/\delta) P_{t-1}$  without introducing arbitrarily an unobserved random variable. Furthermore,  $\bar{V}_t$  is not serially uncorrelated. This can be proved by the law of iterated expectations.

It is assumed that the bubble measure ( $\bar{V}_t$ ) has a Weibull distribution. There is not only a parallel between the burst of a speculative bubble and a material's burning out, but also there is a good reason to believe that the bubble measure can be appropriately modeled as the Weibull function. A bubble is a rare event. Like other rare events, bubbles can be formulated in terms of the instantaneous rate at which an event occurs after duration  $t$  since some prior event has occurred.

We will denote a bursting bubble by a continuous random variable  $T$ . If  $T$  has a probability density function  $f(t)$ , then the probability that optimistic expectations about stock prices continue to hold until a specific time  $t$  is given by

$$(15) \quad z(t) = \Pr(T > t) = \int_t^{\infty} f(t) dt = 1 - F(t)$$

where  $z(t)$  is the survival function for optimistic forecasting until a specific time  $t$ , and  $F(t)$  is the cumulative density function. Then the following rate called the hazard rate measures the likelihood of the bursting of a bubble in the next small unit of time  $\Delta t$ , given that a bubble has survived until time  $t$ .

$$(16) \quad \theta(t) = \lim_{\Delta t \rightarrow 0} \frac{[F(t + \Delta t) - F(t)]}{\Delta t} \cdot \frac{1}{z(t)} = \frac{F'(t)}{z(t)} = \frac{f(t)}{z(t)} = \frac{f(t)}{1 - F(t)}$$

Thus, the busting rate is given by

$$(17) \quad \theta(t) = -\frac{z'(t)}{z(t)} = -\frac{d \ln z(t)}{dt}$$

From equation (17), we can derive the probability density function (*pdf*) as follows:

$$(18a) \quad \ln z(t) = -\int \theta(t) dt + \ln c$$

Equivalently,

$$(18b) \quad z(t) = ce^{-\int \theta(t) dt}$$

Then the cumulative density function can be expressed as

$$(19) \quad F(t) = 1 - ce^{-\int \theta(t) dt}$$

If  $f(t)$  follows the Weibull distribution, then we have the following *pdf*

$$(20) \quad f(t) = \alpha \lambda t^{\alpha-1} \exp(-\lambda t^\alpha)$$

and the bursting rate is given by

$$(21) \quad \theta(t) = \alpha \lambda t^{\alpha-1}$$

When  $\lambda$  is equal to 1, we have  $\theta(t) = \alpha t^{\alpha-1}$ , which gives the possibility of an extraneous bubble (speculative bubble).  $\theta(t)$  can be greater than one since  $\theta(t) \cdot \Delta t$  is equal to the conditional probability. The coefficient  $a$  denotes the shape parameter, also known as the Weibull slope. Different values of the shape parameter can have significant effects on the behavior of the distribution. In fact, different values of the shape parameter may lead to different distributions. For example, when  $a = 1$ , the *pdf* of the two-parameter Weibull reduces to that of the one-parameter exponential distribution. The bursting rate  $\theta(t)$  will increase or decrease depending on the value  $a$ . There are four possibilities.

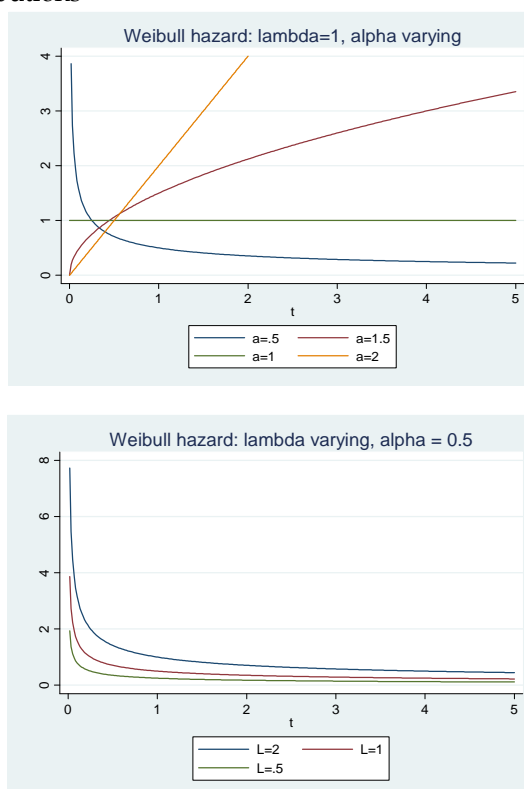
(a) If  $a$  is smaller than one, the bursting rate decreases, so that the possibility of bursting will also decrease as time goes on.

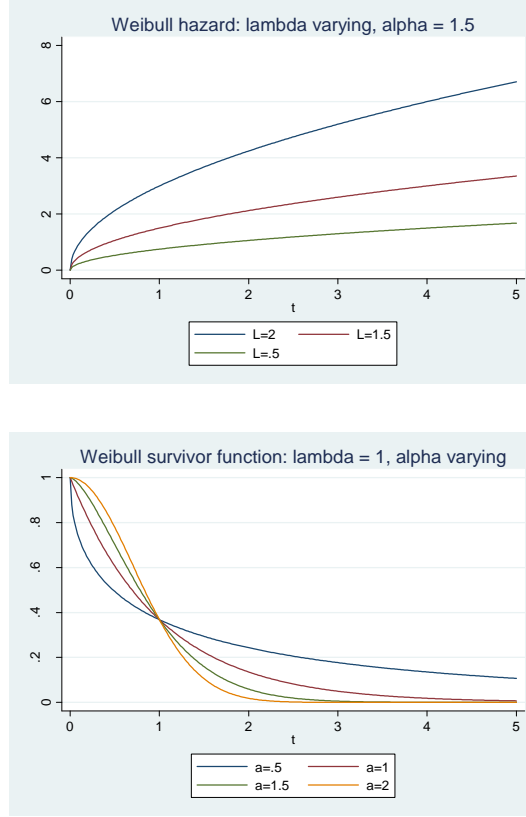
(b) If  $a$  is equal to one, the bursting rate is constant, so that the possibility of bursting will also be constant. This case is the same as the well-known exponential distribution.

(c) If  $1 < a < 2$ , the bursting rate increases at a decreasing rate, so that the possibility of bursting also will increase at a decreasing rate.

(d) If  $a$  is greater than 2, the bursting rate increases at an increasing rate, so that the possibility of bursting will increase at an increasing rate. Thus, an explosive bubble occurs when  $a$  is greater than 2. <Figure 1> shows the Weibull distribution for various values of the parameters.

Figure 1. Weibull Distributions





We can derive the specifications for purely extraneous bubbles and intrinsic bubbles from equation (21). We obtain an intrinsic bubble model if we let  $\lambda = \exp(X'\beta)$  and an extraneous bubble model if we let  $\lambda = 1$ :

$$(22a) \quad \theta(t) = \alpha t^{\alpha-1} \exp(X'\beta) = \psi_1(t)\psi_2(X') : \quad \text{Intrinsic bubbles}$$

$$(22b) \quad \theta(t) = \alpha t^{\alpha-1} = \psi_1(t) \quad \text{with} \quad \psi_2(X') = 1 : \quad \text{Extraneous bubbles}$$

where  $X$  denotes the set of variables that are thought to be related to a firm's fundamental values.

## IV. Empirical Analysis

### 1. Data Description

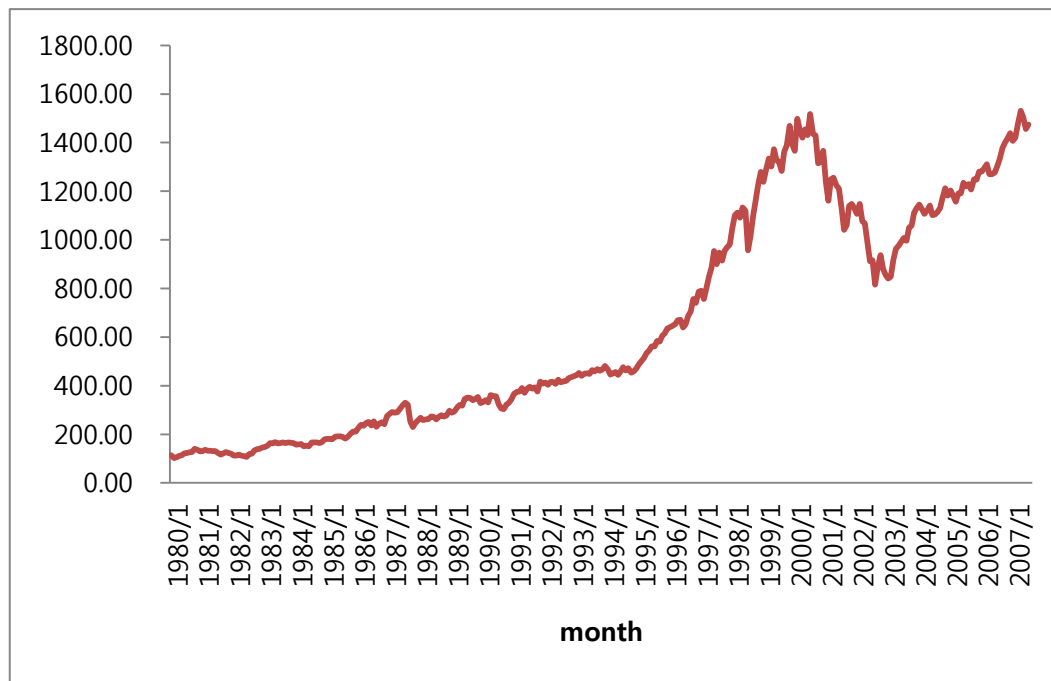
We have used U.S. monthly data from 1980:1 to 2007:10. We have divided the sample into three sub-samples: 1980:1 - 1987:10 (period 1), 1987:11 - 2000:8 (period 2), and 2000:9 - 2007:10 (period 3). This breakdown of the sample coincides with the eruptions and

subsequent collapses of seeming bubbles in the U.S. stock market in modern times. The stock price series reached a peak in October 1987 followed by a downturn commonly known as the Black Monday, and it reached another peak in August 2000 followed by the collapse of the stock prices together with the burst of the IT bubble. The third peak point on the series during the sample period occurred in October 2007.

The data used in this study include the S&P 500 composite index, the price-earnings ratio (PER), the term spread (TERM) between the short-term interest rate (3-month T-bill rate) and the long-term interest rate (10-year T-bond rate), the default rate (DEF), the nominal effective exchange rate (EX), and the unemployment rate (UNEMP). The data have been obtained from the Datastream database and the International Financial Statistics. The price-earnings ratio (PER) is derived by dividing the total market value of an index by the total amount of earnings. The default rate (DEF) is the default rate on all U.S. corporate bonds.

The term spread measures the forecast of the future economy. In a well-developed market, short-term interest rates reflect policy interest rates, but long-term interest rates include market participants' expectations of the future state of the economy. Thus, the term premium is an index of market participants' forecasting of the economy. The term spread contains information on future inflation and economic growth. The following diagram shows movements in the S&P 500 index from January 1980 to December 2007.

Figure 2. S&P500 Index



## 2. Measuring Bubbles

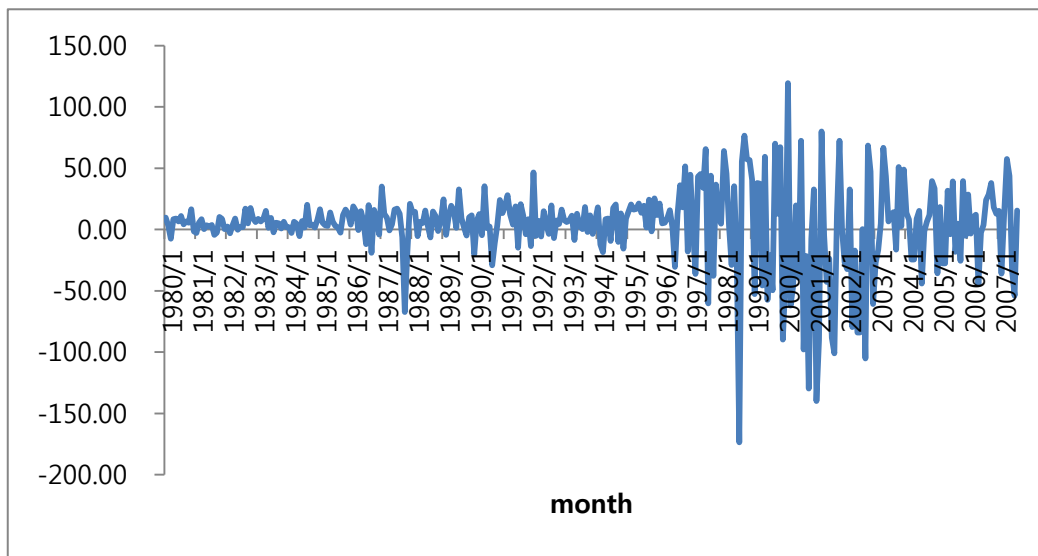
We obtain the portion of unexplained variations of stock prices (bubble measures) from the information error model. It is not possible to judge whether stock prices are 'too high' or 'too low' without any criteria. The information error model gives a criterion that

tells us whether current stock prices are too high or too low compared with the path implied by market fundamentals. Our information error model enables us to divide current stock prices into two parts, the market fundamental measure that is given by

$$P_t = -D_t + \frac{1}{\delta} P_{t-1} \text{ and the bubble measure that deviates from the expected orbit of the}$$

information error model. The bubble measure has been normalized to take positive values. The decomposition of stock prices into these two parts is available from the authors upon request.

Figure 3. Non-Fundamentals in Stock Prices



### 3. Empirical Results

#### A. Unit-Root Tests

It is important to check whether a time series under consideration is stationary. If a variable is stationary, it does not contain a unit root. In this paper, we use the Phillips-Perron test (PP) that allows for serial dependence and heteroskedasticity. We have conducted unit-root tests for the following data-generating processes.

$$(23a) \quad y_t = \mu + \alpha y_{t-1}^* + u_t^*$$

$$(23b) \quad y_t = \mu + \beta(t - T/2) + \alpha y_{t-1} + u_t$$



Table 1. Unit-Root Tests

Variables	Phillips-Perron Test							
	$y_t = \mu + \alpha y_{t-1} + u_t$				$y_t = \mu + \alpha y_{t-1} + \beta (t - T/2) + u_t$			
	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10
Bubble Measure	-18.22*	-6.30*	-15.20*	-7.86*	-18.29*	-6.33*	-15.62*	-8.69*
PER	-215	-111	-0.93	-1.53	-233	-225	-1.87	-234
Term Premium	-4.59*	-3.47*	-2.41	-1.43	-4.54*	-3.78*	-2.39	-2.20
Unemployment Rates	-1.58	-1.36	-0.32	-2.00	-2.81	-2.05	-1.17	-2.52
Default Rates	-210	-1.34	-1.46	-0.24	-1.85	-2.47	-1.39	-2.62
Exchange Rates	-235	-1.51	-1.14	-0.34	0.94	-0.42	-2.88	-3.02

\*indicates significance at the 1% level and \*\* significance at the 5% level.

The tests have produced actually the same results for (23a) and (23b).

1. The bubble measure is unambiguously stationary. The bubble measure has turned out to be stationary in both the data-generating processes (the process with only a constant and the process with both a constant and a trend) in every sub-period as well as in the entire sample period.

2. The term spread is stationary only in period 1 and in the entire period.

3. We fail to reject the unit root null hypothesis for all other variables.

4. Thus, all other variables except for the bubble measure in all sample periods and the term spread (in period 1 and the entire period) contain a unit root. It is necessary to make these nonstationary variables stationary before we run a regression. These nonstationary variables have been first-differenced. We have confirmed that these first-differenced variables are stationary.

### B. Tests for Bubbles: The Weibull Tests

A bubble of stock prices can be detected only when there is the possibility of bursting of the bubble. As long as there is no possibility of explosion although stock prices are very high, such high stock prices will adjust to an appropriate level predicted by market fundamentals with the passage of time. As we have seen from the hazard model, there is the possibility of bursting if  $a$  is greater than 2.

#### B.1. Testing for Purely Extraneous Bubbles

Table 2. Tests for Extraneous Bubbles

Period	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10
$a$	1.32*	1.37*	1.48*	1.64*

\* indicates significance at the 5 percent level.

Purely extraneous bubbles are from participants' psychological wave of moods, not from the current or future state of the economy. It is clear that if  $a$  is greater than 2 in equation (22b) and significant, the explosion of a bubble can be caused by extraneous factors that are not related to market fundamentals. <Table 2> shows that there is no evidence for extraneous bubbles in the U.S. stock market, indicating that there is no possibility of seemingly too high stock prices to become explosive bubbles driven by a wave of people's psychological biases or fads. The estimated value of  $a$  is 1.32 for the entire sample period, and 1.37 for sample period 1, 1.48 for sample period 2, and 1.64 for sample period 3. All the estimates are significant at the 5 percent level of significance. Thus, we can conclude that although stock prices seem to have been overvalued on certain time intervals, overheated stock prices were not driven by extraneous factors.

## B. 2. Testing for Intrinsic bubbles

In order to investigate whether bubbles are driven by market fundamentals or not, we have included a set of variables in the Weibull specification that affect stock prices. Fama and French (1989), McQueen and Thorley (1994), Harman and Zuehlke (2004) and others have maintained that the term spread and the dividend yield (D/P) are useful in predicting real abnormal returns. In the tradition of these studies, the variables that represent market fundamentals include the PER (price-earnings ratio), TERM (term spread), UNEMP (unemployment rate), DEF (default rate) and EX (exchange rate)<sup>1</sup>. We have estimated the following Weibull model with nonstationary variables differenced:

$$(24) \theta(t) = \alpha t^{\alpha-1} \exp(\beta_0 + \beta_1 PER_t + \beta_2 TERM_t + \beta_3 UNEMP_t + \beta_4 DEF_t + \beta_5 EX_t)$$

Table 3. Tests for Intrinsic Bubbles

	With the results of the unit root test			
Period	1980:1-2007:10	1980:1-1987:10	1987:11-2000:8	2000:9-2007:10
A	1.52*	1.78*	1.61*	1.92*
$\beta_0$	0.80	-0.39	1.09	-9.14*
PER	0.06*	-0.05	0.01	-0.13*
TERM	0.04	-0.05	0.34*	0.13
UNEMP	-0.36*	-0.39*	-0.49*	0.21
DEF	0.11*	-0.18	-0.01	0.34
EX	-0.02*	0.06*	-0.01	0.08

\* indicates significance at the 5 percent level.

<sup>1</sup> The referee suggests that in order to detect the probability of stock bubbles, researchers often refer to the extension of private aggregate credit, increases of short-term trading, and the speed of the velocity of stock price increases. This suggestion is worth noting, and the authors plan to deal with this issue in a separate research paper

The key element in the Weibull distribution is the size of  $\alpha$ . When the value of  $\alpha$  is greater than 2, that is, when the hazard function is weakly convex increasing function, then the bursting rate increases at an increasing rate, and this is interpretable in favor of the existence of an explosive bubble. We have found the following results:

1. The value of  $\alpha$  is 1.52 for the entire sample period, and the coefficient is significant. Thus, no evidence in favor of explosive bubbles is found for the entire sample period.

2. The value of  $\alpha$  is considerably less than 2 at the 5 percent level of significance in both the sample period 1 (1980:1-1987:10) and sample period 2 (1987:11-2000:8). Thus, during these briefer sub-sample periods, stock prices seem to have risen too much, but they did not develop into explosive bubbles. The spike of stock prices followed by the largest single-day drop during the 1987 Black Monday was a temporary adjustment of the market. The boom of the stock market starting in the middle of the 1990s and lasting until August 1980 reflected productivity growth brought by the IT (information technology) Revolution and did not represent an explosive bubble.

3. Interestingly enough, the value of  $\alpha$  is 1.92 for the sample period 3 (2000:9-2007:10) and significant at the conventional level of significance. It is interesting to find that the hazard function is estimated to be less concave during the sample period 3 compared with the previous two subsample periods. Since the estimate is so close to 2 that this finding can be construed as evidence for the existence of an explosive bubble during the 2000:9-2007:10 period.

4. This finding is consistent with some recent studies such as Bohl (2003) and Nasseh and Strauss (2004) who have found that explosive bubbles were present in the U.S. stock market when the sample data include recent stock price hikes since the late 1990s. As observed by Rappoport and White (1991), it is entirely possible to detect a bubble in briefer sub-sample periods even though bubbles may not be present over a longer period of time that encompasses the shorter sub-sample periods.

5. On the other hand, McQueen and Thorley have found statistical evidence of negative duration dependence in runs of positive abnormal monthly returns for both the equally weighted and value-weighted portfolios of all NYSE-traded stocks from 1927 to 1991, and interpreted this finding as evidence for the presence of speculative bubbles in the NYSE. Their finding seems to be at odds with our empirical evidence. In contrast, Harman and Zuehlke have questioned the results reported by McQueen and Thorley. Using both equally weighted and value-weighted portfolios of all NYSE stocks from 1927 through 1997 and equally weighted and value-weighted NYSE-AMEX indices for the period 1963 through 1997, they have found that with monthly data, only the Discrete Weibull and Discrete Logistic models in conjunction with value-weighted portfolios provide evidence supporting speculative bubbles, but the Continuous and Interval Weibull models consistently yield evidence of positive duration dependence for runs of both positive and negative abnormal returns. Furthermore, neither of these models provides evidence of speculative bubbles when used with weekly data.

6. We have tested for the model using a broader pool of market fundamentals including industrial production and earnings per share, but this extension has little effect on the test results.

### C. Tests for Bubble: Unit-Root and Cointegration Tests

Table 4. Phillips-Perron Unit-Root Test for Prices (P) and Dividends (D)

Period	$y_t = \mu + \alpha y_{t-1} + u_t$				$y_t = \mu + \alpha y_{t-1} + \beta (t - T/2) + u_t$			
	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10
P	0.129 (0.974)	-0.753 (0.827)	3.152 (1.000)	-1.081 (0.720)	-1.912 (0.646)	-2.262 (0.450)	-0.184 (0.993)	-2.928 (0.159)
D	3.395 (1.000)	1.179 (0.998)	-2.117 (0.238)	1.256 (0.998)	1.386 (1.000)	-3.077 (0.118)	-6.013 (0.000)	-2.205 (0.325)
$\Delta P$	-18.716 (0.000)	-6.584 (0.000)	-14.319 (0.000)	-8.334 (0.000)	-18.732 (0.000)	-6.329 (0.000)	-16.819 (0.000)	-8.798 (0.000)
$\Delta D$	-25.865 (0.000)	-18.682 (0.000)	-24.066 (0.000)	-12.218 (0.000)	-28.433 (0.000)	-13.910 (0.000)	-25.953 (0.000)	-14.604 (0.000)

\*Numbers in parentheses denote p-values.

Following the traditional approach to testing for the existence of explosive bubbles, we have also conducted unit-root and cointegration tests for stock prices and dividends (D). We have examined two data-generating processes: processes with only a constant and processes with both a constant and a trend. Our Phillips-Perron unit-root tests reveal that stock prices unambiguously contain a unit root in both the processes for all sample periods, and the results for dividends are very similar to those of stock prices only with the exception that the dividend series (with both a constant and a trend) is stationary during sample period 2. On the other hand, first-differenced stock prices and first-differenced dividends are stationary in all data-generating processes for all samples.

We have tested for cointegration between stock prices and dividends using the Augmented Engle-Granger test. We are unable to reject the unit-root null hypothesis for the entire sample period as well as for sub-sample periods 1 and 2, but we reject the unit-root null hypothesis for sub-sample period 3. According to the unit-root and cointegration test results, we should conclude that there were eruptions of bubbles during the 1980:1-1989:1 and 1989:2-2000:8 periods, but there was no explosive bubble during the 2000:9-2007 period. These findings are at variance with our Weibull test results. It should be, however, noted that the unit-root and cointegration test results seem to be inconsistent with some recent findings. Several recent studies have found that a bubble was detected only when the recent stock price series was included in the sample.

Table 5. AEG Test for Conintegration between Stock Prices and Dividends

Period	$y_t = \mu + \alpha y_{t-1} + u_t$				$y_t = \mu + \alpha y_{t-1} + \beta (t - T/2) + u_t$			
	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10	1980:1- 2007:10	1980:1- 1987:10	1987:11- 2000:8	2000:9- 2007:10
AEG	-0.732 (0.969)	-2.867 (0.178)	-1.732 (0.732)	-2.901 (0.167)	-1.815 (0.695)	-2.527 (0.315)	-0.528 (0.981)	-4.911 (0.001)

\*Numbers in parentheses denote p-values.

## V. Concluding Remarks

The purpose of this study is to establish theoretical foundations for rational bubbles and to provide empirical evidence on the existence of rational bubbles in the U.S. stock market. There has recently been a resurgence of interest in bubbles in stock prices as U.S. stock prices have begun to rise steeply and exhibited wide fluctuations over the past 20 years or so. The bubble models elaborated by Hamilton and Whiteman (1985), Diba and Grossman (1988a,b,c), Froot and Obstfeld (1991) and others represent a significant departure from the conventional view in that they reinterpret rational bubbles in terms of market fundamentals. The attractive feature of the intrinsic bubble specification may be found in its ability to derive testable implications for bubbles by investigating the stationarity properties of stock prices and dividends or by parameterizing a specific bubble relationship as a function of market fundamentals.

However, the existing approach to modeling intrinsic bubbles still remains unsatisfactory. As Evans and others indicate, unit-root and cointegration tests are unable to detect an important class of rational bubbles. Alternative strategies to the traditional stationarity tests are found in Rappoport and White (1991) and Abreu and Brunnermeier (2003) or in McQueen and Thorley (1994) and Harman and Zuehlke (2004) who have not relied on unit-root and cointegration tests, and instead looked at the nature of bursting bubbles from the aspect of overreaction and informational errors (Rappoport and White, Abreu and Brunnermeier) or from the aspect of duration dependence (McQueen and Thorley, Harman and Zuehlke).

In this study we formulate an information error model that allows one to derive bubble measures in a straightforward manner. This study provides a new method of testing for bubbles by specifying bubble measures in the context of the Weibull distribution. In our model, a bubble can occur as the result of overreaction of market participants to new information. One distinguishing feature of this study may be found in its attempt to formulate the bubble measures as the Weibull distribution.

We have tested for the presence of bubbles in the U.S. stock market using monthly data from January 1980 to October 2007. We have divided the entire sample into three sub-samples: (1) 1980:1–1987:10, (2) 1987:11–2000:8, and (3) 2000:9–2007:10. The division of the sample period into three sub-sample periods roughly coincides with the uphill surge of stock prices followed by their downturns over the past three decades or so.

Our empirical analysis reveals that there is no evidence for extraneous bubbles in the U.S. stock market in any sample period. Our study further shows that there is no evidence in favor of the existence of intrinsic bubbles for the entire sample period as well as for the 1980:1–1987:10 and 1987:11–2000:8 sub-sample periods. However, it is worth noting that the surge and the subsequent collapse of stock prices during the 2000:9–2007:10 period turned out to be an explosive intrinsic bubble. These findings appear to be in agreement with some recent studies on rational bubbles in the U.S. stock market that found evidence for explosive bubbles when volatile stock prices since the middle of the 1990s are in the sample.

Interestingly, our unit-root and cointegration tests have produced opposite results. The stationarity tests show that there were explosive bubbles during the 1980:1–1989:1 and 1989:2–2000:8 periods, but there was no bubble during the 2000:9–2007 period. These findings are at variance with our Weibull test results. However, it should be noted that the stationarity test results seem to be inconsistent with some recent findings. Criticisms of unit-root and cointegration tests by Evans and others have been reinforced by this study.

## References

- Abreu, D. and M. K. Brunnermeier, "Bubbles and Crashes," *Econometrica* 71, 2003, 173-204.
- Ackert, L. and B. Smith, "Stock Price Volatility, Ordinary Dividends, and Other Cash Flows to Sreholders," *Journal of Finance* 48, 1147-1160.
- Bohl, M.T., "Periodically Collapsing Bubbles in the U.S. Stock Market?" *International Review of Economics and Finance* 12, 2003, pp. 385-397.
- Campbell, J.Y. and R.J. Shiller, "Cointegration and Tests of Present Value Models," *Journal of Political Economy* 95, 1987, 1062-1088.
- Campbell, J.Y. and R.J. Shiller, "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors," *Review of Financial Studies* 1, 1988, 195-228.
- Chan, K., G.R. McQueen, and S. Thorley, "Are There Rational Speculative Bubbles in Asian Stock Markets?" *Pacific-Basin Finance Journal* 6, 1998, 125-151.
- Charemza, W.W. and D. F. Deadman, "Rational and Intrinsic Bubbles: A Reinterpretation of Empirical Results," *Applied Financial Economics* 5, 1995, 199-202.
- Cochran, S.J. and R.H. Defina, "Duration Dependence in the U.S. Stock Market Cycle: A Parametric Approach," *Applied Financial Economics* 5, 309-318.
- Craine, R., "Rational Bubbles: A Test," *Journal of Economic Dynamics and Control* 17, 1993, 829-846.
- Crowder, B. and M. Wohar, "Stock Price Effects of Permanent and Transitory Shocks," *Economic Inquiry* 36, 1998, 540-552.
- Cunado, J., L.A. Gil-Alana, and F. Perez de Gracia, "A Test for Rational Bubbles in the NASDAQ Stock Index: A Fractionally Integrated Approach," *Journal of Banking & Finance* 29, 2005, 2633-2654.
- Cunado, J., L.A. Gil-Alana, and F.Perez de Gracia, "Testing for Stock Market Bubbles Using Nonlinear Models and Fractional Integration," *Applied Financial Economics* 17, 2007, 1313-1321.
- DeLong, D.N. and C.H. Whiteman, "The Temporal Stability of Dividends and Stock Prices: Evidence from the Likelihood Function," *American Economic Review* 81, 1991, 600-617.
- Diba, B.T. and H.I. Grossman, "Explosive Rational Bubbles in Stock Prices?" *American Economic Review* 78, 1988a, 520-529.
- Diba, B.T. and H.I. Grossman, "Rational Inflationary Bubbles," *Journal of Monetary Economics* 21, 1988b, 35-46.

- Diba, B.T. and H. I. Grossman, "The Theory of Rational Bubbles in Stock Prices," *Economic Journal* 98, 1988c, 746-754.
- Engle, R., "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation," *Econometrica* 50, 987-1007.
- Engle, R., D. Lilien, and R. Robins, "Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model," *Econometrica* 55, 391-407.
- Evans, G.W., "Pitfalls in Testing for Explosive Bubbles in Asset Prices," *American Economic Review* 81, 1991, 922-930.
- French, K.R., G. W. Schwert, and R.F. Stambaugh, "Expected Stock Returns and Volatility," *Journal of Financial Economics* 19, 1987, 3-29.
- Froot, K.A. and M. Obstfeld, "Intrinsic Bubbles: The Case of Stock Prices," *American Economic Review* 81, 1991, 1189-1214.
- Grossman, S.J. and R.J. Shiller, "The Determinants of the Variability of Stock Market Prices," *American Economic Review* 71, 1981, 222-227.
- Hamilton, J.D., "On Testing for Self-fulfilling Speculative Price Bubbles," *International Economic Review* 27, 1986, 545-552.
- Hamilton, J.D. and C.H. Whiteman, "The Observable Implications of Self-fulfilling Expectations," *Journal of Monetary Economics* 16, 1985, 353-373.
- Harman, Y.S. and T.W. Zuehlke, "Duration Dependence Testing for Speculative Bubbles," *Journal of Economics and Finance* 28, 147-154.
- Koustaş, Z. and A. Serletis, "Rational Bubbles or Persistent Deviations from Market Fundamentals?" *Journal of Banking and Finance* 29, 2005, 2523-2539.
- Lamont, O., "Earnings and Expected Returns," *Journal of Finance* 53, 1998, 1563-1587.
- McQueen, G. and S. Thorley, "Bubbles, Stock Returns, and Duration Dependence," *Journal of Financial and Quantitative Analysis* 29, 1994, 379-401.
- Nasseh, A. and J. Strauss, "Stock Prices and the Dividend Discount Model: Did Their Relation Break Down in the 1990s?" *Quarterly Review of Economics and Finance* 44, 2004, 191-207.
- Phillips, P.C.B., "Time Series Regression with a Unit Root," *Econometrica*, 55, 1987, 277-301.
- Phillips, P.C.B. and P. Perron, "Testing for a Unit Root in Time Series Regression," *Biometrika* 74, 1988, 535-547.
- Rappoport, P. and E.N. White, "Was There a Bubble in the 1929 Stock Market?" NBER Working Paper No. 3612, 1991.

- Sarno, L. and M.P. Taylor, "An Empirical Investigation of Asset Price Bubbles in Latin American Emerging Financial Markets," *Applied Financial Markets* 13, 2003, 635-643.
- Shiller, R.J., "Do Stock Prices Move Too Much To Be Justified by Subsequent Changes in Dividends?" *American Economic Review* 71, 1981a, 421-436.
- Shiller, R.J., "The Use of Volatility Measures in Assessing Market Efficiency," *Journal of Finance* 36, 1981b, 291-311.
- Summers, L.H., "Does the Stock Market Rationally Reflect Fundamentals?" *Journal of Finance* 41, 1986, 591-601.
- Timmermann, A., "Cointegration Tests of Present value Models with a Time-Varying Discount Factor," *Journal of Applied Econometrics* 10, 1995, 17-31.
- Yuhn, Ky H., "Stock Price Volatility: Tests for Linear and Nonlinear Cointegration in the Present Value Model of Stock Prices," *Applied Financial Economics* 6, 1996, 487-494.



## **Comments on “Was There an Explosive Bubble in U.S. Stock Prices before the Recent Stock Market Crash?”**

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While an asset bubble is an all-time interesting topic, it is being discussed more actively nowadays; because the bubble phenomenon would be a very possible side-effect following expansionary economic policies during the recent crisis. This paper tosses us another explanation of stock bubbles.

The main question of this research is whether there were explosive rational bubbles in U.S. stock markets. They use monthly data of S&P 500 from Jan. 1980 through Oct. 2007. The shape of hazard function is suggested to be a key criterion in determining the existence of explosive rational bubbles. If the hazard function is estimated to be a weak-convex increasing function, the bubbles are considered explosive and vice versa. Wisely, Weibull distribution is employed; because the shape of hazard function is easily summarized by the elasticity parameter in the distribution, which is Weibull parameter. They test the existence of bubbles in the cases of both extraneous and intrinsic bubbles and also analyze unit roots and cointegrating relationships for us to compare alternative specifications.

Authors stress formulation of easily observable bubble measures and introduction of Weibull distribution for their main contributions. But the following two things are more eye-catching to me. First, intrinsic variables are brought into their hazard functions rather than bubbles themselves. Froot and Obstfeld(1991) define intrinsic bubble as a kind of rational bubble which is a function of fundamental variables. In this paper, the intrinsic bubbles are the ones whose hazard functions include fundamental covariates. Second, they compare the shapes of hazard functions by sub-sample period. The hazard function of bubble after year 2000 is estimated to be less concave.

Since introduction of intrinsic variables in the hazard function is fairly challenging, detailed discussion of its implications would be very welcomed by many readers. Possible reasons for less concavity of hazard function after 2000 would be another attractive addition to the paper. It is also recommended to compare with McQueen and Thorley(1994) and Harman and Zuehlke(2004), which seem to contradict this paper in some ways. McQueen and Thorley show theoretically that the hazard functions of stock bubbles are decreasing in duration (negative duration dependence). Harman and Zuehlke study decreasing hazard function of stock bubbles using Weibull distribution.

In order to detect the probability of stock bubbles, practical economists often refer to expansion of private aggregate credit, increase of short-term trading, and fast velocity of stock price increase. Such variables could be good supplements to the intrinsic bubble analysis.

A few questions are still in my mind. First, the bubble term in the paper is derived from an equation which does not contain the rational bubble. Is the bubble term in this paper the usual bubble in other literatures? Second, the bubble term in this paper can be interpreted as information update. Could the updates or responses to new information be bubbles conceptually? Third, here the bubble can be negative unlike other literatures. What is the meaning of negative bubbles?

Summing up, this paper surveys and compares a lot of bubble literatures and has its own unique view on stock price bubbles. I expect this paper will improve our understanding of life cycle of stock price bubbles.

## References

- Froot, Kenneth A. and Maurice Obstfeld, "Intrinsic Bubbles: The Case of Stock Prices," *American Economic Review* 81, 1991, 1189-1214.
- McQueen, Grant and Steven Thorley, "Bubbles, Stock Returns, and Duration Dependence," *Journal of Financial and Quantitative Analysis* 29, 1994, 379-401.
- Harman, Yvette S. and Thomas W. Zuehlke, "Duration Dependence Testing for Speculative Bubbles," *Journal of Economics and Finance* 28, 2004, 147-154.

## Testing Financial Contagion with Time-Varying Correlation of Heteroscedastic Asset Returns

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### Abstract

We suggest that there is a significant time-varying relationship between cross-market co-movements and predictable market volatility. We demonstrate that the time-varying component of cross-market correlation is attributable to the responses by rational risk-averse investors who systematically revise their expectations in response to changing market volatility. Our results from the time-varying conditional correlation test for contagion show that (a) only the Philippines or the Philippines and Italy show evidence of contagion from the 1997 Asian crisis, and (b) there is no contagion evidence from both the 1994 Mexican peso crisis and 1987 U.S. stock market crash.

JEL Classifications: C32, F30, G15

Keywords: Financial contagion; cross-market co-movement; time-varying correlation test; cross-market correlation; modified DCC model

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## I. Introduction

With the growing importance of the role of international financial linkage, many studies have investigated the impact of a financial crisis in one region on the financial systems in other regions. In particular, recent financial crises have spawned empirical inquiries on the nature and impact of international equity market contagion. These studies have focused on the sharp increase in market co-movements that occur after an extremely negative return shock in one country.

We suggest that the substantial portion of cross market co-movements is induced by the reactions of rational, risk-averse investors who systematically revise their expectations along with the intertemporal risk-return relation to changing market volatility through various financial linkages. Unlike those previous studies that view the time-varying volatility as causing a heteroscedasticity bias in the correlation test for contagion, we suggest that the time-varying volatility is indeed a fundamental factor inducing the cross-market co-movements. However, the traditional correlation test for contagion ignores incorporating the time-varying aspect of cross-market co-movements.

Postulating that international equity market investors revise their expectations in response to the changing market volatility of other equity markets through many different financial channels, we propose a time-varying conditional correlation test for international equity market contagion. The new test is based on the fact that the time-varying nature of cross-market correlation is attributable to the responses of risk-averse investors who systematically revise their expectation in responding to time-varying volatility. In this new time-varying correlation test, we model cross-market conditional correlation as a function of time-varying volatility between two markets, such that contagion is defined as a sudden, sharp increase (or structural break) in the dynamics of time-varying conditional correlation during a crisis period. Thus, we do not view any temporal changes in correlation dynamics as contagion evidence.

To model time-varying cross-market correlations, we employ the dynamic conditional correlation (DCC) model proposed by Engle (2002) and Engle and Sheppard (2001). The main feature of the DCC model is that it allows the dynamics of conditional correlation to evolve from the cross-product of market volatilities and its own autoregressive process which captures the time-varying components of cross-market co-movements. This time-varying component of the conditional correlation is supposed to capture risk-averse investors' rational responses to changing market volatility.

Using a DCC multivariate GARCH model, we re-examined contagion for the 1997 Asian market crisis, the 1994 Mexican peso crisis, and the 1987 U.S. stock market crash. Contagion in our test is defined as a structural break in the dynamics of the conditional correlation during the crisis period. We found that the number of contagion events reported by the conventional constant correlation test significantly decreases in our time-varying conditional correlation test. For the 1997 Asian crisis, for example, out of the 16 countries reporting contagion evidence with the constant correlation test, only two countries, the Philippines and Italy, exhibit contagion evidence in our time-varying conditional correlation test for daily returns. For the two-day rolling average returns case, our test results show contagion occurs only in the Philippines data.

For the 1994 Mexican peso crisis, of the 2 countries (4 countries for the two-day moving average returns) reporting evidence of contagion by the constant correlation test, none exhibit contagion in our time-varying conditional correlation test. For the 1987 U.S. market crash, of the 4 countries (6 countries for the two-day moving average returns) reporting evidence of contagion by the conventional constant correlation test, none exhibit contagion evidence in our time-varying conditional correlation test. We also performed robustness checks using returns based on local currencies, and found the results robust.

Our test results confirm: (a) cross-market correlations are significant and change over time, reflecting the time-varying components of cross-market co-movements, (b) the main source of time-varying correlation is the systematic responses by risk-averse investors who systematically revise and adjust their expectations due to changing volatility, (c) when the time-varying feature of the conditional correlation is presented, contagion evidence mostly disappears, and (d) a high correlation during the crisis period reported as contagion evidence by the constant correlation test is mostly attributable to the high level of cross-market co-movements induced by the rational risk-averse investors during the crisis period.

Finally, our time-varying correlation test resolves the statistical bias problem in the conventional correlation test pointed out by Forbes and Rigobon (2002), Loretan and English (2000), and Boyer, Gibson, and Loretan (1999). In the conventional correlation test for contagion, heteroscedasticity in asset returns is viewed as a bias causing return correlation to be spuriously inflated and leading to an inaccurate test for contagion. However, in our correlation test for financial contagion, time-varying volatility plays an important role as an underlying force to drive the time-varying cross market correlation, such that the time-varying nature of the cross market correlation is incorporated into the dynamics of the conditional correlation. Thus, with this time-varying nature of the volatility-correlation relation correctly specified in the test of contagion, our time-varying correlation test effectively avoids the statistical bias problem raised by the previous studies.

The rest of this paper is organized as follows. In section 2, we discuss the related literature. In section 3, we describe the DCC multivariate GARCH model and specify the modified DCC model to capture a structural break in the dynamics of time-varying conditional correlation. Section 4 presents empirical results and interpretations for testing the 1997 Asian crisis, and section 5 reports empirical results for the test of the 1994 Mexican peso crisis and the 1987 U.S. market crash. Section 6 concludes the paper with a brief summary.

## II. Related Literature

There are many theoretical explanations of financial contagion. Most of these studies either interpret excess co-movement as an equilibrium result of fully rational behavior of agents in market setting with frictions (such as information asymmetry, information heterogeneity, imperfect competition, wealth and borrowing constraints, risk-bearing capacity, etc) or attribute excess co-movement to irrational decision-making by those same agents (such as herding, categorization, preferred habitat, etc).

For example, Valdes (1996) suggested that, since a crisis in one country can reduce the liquidity of market participants, investors may be forced to sell assets in another market to rebalance their portfolios in order to satisfy margin calls or to meet regulatory requirements. Masson (1999) showed that small triggers in one country can act as precipitating factors that induce a coordination of negative investor expectations about the market equilibrium for other countries. Mullainathan (2002) claimed that investors imperfectly recall past events, so a crisis in one country could trigger memories of past crises, causing investors to re-compute their priors on variables such as debt default, and assign higher probabilities to bad states. Demonstrating that cross-market rebalancing and information asymmetry can be the root of financial contagion, Kodres and Pritsker (2002) suggested that cross-market portfolio rebalancing may be a contagion channel. Yuan (2005) showed that correlated price movements arise from the interaction of information asymmetry and borrowing constraints. Kyle and Xiong (2001) and Gromb

and Vayanos (2002) argued that contagion could occur when financial intermediaries suffer unfavorable shocks to their portfolio positions, such that their portfolio values fall as does their risk bearing ability. Broner, Gelos, and Reinhart (2006) presented a model of investor portfolio rebalancing away from overexposed countries which could act as a crisis transmission channel.

The empirical literature on financial contagion has focused on the excess co-movement beyond the degree that is justified by economic fundamental. The correlation test has been widely used as a conventional methodology for testing financial contagion by examining whether cross-market correlations increase significantly after a crisis in a single country.<sup>1</sup> King and Wadhwani (1990) was the first study to employ this correlation approach in examining cross-market co-movements. They found that the correlation between the London and the New York stock markets rose immediately after the 1987 U.S. market crash, but returned to pre-crash levels when the volatility fell. Calvo and Reinhart (1996) suggested that the 1994 Mexican crisis was contagious because return correlations of weekly stock and Brady bonds for Asian and Latin American emerging markets increased after the Mexican peso's collapse. Baig and Goldfajn (1998) examined five East Asian countries during the 1997 Asian crisis period, and found that the cross-market correlations for stock indices, currencies, interest rates, and sovereign spreads, increased significantly during the crisis. Examining contagion in the context of asset pricing models, Wongswan (2003) and Bekaert, Harvey and Ng (2005) found that the correlations between idiosyncratic shocks are excessive from an asset pricing perspective. Park and Song (2001) and Chakrabarti and Roll (2002) also found that stock market co-movements in the East Asian region became larger during the crisis.

In the traditional correlation test, financial contagion is defined as a significant increase in cross-market co-movement during crises time periods relative to tranquil periods. This definition of contagion is popular for two reasons. First, it is intuitively appealing. If shocks are transmitted because two countries are fundamentally related, then after controlling for the macroeconomic fundamentals and the global shocks, there is little reason for the return correlation to increase during a market crisis, although the magnitudes of the transmitted shocks may be large. Second, this definition makes it easy to implement a test for contagion by examining whether the cross-market correlations are statistically different for two periods, the stable period and the crisis period. In this paper, we also adopt this definition of financial contagion for our analysis.

The traditional correlation test for contagion has been challenged by several studies. Forbes and Rigobon (2002), Loretan and English (2000), and Boyer, Gibson, and Loretan (1999) argued that the traditional correlation test for contagion is considerably biased due to the heteroscedasticity in the asset returns. On statistical grounds, they showed that return correlations can spuriously increase when stock markets become more volatile. Specifically, proposing a statistical adjustment for the heteroscedasticity bias in the correlation measure, Forbes and Rigobon (2002) showed that the previous result of contagion is reversed dramatically once the conditional correlation is adjusted for the bias in the test.<sup>2</sup>

Recently, however, Bartram and Wang (2005) and Corsetti, Pericoli, and Sbracia (2005) raised an issue with Forbes and Rigobon's (2002) adjustment for the heteroscedasticity bias. They pointed out that Forbes and Rigobon's empirical finding relies heavily on their particular assumptions about the stochastic process of idiosyncratic shocks, so that Forbes

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<sup>1</sup> See Forbes and Rigobon (2002) for the definition of equity market contagion and interdependence.

<sup>2</sup> Forbes and Rigobon (2002) showed that, when the bias is adjusted in the correlation tests, there is virtually no evidence of contagion over a set of 27 countries during the 1997 Hong Kong stock market crisis, 1994 Mexican peso devaluation, and 1987 U.S. stock market crash.

and Rigobon's adjustment may cause the correlation test to be severely biased towards the null hypothesis of no contagion. On the other hand, several other recent studies have found evidence of contagion during recent crises after correctly adjusting the estimated correlation for the heteroscedasticity bias. For example, by correcting three types of bias that they assumed affect the contagion tests, Caporale, Cipollini and Spagnolo (2005) showed contagion evidence during the 1997 Asian crisis. Measuring exceedence correlations from the extreme value theory, Bae, Karolyi and Stulz (2003) and Boyer, Kumagai and Yuan (2005) also found evidence of contagion during the Asian crisis. More recently, using copulas with Markov switching models to measure cross-market dependence during the Asian crisis, Rodriguez (2007) found significant evidence of contagion.

Another category of research has attempted to measure excess co-movement in a fashion which is consistent, at least in its principles, to the definition of financial contagion. For example, Pyndick and Rotemberg (1990, 1993), Bekaert, Harvey, and Ng (2005), Bekaert, Hodrick, and Zhang (2008), and Kallberg and Pasquariello (2008) attempt to measure co-movement in asset prices beyond what could be explained by common factors such as inflation, aggregate demand, foreign exchange or interest rates, and other fundamentals which should be expected to affect asset's payoffs at liquidity.

On the other hand, many recent studies have documented that the international equity market correlations are not constant, but time-varying. For example, Longin and Solnik (1995) showed that for seven OECD countries over the thirty-year period 1960-1990, correlations between U.S. and other OECD countries increased over time. They also found that the return correlation rises for the time periods when the market volatility is high. Ramchand and Susmel (1998) confirmed Longin and Solnik's (1995) findings of changing cross-market correlations with more recent data. Karolyi and Stulz (1996) showed that the correlation between the U.S. and Japanese stocks is high when there are large return shocks to the markets. Longin and Solnik (2001) and Ang and Chen (2002) also showed that the correlation increases only in periods of market downturns, and is not related to the market volatility of the bullish market. The common results from these studies are that correlation changes over time, and there is a significant relationship between cross market correlation and time-varying volatility.

Therefore, time-varying volatility plays an important role in the cross market co-movements, as substantial amount of cross market co-movements is induced by the responses of international equity market investors to the changes in predictable volatility. This implies that time-varying volatility should be considered as a fundamental economic factor inducing time-varying cross market correlation other than as a noise factor causing a statistical bias in the correlation test for contagion. Thus, the nature of the international equity market investors' response to the changing volatility could be explained by two widely used hypotheses in finance, the time-varying rational expectation hypothesis and the stock market overreaction (psychology) hypothesis.<sup>3</sup>

The time-varying rational expectation hypothesis assumes that risk-averse investors revise their expectations in response to changing market volatility. This implies that, given the risk-return tradeoff relationship, investors require a higher risk premium for a

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<sup>3</sup> The two hypotheses have been used as competing explanations on the predictable variation in stock returns. For the mean reverting behavior of stock prices explored initially by Summers (1986), for example, the time-varying rational expectation hypothesis argues that the mean reversion in the stock price is attributed to the adjustment of risk premium by risk-averse investors to changing market volatility. In contrast, the stock market overreaction hypothesis interprets the reverting behavior of stock prices as evidence of stock market inefficiency. It argues that the temporary long swings of the stock price away from its fundamental value is a result of stock market overreaction with irrational expectations to waves of optimism and pessimism, thereby rejecting the random walk process of stock price.

higher level of perceived future volatility [see Fama and French (1988), Ball and Kothari (1989), and Cecchetti, Lam and Mark (1990)]. In contrast, the stock market overreaction hypothesis argues that investors tend to overreact to any market news, with extremely optimistic or pessimistic expectations [see Shiller (1984), Summers (1986), Poterba and Summers (1988), DeBondt and Thaler (1985, 1987), Lehmann (1990), and Lo and MacKinlay (1990)].

These two hypotheses are not mutually exclusive in generating international equity market co-movements, as cross-market co-movements are attributable not only to intertemporal risk-return relation but also to investor overreaction with extremely optimistic or pessimistic expectations. We concentrate on the role of the two hypotheses in the correlation test for contagion by focusing on how the cross-market co-movements induced by risk-averse investors' rational responses differ from those induced by investors' overreactions to changing market volatility. This approach is based upon a different view from that of previous studies, which focuses on a statistical bias of time-varying volatility, but it provides a more reasonable economic rationale for the explanation of cross-market correlation.

### III. The Model

Our modeling strategy is (a) to capture the time-varying nature of the conditional correlation and (b) to capture a structural break in the dynamics of the conditional correlation during the crisis period. As a base model, we use the dynamic conditional correlation (DCC) model proposed by Engle (2002), which captures the time-varying component of correlation dynamics induced by the cross-product of conditional variances and its own autoregressive process. In our time-varying conditional correlation test, contagion is defined as a statistically significant structural break in the correlation dynamics during the crisis periods. To examine contagion, we specify two modified DCC multivariate GARCH models, with a time dummy variable imposed for representing the turmoil periods.

#### 1. The Dynamic Conditional Correlation Multivariate GARCH Model

Typical problems in the estimation of multivariate GARCH models mostly involve the computational difficulties associated with the number of parameters to be estimated and the assurance of positive definiteness of the estimated conditional covariance matrix. Since the introduction of the multivariate ARCH model by Kraft and Engle (1982), many studies have suggested various model specifications for resolving the problems arising in estimation. Among them are the diagonal-vech model by Bollerslev et al. (1988) and the BEKK model by Baba, Engle, Kraft, and Kroner (1990).

However, these early specifications did not completely resolve the mentioned problems. For example, while the diagonal-vech model by Bollerslev et al. (1988) reduces the number of parameters to be estimated, it is still computationally not feasible when the number of the time-series is greater than five, with no assurance that the estimated covariance matrix is positive definite for all realizations. Even with its capability to ensure the positive definiteness of the covariance matrix, the BEKK model by Baba et al. (1990) still suffers from a difficulty in the exact interpretation of the individual coefficients.

In contrast, the Constant Conditional Correlation (CCC) model by Bollerslev (1990) is relatively safer than the other two models in the sense that the assumption of constant correlation reduces computational complexity and the number of parameters to be



estimated, and it guarantees the positive definiteness of the covariance matrix.<sup>4</sup> Due to these attractive features, the CCC model has been used in many empirical applications.

Although Bollerslev's (1990) test for constant correlation accepts the null of constant correlation, the formal tests developed by Tse (2000) and Bera and Kim (2002) both reject the null of constant correlation for certain types of asset returns, notably for the national stock index returns. This motivated an extension of the CCC model to the dynamic conditional correlation (DCC) models by Engle (2002) and Engle and Sheppard (2001).

The DCC model assumes that the correlation matrix of the normalized residuals is time-varying. One of the critical merits of the DCC model lies in its simplicity of estimation with the two-stage estimation method. The first stage involves estimating univariate GARCH models for each series. Using the normalized residuals estimated from the first stage, the second stage involves estimating a conditional correlation matrix. The two-stage estimation method dramatically reduces the number of parameters to be estimated using maximum likelihood.

The DCC multivariate GARCH process of returns,  $r_t$ , from  $N$  different return series is:

$$r_t = E(r_t | \Omega_{t-1}) + \varepsilon_t, \quad \varepsilon_t | \Omega_{t-1} \sim N(0, H_t) \quad (1)$$

$$H_t = D_t R_t D_t, \quad (2)$$

where  $\Omega_{t-1}$  is the set of information available up to time  $t-1$ ;  $\varepsilon_t$  is the vector of innovations that is assumed to be conditionally multivariate normal with zero mean and time-varying conditional covariance matrix  $H_t$ ;  $R_t$  is the time-varying conditional correlation matrix; and  $D_t$  is the  $N \times N$  diagonal matrix of the conditional standard deviation,  $\sqrt{h_{it}}$ , on the  $i^{\text{th}}$  diagonal. The elements of the volatility matrix  $D_t$  are assumed to be the following GARCH model:

$$h_{it} = \kappa_i + \sum_{s=1}^p \alpha_{is} \varepsilon_{it-s}^2 + \sum_{s=1}^q \beta_{is} h_{it-s} \quad (3)$$

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<sup>4</sup> With the time-invariant correlation matrix, the CCC model implies that the temporal variation in conditional covariance is determined solely by the time-varying conditional variance process. If the conditional variance process takes all positive values, and the conditional correlation matrix is positive definite, then the conditional covariance matrix is guaranteed to be positive definite.

We consider the following DCC model:

$$Q_t = (1 - \sum_{r=1}^R \delta_r - \sum_{s=1}^S \gamma_s) \bar{Q} + \sum_{r=1}^R \delta_r Q_{t-r} + \sum_{s=1}^S \gamma_s (v_{t-s} v_{t-s}') \quad (4)$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1},$$

where  $\bar{Q}$  is the unconditional covariance matrix of the standardized residual vector  $v_t$  from the first stage estimation, and  $Q_t^*$  is the diagonal matrix composed of the square root of the diagonal elements of  $Q_t$ .  $\bar{Q}$  is constrained such that the long-run covariance matrix is the sample covariance matrix and is replaced with the sample analogue,  $T^{-1} \sum_{i=1}^T v_i v_i'$ . Engle and Sheppard (2001) show that for  $Q_t$  to be positive

definite,  $\delta$ 's and  $\gamma$ 's should be non-negative with  $\sum_{r=1}^R \delta_r + \sum_{s=1}^S \gamma_s < 1$ .  $R_t$  is also positive definite when  $Q_t$  is positive definite.

The log likelihood function for the estimation of parameters can be specified as follow:

$$\begin{aligned} L(\theta) &= -\frac{TN}{2} \log 2\pi - \frac{1}{2} \sum_{t=1}^T (\log |H_t| - \varepsilon_t' H_t^{-1} \varepsilon_t) \\ &= -\frac{TN}{2} \log 2\pi - \frac{1}{2} \sum_{t=1}^T (\log |D_t R_t D_t| - \varepsilon_t' D_t^{-1} R_t^{-1} D_t^{-1} \varepsilon_t) \\ &= -\frac{TN}{2} \log 2\pi - \frac{1}{2} \sum_{t=1}^T (2 \log |D_t| + \log |R_t| - v_t' R_t^{-1} v_t). \end{aligned} \quad (5)$$

## 2. Empirical Models for the Test of Contagion

We specify the following DCC (1,1) multivariate GARCH model as a base model to capture the time-varying component of the conditional correlation:

*Model 1: DCC model*

$$r_{jt} = \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt},$$

$$\begin{aligned}
h_{jt} &= \kappa_j + \alpha_j \varepsilon_{jt-1}^2 + \beta_j h_{jt-1}, \\
Q_t &= (1 - \delta - \gamma) \bar{Q} + \delta Q_{t-1} + \gamma (v_{t-1} v'_{t-1}),
\end{aligned} \tag{6}$$

where  $j$  is the country other than the crisis country, and  $r_{jt}$  is the return of country  $j$ .  $i_{jt}$  is the short-term interest rate of country  $j$ , and  $i_{US,t}$  is the 3-month U.S. Treasury bill rate.<sup>5</sup>

To capture a structural change in the dynamics of the conditional correlation during the periods of turmoil, we specify the following modified DCC (1,1) multivariate GARCH model as model 2, with a crisis dummy variable added to capture a structural break in the autoregressive process of the conditional correlation.

Model 2: Modified DCC Model A

$$\begin{aligned}
r_{jt} &= \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt}, \\
h_{jt} &= \kappa_j + \alpha_j \varepsilon_{jt-1}^2 + \beta_j h_{jt-1}, \\
Q_t &= (1 - \delta - \delta^c D - \gamma) \bar{Q} + (\delta + \delta^c D) Q_{t-1} + \gamma v_{t-1} v'_{t-1},
\end{aligned} \tag{7}$$

where  $D$  is a dummy variable taking a value 1 for the crisis period, otherwise taking 0.

$\delta^c$  is a smoothing crisis dummy parameter, which captures a shift in the time-varying conditional correlation, if any. The parameter restrictions for the positive definite covariance matrix are given by  $\delta \geq 0$ ,  $\delta^c \geq 0$ , and  $\delta + \delta^c + \gamma < 1$ . Using model 2 as an unrestricted model, we performed the likelihood ratio (LR) test for contagion against model 1 (the base DCC model) for the null hypothesis of  $H_0 : \delta^c = 0$ . The test statistic is distributed as a  $\chi^2$  with one degree of freedom.

In order to capture a structural break in the dynamics of the conditional correlation more effectively, we estimate the following modified DCC (1,1) model as model 3. The

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<sup>5</sup> Several studies have employed different control variables. For example, Baig and Goldfajn (1998) used domestic news dummies to control for domestic fundamentals and the S&P 500 index returns and the yen-U.S. dollar exchange rate to control for global factors. Park and Song (2001) used the overnight call rate to control for domestic fundamentals and the S&P 500 index returns and the differential between the yen-U.S. dollar and own currency-U.S. dollar exchange rates to control for global factors. We also used the S&P 500 index returns as a control variable, and found the results were robust.

only difference between model 2 and model 3 is that we add one more crisis dummy variable to the news impact term in addition to the autoregressive term.

Model 3: Modified DCC Model B

$$r_{jt} = \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt},$$

$$h_{jt} = \kappa_j + \alpha_j \varepsilon_{j,t-1}^2 + \beta_j h_{j,t-1}, \quad (8)$$

$$Q_t = (1 - \delta - \delta^c D - \gamma - \gamma^c D) \bar{Q} + (\delta + \delta^c D) Q_{t-1} + (\gamma + \gamma^c D) v_{t-1} v'_{t-1},$$

where  $\delta^c$  and  $\gamma^c$  are a smoothing crisis dummy parameter and a news impact crisis dummy parameter, respectively. A structural change in the time-varying conditional correlation, if any, can be captured by  $\delta^c$  and  $\gamma^c$ . To ensure the positive definite covariance matrix, parameter restrictions are given by  $\delta, \delta^c, \gamma, \gamma^c \geq 0$ , and  $\delta + \delta^c + \gamma + \gamma^c < 1$ . In our proposed likelihood ratio tests for contagion, the above model 3 was tested against model 1 for the null hypothesis of  $H_0 : \delta^c = \gamma^c = 0$ . The LR test statistic is distributed as a  $\chi^2$  with two degrees of freedom.

#### IV. Empirical Results and Interpretations

##### 1. Data Description

The sample of countries for testing contagion from the 1997 Asian crisis includes 28 national stock markets: eleven markets from Asia, ten markets from Europe, and six markets from North and South America. Using 28 daily national stock market indexes retrieved from the Datastream, we calculate daily percentage returns as logarithmic differences multiplied by 100. Returns are based on both local currencies and U.S. dollars. We employ the 3-month short-term interest rate as a proxy to capture the changes in domestic macroeconomic fundamentals and the aggregate monetary shocks for each country. A list of market indexes and short-term interest rates used in the analysis is reported in the Appendix.

For the 1997 Asian market crash, we test for contagion from Hong Kong to the rest of the world. While there is a sufficient agreement as to when a crisis started, there is more ambiguity and disagreement as to the ending date of the crisis. Following Forbes and Rigobon (2002), we apply a somewhat narrow crisis window to our test, given that the Hong Kong market lost about a quarter of its value in four trading days starting on October 17, 1997, and it continued to decline until the end of November. We thus define the crisis period for the 1997 Asian market crash as starting on October 17, 1997, and ending on November 14, 1997. We define the stable period as January 1, 1996, to October 16, 1997, such that the stable period is immediately followed by the one-month-long crisis

period.<sup>6</sup> Thus, the full period considered in our test is from January 1, 1996, to November 14, 1997.

On any given day, the Hong Kong market opens earlier than any other market in our sample, except for Australia, Japan, and Korea. Australia opens 2 hours earlier, and Japan and Korea open 1 hour earlier than Hong Kong. Major European markets such as France, Germany, Italy, and the Netherlands open 7 hours later, and the U.K. opens 8 hours later than Hong Kong. As the last, Wall Street opens 13 hours later than Hong Kong. Thus, we match the Hong Kong stock return at time  $t$  with the other countrys' returns at time  $t$  for the 1997 Asian market crash.

For the 1994 Mexican peso crisis, the stable period is from January 1, 1993, to December 18, 1994, and the crisis period is from December 19, 1994, to December 31, 1994. For the 1987 U.S. market crash, the stable period is from January 1, 1986, to October 16, 1987, and the crisis period is from October 17, 1987, to December 4, 1987. If a country's stock market is open at the same time as the U.S. and Mexico markets, we match the country's index return at time  $t$  with the U.S. and Mexico index returns at time  $t$ ; <sup>7</sup> otherwise, we match the country's index return at time  $t$  with the U.S. and Mexico index returns at time  $t-1$ . <sup>8</sup>

Following Forbes and Rigobon (2002) and Corsetti et al. (2005), we also employ two-day rolling-average returns of each country for the contagion test. While the use of the two-day moving average returns is effective in controlling the problem arising from the different time-zones of the national stock markets, the two-day return series exhibits a high degree of serial correlation for all countries. We remove serial correlations in the two-day rolling average returns by estimating AR(8) model for all series. After removing serial dependence, we estimate the DCC multivariate GARCH model on the resulting residuals.

Table I reports the summary statistics of both daily and two-day rolling-average return series for each country. It shows that both return series exhibit an excess kurtosis, and the *squared* returns are all strongly serially correlated. This indicates that all the index returns are characterized by the time-varying heteroscedasticity, which is known as a stylized fact of stock returns. As mentioned earlier, we view the time-varying heteroscedasticity of stock returns as one of the important economic factors to induce the time-varying conditional return correlation.

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<sup>6</sup> According to Forbes and Rigobon (2002), although the Thailand and Indonesian markets declined sharply in July and August 1997 respectively, the press in the U.S. and Europe paid little attention to the earlier movements in these markets until the sharp decline in the Hong Kong market in mid-October. After this, events in Asia became headline news, and an avid discussion quickly began on the East Asian "crisis" and possibility of "contagion" to the rest of the world. Thus, we tested for financial contagion from Hong Kong to the rest of the world during the Hong Kong market turmoil.

<sup>7</sup> Canada and countries in Latin America belong to this category.

<sup>8</sup> Countries in Asia and Europe belong to this category.

Table 1. Summary Statistics of Daily and Two-day Rolling Average Returns for the 1997 Asian Crisis

The source of the data is Datastream. Summary statistics include the mean (Mean), standard deviation (SD), skewness (Skew), kurtosis (Kurt), minimum (Min), maximum (Max), and the p-values of the Ljung-Box statistics ( $Q(12)$ ). Both daily and two-day rolling average returns are based on U.S. dollars. Countries in the sample include Australia (AUS), Hong Kong (HK), India (INA), Indonesia (IND), Japan (JAP), Korea (KOR), Malaysia (MAL), the Philippines (PHI), Singapore (SIN), Taiwan (TWN), Thailand (THA), Belgium (BEL), France (FRA), Germany (GER), Italy (ITA), the Netherlands (NET), Russia (RUS), Spain (SPA), Sweden (SWE), Switzerland (SWI), the U.K. (UK), Argentina (ARG), Brazil (BRA), Chile (CHI), Mexico (MEX), Canada (CAN), the U.S. (US), and South Africa (SA).  $Q(12)$  is the Ljung-Box statistic for the 12<sup>th</sup> order serial correlation of *squared* returns.

Panel A: Daily Returns								Panel B: Two-day Moving Average Returns						
Country	Mean	SD	Skew	Kurt	Min	Max	$Q(12)$	Mean	SD	Skew	Kurt	Min	Max	$Q(12)$
<i>Asia</i>														
AUS	0.01	0.98	-0.31	10.07	-5.63	6.41	0.00	0.01	0.69	-1.11	10.74	-5.09	2.68	0.00
HK	-0.00	1.79	-0.20	25.26	-13.58	15.56	0.00	-0.01	1.20	-2.02	19.71	-9.41	6.36	0.00
INA	0.05	1.33	0.40	9.23	-7.08	8.71	0.98	0.05	1.04	0.43	6.14	-3.69	5.49	0.00
IND	-0.11	2.10	0.12	16.43	-13.67	14.47	0.00	-0.11	1.64	0.13	10.96	-7.05	9.48	0.00
JAP	-0.09	1.05	-0.04	4.34	-3.88	3.79	0.00	-0.09	0.75	-0.27	4.34	-3.41	2.09	0.00
KOR	-0.17	1.72	-0.33	8.20	-8.92	7.77	0.00	-0.17	1.36	-0.53	10.20	-8.64	7.55	0.00
MAL	-0.13	1.67	0.89	21.29	-10.39	13.80	0.00	-0.13	1.31	1.14	18.10	-6.47	10.65	0.00
PHI	-0.11	1.54	-0.54	8.92	-9.71	6.75	0.00	-0.12	1.22	-0.54	7.50	-6.52	5.62	0.00
SIN	-0.08	1.09	-0.04	12.01	-6.65	7.70	0.00	-0.08	0.80	0.18	8.54	-3.48	4.86	0.00
TWN	0.07	1.69	-0.96	10.39	-12.30	5.80	0.00	0.08	1.20	-0.85	9.49	-8.33	5.37	0.00
THA	-0.28	2.38	0.25	8.08	-9.72	14.01	0.00	-0.29	1.81	0.48	6.52	-8.09	7.99	0.00
<i>Europe</i>														
BEL	0.04	0.68	-0.36	4.60	-2.74	2.39	0.00	0.04	0.51	-0.33	4.55	-2.28	1.62	0.00
FRA	0.04	0.85	-0.04	6.74	-3.79	5.14	0.00	0.04	0.60	-0.35	4.01	-2.08	1.88	0.00
GER	0.04	0.89	-0.67	7.18	-5.19	4.26	0.00	0.04	0.59	-0.85	7.65	-3.88	2.07	0.00
ITA	0.07	1.23	0.26	5.92	-5.09	5.93	0.00	0.07	0.89	0.24	4.89	-3.53	3.65	0.00
NET	0.07	0.90	-0.15	5.06	-4.00	4.30	0.00	0.07	0.62	-0.33	4.07	-2.09	2.10	0.00
RUS	0.33	2.94	-0.01	15.44	-19.66	20.08	0.00	0.33	2.09	-0.38	9.85	-14.3	8.94	0.00
SPA	0.07	0.96	-0.48	7.10	-5.76	4.89	0.00	0.07	0.72	-0.61	6.44	-3.72	3.34	0.00
SWE	0.09	1.01	-0.13	7.25	-5.20	6.05	0.00	0.09	0.73	-0.54	5.70	-3.97	2.32	0.00
SWI	0.05	0.85	-0.25	4.05	-3.08	2.57	0.00	0.05	0.63	0.02	3.14	-1.72	1.78	0.00
UK	0.06	0.68	-0.04	4.75	-3.10	3.47	0.31	0.07	0.50	-0.25	4.02	-2.14	1.71	0.00
<i>Latin America</i>														
ARG	0.03	1.53	-1.89	16.69	-13.44	5.65	0.00	0.03	1.14	-1.47	10.93	-8.59	3.51	0.00
BRA	0.02	1.49	-2.18	17.08	-10.75	5.53	0.00	0.02	1.11	-1.80	10.74	-5.89	4.03	0.00
CHI	-0.02	0.77	-0.24	7.69	-5.27	2.89	0.00	-0.02	0.61	-0.18	5.29	-3.10	1.96	0.00
MEX	0.06	1.40	-1.97	22.23	-13.49	5.69	0.00	0.06	1.07	-1.43	13.18	-8.44	3.75	0.00
<i>North America</i>														
CAN	0.08	0.73	-1.79	17.92	-6.62	2.33	0.05	0.08	0.56	-0.97	7.85	-3.59	1.70	0.00
US	0.09	0.90	-0.87	10.81	-6.80	4.31	0.00	0.09	0.65	-0.40	5.57	-3.83	2.13	0.00
<i>Africa</i>														
SA	-0.03	1.33	-2.52	36.70	-14.48	8.18	0.00	-0.03	0.93	-3.17	40.37	-10.8	4.52	0.00

## 2. Test for the 1997 Asian Market Crisis

### 2.1. Conventional Z-Tests for Contagion

The conventional test procedure conducted in this paper is as follows. First, we estimate the univariate GARCH (1,1) model of equation (6) for the entire period and obtain the residuals. Dividing the residuals into the stable and crisis periods, we compute the cross-market correlation coefficients between crisis country,  $c$ , and other country,  $j$ , for each of the two sample periods. To examine if the correlation coefficient of the crisis period is significantly greater than that of the stable period, the hypotheses of the test are specified as:

$$\begin{aligned} H_0 : \rho_{c,j}^{crisis} &\leq \rho_{c,j}^{stable} \\ H_1 : \rho_{c,j}^{crisis} &> \rho_{c,j}^{stable} . \end{aligned} \quad (9)$$

The test statistic can be obtained by considering the distribution of the sample correlation coefficient, which is approximately normal *only* when the population correlation is zero. When the sample correlation coefficient is other than zero, its distribution is highly skewed and not even normal for large samples [see Hays (1994)].<sup>9</sup> With the Fisher's z-transformation, however, the following z-statistic can be derived for testing:

$$z = T(\hat{\rho}) = \frac{1}{2} \ln \frac{1 + \hat{\rho}}{1 - \hat{\rho}} \sim N \left[ T(\rho), \frac{1}{n-3} \right], \quad (10)$$

where  $T(\hat{\rho})$  is approximately Gaussian if the joint distribution of the samples is not too far from the bivariate normal, and the sample size,  $n$ , is not too small (e.g.,  $n \geq 20$ ).<sup>10</sup> Since the variance of  $z$  is independent of the population correlation  $\rho$ , a very simple approach for statistical inferences is possible.

Thus, under the assumption that two samples are drawn from two independent bivariate normal distributions with the same population correlation, the distribution of the z-test statistic converges to a normal distribution with the following mean and variance:

$$z(\hat{\rho}^C) - z(\hat{\rho}^S) \sim N(0, \frac{1}{n^C - 3} + \frac{1}{n^S - 3}), \quad (11)$$

where  $n^C$  and  $n^S$  are the sample sizes of the two periods.

One-sided tests were performed for the hypotheses. If the difference between the transformed correlations is statistically significant, then it is interpreted as evidence of contagion. The critical value for the z-test at the 5% significance level is 1.645.

The results of z-test for the 1997 Asian crisis are reported in Table II. Panel A shows the test results for both daily returns and two-day returns based on U.S. dollars, while

<sup>9</sup> When  $\rho$  is greater than zero, the distribution has a negative skew, with intervals of high values of  $r$  relatively more probable than similar intervals of low values.

<sup>10</sup> For example, Kocherlakota and Singh (1982) showed that the Fisher's z-transformation is robust to samples drawn from bivariate t and bivariate  $\chi^2$  distributions.

Panel B shows the results for returns based on the local currency. Our z-test results show significant cases of contagion from the Hong Kong market crash, which is similar to the results of other studies. Panel A shows that contagion from Hong Kong occurs to 16 out of 27 countries for daily returns and 11 out of 27 countries for two-day rolling average returns. For the returns based on local currency, Panel B shows that contagion occurs to 15 countries for daily returns and 13 countries for two-day rolling average returns. As mentioned earlier, the constant correlation test is not accurate due to a statistical bias caused by heteroskedasticity.



Table 2. The z-test results for 1997 Asian crisis

This table presents the z-test results of contagion for the 1997 Asian crisis. We specify the univariate GARCH (1,1) process to capture the heteroscedasticity of returns. The stable period is from January 1, 1996 to October 16, 1997, while the crisis period is from October 17, 1997 to November 14, 1997. The full period includes both the stable and turmoil periods. The test statistics are for one-sided tests examining if the correlation coefficient during the turmoil period is greater than during the stable period. The p-values of the test statistics are reported in parentheses. "C" means a contagion with the test statistic significant at the 5% level, while "N" indicates that the test statistic is insignificant at the 5% level and therefore no contagion occurred.

Panel A. Results for returns based on U.S. dollar										
Country	Daily Returns					Two-day Moving Average Returns				
	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?
<i>Asia</i>										
Australia	0.359	0.729	0.497	2.29	C	0.336	0.611	0.427	1.50	N
India	0.031	-0.115	0.013	-0.61	N	0.073	0.039	0.062	-0.14	N
Indonesia	0.247	0.737	0.430	2.88	C	0.207	0.587	0.341	1.92	C
Japan	0.263	0.371	0.258	0.50	N	0.245	0.300	0.239	0.25	N
Korea	0.081	0.277	0.159	0.84	N	0.094	0.016	0.071	-0.33	N
Malaysia	0.223	0.715	0.373	2.79	C	0.196	0.574	0.315	1.89	C
Philippines	0.181	0.732	0.328	3.12	C	0.192	0.779	0.339	3.53	C
Singapore	0.327	0.799	0.493	3.15	C	0.322	0.731	0.448	2.48	C
Taiwan	0.120	0.128	0.122	0.03	N	0.123	-0.053	0.065	-0.73	N
Thailand	0.059	0.087	0.066	0.12	N	0.026	0.232	0.083	0.87	N
<i>Europe</i>										
Belgium	0.111	0.387	0.165	1.24	N	0.118	0.295	0.149	0.77	N
France	0.138	0.690	0.288	2.95	C	0.114	0.592	0.247	2.35	C
Germany	0.297	0.696	0.421	2.30	C	0.298	0.558	0.375	1.34	N
Italy	0.105	0.722	0.232	3.35	C	0.067	0.640	0.190	2.87	C
Netherlands	0.233	0.692	0.333	2.55	C	0.237	0.545	0.303	1.53	N
Russia	0.103	0.726	0.330	3.39	C	0.117	0.644	0.308	2.69	C
Spain	0.101	0.551	0.225	2.16	C	0.084	0.418	0.171	1.50	N
Sweden	0.134	0.654	0.297	2.69	C	0.091	0.531	0.229	2.08	C
Switzerland	0.134	0.589	0.214	2.25	C	0.143	0.537	0.216	1.90	C
U.K.	0.133	0.643	0.248	2.62	C	0.116	0.528	0.201	1.96	C
<i>Latin America</i>										
Argentina	0.089	-0.112	0.008	-0.84	N	0.125	-0.239	-0.017	-1.53	N
Brazil	0.114	0.158	0.138	0.19	N	0.129	-0.062	0.063	-0.80	N
Chile	0.043	0.432	0.164	1.75	C	0.042	0.204	0.088	0.68	N
Mexico	0.173	0.296	0.230	0.54	N	0.213	0.098	0.173	-0.49	N
<i>North America</i>										
Canada	0.111	0.234	0.159	0.53	N	0.104	-0.087	0.040	-0.80	N
U.S.	0.060	-0.048	0.022	-0.45	N	0.095	-0.235	-0.012	-1.40	N
<i>Africa</i>										
S. Africa	0.246	0.745	0.499	2.96	C	0.241	0.665	0.439	2.31	C

Panel B. Results for returns based on local currency										
Country	Daily Returns					Two-day Moving Average Returns				
	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?
<i>Asia</i>										
Australia	0.403	0.630	0.490	1.31	N	0.370	0.534	0.429	0.86	N
India	0.042	-0.120	0.020	-0.68	N	0.080	0.062	0.069	-0.07	N
Indonesia	0.291	0.643	0.383	1.93	C	0.304	0.586	0.390	1.48	N
Japan	0.280	0.511	0.312	1.15	N	0.277	0.433	0.299	0.75	N
Korea	0.083	0.269	0.155	0.80	N	0.100	-0.014	0.064	-0.47	N
Malaysia	0.293	0.783	0.411	3.13	C	0.247	0.655	0.355	2.21	C
Philippines	0.288	0.787	0.404	3.19	C	0.298	0.814	0.415	3.45	C
Singapore	0.352	0.820	0.508	3.28	C	0.344	0.784	0.473	2.90	C
Taiwan	0.124	0.135	0.122	0.05	N	0.130	-0.049	0.075	-0.75	N
Thailand	0.086	0.126	0.089	0.17	N	0.055	0.281	0.103	0.97	N
<i>Europe</i>										
Belgium	0.162	0.656	0.302	2.59	C	0.179	0.541	0.265	1.77	C
France	0.163	0.754	0.351	3.40	C	0.145	0.649	0.300	2.61	C
Germany	0.317	0.742	0.471	2.60	C	0.329	0.611	0.420	1.53	N
Italy	0.112	0.747	0.272	3.56	C	0.080	0.661	0.222	2.97	C
Netherlands	0.239	0.749	0.374	3.03	C	0.248	0.618	0.338	1.95	C
Russia	0.140	0.743	0.382	3.40	C	0.166	0.673	0.357	2.70	C
Spain	0.133	0.663	0.301	2.77	C	0.125	0.504	0.235	1.79	C
Sweden	0.138	0.675	0.334	2.83	C	0.108	0.541	0.257	2.07	C
Switzerland	0.176	0.771	0.343	3.52	C	0.202	0.661	0.326	2.45	C
U.K.	0.175	0.787	0.347	3.69	C	0.160	0.682	0.289	2.79	C
<i>Latin America</i>										
Argentina	0.089	-0.112	0.007	-0.84	N	0.124	-0.240	-0.018	-1.54	N
Brazil	0.111	0.155	0.135	0.19	N	0.126	-0.067	0.059	-0.81	N
Chile	0.055	0.267	0.104	0.91	N	0.060	0.024	0.051	-0.15	N
Mexico	0.152	-0.062	0.064	-0.89	N	0.196	-0.246	0.029	-1.87	N
<i>North America</i>										
Canada	0.109	0.141	0.122	0.13	N	0.112	-0.121	0.030	-0.97	N
U.S.	0.060	-0.047	0.022	-0.44	N	0.096	-0.234	-0.011	-1.39	N
<i>Africa</i>										
S. Africa	0.299	0.733	0.536	2.60	C	0.302	0.648	0.476	1.91	C

## 2.2. Time-Varying Conditional Correlation Test for Contagion

We estimated the dynamic conditional correlation (DCC) model to capture the time-varying nature of the conditional correlation and two modified DCC models to capture a structural break in the conditional correlation dynamics during the crisis period. Table III presents the results of our time-varying conditional correlation test for contagion from the 1997 Asian crisis, with the estimates of the DCC model and the two modified DCC models. We used both daily and two-day rolling average returns based on U.S. dollars from January 1, 1996 to October 16, 1997 as the stable period and from October 17, 1997 to November 14, 1997 as the crisis period.

For estimations, we used the Constrained Maximum Likelihood (CML) module in GAUSS, and report the estimated values with the Bollerslev-Wooldridge heteroscedastic-consistent standard errors. It should be noted that the coefficients of all three DCC models in the CML procedure are restricted to be greater than zero, such that, when restrictions are binding, the standard errors of the coefficients are not reported. For the likelihood ratio tests of financial contagion, the base DCC model is used as a restricted model, while the two modified DCC models are used as unrestricted models. "z-test" in the table refers to the results of the conventional z-test of contagion, and "N" and "C" stand for no contagion and contagion, respectively. Also, "?" refers to the log likelihood ratio test results of contagion. "LL" is the log likelihood value of the estimated DCC models.

Panel A of Table III presents test results of the 1997 Asian crisis for daily returns. For the log likelihood ratio test, Model 1 is used as a null model, while models 2 and 3 are used as an alternative model. Note that model 2 is to capture a structural break in the autoregressive process of the conditional correlation, while model 3 is to capture a structural break in both the autoregressive process and the news impact process. The test results for model 2 show that none of the countries exhibited contagion evidence, while the results for model 3 show only two countries (the Philippines and Italy) exhibited contagion evidence. This result is completely different from the z-test results, which show that contagion occurred in 16 out of 27 countries during the Asian crisis. Note that the estimated value of  $\delta^c$  and  $\gamma^c$  is close to zero for the most countries except for Philippines and Italy. This implies that there is no significant jump in the conditional correlation dynamics during the crisis period once the conditional correlation is modeled by the time-varying cross-market volatilities.

Panel B of Table III shows test results of the Asian crisis for two-day rolling average returns. Test results of both models show that, out of 11 countries reported as contagion evidence from the z-test, contagion occurred only to the Philippines. The estimated value of  $\delta^c$  is positive and statistically significant at the 5% level, implying that there was a sudden jump in the conditional correlation dynamics for the Philippines.

Table 3. Time-Varying Conditional Correlation Test of the 1997 Asian Crisis for Returns Based on U.S. Dollars

The likelihood ratio (LR) tests of financial contagion are based on the Engle (2002)'s dynamic conditional correlation (DCC) model as a restricted model and the two modified DCC models as unrestricted models. The models are specified as:

Model 1(DCC model):  $Q_t = (1 - \delta - \gamma)\bar{Q} + \delta Q_{t-1} + \gamma v_{t-1}v_{t-1}'$

Model 2 (Modified DCC model A):  $Q_t = (1 - \delta - D\delta^C - \gamma)Q + (\delta + D\delta^C)Q_{t-1} + \gamma v_{t-1}v_{t-1}'$

Model 3 (Modified DCC model B):  $Q_t = (1 - \delta - D\delta^C - \gamma - D\gamma^C)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + (\gamma + D\gamma^C)v_{t-1}v_{t-1}'$

where  $\bar{Q}$  is the unconditional covariance matrix of the standardized residual vector  $v_t$ , and  $D$  is a dummy variable taking value 1 for the crisis period and 0 for the stable period. The stable period is from January 1, 1996 to October 16, 1997 and the crisis period is from October 17, 1997 to November 14, 1997. The test hypotheses for the model 1 and model 2 are  $H_0: \delta^C = 0$  and  $H_0: \delta^C = \gamma^C = 0$ , respectively. "z-test" refers to the results of conventional z-test of contagion, and "N" stands for no contagion and "C" for contagion. "?" refers to the LR test results of contagion. "LL" is the log likelihood value of the estimated DCC models. We use the Constrained Maximum Likelihood (CML) module in GAUSS. The Bollerslev-Wooldridge heteroscedastic-consistent standard errors are reported in parentheses.

Panel A: Results for daily returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^c$	$\gamma$	LL	?	$\delta$	$\delta^c$	$\gamma$	$\gamma^c$	LL	?
Asia															
AUS	C	0.736 (0.086)	0.103 (0.051)	-1357.83	0.736 (0.086)	0.000 (0.000)	0.103 (0.051)	-1357.83	N	0.736 (0.086)	0.000 (0.000)	0.103 (0.051)	0.000 (0.000)	-1357.83	N
INA	N	0.910 (0.079)	0.001 (0.020)	-1570.52	0.910 (0.080)	0.000 (0.000)	0.000 (0.020)	-1570.52	N	0.910 (0.076)	0.000 (0.000)	0.000 (0.020)	0.000 (0.000)	-1570.52	N
IND	C	0.892 (0.061)	0.051 (0.026)	-1592.87	0.892 (0.061)	0.000 (0.000)	0.051 (0.026)	-1592.87	N	0.866 (0.075)	0.000 (0.000)	0.049 (0.024)	0.085 (0.070)	-1591.72	N
JAP	N	0.825 (0.064)	0.019 (0.022)	-1424.90	0.825 (0.064)	0.000 (0.000)	0.019 (0.022)	-1424.90	N	0.825 (0.064)	0.000 (0.000)	0.019 (0.022)	0.000 (0.000)	-1424.90	N
KOR	N	0.234 (0.352)	0.059 (0.063)	-1635.42	0.234 (0.352)	0.000 (0.000)	0.059 (0.063)	-1635.42	N	0.233 (0.353)	0.000 (0.000)	0.059 (0.063)	0.000 (0.000)	-1635.42	N
MAL	C	0.986 (0.022)	0.004 (0.008)	-1444.54	0.986 (0.023)	0.000 (0.000)	0.004 (0.009)	-1444.54	N	0.931 (0.038)	0.000 (0.000)	0.000 (0.000)	0.069 (0.038)	-1443.42	N
PHI	C	0.878 (0.065)	0.013 (0.025)	-1505.47	0.878 (0.065)	0.000 (0.000)	0.013 (0.025)	-1505.47	N	0.822 (0.140)	0.000 (0.000)	0.000 (0.000)	0.129 (0.074)	-1502.28	C
SIN	C	0.889 (0.058)	0.037 (0.018)	-1403.37	0.889 (0.058)	0.000 (0.000)	0.037 (0.018)	-1403.37	N	0.907 (0.048)	0.000 (0.000)	0.027 (0.017)	0.039 (0.034)	-1402.66	N
TWN	N	0.946 (0.033)	0.000 (0.000)	-1644.50	0.935 (0.054)	0.010 (0.040)	0.000 (0.000)	-1644.50	N	0.930 (0.063)	0.009 (0.055)	0.000 (0.000)	0.000 (0.000)	-1644.50	N

THA	N	0.984 (0.007)	0.012 (0.009)	-1764.06	0.984 (0.007)	0.000 (0.000)	0.012 (0.009)	-1764.06	N	0.984 (0.007)	0.000 (0.000)	0.012 (0.009)	0.000 (0.000)	-1764.06	N
Europe															
BEL	N	0.964 (0.020)	0.004 (0.010)	-1245.38	0.964 (0.020)	0.000 (0.000)	0.004 (0.010)	-1245.38	N	0.964 (0.020)	0.000 (0.000)	0.004 (0.010)	0.000 (0.000)	-1245.38	N
FRA	C	0.911 (0.072)	0.017 (0.015)	-1337.61	0.904 (0.069)	0.077 (0.065)	0.018 (0.014)	-1337.54	N	0.778 (0.083)	0.000 (0.000)	0.000 (0.000)	0.202 (0.093)	-1335.73	N
GER	C	0.813 (0.074)	0.087 (0.038)	-1305.47	0.813 (0.074)	0.000 (0.000)	0.087 (0.038)	-1305.47	N	0.788 (0.113)	0.000 (0.000)	0.089 (0.039)	0.117 (0.113)	-1304.86	N
ITA	C	0.529 (0.349)	0.094 (0.058)	-1529.35	0.000 (0.000)	0.785 (0.085)	0.178 (0.070)	-1528.28	N	0.000 (0.000)	0.534 (0.103)	0.089 (0.072)	0.340 (0.124)	-1525.72	C
NET	C	0.938 (0.035)	0.018 (0.018)	-1340.90	0.933 (0.036)	0.048 (0.034)	0.018 (0.017)	-1340.83	N	0.644 (0.132)	0.000 (0.000)	0.000 (0.000)	0.346 (0.148)	-1338.02	N
RUS	C	0.000 (0.000)	0.158 (0.073)	-1865.74	0.000 (0.000)	0.472 (0.298)	0.170 (0.078)	-1864.20	N	0.000 (0.000)	0.472 (0.298)	0.170 (0.078)	0.000 (0.000)	-1864.20	N
SPA	C	0.000 (0.000)	0.159 (0.063)	-1401.60	0.000 (0.000)	0.000 (0.000)	0.159 (0.063)	-1401.60	N	0.000 (0.000)	0.000 (0.000)	0.156 (0.081)	0.008 (0.144)	-1401.60	N
SWE	C	0.920 (0.058)	0.026 (0.019)	-1429.73	0.921 (0.063)	0.008 (0.410)	0.026 (0.023)	-1429.73	N	0.655 (0.086)	0.000 (0.000)	0.035 (0.054)	0.310 (0.107)	-1428.12	N
SWI	C	0.000 (0.000)	0.094 (0.073)	-1352.41	0.000 (0.000)	0.444 (0.381)	0.091 (0.070)	-1352.27	N	0.000 (0.000)	0.000 (0.000)	0.030 (0.082)	0.540 (0.214)	-1349.47	N
UK	C	0.926 (0.029)	0.038 (0.015)	-1255.12	0.918 (0.038)	0.042 (0.031)	0.040 (0.016)	-1254.95	N	0.923 (0.029)	0.000 (0.000)	0.033 (0.016)	0.044 (0.028)	-1254.44	N
Latin America															
ARG	N	0.334 (0.148)	0.183 (0.093)	-1581.18	0.235 (0.269)	0.134 (0.316)	0.218 (0.108)	-1581.03	N	0.235 (0.269)	0.134 (0.316)	0.218 (0.107)	0.000 (0.000)	-1581.03	N
BRA	N	0.935 (0.062)	0.019 (0.015)	-1515.43	0.929 (0.063)	0.050 (0.054)	0.021 (0.016)	-1514.81	N	0.929 (0.063)	0.050 (0.054)	0.021 (0.016)	0.000 (0.000)	-1514.81	N
CHI	C	0.145 (0.438)	0.087 (0.092)	-1297.14	0.000 (0.000)	0.854 (0.113)	0.146 (0.113)	-1295.89	N	0.000 (0.000)	0.854 (0.113)	0.146 (0.113)	0.000 (0.000)	-1295.89	N
MEX	N	0.909 (0.148)	0.000 (0.000)	-1535.42	0.915 (0.113)	0.016 (0.044)	0.000 (0.000)	-1535.42	N	0.915 (0.107)	0.016 (0.071)	0.000 (0.000)	0.000 (0.000)	-1535.42	N
North America															
CAN	N	0.974	0.000	-1256.12	0.974	0.020	0.000	-1256.12	N	0.974	0.020	0.000	0.000	-1256.12	N

US	N	(0.014)	(0.000)		(0.014)	(0.035)	(0.000)		N	(0.014)	(0.083)	(0.000)	(0.000)		N
		0.912	0.000	-1382.21	0.896	0.028	0.000	-1382.21		0.895	0.027	0.000	0.000	-1382.21	
		(0.034)	(0.000)		(0.060)	(0.078)	(0.000)			(0.053)	(0.098)	(0.000)	(0.000)		
SA	C	0.546	0.074	-1410.87	0.554	0.000	0.074	-1410.87	N	0.548	0.000	0.074	0.000	-1410.87	N
		(1.947)	(0.220)		(1.473)	(0.000)	(0.169)			(1.854)	(0.000)	(0.210)	(0.000)		

Panel B: Results for two-day average returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^c$	$\gamma$	LL	?	$\delta$	$\delta^c$	$\gamma$	$\gamma^c$	LL	?
<i>Asia</i>															
AUS	N	0.774 (0.187)	0.056 (0.053)	-752.73	0.774 (0.187)	0.000 (0.000)	0.056 (0.053)	-752.73	N	0.774 (0.187)	0.000 (0.000)	0.056 (0.053)	0.000 (0.000)	-752.73	N
INA	N	0.927 (0.044)	0.008 (0.018)	-935.99	0.927 (0.044)	0.000 (0.000)	0.008 (0.018)	-935.99	N	0.927 (0.044)	0.000 (0.000)	0.008 (0.018)	0.000 (0.000)	-935.99	N
IND	C	0.918 (0.057)	0.038 (0.024)	-981.56	0.918 (0.057)	0.000 (0.000)	0.038 (0.024)	-981.56	N	0.924 (0.043)	0.000 (0.000)	0.032 (0.021)	0.043 (0.034)	-981.08	N
JAP	N	0.808 (0.151)	0.013 (0.023)	-806.41	0.808 (0.151)	0.000 (0.000)	0.013 (0.023)	-806.41	N	0.808 (0.150)	0.000 (0.000)	0.013 (0.023)	0.000 (0.000)	-806.41	N
KOR	N	0.964 (0.014)	0.000 (0.000)	-1015.53	0.960 (0.017)	0.020 (0.087)	0.000 (0.000)	-1015.53	N	0.964 (0.014)	0.020 (0.200)	0.000 (0.000)	0.000 (0.000)	-1015.53	N
MAL	C	0.990 (0.031)	0.000 (0.000)	-835.24	0.991 (0.022)	0.000 (0.000)	0.000 (0.000)	-835.24	N	0.990 (0.019)	0.000 (0.000)	0.000 (0.000)	0.010 (0.019)	-835.13	N
PHI	C	0.896 (0.049)	0.028 (0.028)	-885.63	0.000 (0.000)	0.860 (0.049)	0.140 (0.049)	-879.32	C	0.000 (0.000)	0.792 (0.283)	0.082 (0.071)	0.124 (0.222)	-878.60	C
SIN	C	0.914 (0.038)	0.025 (0.017)	-791.33	0.914 (0.038)	0.000 (0.000)	0.025 (0.017)	-791.33	N	0.922 (0.037)	0.000 (0.000)	0.019 (0.018)	0.022 (0.032)	-791.00	N
TWN	N	0.945 (0.026)	0.000 (0.000)	-1013.46	0.945 (0.027)	0.000 (0.000)	0.000 (0.000)	-1013.46	N	0.945 (0.026)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1013.46	N
THA	N	0.983 (0.012)	0.009 (0.009)	-1139.46	0.983 (0.012)	0.000 (0.000)	0.009 (0.009)	-1139.46	N	0.983 (0.012)	0.000 (0.000)	0.009 (0.009)	0.000 (0.000)	-1139.46	N
<i>Europe</i>															
BEL	N	0.975 (0.026)	0.000 (0.000)	-627.39	0.982 (0.012)	0.000 (0.000)	0.000 (0.000)	-627.39	N	0.983 (0.013)	0.002 (0.032)	0.000 (0.000)	0.000 (0.000)	-627.39	N
FRA	C	0.944 (0.031)	0.007 (0.013)	-722.71	0.936 (0.034)	0.056 (0.034)	0.008 (0.012)	-722.66	N	0.797 (0.173)	0.000 (0.000)	0.000 (0.000)	0.061 (0.053)	-722.28	N
GER	N	0.825 (0.092)	0.078 (0.037)	-695.82	0.825 (0.092)	0.000 (0.000)	0.078 (0.038)	-695.82	N	0.825 (0.092)	0.000 (0.000)	0.078 (0.037)	0.000 (0.000)	-695.82	N
ITA	C	0.778 (0.121)	0.059 (0.026)	-900.76	0.777 (0.131)	0.050 (0.172)	0.059 (0.028)	-900.75	N	0.730 (0.104)	0.000 (0.000)	0.057 (0.026)	0.210 (0.119)	-899.51	N
NET	N	0.916 (0.035)	0.032 (0.019)	-723.15	0.914 (0.036)	0.054 (0.031)	0.032 (0.019)	-723.05	N	0.911 (0.040)	0.000 (0.000)	0.032 (0.019)	0.057 (0.035)	-722.93	N

RUS	C	0.763 (0.577)	0.024 (0.066)	-1237.89	0.749 (0.219)	0.224 (0.204)	0.027 (0.036)	-1237.57	N	0.743 (0.243)	0.230 (0.229)	0.027 (0.037)	0.000 (0.000)	-1237.57	N
SPA	N	0.902 (0.091)	0.020 (0.024)	-788.06	0.895 (0.078)	0.084 (0.071)	0.021 (0.021)	-787.95	N	0.894 (0.082)	0.085 (0.076)	0.021 (0.022)	0.000 (0.000)	-787.95	N
SWE	C	0.917 (0.093)	0.024 (0.030)	-803.60	0.917 (0.080)	0.060 (0.064)	0.023 (0.026)	-803.56	N	0.917 (0.080)	0.060 (0.064)	0.023 (0.026)	0.000 (0.000)	-803.56	N
SWI	C	0.985 (0.012)	0.000 (0.000)	-730.64	0.985 (0.013)	0.001 (0.033)	0.000 (0.000)	-730.64	N	0.485 (0.228)	0.000 (0.000)	0.000 (0.000)	0.157 (0.077)	-729.23	N
UK	C	0.917 (0.026)	0.034 (0.016)	-640.45	0.911 (0.030)	0.054 (0.027)	0.034 (0.016)	-640.27	N	0.915 (0.029)	0.000 (0.000)	0.030 (0.016)	0.054 (0.027)	-640.06	N
<i>Latin America</i>															
ARG	N	0.832 (0.134)	0.069 (0.040)	-957.30	0.832 (0.134)	0.000 (0.000)	0.069 (0.040)	-957.30	N	0.832 (0.134)	0.000 (0.000)	0.069 (0.039)	0.000 (0.000)	-957.30	N
BRA	N	0.946 (0.062)	0.016 (0.015)	-900.03	0.946 (0.062)	0.000 (0.000)	0.016 (0.015)	-900.03	N	0.946 (0.062)	0.000 (0.000)	0.016 (0.015)	0.000 (0.000)	-900.03	N
CHI	N	0.000 (0.000)	0.121 (0.067)	-681.78	0.000 (0.000)	0.000 (0.000)	0.121 (0.067)	-681.78	N	0.000 (0.000)	0.000 (0.000)	0.121 (0.067)	0.000 (0.000)	-681.78	N
MEX	N	0.906 (0.030)	0.013 (0.020)	-918.87	0.906 (0.030)	0.000 (0.000)	0.013 (0.020)	-918.87	N	0.906 (0.030)	0.000 (0.000)	0.013 (0.020)	0.000 (0.000)	-918.87	N
<i>North America</i>															
CAN	N	0.818 (0.055)	0.028 (0.040)	-630.77	0.818 (0.055)	0.000 (0.000)	0.028 (0.039)	-630.77	N	0.845 (0.048)	0.000 (0.000)	0.025 (0.034)	0.047 (0.036)	-630.54	N
US	N	0.848 (0.057)	0.025 (0.024)	-755.72	0.848 (0.057)	0.000 (0.000)	0.025 (0.024)	-755.72	N	0.841 (0.095)	0.000 (0.000)	0.015 (0.029)	0.034 (0.050)	-755.46	N
<i>Africa</i>															
SA	C	0.617 (0.416)	0.100 (0.082)	-812.82	0.615 (0.433)	0.000 (0.000)	0.100 (0.084)	-812.81	N	0.617 (0.418)	0.000 (0.000)	0.100 (0.082)	0.000 (0.000)	-812.81	N



We also performed the time-varying conditional correlation test for the returns based on local currencies. Test results are reported in Table IV. Panel A of Table IV shows test results of the Asian crisis for daily returns, and Panel B presents the results for two-day rolling average returns. First, the z-test results show that contagion from Hong Kong occurred to 15 out of 27 countries for daily returns and 11 out of 27 countries for two-day rolling average returns. Second, Panel A shows that, while none of the countries exhibited contagion evidence under model 2, only two countries (the Philippines and Italy) exhibited contagion under model 3. Third, Panel B shows that under two-day rolling average returns only the Philippines exhibited contagion evidence out of 11 countries reported as contagion evidence by the z-test. These results are the same as those for the U.S. dollar-based returns, implying that the results are robust to the different currency-based returns.

Table 4. Time-Varying Conditional Correlation Test of the 1997 Asian Crisis for Returns Based on Local Currencies

The likelihood ratio (LR) tests of financial contagion are based on the Engle (2002)'s dynamic conditional correlation (DCC) model as a restricted model and the two modified DCC models as unrestricted models. The models are specified as:

$$\text{Model 1 (DCC model): } Q_t = (1 - \delta - \gamma)\bar{Q} + \delta Q_{t-1} + \gamma v_{t-1} v_{t-1}'$$

$$\text{Model 2 (Modified DCC model A): } Q_t = (1 - \delta - D\delta^C - \gamma)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + \gamma v_{t-1} v_{t-1}'$$

$$\text{Model 3 (Modified DCC model B): } Q_t = (1 - \delta - D\delta^C - \gamma - D\gamma^C)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + (\gamma + D\gamma^C)v_{t-1} v_{t-1}'$$

where  $\bar{Q}$  is the unconditional covariance matrix of the standardized residual vector  $v_t$ , and  $D$  is a dummy variable taking value 1 for the crisis period and 0 for the stable period. The stable period is from January 1, 1996 to October 16, 1997 and the crisis period is from October 17, 1997 to November 14, 1997. The test hypotheses for the model 1 and model 2 are  $H_0: \delta^C = 0$  and  $H_0: \delta^C = \gamma^C = 0$ , respectively. "z-test" refers to the results of conventional z-test of contagion, and "N" stands for no contagion and "C" for contagion. "?" refers to the LR test results of contagion. "LL" is the log likelihood value of the estimated DCC models. We use the Constrained Maximum Likelihood (CML) module in GAUSS. The Bollerslev-Wooldridge heteroscedastic-consistent standard errors are reported in parentheses.

Panel A: Results for daily returns based on local currencies															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^c$	$\gamma$	LL	?	$\delta$	$\delta^c$	$\gamma$	$\gamma^c$	LL	?
Asia															
AUS	N	0.634 (0.124)	0.127 (0.056)	-1286.48	0.634 (0.124)	0.000 (0.000)	0.127 (0.056)	-1286.48	N	0.634 (0.124)	0.000 (0.000)	0.127 (0.056)	0.000 (0.000)	-1286.48	N
INA	N	0.920 (0.069)	0.003 (0.018)	-1563.88	0.920 (0.069)	0.000 (0.000)	0.003 (0.018)	-1563.88	N	0.920 (0.069)	0.000 (0.000)	0.003 (0.018)	0.000 (0.000)	-1563.88	N
IND	C	0.935 (0.031)	0.029 (0.016)	-1528.47	0.935 (0.031)	0.000 (0.000)	0.029 (0.016)	-1528.47	N	0.937 (0.029)	0.000 (0.000)	0.028 (0.015)	0.033 (0.094)	-1528.32	N
JAP	N	0.835 (0.085)	0.021 (0.031)	-1361.65	0.835 (0.089)	0.000 (0.000)	0.021 (0.031)	-1361.65	N	0.835 (0.095)	0.000 (0.000)	0.021 (0.031)	0.000 (0.000)	-1361.65	N
KOR	N	0.950 (0.023)	0.000 (0.000)	-1617.84	0.952 (0.022)	0.008 (0.075)	0.000 (0.000)	-1617.84	N	0.946 (0.027)	0.007 (0.107)	0.000 (0.000)	0.000 (0.000)	-1617.84	N
MAL	C	0.949 (0.049)	0.019 (0.016)	-1401.91	0.749 (0.535)	0.222 (0.529)	0.030 (0.019)	-1401.75	N	0.930 (0.045)	0.000 (0.000)	0.008 (0.019)	0.062 (0.055)	-1400.76	N

PHI	C	0.888 (0.042)	0.041 (0.023)	-1474.10	0.834 (0.173)	0.121 (0.167)	0.045 (0.024)	-1473.51	N	0.610 (0.309)	0.001 (0.056)	0.000 (0.000)	0.270 (0.201)	-1470.90	C
SIN	C	0.888 (0.054)	0.043 (0.020)	-1384.59	0.886 (0.059)	0.038 (0.119)	0.043 (0.020)	-1384.57	N	0.890 (0.056)	0.000 (0.000)	0.035 (0.020)	0.045 (0.042)	-1383.97	N
TWN	N	0.848 (0.221)	0.000 (0.000)	-1627.80	0.849 (0.254)	0.002 (0.076)	0.000 (0.000)	-1627.79	N	0.849 (0.369)	0.001 (0.065)	0.000 (0.000)	0.000 (0.000)	-1627.79	N
THA	N	0.985 (0.007)	0.011 (0.008)	-1727.16	0.985 (0.007)	0.000 (0.000)	0.011 (0.008)	-1727.16	N	0.985 (0.007)	0.000 (0.000)	0.011 (0.008)	0.000 (0.000)	-1727.16	N
Europe															
BEL	C	0.947 (0.023)	0.028 (0.013)	-1219.50	0.944 (0.028)	0.027 (0.024)	0.029 (0.013)	-1219.43	N	0.939 (0.033)	0.000 (0.000)	0.029 (0.013)	0.032 (0.031)	-1219.18	N
FRA	C	0.932 (0.041)	0.023 (0.015)	-1367.95	0.917 (0.050)	0.058 (0.047)	0.025 (0.015)	-1367.78	N	0.865 (0.364)	0.000 (0.000)	0.015 (0.041)	0.120 (0.401)	-1366.54	N
GER	C	0.830 (0.067)	0.096 (0.040)	-1321.64	0.830 (0.067)	0.000 (0.000)	0.096 (0.040)	-1321.64	N	0.830 (0.066)	0.000 (0.000)	0.096 (0.038)	0.000 (0.162)	-1321.64	N
ITA	C	0.645 (0.221)	0.064 (0.046)	-1517.10	0.549 (0.407)	0.336 (0.384)	0.084 (0.074)	-1516.73	N	0.638 (0.121)	0.000 (0.000)	0.035 (0.041)	0.326 (0.128)	-1512.87	C
NET	C	0.953 (0.034)	0.022 (0.016)	-1373.14	0.947 (0.044)	0.029 (0.038)	0.023 (0.016)	-1373.09	N	0.722 (0.110)	0.000 (0.000)	0.000 (0.000)	0.278 (0.110)	-1371.66	N
RUS	C	0.781 (0.206)	0.092 (0.057)	-1859.28	0.000 (0.000)	0.749 (0.106)	0.181 (0.065)	-1858.53	N	0.000 (0.000)	0.749 (0.106)	0.181 (0.065)	0.000 (0.000)	-1858.53	N
SPA	C	0.640 (0.143)	0.096 (0.049)	-1397.90	0.657 (0.146)	0.255 (0.125)	0.088 (0.057)	-1397.63	N	0.691 (0.093)	0.032 (0.225)	0.082 (0.043)	0.195 (0.217)	-1396.82	N
SWE	C	0.924 (0.056)	0.020 (0.019)	-1404.70	0.911 (0.101)	0.068 (0.093)	0.021 (0.020)	-1404.62	N	0.711 (0.130)	0.000 (0.000)	0.010 (0.059)	0.278 (0.173)	-1403.98	N
SWI	C	0.959 (0.040)	0.009 (0.012)	-1347.38	0.959 (0.040)	0.000 (0.000)	0.009 (0.012)	-1347.38	N	0.777 (0.179)	0.000 (0.000)	0.000 (0.000)	0.216 (0.214)	-1344.69	N
UK	C	0.914 (0.036)	0.043 (0.019)	-1211.24	0.896 (0.045)	0.057 (0.036)	0.046 (0.019)	-1210.72	N	0.904 (0.031)	0.000 (0.000)	0.035 (0.018)	0.061 (0.030)	-1209.51	N
Latin America															

ARG	N	0.342 (0.155)	0.179 (0.095)	-1580.97	0.284 (0.330)	0.085 (0.390)	0.189 (0.117)	-1580.95	N	0.284 (0.330)	0.085 (0.390)	0.189 (0.116)	0.000 (0.000)	-1580.95	N
BRA	N	0.934 (0.055)	0.019 (0.016)	-1509.59	0.931 (0.056)	0.049 (0.049)	0.020 (0.015)	-1509.52	N	0.931 (0.056)	0.049 (0.049)	0.020 (0.015)	0.000 (0.000)	-1509.52	N
CHI	N	0.549 (0.716)	0.041 (0.093)	-1275.88	0.000 (0.000)	0.845 (0.256)	0.102 (0.117)	-1275.32	N	0.000 (0.000)	0.845 (0.255)	0.102 (0.117)	0.000 (0.000)	-1275.32	N
MEX	N	0.932 (0.063)	0.000 (0.000)	-1439.20	0.942 (0.039)	0.007 (0.010)	0.000 (0.000)	-1439.20	N	0.942 (0.037)	0.008 (0.017)	0.000 (0.000)	0.000 (0.000)	-1439.20	N
<i>North America</i>															
CAN	N	0.965 (0.021)	0.000 (0.000)	-1204.91	0.968 (0.019)	0.010 (0.017)	0.000 (0.000)	-1204.91	N	0.968 (0.019)	0.009 (0.015)	0.000 (0.000)	0.000 (0.000)	-1204.91	N
US	N	0.912 (0.033)	0.000 (0.000)	-1381.80	0.909 (0.046)	0.019 (0.122)	0.000 (0.000)	-1381.80	N	0.909 (0.044)	0.019 (0.083)	0.000 (0.000)	0.000 (0.000)	-1381.80	N
<i>Africa</i>															
SA	C	0.230 (1.651)	0.100 (0.158)	-1312.01	0.230 (1.665)	0.000 (0.000)	0.100 (0.160)	-1312.01	N	0.230 (1.658)	0.000 (0.000)	0.100 (0.159)	0.000 (0.000)	-1312.01	N

Panel B: Results for two-day average returns based on local currencies															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^C$	$\gamma$	LL	?	$\delta$	$\delta^C$	$\gamma$	$\gamma^C$	LL	?
Asia															
AUS	N	0.541 (0.310)	0.084 (0.074)	-684.42	0.541 (0.310)	0.000 (0.000)	0.084 (0.074)	-684.42	N	0.541 (0.310)	0.000 (0.000)	0.084 (0.074)	0.000 (0.000)	-684.42	N
INA	N	0.936 (0.042)	0.009 (0.016)	-930.97	0.936 (0.042)	0.000 (0.000)	0.009 (0.016)	-930.97	N	0.936 (0.042)	0.000 (0.000)	0.009 (0.016)	0.000 (0.000)	-930.97	N
IND	N	0.898 (0.107)	0.044 (0.027)	-902.88	0.898 (0.107)	0.000 (0.000)	0.044 (0.027)	-902.88	N	0.902 (0.121)	0.000 (0.000)	0.042 (0.031)	0.009 (0.043)	-902.86	N
JAP	N	0.156 (0.418)	0.031 (0.053)	-744.12	0.156 (0.418)	0.000 (0.000)	0.031 (0.053)	-744.12	N	0.156 (0.372)	0.000 (0.000)	0.031 (0.053)	0.000 (0.000)	-744.12	N
KOR	N	0.318 (0.216)	0.033 (0.049)	-996.07	0.318 (0.216)	0.000 (0.000)	0.033 (0.049)	-996.07	N	0.318 (0.216)	0.000 (0.000)	0.033 (0.049)	0.000 (0.000)	-996.07	N
MAL	C	0.991 (0.014)	0.002 (0.008)	-793.58	0.991 (0.014)	0.000 (0.000)	0.002 (0.008)	-793.58	N	0.954 (0.044)	0.010 (0.038)	0.000 (0.000)	0.036 (0.031)	-792.67	N
PHI	C	0.858 (0.049)	0.074 (0.028)	-850.49	0.211 (0.267)	0.681 (0.271)	0.107 (0.040)	-848.14	C	0.819 (0.089)	0.000 (0.000)	0.047 (0.028)	0.134 (0.085)	-846.46	C
SIN	C	0.896 (0.054)	0.033 (0.020)	-769.94	0.896 (0.054)	0.000 (0.000)	0.033 (0.020)	-769.94	N	0.880 (0.126)	0.000 (0.000)	0.024 (0.022)	0.045 (0.059)	-769.23	N
TWN	N	0.935 (0.053)	0.000 (0.000)	-994.74	0.934 (0.055)	0.002 (0.089)	0.000 (0.000)	-994.74	N	0.936 (0.053)	0.001 (0.026)	0.000 (0.000)	0.000 (0.000)	-994.74	N
THA	N	0.986 (0.007)	0.007 (0.008)	-1106.14	0.986 (0.007)	0.000 (0.000)	0.007 (0.008)	-1106.14	N	0.986 (0.007)	0.000 (0.000)	0.007 (0.008)	0.000 (0.000)	-1106.14	N
Europe															
BEL	C	0.959 (0.027)	0.014 (0.014)	-606.94	0.955 (0.034)	0.031 (0.033)	0.014 (0.013)	-606.91	N	0.957 (0.029)	0.000 (0.000)	0.013 (0.014)	0.028 (0.083)	-606.88	N
FRA	C	0.928 (0.032)	0.012 (0.017)	-751.45	0.899 (0.054)	0.085 (0.056)	0.016 (0.016)	-751.21	N	0.831 (0.126)	0.000 (0.000)	0.000 (0.000)	0.136 (0.129)	-750.37	N
GER	N	0.858	0.068	-715.44	0.858	0.000	0.068	-715.44	N	0.858	0.000	0.068	0.000	-715.44	N

		(0.062)	(0.031)		(0.062)	(0.000)	(0.031)			(0.062)	(0.000)	(0.031)	(0.000)		
ITA	C	0.790	0.048	-888.13	0.764	0.182	0.054	-887.85	N	0.747	0.000	0.046	0.207	-886.51	N
		(0.107)	(0.030)		(0.119)	(0.105)	(0.035)			(0.088)	(0.000)	(0.031)	(0.085)		
NET	C	0.967	0.016	-762.15	0.933	0.044	0.023	-762.08	N	0.909	0.000	0.024	0.066	-761.72	N
		(0.108)	(0.027)		(0.136)	(0.116)	(0.025)			(0.124)	(0.000)	(0.018)	(0.116)		
RUS	C	0.807	0.097	-1239.91	0.795	0.101	0.097	-1239.74	N	0.803	0.013	0.093	0.056	-1239.68	N
		(0.109)	(0.054)		(0.151)	(0.132)	(0.064)			(0.131)	(0.242)	(0.057)	(0.176)		
SPA	C	0.776	0.029	-786.20	0.790	0.183	0.027	-785.91	N	0.789	0.184	0.027	0.000	-785.91	N
		(0.144)	(0.040)		(0.089)	(0.084)	(0.030)			(0.089)	(0.084)	(0.030)	(0.000)		
SWE	C	0.912	0.016	-783.67	0.865	0.114	0.021	-783.51	N	0.863	0.115	0.021	0.000	-783.51	N
		(0.085)	(0.025)		(0.108)	(0.105)	(0.025)			(0.109)	(0.106)	(0.025)	(0.000)		
SWI	C	0.976	0.000	-726.08	0.983	0.001	0.000	-726.08	N	0.664	0.001	0.000	0.138	-725.09	N
		(0.030)	(0.000)		(0.031)	(0.211)	(0.000)			(0.289)	(0.027)	(0.000)	(0.192)		

UK	C	0.903 (0.029)	0.045 (0.024)	-597.29	0.890 (0.033)	0.064 (0.027)	0.046 (0.022)	-596.74	N	0.901 (0.026)	0.000 (0.000)	0.037 (0.021)	0.062 (0.025)	-596.27	N
<i>Latin America</i>															
ARG	N	0.828 (0.136)	0.070 (0.041)	-957.17	0.828 (0.136)	0.000 (0.000)	0.070 (0.041)	-957.17	N	0.828 (0.136)	0.000 (0.000)	0.070 (0.041)	0.000 (0.000)	-957.17	N
BRA	N	0.934 (0.057)	0.018 (0.016)	-894.30	0.934 (0.057)	0.000 (0.000)	0.018 (0.016)	-894.30	N	0.934 (0.057)	0.000 (0.000)	0.018 (0.016)	0.000 (0.000)	-894.30	N
CHI	N	0.000 (0.000)	0.121 (0.080)	-662.39	0.000 (0.000)	0.028 (0.266)	0.122 (0.088)	-662.38	N	0.000 (0.000)	0.028 (0.253)	0.122 (0.087)	0.000 (0.000)	-662.38	N
MEX	N	0.962 (0.010)	0.000 (0.000)	-819.73	0.962 (0.010)	0.004 (0.011)	0.000 (0.000)	-819.73	N	0.962 (0.010)	0.005 (0.020)	0.000 (0.000)	0.000 (0.000)	-819.73	N
<i>North America</i>															
CAN	N	0.797 (0.070)	0.026 (0.044)	-585.97	0.797 (0.070)	0.000 (0.000)	0.026 (0.044)	-585.97	N	0.821 (0.053)	0.111 (0.066)	0.018 (0.038)	0.049 (0.039)	-585.66	N
US	N	0.848 (0.058)	0.024 (0.024)	-755.33	0.850 (0.057)	0.000 (0.000)	0.024 (0.024)	-755.33	N	0.842 (0.101)	0.000 (0.000)	0.014 (0.029)	0.034 (0.052)	-755.07	N
<i>Africa</i>															
SA	C	0.025 (0.322)	0.215 (0.084)	-713.77	0.026 (0.338)	0.000 (0.000)	0.215 (0.084)	-713.77	N	0.025 (0.321)	0.000 (0.000)	0.215 (0.084)	0.000 (0.000)	-713.77	N

In summary, our time-varying conditional correlation test shows a completely different result from those of the constant correlation test. Our modified DCC test results show that only the Philippines and Italy (or only the Philippines with two-day rolling average returns) exhibited contagion evidence from the 1997 Asian crisis, while the z-test indicates that contagion from Hong Kong occurred to 16 out of 27 countries (or 11 countries with two-day rolling average returns). This difference between the two tests is mainly due to the failure of the z-test to incorporate the time-varying nature of cross-market co-movements into the correlation test. Statistically significant increases in the constant correlation reported as contagion evidence by the z-test disappear in our time-varying conditional correlation test. This implies that the high correlation during the crisis period is attributed to the high level of cross-market co-movements induced by rational risk-averse investors who systematically adjust their investment positions along with their perceived high future volatility for the crisis country during the crisis period.

## **V. Test for the 1994 Mexican Peso Crisis and the 1987 U.S. Market Crash**

### **1. Test for the 1994 Mexican Peso Crisis**

We also performed the contagion tests for the 1994 Mexican peso crisis. We used U.S. dollar-based returns for the period from January 1, 1993 to December 18, 1994 as the stable period and the period from December 19, 1994 to December 31, 1994 as the crisis period. The z-test results for the peso crisis are reported in Table V, which shows that only two countries (Sweden and Brazil) exhibited contagion evidence for daily dollar-based returns and three countries (Spain, Brazil, and Chile) for two-day rolling average returns. During the stable period, most East Asian and European countries, after controlling for domestic and global factors, show a relatively low correlation with Mexico with an average of 0.036 and 0.065, respectively, for daily returns. Countries in both Latin America and North America show a relatively high correlation with Mexico with an average during the stable period of 0.237. During the crisis period, the correlation substantially increases for Sweden and Brazil to 0.793 and 0.754, respectively, leading to contagion in the two countries. The similar situation happens to Spain, Brazil, and Chile when using two-day rolling average returns. Again, since the z-test is not capable of capturing the time-varying nature of cross-market co-movements, its results are not accurate and reliable for the test of contagion.



Table 5. The z-test results for 1994 Mexican peso crisis

This table presents the z-test results of contagion for the 1994 Mexico Peso crisis. We specify the univariate GARCH (1,1) process to capture the heteroscedasticity of returns. Correlations are between daily returns of Mexico index in calendar time  $t$  and those of the Asia and Europe indices in the calendar time  $t + 1$ , and those of North America indices in the calendar time  $t$ . The stable period is from January 1, 1993 to December 18, 1994, while the turmoil period is from December 19, 1994 to December 31, 1994. The full period includes both the stable and turmoil periods. The test statistics are for one-sided tests examining if the correlation coefficient during the turmoil period is greater than during the stable period. The p-values of the test statistics are reported in parentheses. "C" means a contagion with the test statistic significant at the 5% level, while "N" indicates that the test statistic is insignificant at the 5% level and therefore no contagion occurred

	Daily Returns					Two-day Moving Average Returns				
Country	Stable period	Turmoil period	Full period	Z- Stat.	Contagion?	Stable period	Turmoil period	Full period	Z- Stat.	Contagion?
Asia										
Australia	0.101	-0.875	0.125	-3.83	N	0.139	0.277	0.123	0.38	N
Hong Kong	0.090	0.074	0.080	-0.04	N	0.106	-0.496	0.056	-1.71	N
India	-0.059	-0.163	-0.072	-0.28	N	-0.106	0.318	-0.073	1.14	N
Indonesia	0.083	-0.313	0.100	-1.07	N	0.121	-0.111	0.082	-0.61	N
Japan	-0.030	0.405	-0.044	1.21	N	-0.068	0.035	-0.059	0.27	N
Korea	0.094	-0.169	0.105	-0.70	N	0.119	-0.041	0.092	-0.42	N
Malaysia	0.016	0.259	0.042	0.65	N	0.103	-0.526	0.047	-1.81	N
Philippines	0.033	0.548	0.064	1.53	N	0.109	-0.402	0.061	-1.41	N
Singapore	0.032	0.411	0.106	1.06	N	0.119	0.008	0.087	-0.29	N
Taiwan	0.035	0.343	0.076	0.84	N	0.093	0.057	0.073	-0.10	N
Thailand	-0.003	-0.355	0.049	-0.97	N	0.082	-0.399	0.050	-1.33	N
Europe										
Belgium	0.092	0.400	0.108	0.87	N	0.113	0.324	0.097	0.58	N
France	0.043	0.418	0.139	1.06	N	0.158	0.154	0.128	-0.01	N
Germany	0.045	0.360	0.077	0.87	N	0.080	0.192	0.061	0.30	N
Italy	0.044	0.382	-0.022	0.94	N	0.008	-0.271	-0.022	-0.75	N
Netherlands	0.077	0.526	0.097	1.33	N	0.116	-0.126	0.074	-0.64	N
Spain	0.052	0.096	0.213	0.12	N	0.159	0.708	0.192	1.90	C
Sweden	0.095	0.793	0.062	2.58	C	0.061	-0.279	0.029	-0.91	N
Switzerland	0.084	0.458	0.082	1.08	N	0.094	-0.345	0.047	-1.19	N
U.K.	0.052	0.001	0.176	-0.13	N	0.205	-0.055	0.151	-0.69	N
Latin America										
Argentina	0.330	0.480	0.310	0.47	N	0.324	0.447	0.306	0.38	N
Brazil	0.181	0.754	0.209	2.10	C	0.175	0.754	0.206	2.11	C
Chile	0.214	0.600	0.220	1.25	N	0.197	0.737	0.227	1.96	C
North America										
Canada	0.231	-0.164	0.155	-1.05	N	0.212	0.020	0.159	-0.51	N
U.S.	0.227	-0.379	0.144	-1.65	N	0.230	-0.431	0.150	-1.83	N
Africa										
S. Africa	-0.017	-0.223	0.040	-0.55	N	0.030	0.255	0.028	0.61	N

Table VI presents the results of the time-varying conditional correlation test. It shows that none of 26 countries exhibited contagion evidence from the peso crisis for both daily and two-day rolling average returns. Test results shown in Panels A and B imply that there was no irrational market reaction to the peso crisis to lead to contagion, but only time-varying rational responses to the crisis. Our results are consistent with those results reported by Bakaert, Harvey, and Ng (2005), Rigobon (2003), and Rodriguez (2007), concluding that the 1994 Mexican peso crisis was relatively less severe than other crisis episodes. Therefore, we conclude that there was no contagion from the 1994 Mexican peso crisis to the national stock markets.

Table 6. Time-Varying Conditional Correlation Test of the 1994 Mexican Peso Crisis for Returns Based on U.S. Dollars

The likelihood ratio (LR) tests of financial contagion are based on the Engle (2002)'s dynamic conditional correlation (DCC) model as a restricted model and the two modified DCC models as unrestricted models. The models are specified as:

$$\text{Model 1 (DCC model): } Q_t = (1 - \delta - \gamma)\bar{Q} + \delta Q_{t-1} + \gamma v_{t-1} v_{t-1}'$$

$$\text{Model 2 (Modified DCC model A): } Q_t = (1 - \delta - D\delta^C - \gamma)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + (\gamma + D\gamma^C)v_{t-1} v_{t-1}'$$

$$\text{Model 3 (Modified DCC model B): } Q_t = (1 - \delta - D\delta^C - \gamma - D\gamma^C)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + (\gamma + D\gamma^C)v_{t-1} v_{t-1}'$$

where  $\bar{Q}$  is the unconditional covariance matrix of the standardized residual vector  $v_t$ , and  $D$  is a dummy variable taking value 1 for the crisis period and 0 for the stable period. The stable period is from January 1, 1993 to December 18, 1994 and the crisis period is from December 19, 1994 to December 31, 1994. The test hypotheses for the model 1 and model 2 are  $H_0: \delta^C = 0$  and  $H_0: \delta^C = \gamma^C = 0$ , respectively. "z-test" refers to the results of conventional z-test of contagion, and "N" stands for no contagion and "C" for contagion. "?" refers to the LR test results of contagion. "LL" is the log likelihood value of the estimated DCC models. We use the Constrained Maximum Likelihood (CML) module in GAUSS. The Bollerslev-Wooldridge heteroscedastic-consistent standard errors are reported in parentheses.

Panel A: Results for daily returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^c$	$\gamma$	LL	?	$\delta$	$\delta^c$	$\gamma$	$\gamma^c$	LL	?
<i>Asia</i>															
AUS	N	0.951 (0.049)	0.025 (0.017)	-1689.88	0.450 (0.659)	0.426 (0.568)	0.123 (0.104)	-1688.87	N	0.638 (0.493)	0.082 (0.471)	0.072 (0.083)	0.208 (0.074)	-1687.57	N
HK	N	0.969 (0.019)	0.017 (0.008)	-1873.73	0.969 (0.019)	0.000 (0.000)	0.017 (0.008)	-1873.73	N	0.969 (0.019)	0.000 (0.000)	0.017 (0.008)	0.000 (0.000)	-1873.73	N
INA	N	0.925 (0.131)	0.000 (0.000)	-1839.51	0.925 (0.130)	0.000 (0.000)	0.000 (0.000)	-1839.51	N	0.926 (0.130)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1839.51	N
IND	N	0.972 (0.006)	0.023 (0.007)	-1715.25	0.971 (0.007)	0.005 (0.008)	0.023 (0.008)	-1715.24	N	0.971 (0.007)	0.005 (0.008)	0.023 (0.008)	0.000 (0.000)	-1715.25	N
JAP	N	0.647 (0.087)	0.053 (0.023)	-1693.22	0.647 (0.087)	0.000 (0.000)	0.053 (0.023)	-1693.22	N	0.647 (0.087)	0.000 (0.000)	0.053 (0.023)	0.000 (0.000)	-1693.22	N
KOR	N	0.962 (0.018)	0.010 (0.013)	-1821.88	0.962 (0.018)	0.000 (0.000)	0.010 (0.013)	-1821.88	N	0.962 (0.018)	0.000 (0.000)	0.010 (0.013)	0.000 (0.000)	-1821.88	N

MAL	N	0.941 (0.017)	0.000 (0.000)	-1779.67	0.941 (0.017)	0.000 (0.000)	0.000 (0.000)	-1779.67	N	0.941 (0.018)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1779.67	N
PHI	N	0.976 (0.070)	0.000 (0.000)	-1815.12	0.976 (0.074)	0.000 (0.000)	0.000 (0.000)	-1815.12	N	0.976 (0.068)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1815.12	N
SIN	N	0.976 (0.008)	0.014 (0.007)	-1576.19	0.976 (0.008)	0.000 (0.000)	0.014 (0.007)	-1576.19	N	0.976 (0.008)	0.000 (0.000)	0.014 (0.007)	0.000 (0.000)	-1576.19	N
TWN	N	0.945 (0.105)	0.000 (0.000)	-1976.01	0.953 (0.062)	0.000 (0.000)	0.000 (0.000)	-1976.01	N	0.953 (0.075)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1976.01	N

THA	N	0.692 (0.140)	0.085 (0.046)	-1870.48	0.692 (0.140)	0.000 (0.000)	0.085 (0.046)	-1870.48	N	0.703 (0.158)	0.000 (0.000)	0.082 (0.050)	0.025 (0.047)	-1870.45	N
<i>Europe</i>															
BEL	N	0.915 (0.056)	0.019 (0.027)	-1503.29	0.915 (0.056)	0.000 (0.000)	0.019 (0.027)	-1503.29	N	0.915 (0.056)	0.000 (0.000)	0.019 (0.027)	0.000 (0.000)	-1503.29	N
FRA	N	0.948 (0.034)	0.000 (0.000)	-1604.78	0.947 (0.034)	0.000 (0.000)	0.000 (0.000)	-1604.78	N	0.946 (0.036)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1604.78	N
GER	N	0.907 (0.063)	0.014 (0.024)	-1597.91	0.904 (0.065)	0.048 (0.228)	0.013 (0.024)	-1597.90	N	0.904 (0.065)	0.048 (0.225)	0.013 (0.024)	0.000 (0.000)	-1597.90	N
ITA	N	0.959 (0.114)	0.000 (0.000)	-1872.50	0.958 (0.118)	0.000 (0.000)	0.000 (0.000)	-1872.50	N	0.958 (0.113)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1872.50	N
NET	N	0.943 (0.067)	0.000 (0.000)	-1468.00	0.942 (0.042)	0.000 (0.000)	0.000 (0.000)	-1468.00	N	0.941 (0.039)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1468.00	N
SPA	N	0.946 (0.067)	0.000 (0.000)	-1708.06	0.946 (0.063)	0.000 (0.000)	0.000 (0.000)	-1708.06	N	0.945 (0.061)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1708.06	N
SWE	C	0.974 (0.015)	0.010 (0.010)	-1776.28	0.974 (0.015)	0.000 (0.000)	0.010 (0.010)	-1776.28	N	0.974 (0.015)	0.000 (0.000)	0.010 (0.010)	0.000 (0.000)	-1776.28	N
SWI	N	0.985 (0.025)	0.000 (0.000)	-1589.00	0.984 (0.031)	0.000 (0.000)	0.000 (0.000)	-1589.00	N	0.983 (0.033)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1589.00	N
UK	N	0.963 (0.027)	0.012 (0.012)	-1533.41	0.963 (0.027)	0.025 (0.023)	0.012 (0.011)	-1533.40	N	0.967 (0.025)	0.000 (0.000)	0.010 (0.012)	0.022 (0.020)	-1533.29	N
<i>L. America</i>															
ARG	N	0.955 (0.029)	0.026 (0.014)	-1887.16	0.955 (0.029)	0.019 (0.019)	0.026 (0.014)	-1887.15	N	0.955 (0.029)	0.019 (0.019)	0.026 (0.014)	0.000 (0.000)	-1887.15	N
BRA	C	0.966 (0.017)	0.021 (0.010)	-2324.12	0.966 (0.018)	0.012 (0.012)	0.021 (0.010)	-2324.11	N	0.966 (0.016)	0.000 (0.000)	0.021 (0.009)	0.014 (0.012)	-2323.93	N
CHI	N	0.916 (0.034)	0.044 (0.020)	-1707.91	0.916 (0.034)	0.000 (0.000)	0.044 (0.020)	-1707.91	N	0.916 (0.034)	0.000 (0.000)	0.044 (0.020)	0.000 (0.000)	-1707.91	N
<i>N. America</i>															
CAN	N	0.850	0.047	-1422.14	0.847	0.108	0.045	-1422.06	N	0.842	0.000	0.041	0.048	-1421.96	N

US	N	(0.107)	(0.035)		(0.114)	(0.104)	(0.029)		N	(0.149)	(0.000)	(0.039)	(0.069)		N
		0.952	0.025	-1355.89	0.945	0.028	0.027	-1355.78		0.944	0.000	0.025	0.031	-1355.70	
		(0.038)	(0.019)		(0.059)	(0.037)	(0.025)			(0.058)	(0.000)	(0.023)	(0.041)		
<i>Africa</i>															
SA	N	0.965	0.000	-1682.30	0.965	0.001	0.000	-1682.30	N	0.972	0.005	0.000	0.023	-1682.16	N
		(0.117)	(0.000)		(0.116)	(0.145)	(0.000)			(0.041)	(0.046)	(0.000)	(0.026)		

Panel B: Results for two-day average returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^C$	$\gamma$	LL	?	$\delta$	$\delta^C$	$\gamma$	$\gamma^C$	LL	?
<i>Asia</i>															
AUS	N	0.961 (0.023)	0.008 (0.012)	-1026.85	0.961 (0.023)	0.031 (0.022)	0.008 (0.012)	-1026.84	N	0.962 (0.023)	0.005 (0.804)	0.007 (0.013)	0.016 (0.188)	-1026.84	N
HK	N	0.862 (0.094)	0.040 (0.024)	-1211.94	0.851 (0.100)	0.108 (0.092)	0.040 (0.022)	-1211.87	N	0.851 (0.101)	0.108 (0.093)	0.040 (0.022)	0.000 (0.000)	-1211.87	N
INA	N	0.835 (0.067)	0.028 (0.019)	-1189.56	0.840 (0.099)	0.093 (0.876)	0.027 (0.027)	-1189.56	N	0.840 (0.099)	0.092 (0.874)	0.027 (0.027)	0.000 (0.000)	-1189.56	N
IND	N	0.965 (0.022)	0.000 (0.000)	-1063.50	0.965 (0.022)	0.000 (0.000)	0.000 (0.000)	-1063.50	N	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.594 (1.055)	-1062.51	N
JAP	N	0.971 (0.016)	0.000 (0.000)	-1020.68	0.971 (0.015)	0.000 (0.000)	0.000 (0.000)	-1020.68	N	0.971 (0.015)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1020.68	N
KOR	N	0.949 (0.015)	0.000 (0.000)	-1165.85	0.949 (0.015)	0.000 (0.000)	0.000 (0.000)	-1165.85	N	0.949 (0.018)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-1165.85	N
MAL	N	0.390 (0.195)	0.219 (0.078)	-1117.16	0.369 (0.270)	0.041 (0.239)	0.221 (0.078)	-1117.15	N	0.322 (0.141)	0.000 (0.000)	0.214 (0.073)	0.130 (0.117)	-1116.90	N
PHI	N	0.025 (0.391)	0.138 (0.063)	-1148.50	0.000 (0.000)	0.595 (0.362)	0.121 (0.070)	-1148.26	N	0.000 (0.000)	0.595 (0.362)	0.121 (0.070)	0.000 (0.000)	-1148.26	N
SIN	N	0.949 (0.036)	0.026 (0.018)	-911.61	0.949 (0.036)	0.000 (0.000)	0.026 (0.018)	-911.61	N	0.949 (0.036)	0.000 (0.000)	0.026 (0.018)	0.000 (0.000)	-911.61	N
TWN	N	0.983 (0.026)	0.001 (0.006)	-1311.57	0.982 (0.029)	0.018 (0.029)	0.001 (0.006)	-1311.57	N	0.982 (0.028)	0.018 (0.028)	0.001 (0.006)	0.000 (0.000)	-1311.57	N
THA	N	0.886 (0.067)	0.019 (0.019)	-1209.59	0.866 (0.121)	0.114 (0.121)	0.020 (0.018)	-1209.51	N	0.905 (0.061)	0.000 (0.000)	0.011 (0.020)	0.066 (0.039)	-1209.24	N
<i>Europe</i>															
BEL	N	0.961 (0.034)	0.000 (0.000)	-850.59	0.960 (0.038)	0.000 (0.000)	0.000 (0.000)	-850.59	N	0.960 (0.037)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-850.59	N
FRA	N	0.975	0.000	-944.10	0.974	0.023	0.000	-944.00	N	0.974	0.023	0.000	0.000	-944.00	N

		(0.036)	(0.000)		(0.038)	(0.047)	(0.000)			(0.038)	(0.047)	(0.000)	(0.000)		
GER	N	0.953	0.000	-937.96	0.952	0.000	0.000	-937.96	N	0.942	0.001	0.000	0.057	-937.80	N
		(0.034)	(0.000)		(0.035)	(0.000)	(0.000)			(0.061)	(0.018)	(0.000)	(0.065)		
ITA	N	0.979	0.003	-1219.20	0.978	0.019	0.003	-1219.19	N	0.981	0.004	0.001	0.014	-1219.13	N
		(0.018)	(0.009)		(0.025)	(0.027)	(0.009)			(0.014)	(0.023)	(0.011)	(0.026)		
NET	N	0.920	0.000	-816.35	0.920	0.000	0.000	-816.35	N	0.927	0.007	0.000	0.065	-815.90	N
		(0.053)	(0.000)		(0.052)	(0.000)	(0.000)			(0.063)	(0.026)	(0.000)	(0.071)		
SPA	C	0.874	0.034	-1041.33	0.835	0.127	0.038	-1041.08	N	0.892	0.039	0.024	0.045	-1040.88	N
		(0.096)	(0.028)		(0.116)	(0.106)	(0.028)			(0.272)	(0.297)	(0.046)	(0.091)		
SWE	N	0.887	0.047	-1114.12	0.887	0.057	0.046	-1114.11	N	0.887	0.057	0.046	0.000	-1114.11	N
		(0.050)	(0.022)		(0.051)	(0.134)	(0.022)			(0.051)	(0.134)	(0.022)	(0.000)		
SWI	N	0.979	0.001	-922.12	0.979	0.020	0.001	-922.12	N	0.935	0.000	0.000	0.064	-921.50	N
		(0.025)	(0.009)		(0.023)	(0.023)	(0.008)			(0.058)	(0.000)	(0.000)	(0.058)		
UK	N	0.935	0.000	-864.21	0.935	0.000	0.000	-864.21	N	0.901	0.000	0.000	0.077	-863.01	N
		(0.030)	(0.000)		(0.031)	(0.000)	(0.000)			(0.130)	(0.000)	(0.000)	(0.029)		
<i>L. America</i>															
ARG	N	0.970	0.023	-1226.63	0.970	0.000	0.023	-1226.63	N	0.970	0.000	0.023	0.000	-1226.63	N
		(0.012)	(0.009)		(0.012)	(0.000)	(0.009)			(0.012)	(0.000)	(0.009)	(0.000)		
BRA	C	0.975	0.017	-1651.45	0.974	0.009	0.017	-1651.43	N	0.973	0.000	0.016	0.010	-1651.30	N
		(0.016)	(0.010)		(0.016)	(0.011)	(0.010)			(0.015)	(0.000)	(0.009)	(0.012)		
CHI	C	0.923	0.035	-1044.27	0.921	0.043	0.035	-1044.22	N	0.932	0.007	0.029	0.032	-1044.07	N
		(0.032)	(0.022)		(0.034)	(0.032)	(0.021)			(0.034)	(0.052)	(0.025)	(0.044)		
<i>N. America</i>															
CAN	N	0.916	0.043	-761.28	0.916	0.000	0.043	-761.28	N	0.916	0.000	0.043	0.000	-761.28	N
		(0.030)	(0.022)		(0.030)	(0.000)	(0.022)			(0.030)	(0.000)	(0.022)	(0.000)		
US	N	0.961	0.023	-693.30	0.958	0.018	0.023	-693.21	N	0.956	0.000	0.022	0.021	-693.12	N
		(0.020)	(0.011)		(0.024)	(0.017)	(0.011)			(0.029)	(0.000)	(0.012)	(0.024)		
<i>Africa</i>															
SA	N	0.928	0.000	-1011.40	0.928	0.000	0.000	-1011.40	N	0.000	0.000	0.000	0.244	-1009.75	N
		(0.197)	(0.000)		(0.198)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.054)		



## 2. Test for the 1987 U.S. Stock Market Crash

For the 1987 U.S. stock market crash, Table VII reports the z-test results for both daily returns and two-day rolling average returns based on U.S. dollars. It shows that for daily returns, contagion from the U.S. market occurred to four out of nine countries, Australia, Japan, the U.K. and Canada, with an average correlation of 0.711 during the crisis period and 0.270 during the stable period. However, for two-day rolling average returns, six out of nine countries exhibited contagion from U.S. market, with an average correlation of 0.560 during the crisis period and 0.116 during the stable period.

Table 7. The Z-Test Results for 1987 U.S. Stock Market Crash

This table presents the z-test results of contagion for the 1987 U.S. stock market crash. We specify the univariate GARCH (1,1) process to capture the heteroscedasticity of returns. The stable period is from January 1, 1986 to October 16, 1987, and the turmoil period is from October 17, 1987 to December 4, 1987. The full period includes both the stable and turmoil periods. The test statistics are for one-sided tests examining if the correlation coefficient during the turmoil period is greater than during the stable period. The p-values of the test statistics are reported in parentheses. "C" means a contagion with the test statistic significant at the 5% level, while "N" indicates that the test statistic is insignificant at the 5% level and therefore no contagion occurred.

Country	Daily Returns					Two-day Moving Average Returns				
	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?	Stable period	Turmoil period	Full period	Z-Stat.	Contagion?
Asia										
Australia	0.110	0.822	0.571	5.67	C	-0.012	-0.078	-0.033	-0.36	N
Hong Kong	0.211	0.024	0.106	-1.02	N	0.016	0.468	0.334	2.68	C
Japan	0.182	0.790	0.475	4.77	C	0.096	0.064	0.085	-0.17	N
Europe										
France	0.249	0.064	0.162	-1.02	N	0.073	0.643	0.362	3.77	C
Germany	0.276	0.361	0.302	0.51	N	0.089	0.463	0.256	2.25	C
Netherlands	0.426	0.366	0.394	-0.38	N	0.261	0.612	0.477	2.43	C
Switzerland	0.328	0.289	0.310	-0.23	N	0.060	0.695	0.431	4.36	C
U.K.	0.214	0.479	0.352	1.64	C	0.206	0.480	0.360	1.71	C
North America										
Canada	0.574	0.753	0.693	1.79	C	0.576	0.734	0.680	1.53	N

However, the results of the time-varying conditional correlation test reported in Table VIII show that none of the nine countries exhibited contagion evidence from the 1987 stock market crash. Our results for the 1987 U.S. market crash are similar to those found for the 1994 peso crisis. The results for both the Mexican peso crisis and the U.S. market crash confirm the role of time-varying rationality in the test of contagion. They show that contagion evidence reported by the z-test disappears after controlling the time-varying nature of cross-market co-movements. In sum, our test results for the 1994 peso crisis and the 1987 U.S. market crash confirms that the high correlation during the crisis period is mostly attributed to a high level of cross-market co-movements induced by risk-averse investors rationally responding to the high level of predictable volatility of the crisis country during the crisis period.

Table 8. Time-Varying Conditional Correlation Test of the 1987 U.S. Stock Market Crash for Returns Based on U.S. Dollars

The likelihood ratio (LR) tests of financial contagion are based on the Engle (2002)'s dynamic conditional correlation (DCC) model as a restricted model and the two modified DCC models as unrestricted models. The models are specified as:

$$\text{Model 1 (DCC model): } Q_t = (1 - \delta - \gamma)\bar{Q} + \delta Q_{t-1} + \gamma v_{t-1} v_{t-1}'$$

$$\text{Model 2 (Modified DCC model A): } Q_t = (1 - \delta - D\delta^C - \gamma)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + \gamma v_{t-1} v_{t-1}'$$

$$\text{Model 3 (Modified DCC model B): } Q_t = (1 - \delta - D\delta^C - \gamma - D\gamma^C)\bar{Q} + (\delta + D\delta^C)Q_{t-1} + (\gamma + D\gamma^C)v_{t-1} v_{t-1}'$$

where  $\bar{Q}$  is the unconditional covariance matrix of the standardized residual vector  $v_t$ , and  $D$  is a dummy variable taking value 1 for the crisis period and 0 for the stable period. The stable period is from January 1, 1986 to October 16, 1987 and the crisis period is from October 17, 1987 to December 4, 1987. The test hypotheses for the model 1 and model 2 are  $H_0: \delta^C = 0$  and  $H_0: \delta^C = \gamma^C = 0$ , respectively. "z-test" refers to the results of conventional z-test of contagion, and "N" stands for no contagion and "C" for contagion. "?" refers to the LR test results of contagion. "LL" is the log likelihood value of the estimated DCC models. We use the Constrained Maximum Likelihood (CML) module in GAUSS. The Bollerslev-Wooldridge heteroscedastic-consistent standard errors are reported in parentheses.

Panel A: Results for daily returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^c$	$\gamma$	LL	?	$\delta$	$\delta^c$	$\gamma$	$\gamma^c$	LL	?
<i>Asia</i>															
AUS	C	0.894 (0.116)	0.050 (0.040)	-1619.80	0.894 (0.116)	0.000 (0.000)	0.050 (0.040)	-1619.80	N	0.894 (0.116)	0.000 (0.000)	0.050 (0.040)	0.000 (0.000)	-1619.80	N
HK	N	0.969 (0.022)	0.000 (0.000)	-1667.25	0.966 (0.062)	0.012 (0.182)	0.000 (0.000)	-1667.25	N	0.966 (0.066)	0.012 (0.154)	0.000 (0.000)	0.000 (0.000)	-1667.25	N
JAP	C	0.367 (0.417)	0.152 (0.094)	-1594.88	0.367 (0.417)	0.000 (0.000)	0.152 (0.094)	-1594.88	N	0.001 (0.056)	0.000 (0.000)	0.085 (0.098)	0.218 (0.243)	-1594.29	N
<i>Europe</i>															
FRA	N	0.979 (0.039)	0.000 (0.000)	-1563.51	0.979 (0.047)	0.001 (0.095)	0.000 (0.000)	-1563.51	N	0.980 (0.096)	0.002 (0.089)	0.000 (0.000)	0.000 (0.000)	-1563.51	N
GER	N	0.974 (0.014)	0.008 (0.006)	-1530.18	0.973 (0.014)	0.007 (0.097)	0.008 (0.007)	-1530.18	N	0.973 (0.014)	0.007 (0.099)	0.008 (0.007)	0.000 (0.000)	-1530.18	N
NET	N	0.981	0.000	-1394.69	0.981	0.018	0.000	-1394.69	N	0.980	0.017	0.000	0.000	-1394.69	N

		(0.012)	(0.000)		(0.020)	(0.210)	(0.000)			(0.041)	(0.461)	(0.000)	(0.000)		
SWI	N	0.966	0.000	-1471.20	0.966	0.005	0.000	-1471.20	N	0.966	0.005	0.000	0.000	-1471.20	N
		(0.050)	(0.000)		(0.055)	(0.056)	(0.000)			(0.076)	(0.075)	(0.000)	(0.000)		
UK	C	0.000	0.068	-1504.50	0.000	0.000	0.068	-1504.50	N	0.000	0.000	0.067	0.001	-1504.50	N
		(0.000)	(0.044)		(0.000)	(0.000)	(0.044)			(0.000)	(0.000)	(0.089)	(0.104)		
<i>N. America</i>															
CAN	C	0.937	0.021	-1209.03	0.927	0.026	0.021	-1208.90	N	0.927	0.026	0.021	0.000	-1208.90	N
		(0.044)	(0.021)		(0.058)	(0.051)	(0.024)			(0.057)	(0.051)	(0.024)	(0.000)		

Panel B: Results for two-day average returns based on U.S. dollars															
		Model 1: DCC Model			Model 2: Modified DCC Model A					Model 3: Modified DCC Model B					
	z-test	$\delta$	$\gamma$	LL	$\delta$	$\delta^C$	$\gamma$	LL	?	$\delta$	$\delta^C$	$\gamma$	$\gamma^C$	LL	?
<i>Asia</i>															
AUS	N	0.931 (0.071)	0.000 (0.000)	-1035.10	0.934 (0.194)	0.054 (0.097)	0.000 (0.000)	-1035.10	N	0.936 (0.204)	0.053 (0.152)	0.000 (0.000)	0.000 (0.000)	-1035.10	N
HK	C	0.281 (0.071)	0.221 (0.074)	-1031.53	0.281 (0.071)	0.000 (0.000)	0.221 (0.074)	-1031.53	N	0.256 (0.113)	0.000 (0.000)	0.192 (0.108)	0.061 (0.186)	-1031.44	N
JAP	N	0.972 (0.018)	0.001 (0.010)	-1013.47	0.958 (0.029)	0.039 (0.031)	0.002 (0.006)	-1013.45	N	0.957 (0.033)	0.040 (0.035)	0.002 (0.006)	0.000 (0.000)	-1013.45	N
<i>Europe</i>															
FRA	C	0.889 (0.048)	0.031 (0.019)	-942.26	0.720 (0.324)	0.187 (0.317)	0.036 (0.023)	-941.62	N	0.720 (0.325)	0.186 (0.317)	0.036 (0.023)	0.000 (0.000)	-941.62	N
GER	C	0.821 (0.371)	0.023 (0.058)	-926.79	0.716 (0.129)	0.199 (0.128)	0.022 (0.043)	-926.39	N	0.716 (0.129)	0.199 (0.128)	0.022 (0.043)	0.000 (0.000)	-926.39	N
NET	C	0.910 (0.161)	0.028 (0.054)	-780.38	0.819 (0.179)	0.118 (0.187)	0.028 (0.056)	-779.95	N	0.819 (0.179)	0.117 (0.188)	0.028 (0.056)	0.000 (0.000)	-779.95	N
SWI	C	0.752 (0.119)	0.122 (0.086)	-852.24	0.740 (0.127)	0.024 (0.100)	0.122 (0.080)	-852.20	N	0.740 (0.127)	0.024 (0.099)	0.122 (0.080)	0.000 (0.000)	-852.20	N
UK	C	0.960 (0.030)	0.016 (0.022)	-875.92	0.949 (0.037)	0.034 (0.030)	0.016 (0.017)	-874.90	N	0.949 (0.037)	0.034 (0.030)	0.016 (0.018)	0.000 (0.000)	-874.90	N
<i>N. America</i>															
CAN	N	0.959 (0.033)	0.013 (0.014)	-598.39	0.957 (0.028)	0.031 (0.025)	0.011 (0.010)	-598.15	N	0.957 (0.028)	0.031 (0.025)	0.011 (0.010)	0.000 (0.000)	-598.15	N

## **VI. Summary and Conclusion**

In this paper, we suggest and demonstrate that there is a significant time-varying relationship between cross-market co-movements and predictable cross-market market volatilities, and that the time-varying component of the cross-market correlation is due to the rational responses by risk-averse investors who systematically revise their expectations in response to their perceived future volatility.

We propose a time-varying conditional correlation test for contagion to correctly reflect the correlation-volatility relation in the test. In this time-varying correlation test, contagion is defined as a structural break in the dynamics of conditional correlation during the crisis period. Using the dynamic conditional correlation (DCC) model, we found that (a) only the Philippines and Italy show evidence of contagion from the 1997 Asian crisis, and (b) none of the countries considered in the test show contagion evidence from the 1994 Mexican peso crisis and 1987 U.S. stock market crash.

Our results imply that a high correlation during the crisis time period reported as contagion evidence by the constant correlation test is mostly attributable to the high level of cross-market co-movements induced by the rational risk-averse investors during the crisis period. In general, risk-averse investors rationally respond to the crisis by adjusting their investment positions along with their perceived high future volatility for the crisis country during the crisis period.

## Appendix

### List of Interest Rates

Country		Interest Rate
	<i>East Asia</i>	
Hong Kong		Hong Kong Interbank 3 month rate
Australia		Dealer bill 90 days rate
Indonesia		Indonesia interbank call rate.
Japan		Japan interbank 3 month rate
Korea		Certificates of deposits 91 day rate
Malaysia		Offshore 3 month rate
Philippines		Philippines' interbank call loan rate
Singapore		Singapore Interbank 3 month rate
Taiwan		Taiwan money market 90 day rate
Thailand		Thailand interbank 3 month rate
	<i>Europe</i>	
Belgium		Belgium interbank offered 3 month rate
France		French Euro-Franc 3 month rate
Germany		Germany Euro-Mark 3 month rate
Italy		Euro-Lira 3 month rate
Netherlands		Netherlands' Interbank 3 month rate
Russia		Moscow interbank offered rate 90-day rate
Spain		Spain interbank 3 month rate
Sweden		Sweden Treasury bill 90 day rate
Swiss		Swiss interbank 3 month rate
U.K.		U.K. Treasury bills 3 month rate
	<i>South America</i>	
Argentina		Deposit rate per annum 90 day rate
Brazil		Financing overnight rate
Canada		Euro Currency Canadian Dollar 3 month rate
Chile		CD 90 day rate
Mexico		CETES 91 day closing rate
U.S.		U.S. Treasury bills 3 month rate
	<i>Africa</i>	
S. Africa		Bond yield

## References

- Ang, Andrew, and Joseph Chen, 2002, Asymmetric correlations of equity portfolios, *Journal of Financial Economics* 63, 443-494.
- Baba, Yoshihisa, Robert F. Engle, Dennis F. Kraft, and Kenneth F. Kroner, 1990, Multivariate simultaneous generalized ARCH, Unpublished paper, Department of Economics, UC San Diego, CA.
- Bae, Kee-Hong, G. Andrew Karolyi, and Rene M. Stulz, 2003, A new approach to measuring financial contagion, *Review of Financial Studies* 16, 717-763.
- Baig, Taimur, and Ilan Goldfajn, 1998, Financial market contagion in the Asian crisis, International Monetary Fund, Washington, D.C.
- Ball, Ray, and S.P. Kothari, 1989, Nonstationary expected returns: Implications for tests of market efficiency and serial correlation in returns, *Journal of Financial Economics* 25, 51-74.
- Bera, Anil K., and Sangwhan Kim, 2002, Testing constancy of correlation and other specifications of the BGARCH model with an application to international equity returns, *Journal of Empirical Finance* 9, 171-195.
- Bartram, Sohnke M., and Yaw-Huei Wang, 2005, Another look at the relationship between cross-market correlation and volatility, *Finance Research Letters* 2, 75-88.
- Bekaert, Geert, Campbell R. Harvey, and Angela Ng, 2005, Market integration and contagion, *Journal of Business* 78, 39-70.
- Bollerslev, Timothy, 1990, Modelling the coherence in short-run nominal exchange rates: A multivariate generalized approach, *Review of Economics and Statistics* 72, 498-505.
- Bollerslev, Timothy, Robert F. Engle, and Jeffrey M. Wooldridge, 1988, A capital asset pricing model with time-varying covariances, *Journal of Political Economy* 96, 116-131.
- Boyer, Brian H., Michael S. Gibson, and Mico Loretan, 1999, Pitfalls in tests for changes in correlations, International Finance Division Discussion Paper No. 597R, Federal Reserve Board, Washington, D.C.
- Boyer, Brian H., Tomomi Kumagai, and Kathy Yuan, 2006, How do crises spread?: Evidence from accessible and inaccessible stock indices, *Journal of Finance* 61, 957-1003.
- Broner, Fernando A., R. Gaston Gelos, and Carmen M. Reinhart, 2006, When in peril, retrench: Testing the portfolio channel of contagion, *Journal of International Economics* 69, 203-230.

- Caporale, Guglielmo M., Andrea Cipollini, and Nicola Spagnolo, 2005, Testing for contagion: A conditional correlation analysis, *Journal of Empirical Finance* 12, 476-489.
- Cecchetti, Stephen G., Pok-Sang Lam, and Nelson C. Mark, 1990, Mean reversion in equilibrium asset prices, *American Economic Review* 80, 398-418.
- Chakrabarti, Rajesh, and Richard Roll, 2002, East Asia and Europe during the 1997 Asian collapse: A clinical study of a financial crisis, *Journal of Financial Markets* 5, 1-30.
- Calvo, Sara, and Carmen M. Reinhart, 1996, Capital flows to Latin America: Is there evidence of contagion effects?, in Guillermo A. Calvo, Morris Goldstein, and Eduard Hochreiter, eds.: *Private Capital Flows to Emerging Markets after the Mexican Crisis* (Institute for International Economics, Washington, D.C.).
- Corsetti, Giancarlo, Marcello Pericoli, and Massimo Sbracia, 2005, 'Some contagion, some interdependence': more pitfalls in tests of financial contagion, *Journal of International Money and Finance* 24, 1177-1199.
- De Bondt, Werner F.M., and Richard Thaler, 1985, Does the stock market overreact?, *Journal of Finance* 40, 793-805.
- De Bondt, Werner F.M., and Richard Thaler, 1987, Further evidence on investor overreaction and stock market seasonality, *Journal of Finance* 42, 557-582.
- Engle, Robert F., 2002, Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroscedasticity models, *Journal of Business and Economic Statistics* 20, 339-350.
- Engle, Robert F., and Kevin Sheppard, 2001, Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH, Working paper, UC San Diego, CA.
- Fama, Eugene F., and Kenneth R. French, 1988, Permanent and temporary components of stock prices, *Journal of Political Economy* 96, 246-273.
- Forbes, Kristine J., and Roberto Rigobon, 2002, No contagion, only interdependence: Measuring stock market co-movements, *Journal of Finance* 57, 2223-2261.
- Gromb, Denis, and Dimitri Vayanos, 2002, Equilibrium and welfare in markets with financially constrained arbitrageurs, *Journal of Financial Economics* 66, 361-407.
- Hays, William L., 1994, *Statistics*, 5<sup>th</sup> ed. (Wadsworth Publishing Company).
- Karolyi, G. Andrew, and Rene M. Stulz, 1996, Why do markets move together? An investigation of U.S.-Japan stock return comovements, *Journal of Finance* 51, 951-986.
- King, Mervyn A., and Sushil Wadhwani, 1990, Transmission of volatility between stock markets, *Review of Financial Studies* 3, 5-33.



- Kocherlakota, Subrahmaniam, and Murari Singh, 1982, On the behavior of some transforms of the sample correlation coefficient in samples from the bivariate  $t$  and the bivariate  $\chi^2$  distribution, *Communications in Statistics-Theory and Methods* 11, 2045-2060.
- Kodres, Laura E., and Matthew Pritsker, 2002, A rational expectations model of financial contagion, *Journal of Finance* 57, 769-799.
- Kraft, Dennis F., and Robert F. Engle, 1982, Autoregressive conditional heteroscedasticity in multiple time series, Unpublished paper, Department of Economics, UC San Diego, CA.
- Kyle, Albert S., and Wei Xiong, 2001, Contagion as a wealth effect, *Journal of Finance* 56, 1401-1440.
- Lehmann, Bruce, 1990, Fads, martingales, and market efficiency, *Quarterly Journal of Economics* 105, 1-28.
- Lo, Andrew W., and A. Craig MacKinlay, 1990, When are contrarian profits due to stock market overreaction?, *Review of Financial Studies* 3, 175-208.
- Longin, Francois, and Bruno Solnik, 1995, Is the correlation in international equity returns constant: 1960-1990?, *Journal of International Money and Finance* 14, 3-26.
- Longin, Francois, and Bruno Solnik, 2001, Extreme correlation of international equity markets, *Journal of Finance* 56, 649-676.
- Loretan, Mico, and William B. English, 2000, Evaluating "correlation breakdowns" during periods of market volatility, International Finance Division Discussion Paper No. 658, Federal Reserve Board, Washington, D.C.
- Masson, Paul R., 1999, Contagion: Monsoonal effects, spillovers, and jumps between multiple equilibria, in Pierre-Richard Agenor, Marcus Miller, David Vines, and Axel Weber, eds.: *The Asian Financial Crises: Causes, Contagion and Consequences* (Cambridge University Press, Cambridge, U.K.).
- Mullainathan, Sendhil, 2002, A memory based model of bounded rationality, *Quarterly Journal of Economics* 117, 735-774.
- Park, Yung Chul, and Chi-Young Song, 2001, Financial contagion in the East Asian crisis: With special reference to the Republic of Korea, in Stijn Claessens, and Kristine J. Forbes, eds.: *International Financial Contagion* (Kluwer Academic Publishers, Norwell, MA).
- Poterba, James M., and Lawrence H. Summers, 1988, Mean reversion in stock returns: Evidence and implications, *Journal of Financial Economics* 22, 27-60.
- Ramchand, Latha, and Raul Susmel, 1998, Volatility and cross correlation across major stock markets, *Journal of Empirical Finance* 5, 397-416.

- Rigobon, Roberto, 2003, On the measurement of the international propagation of shocks: Is the transmission stable?, *Journal of International Economics* 61, 261-283.
- Rodriguez, Juan C., 2007, Measuring financial contagion: A copula approach, *Journal of Empirical Finance* 14, 401-423.
- Schiller, Robert J., 1984, Stock prices and social dynamics, *Brookings Papers on Economic Activity* 2, 457-498.
- Summers, Lawrence H., 1986, Does the stock market rationally reflect fundamental values?, *Journal of Finance* 41, 591-600.
- Tse, Yiu Kuen, 2000, A test for constant correlations in a multivariate GARCH model, *Journal of Econometrics* 98, 107-127.
- Valdes, Rodrigo, 1996, Emerging market contagion: Evidence and theory, Working paper, MIT.
- Wongswan, Jon, 2003, Contagion: An empirical test, International Finance Discussion Papers No. 775, Federal Reserve Board, Washington, D.C.
- Yuan, Kathy, 2005, Asymmetric price movements and borrowing constraints: A rational expectations equilibrium model of crises, contagion, and confusion, *Journal of Finance* 60, 379-411.

## Comments on “Testing Financial contagion with Time-Varying Correlation of Heteroscedastic Asset Returns”

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The paper is about testing for Financial Contagion.  
Financial contagion: a significant increase in....  
Conventional method for testing for financial contagion correlation.  
This paper applies the Dynamic Conditional Correlation (DCC) model of Engle (2002) for the problem.

Basic Idea 1: rational behavior in normal periods.  
(mild) cross-market co-movements induced by rational responses to the time-varying volatility.  
(sudden) shift of them caused by irrational responses.

Basic Idea 2: A significant relationship between correlation (co-movement) and individual volatility.

Model 1: DCC model

$$\begin{aligned} r_{jt} &= \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt}, \\ h_{jt} &= \kappa_j + \alpha_j \varepsilon_{j,t-1}^2 + \beta_j h_{j,t-1}, \\ Q_t &= (1 - \delta - \gamma) \bar{Q} + \delta Q_{t-1} + \gamma (v_{t-1} v'_{t-1}), \end{aligned}$$

Model 2 : Modified DCC Model A

$$\begin{aligned} r_{jt} &= \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt}, \\ h_{jt} &= \kappa_j + \alpha_j \varepsilon_{j,t-1}^2 + \beta_j h_{j,t-1}, \\ Q_t &= (1 - \delta - \delta^c D - \gamma) \bar{Q} + (\delta + \delta^c D) Q_{t-1} + \gamma v_{t-1} v'_{t-1}, \end{aligned}$$

Model 3 : Modified DCC Model B

$$\begin{aligned} r_{jt} &= \mu_j + \rho r_{j,t-1} + a_j i_{jt} + b_j i_{US,t} + \varepsilon_{jt}, \\ h_{jt} &= \kappa_j + \alpha_j \varepsilon_{j,t-1}^2 + \beta_j h_{j,t-1}, \\ Q_t &= (1 - \delta - \delta^c D - \gamma - \gamma^c D) \bar{Q} + (\delta + \delta^c D) Q_{t-1} + (\gamma + \gamma^c D) v_{t-1} v'_{t-1}, \end{aligned}$$

Questions

Q1. Why the same change in  $\delta$ ,  $\delta^c$  for  $\bar{Q}$  and  $Q_{t-1}$  ?

Q2. What is the test statistic and its behavior for testing  $H_0 : \delta^c = 0$  ( $\gamma^c = 0$ ) ?

Q3. Test for breaks (contagion)

Problem of the periods of actual breaks being unknown.  
misleading inference , results

Q4. The results, size/ power properties depend on the truth.

Ex) truth – constant volatility

$H_0$  : constant volatility

$H_0$  : time-varying volatility size smaller (lower power)

Ex) truth – time-varying volatility

$H_0$  : constant volatility (size distortion over rejection)

$H_0$  :

## **Forecasting Time-varying Densities of Inflation Rates: A Functional Autoregressive Approach**

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### **Abstract**

This paper utilizes the nonparametric functional autoregressive approach (FAR) to model the time-varying distribution of UK monthly inflation rates using disaggregated cross-sectional data. Our approach is free of any assumptions on the class or structure of the density functions themselves, or the number of dimensions in which the densities may vary. The "pseudo real time" in-sample forecasting evaluation results show that our proposed models track the realized event probabilities fairly closely. Furthermore, out-of-sample forecasting results suggest that the mean is projected to be stable at around 2.5%-2.6% over the period March 2008 - February 2009 whilst the uncertainty bands stay between 1.5% and 4% over the 12-month forecast horizon. In addition, the probability of achieving the 2% inflation target is relatively low.

JEL Classification: C14, C53, E31.

Keywords : Functional Autoregression, Time-varying Density, Density Forecasting, the UK inflation, Out-of-Sample Probability Event Forecasting.

## I. Introduction

In the 1990s, monetary authorities around the world, including those of Australia, Canada, Finland, New Zealand, Spain, Sweden and the UK, began to adopt inflation targeting as the monetary policy framework. Since 1992, inflation targets have been set explicitly. The Chancellor's stated objective at that time was to achieve an average annual rate of inflation of 2%. In June 1997, the UK government granted the Bank of England operational independence and established the Monetary Policy Committee (MPC), charging it with sole responsibility for maintaining inflation within the target range of 1% to 4% per annum. In this policy framework, forecasts of inflation are a key input into the decision making process of the MPC since they signal to the monetary authority that a potential change in policy may be required to ensure that inflation does not move outside its target range. Our contribution to the literature is to develop an inflation forecasting framework using sectoral cross-section data that utilizes both the informational content in the higher-order moments as well as the time-varying distribution of inflation.

Point estimates of inflation forecasts can work well only in restrictive cases.<sup>1</sup> Monetary policy decisions should explicitly accommodate the uncertainty surrounding point estimates. Such information is now provided by many institutes. The Bank of England itself produces a quarterly Inflation Report in which this uncertainty is conveyed using fan charts over a two year horizon, with bands of various shades of red illustrating the range of likely inflation outcomes (the so-called 'river of blood'). Similarly, the European Forecasting Network provides such forecasts for a set of key macroeconomic variables.

Previous studies have focused on modeling national inflation as an autoregressive (AR) process or the uncertainty in inflation as a generalized autoregressive conditional heteroskedastic (GARCH) process (e.g. Engle, 1982; Bollerslev, 1986). Here, the conditional distributions are assumed to be time-varying only in their first two moments, thus neglecting the importance of accounting for higher-order moments. Recently, there have been many studies examining the role of higher-order moments in the analysis of financial and macroeconomic data (e.g. Hansen, 1994; Harvey and Siddique, 2000; Jondeau and Rockinger, 2003; Brooks, 2005). A natural extension is to consider the temporal dependence structure between conditional distributions of inflation.<sup>2</sup>

On the other hand, analysis based on national level data may be severely biased given the presence of informational heterogeneity across the sub-sectors as documented by Pesaran and Smith (1995) and Hsiao et al. (2005). Inflation is the change in national price level and hence can be viewed as a weighted average over different commodities across different periods. Researchers in the past have attempted to incorporate the importance of informational heterogeneity by using the data from the Survey of Professional Forecasters (SPF) (e.g. Zarnowitz and Llambrós, 1987; Lahari and Lui 2006; Garcia and Manzanarez, 2007; Lahiri and Sheng, 2008).

We start with the idea that we can model the national inflation rate as a weighted function of disaggregated inflation rates. We then develop a framework where we utilize both the informational content in the higher-order moments as well as the time-varying distribution of inflation. To this end, we follow Bosq (2000) and Park and Qian (2006), and introduce a nonparametric model for estimating time-varying densities of the underlying national inflation rates. These time-varying density functions are treated as time series of functional data and then estimated via an autoregressive model in functional space. As the

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<sup>1</sup> They are effective only with linear constraints and when the loss function is quadratic - see Granger and Pesaran (2000).

<sup>2</sup> Indeed, Bryan et al. (1997) document fat-tailed properties in inflation data and Roger (2000) provides evidence of right skewness.

dependence of the densities across time periods and over commodities is being modeled nonparametrically, we do not impose any assumptions on the class or structure of the density functions themselves, or the number of dimensions in which the densities may vary. Furthermore, instead of using data like the SPF, we exploit the variation across sectors in the UK to construct our forecasts. This is important since the SPF data are likely to suffer from a small-sample bias regarding cross-sectional dimension. We relate our findings to the inflation targeting policy pursued by the Bank of England regarding perceived inflation risks and their dynamic implications.

Based on a careful descriptive analysis of the time-varying moments obtained from the cross-sectional distribution, we find that the mean inflation is positively correlated with both variance and skewness. Our findings are thus consistent with Friedman (1977) and favor the menu cost explanation of Ball and Mankiw (1995) regarding the sluggish adjustment of individual prices in response to aggregate shocks. We also obtain a strong positive association between variance and skewness, a finding which is highly robust to possible breaks during the period 1999-2001, triggered by various global events such as the introduction of the Euro, the dotcom bubble and the US September 11th episode. Our evidence thus suggests that thorough analysis of the time-varying probability distributions of the disaggregated sectoral inflation rates provides additional insights for the modeling of national inflation rates.

We consider six different models<sup>3</sup> of the UK monthly inflation rate over the period January 1997 - February 2008. Our in-sample forecasting results shows that the Functional Autoregressive model with a 3-month moving average accounting for the time-varying mean (FAR-3m) and the Functional Autoregressive model with the first-differenced density functions (DFAR) accounting for nonstationary behavior outperform the other competing models. The probabilities of the 'inflation target' event generated by both models have been able to track the realized probabilities fairly well. Out-of-sample forecasting results for these models also suggest that though the mean is projected to be stable around 2.5%-2.6% over the period March 2008 - February 2009, with the associated uncertainty bands quickly growing within 3-4 months and staying between 1.5% and 4% over the 12-month forecast horizon. Notice that the current inflation rate as announced by the Bank of England (BOE) is 3.1% lying well within our predicted band. In addition, the probability of achieving the inflation target of less than 2% over the same period is fairly low (around 30%) while the probabilities of maintaining inflation between 1% and 3% keep decreasing as the forecast horizon increases. Combining these results, we conclude that the (recent) high inflationary pressure has been correctly predicted by our proposed approach.<sup>4</sup> Our evidence thus justifies the use of a thorough analysis of the probability distributions of the cross-sectional inflation rates for additional insights regarding time-varying inflation expectations and the uncertainty associated with them.

The rest of the paper is organized as follows. Section 2 introduces the econometric methodology. The data and descriptive statistics are reported in Section 3. The main estimation and forecasting results based on the FAR models are provided along with other competing models in Section 4. Section 5 concludes.

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<sup>3</sup> See Table 2 for details.

<sup>4</sup> A recent report from BOE predicts that inflation based on the consumer price index will be below the 2% target in 2009 on a quarterly basis. The actual figures indicate an inflation rate of 3.1% in January 2009.

## II. Econometric Methodology: Functional Autoregression

Let  $\{f_t\}_{t=1}^T$  is the sequence of the density function process of aggregate national inflation,  $\pi_t$  that is time-varying, and define the fluctuation of the density function as

$$w_t = f_t - \mathbb{E}f, \quad t = 1, \dots, T, \quad (1)$$

Where  $\mathbb{E}f$  is the well-defined common expectation of  $\{f_t\}_{t=1}^T$ . On the other hand,  $\pi_t$ , is constructed as the weighted average of  $N$  sectoral inflation rates  $\{\pi_{it}\}$  at each time  $t$ :

$$\pi_t = \sum_{i=1}^N v_{it} \pi_{it}, \quad t = 1, \dots, T, \quad (2)$$

where  $v_{it}$  is the weight on  $\pi_{it}$  with  $\sum_{i=1}^N v_{it} = 1$  at each  $t$ . The sectoral inflation rate for given  $t$  can be expressed as:

$$\pi_{it} = \pi_t + d_{it}, \quad i = 1, \dots, N, \quad (3)$$

where the mean of  $d_{it}$  over  $i$  is zero by construction. Our goal is to estimate the probability density function of  $\pi_t$  utilizing the informational content in the sectoral inflation rates using a nonparametric kernel method. We thus use a transformation for given  $t$  defined as:

$$\pi_{it}^* = \pi_t + d_{it}^*, \quad i = 1, \dots, N, \quad (4)$$

Where

$$d_{it}^* = \|v\| d_{it}, \quad i = 1, \dots, N, \quad \text{with } \|v\| = \left( \sum_{i=1}^N v_{it}^2 \right)^{1/2}. \quad (5)$$

The probability density function of the aggregated inflation,  $\pi_t$ , can therefore be evaluated by the time-varying cross-sectional density function of  $\pi_{it}^*$ .<sup>5</sup>

We assume that  $\{w_t\}_{t=1}^T$  can be generated by an autoregressive process in a functional space:

$$w_t = Aw_{t-1} + \epsilon_t, \quad t = 1, 2, \dots, T, \quad (6)$$

where  $A$  is an autoregressive operator on the Hilbert space (H) and  $\{\epsilon_t\}_{t=1}^T$  is the sequence of the functional white noise process. This model is usually referred as a FAR model of order one in a functional space (FAR(1)). Combining (1) and (6), we get:

$$f_t = \mathbb{E}f + Aw_{t-1} + \epsilon_t. \quad (7)$$

This portrays that the probability density function (pdf) at time  $t$  consists of the common expectation ( $\mathbb{E}f$ ) and the correction of the fluctuation at time  $t-1$  ( $Aw_{t-1}$ ). Figure 1

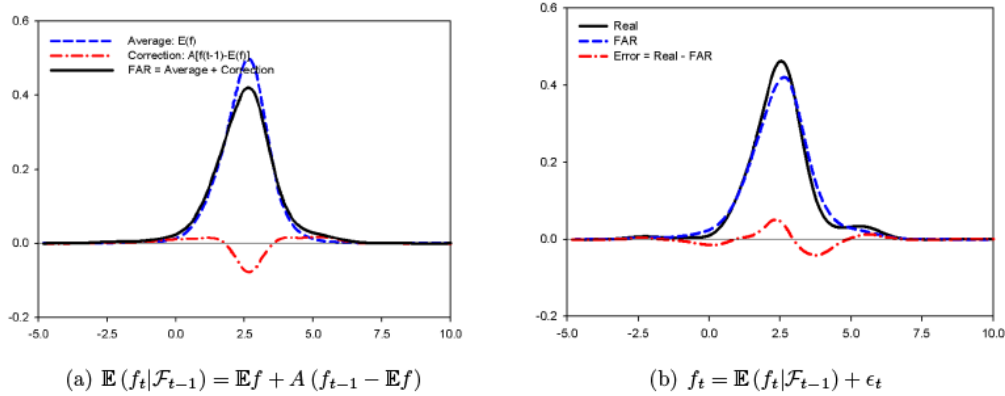
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<sup>5</sup> This transformation equates the variation of  $\pi_{it}^*$  it with that of  $\pi_t$  up to second-order moments. Notice also that the influence of higher-order moments gradually declines with an increase in the number of cross-sectional units.



illustrates the FAR structure of the density function given the terminal date of our data.<sup>6</sup> The expectation of the density function and the correction function are shown in the upper panel, while the functional white noises are presented in the lower panel. Our correction factor is downward on the unconditional time average (AVE) of all estimated densities in the central part of AVE and hence accommodates impact of uncertainty associated with the next month's inflation.

Figure 1: Functional Autoregressive Structure



Note. Actual density function of February 2008 (Real in the right panel) is estimated by the kernel estimation. The prediction for the actual density function of February 2008 (FAR in the left panel) is obtained by FAR estimation.

We need to estimate the density functions at each point of time to construct the FAR model, that require nonparametric kernel density estimation where the density estimator is defined as:

$$\hat{f}_t(z) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{z - \pi_{it}}{h}\right), \quad t = 1, \dots, T, \quad (8)$$

where  $K$  is a kernel,  $n$  the number of grids,<sup>7</sup> and  $h$  a bandwidth. One important issue lies with the selection of an appropriate kernel and the bandwidth. We follow Silverman (1986) and use a Gaussian kernel with an optimal bandwidth given by<sup>8</sup>

where  $\sigma$  is the standard deviation. Following Wang and Wang (2009), with weighted data, we modify it as:

<sup>6</sup> The actual density function (Real in the right panel) is obtained by the nonparametric kernel estimation using disaggregate sectoral inflation rates while the fitted counterpart (FAR in the left panel) is obtained from the FAR estimation.

<sup>7</sup> In empirical section below we set  $n = 1024$ .

<sup>8</sup> Various other kernels are also available in the literature including Epanechnikov, Bi-weight, Triangular, and Rectangular.

$$\hat{f}_t(z) = \frac{1}{h} \sum_{i=1}^n v_{it} K\left(\frac{z - \pi_{it}}{h}\right), \quad t = 1, \dots, T. \quad (10)$$

Given the obtained sequence of the estimated density functions  $\{\hat{f}_t\}_{t=1}^T$ , we estimate the sequence of fluctuation of the density function by:

$$\hat{w}_t = \hat{f}_t - \bar{f}, \quad t = 1, \dots, T,$$

where  $Ef$  is estimated by the sample average,  $\bar{f} = \frac{1}{T} \sum_{t=1}^T \hat{f}_t$ .

To estimate the functional autoregressive model in (6), we need to estimate an autoregressive operator,  $A$  from the autocovariance operators defined as

$$C_s = \mathbb{E}(w_t \otimes w_{t-s}), \quad s = 0, 1, 2, \dots \quad (11)$$

Considering two autocovariance operators of order 0 and 1, denoted  $C_0$  and  $C_1$ , respectively and using the relationship,  $C_1 = AC_0$ , we obtain an autoregressive operator of order 1 as:

$$A = C_0^{-1}C_1. \quad (12)$$

Autocovariance operators are consistently estimated by<sup>9</sup>

$$C_s = \frac{1}{T} \sum_{t=1}^T (\hat{w}_t \otimes \hat{w}_{t-s}), \quad s = 0, 1, 2, \dots$$

and thus the autoregressive operator of order 1 is consistently estimated by

$$\hat{A} = \hat{C}_0^{-1}\hat{C}_1. \quad (13)$$

Using the spectral representation for a compact and self-adjoint  $C_0$ ,

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<sup>9</sup> In finite space, tensor product  $(u \otimes v)$  is the same as outer product  $uv'$ . In finite space, we define tensor product as  $(u \otimes v) = \langle v, \cdot \rangle u$ .

$$C_0 = \sum_{k=1}^{\infty} \lambda_k (v_k \otimes v_k),$$

where  $(\lambda_k, v_k)$  are the pair of eigenvalue and eigenfunction of  $C_0$ , the inverse of  $C_0$  can be easily obtained by

$$C_0^{-1} = \sum_{k=1}^{\infty} \lambda_k^{-1} (v_k \otimes v_k). \quad (14)$$

Notice, however that there is an ill-posed inverse problem since  $C_0$  is defined on the infinite dimension in principle. To avoid this problem, we restrict  $A$  to be in the finite subset of  $H$ . We define  $V_\ell$  as the subspace of  $H$  spanned by the  $\ell$ -eigenfunction,  $v_1, \dots, v_\ell$ , and let  $C_{0,\ell} = \Pi_\ell C_0 \Pi_\ell$ , where  $\Pi_\ell$  is the projection on  $V_\ell$ . Then, we approximate the inverse of  $C_0$  by

$$C_{0,\ell}^+ = \sum_{k=1}^{\ell} \lambda_k^{-1} (v_k \otimes v_k), \quad (15)$$

which is the inverse of  $C_0$  defined on  $V_\ell$ . Therefore, our estimator of  $C_0^{-1}$  can be obtained as:

$$\hat{C}_{0,\ell}^+ = \sum_{k=1}^{\ell} \hat{\lambda}_k^{-1} (\hat{v}_k \otimes \hat{v}_k). \quad (16)$$

In practice, the choice of  $\ell$  is guided by applying a functional principle component analysis (FPCA) and a cross validation (CV) method.<sup>10</sup> We then select  $\ell (\leq \ell_{max})$  by minimizing the following criterion:<sup>11</sup>

<sup>10</sup> FPCA explains the variation of the fluctuation of density functions and CV chooses a dimension,  $\ell$

<sup>11</sup> In empirical section we set  $\ell_{max} = 20$ . We find that the cross-validation procedure given by (17), selects the optimal value of  $\ell$  ranging between 5 and 10.

$$\sum_{i=1}^{N_{cv}} \|\hat{w}_{T-i+1}^\ell - \hat{w}_{T-i+1}\|^2 = \sum_{i=1}^{N_{cv}} \int [\hat{w}_{T-i+1}^\ell(x) - \hat{w}_{T-i+1}(x)]^2 dx, \quad (17)$$

where  $N_{cv}$  is the number of the last observations used in CV, and  $\hat{w}_{T-i+1}^\ell$  is the in-sample forecast of  $w_{T-i+1}$  on  $\ell$ -dimensional sub-eigenspace and  $\hat{w}_{T-i+1}$  is the kernel estimate of  $w_{T-i+1}$ .

The autoregressive operator on the subspace  $V_\ell$  of  $H$  is now estimated by<sup>12</sup>

$$\hat{A}_\ell = \hat{C}_1 \hat{C}_0^+, \quad (18)$$

Where

$$\hat{C}_1 = \frac{1}{T-1} \sum_{t=2}^T (\hat{w}_t \otimes \hat{w}_{t-1}) \quad \text{and} \quad \hat{C}_0^+ = \sum_{k=1}^{\ell} \hat{\lambda}_k^{-1} (\hat{v}_k \otimes \hat{v}_k).$$

Under the regularity conditions,<sup>13</sup> Park and Qian (2006) show that  $\hat{A}_\ell$  is the consistent estimator:

<sup>12</sup> Alternatively,  $\hat{A}_\ell$  can be expressed as

$$\hat{A}_\ell(x) = \frac{1}{T-1} \sum_{h=1}^{\ell} \sum_{i=2}^T \sum_{j=1}^{\ell} \hat{\lambda}_k^{-1} \langle x, \hat{v}_j \rangle \langle X_{i-1}, \hat{v}_j \rangle \langle X_i, \hat{v}_h \rangle \hat{v}_h.$$

<sup>13</sup> In particular Park and Qian (2006) make the following assumptions: (i)  $A$  is a compact linear operator on Hilbert-Schmidt such that  $\|A^k\| < 1$  for some  $k \geq 1$ , (ii)  $(\epsilon_t)$  are IID with  $E[\epsilon_t] = 0$  and  $E\|\epsilon_t\|^4 < \infty$ , and independent of  $w_0$ , (iii)  $\lambda_k'' > 0$  for all  $k$ , (iv)  $\|f_t\| \leq M$  a.s. for some constant  $M > 0$ , (iv)

$$\sup_{t \geq 1} E \|\hat{f}_t - f_t\|^2 = O(N^{-r})$$

for some  $r > 0$  for  $t = 1, \dots, T$ . Furthermore, they impose the following technical assumptions on the order of  $N$  relative to  $N > cT^{2/r} \log^s T$  for some constants  $c, s > 0$ , and

$$T \lambda_\ell^2 / \left[ \log T \left( \sum_{i=1}^{\ell} \tau_i \right)^2 \right] \rightarrow \infty, \quad \text{where}$$

$$\tau_i = 2\sqrt{2} \max \left[ (\lambda_{i-1} - \lambda_i)^{-1}, (\lambda_i - \lambda_{i+1})^{-1} \right] \text{ for } i \geq 2.$$

$$\left\| \hat{\mathbf{A}}_\ell - \mathbf{A} \right\| \xrightarrow{a.s.} 0 \text{ as } T \rightarrow \infty,$$

and that the forecast errors follow the normal distribution asymptotically:

$$\sqrt{T/\ell} \left( \hat{\mathbf{A}}_\ell \hat{\mathbf{w}}_T - \mathbf{A} \mathbf{w}_T \right) \xrightarrow{d} \mathbf{N}(0, \mathbf{\Sigma}).$$

See also Theorem 8.8 in Bosq (2000).

An m-step ahead forecasts of the density function is now evaluated by

$$\hat{f}_{T+m} = \bar{f} + \hat{A}_\ell^m \left( \hat{f}_T - \bar{f} \right), \quad m = 1, 2, \dots, \quad (19)$$

Where  $\hat{f}_T$  is the estimate of the density function at time T. The probability over the range (a, b) can then be calculated by integrating out the density function:<sup>14</sup>

$$\mathbb{P}(a < x < b) = \int_a^b \hat{f}_{T+m}(x) dx = \hat{F}_{T+m}(b) - \hat{F}_{T+m}(a), \quad (20)$$

where  $\hat{F}_{T+m}$  is the m-step ahead forecast of the cumulative density function.

### III. Data and Descriptive Statistics

For our study, we use a set of sub-sector inflation rates (defined as the annual percentage change) based on Consumer Price Index (CPI, 2005 =100) and their respective weights from the Office for National Statistics. The data spans over January 1997 to February 2008, thus giving us a total of 134 monthly observations. Two levels of disaggregation at the sub-sectors level, namely, Level 2 (at the two-digit level) and Level 3 (at the three-digit level) are collected.<sup>15</sup>

Using (4), we calculate four sets of sub-sector deviation weights:

$$\text{Average of } \|\mathbf{v}\| = \begin{cases} 0.23 \text{ (Level 2)} > 0.17 \text{ (Level 3)} & \text{weighted} \\ 0.16 \text{ (Level 2)} > 0.11 \text{ (Level 3)} & \text{equal-weighted} \end{cases}$$

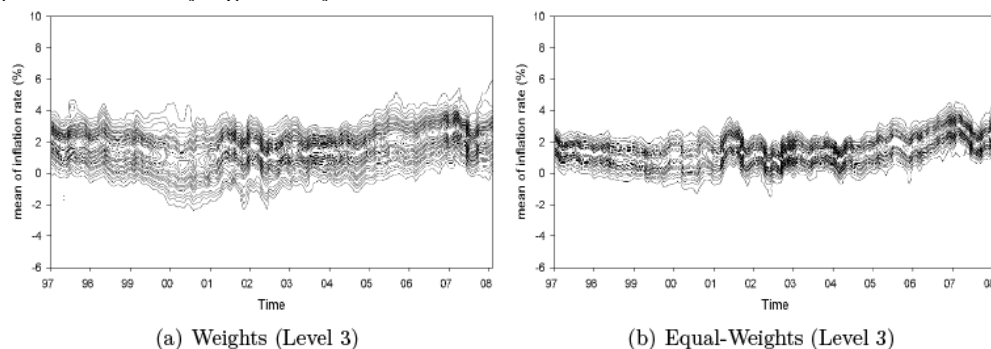
We find that uncertainty associated with Level 2 disaggregation is always higher irrespective of the weighting scheme. Furthermore, the small sample bias would likely to be higher with the Level 2 disaggregation. Figure 2 shows that the time-varying distribution of inflation rates for Level 2-weighted is wider than that for Level 3-equal-weighted. But use of equal-weight is inconsistent with the definition of the aggregate national inflation rate (see (2)). We therefore conclude that the use of weighted inflation rates with Level 3

<sup>14</sup> An integral operator can be numerically approximated using the middle Riemann sum.

<sup>15</sup> In some cases we have less observations as the disaggregation has started at a later date. Level 2 includes 35 sectors (Jan. 1997-Nov. 2000), 38 sectors (Dec. 2000-Nov. 2001) and 39 sectors (Dec. 2001-Feb. 2008). Level 3 consists of 79 sectors (Jan. 1997-Nov. 2000), 84 sectors (Dec. 2000-Nov. 2001) and 85 sectors (Dec. 2001-Feb. 2008). Sub-sector weights are changed annually. The data can be downloaded from [www.statistics.gov.uk/statbase/TSDSeries1.asp](http://www.statistics.gov.uk/statbase/TSDSeries1.asp)

disaggregated data would be ideal to model and forecast the dynamics of national inflation rate.

Figure 2: Time-Varying Density Function of Inflation Rates

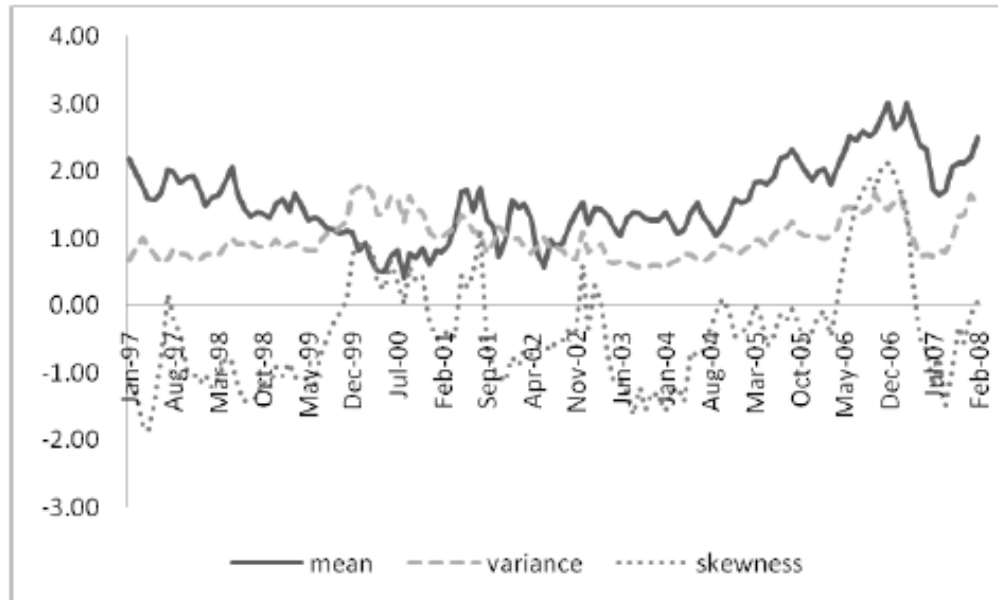


Note: Figures show the projection of density function from January 1997 to February 2008. Density functions are estimated by kernel estimation with a Gaussian kernel and an optimal bandwidth  $h = 1.06\sigma n^{-1/5}$ .

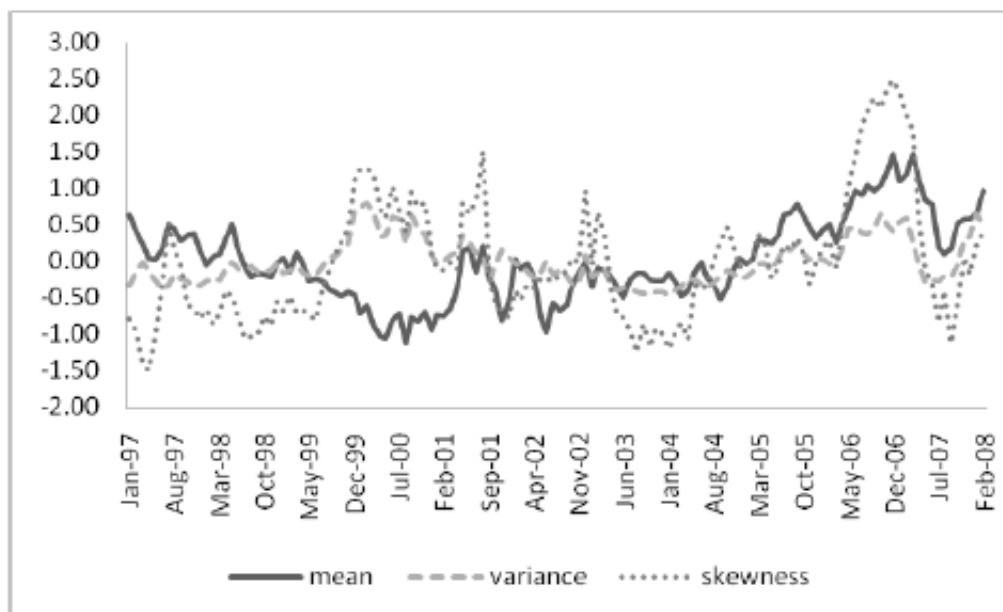
The average inflation rate (across the sectors and over the time periods) stands at 1.5 percent with a median inflation rate of 1.6 percent. Considerable heterogeneity exists across the sectors: liquid fuels experiencing the highest inflation (10.5 percent) and information processing equipment the lowest (-22.3 percent). The standard deviation for the sector inflation rates ranges from 0.4 percent (in case of social protection) to 26.5 percent (in case of liquid fuels). Out of the eighty-five sub-sectors, inflation is positively skewed for the forty-nine sub-sectors. Excess kurtosis is present for the thirty-six sub-sectors where the Jarque-Bera statistic is also significant at the 5-percent level.

To understand the time-varying nature of the moments, we provide the time series plots of three moments (mean, variance and skewness) evaluated from the probability density function of inflation rates (Figure 3). These are obtained by applying the non-parametric kernel estimation to the sectoral inflation rates. The maximum average inflation rate was in December 2006 and the minimum in June 2002. Between January 2004 and February 2008, the average inflation rate is 1.9 percent. Inflation has deviated by more than 1 percentage point from the target only thrice, but around 11 times by more than 0.5 percentage point in recent years (September 2006 to February 2008). The uncertainty associated with the inflation substantially differs across the time periods. In fifty-one out of 134 months, inflation is positively skewed.

Figure 3: Moments of Inflation Rates



(a) Original



(b) Demeaned

We compute the moments of the aggregate inflation rate from the estimated density function of the aggregate inflation rate using transformed disaggregate inflation rates. All moments in the figure defined by

$$\mu_t = \int_{\mathbb{R}} x f_t(x) dx, \sigma_t^2 = \int_{\mathbb{R}} (x - \mu_t)^2 f_t(x) dx \quad \text{and}$$

$$sk_t = \frac{\int_{\mathbb{R}} (x - \mu_t)^3 f_t(x) dx}{\sigma_t^3}.$$

The integral operator is approximated by the numerical approximation using the middle Riemann sum. The Figure (a) presents the moments of the aggregate inflation rate and the Figure (b) presents the demeaned moments.

Table 1 documents the persistent nature of the national inflation rates regarding first three moments for the whole sample and the sub-period. The mean (by construction the same as national inflation rates) is highly persistent with an AR(1) coefficient being 0.93. Interestingly, both variance and skewness also exhibit high persistence with an AR(1) coefficient of 0.89. This finding suggests that inflation rate as well as its uncertainty (measured by variance and/or skewness) are both close to being nonstationary.

Table 1: Autoregressive Property of Moments of Inflation Rate

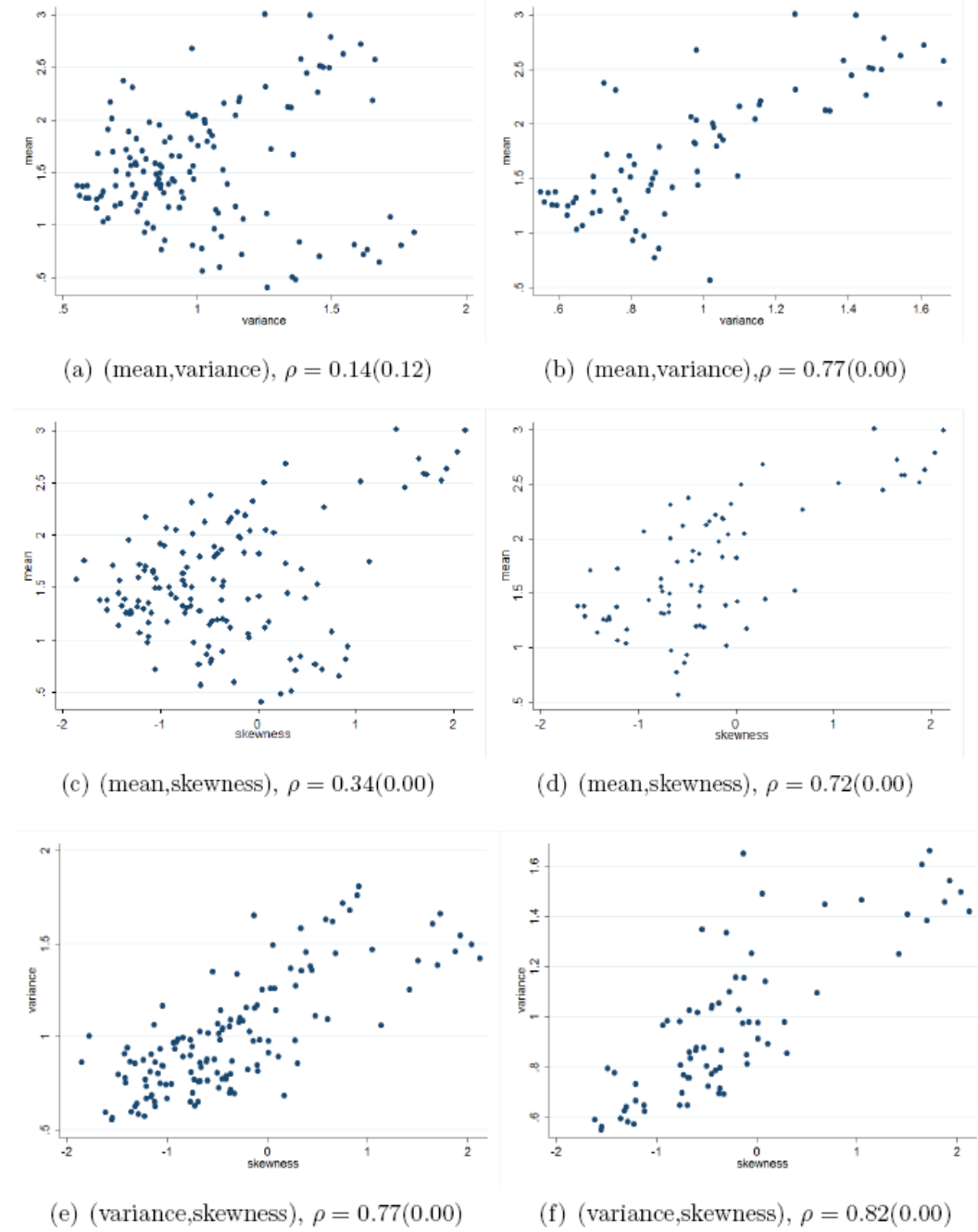
	Jan 1997 - Feb 2008	Jan 2001 - Feb 2008
mean (t)		
mean (t-1)	0.93 (0.00)	0.93 (0.00)
constant	0.10 (0.07)	0.14 (0.12)
variance (t)		
variance (t-1)	0.89 (0.00)	0.91 (0.00)
constant	0.11 (0.00)	0.09 (0.07)
skewness (t)		
skewness (t-1)	0.89 (0.00)	0.91 (0.00)
constant	-0.03 (0.47)	-0.01 (0.85)

In Figure 4, we document the relationship between the pair of the first three moments for the whole period and the sub-period after December 2001, respectively. Over the whole period, the correlations between mean and variance, mean and skewness, and variance and skewness are all positive at (0.14, 0.34, 0.77), but surprisingly the correlation between the mean-variance is small and insignificant. This is mainly due to the negative correlation during end-1999 to end-2001. This period is characterized by the dot.com bubble and the US September 11 episode. The correlations for the sub-period after December 2001 are significant and higher. We note that positive association between variance and skewness is robust to the presence of possible breaks during 1999-2001. In the low-variance regime, the association between mean and skewness is considerably smaller than that in the high-variance regime.<sup>16</sup>

<sup>16</sup> Given skewness represents the asymmetric risks, higher skewness implies the higher variance, but not vice-versa. Investigation of any theoretical prior about this strong positive association is beyond scope of this paper but will provide an additional insight to the existing literature.



Figure 4: Contemporaneous Relationship between Moments of Inflation Rate



Note: The figures in the left panel are for whole period and the figures in the right panel are for the sub-period after December 2001.

In the next section we turn to the density estimation and forecast of inflation rates using a FAR approach.

#### IV. Forecasting the UK Inflation Rates

To estimate the probability density function of the aggregate national inflation rates  $(\pi_t)$  using the Level 3-disaggregated weighted sectoral inflation rates  $(\pi_{it}^*)$  over the period from January 1997 to February 2008, we consider six different models (see Table 2 for details). The first model is the FAR model described in Section 2, where typical estimation results have been illustrated in Figure 1. The maintained assumption of this model is that the density function,  $f_t$  is stationary in functional space, see Park and Qian (2006) for details. The second model uses the last estimated/observed density (LAST) for forecasting purpose. Here the assumption is that  $f_t$  follows the functional martingale difference process and the best predictor would be the current density function. The third model utilizes unconditional time average of all estimated or observed densities (referred to as AVE). The fourth model (FAR-3m) allows the possibility of the time-varying mean ( $Ef_t$ ) in FAR, where we estimate ( $Ef_t$ ) by 3-month moving average of  $f_t$ . To accommodate that inflation rates as well as their higher moments are close to being nonstationary as discussed in section 3, we also consider the fifth model (DFAR) that applies the FAR approach to the first-difference of the density functions. The last sixth model is the combination of all the other five models using equal weights (referred as EWMAVE).<sup>17</sup>

Table 2: Forecasting Models

Model	Equation
FAR	$w_t = Aw_{t-1} + \epsilon_t$ , where $w_t = f_t - \mathbb{E}f$
LAST	$f_t = f_{t-1} + \epsilon_t$
AVE	$f_t = \mathbb{E}f + \epsilon_t$
FAR-3m	$w_t = Bw_{t-1} + \xi_t$ , where $w_t = f_t - \mathbb{E}f_t$
DFAR	$w_t = Cw_{t-1} + \nu_t$ , where $w_t = f_t - f_{t-1}$
EWMAVE	$f_t = \frac{1}{5} (f_t^{FAR} + f_t^{LAST} + f_t^{AVE} + f_t^{FAR-3m} + f_t^{DFAR})$

##### 1. In-Sample Forecasting Evaluation

We conduct two evaluation exercises in a recursive manner to evaluate the forecasting performance of the FAR modeling.<sup>18</sup> We start with density forecasting evaluation exercise. We first estimate all the six models over the period from January 1997 to December 2002, and compute one month to twelve month-ahead density forecasts of national inflation rates. We repeat this process moving forward one month at a time, ending with forecasts for March 2007 - February 2008 based on models estimated over the period January 1997 - February 2007. Hence, we obtain 51 observations for each of  $m$ -month-ahead density forecasts,  $m = 1, \dots, 12$ , giving us a total of 612 experiments. Either the uniform and Hilbert-norm divergence measures can be used to measure the distance between the

<sup>17</sup> Elliott and Timmermann (2008) argue that this simple combination modeling performs relatively better than the more sophisticated model based on the optimal weights.

<sup>18</sup> This practice of holding out sample is called "pseudo real time" experiments, see Elliott and Timmermann (2008) for details.

forecasted and the actual density functions and therefore the ranking of the six models can be obtained. Following Ullah (1996), we use the generalized entropy measure defined as:

$$D_E \left( \hat{f}_i, f \right) = \int_{\pi-a}^{\pi+a} f(x) g \left( \frac{\hat{f}_i(x)}{f(x)} \right) dx, \quad i = 1, \dots, 6, \quad (21)$$

where  $i$  indicates the individual model, and  $g(y) = (\gamma - 1)^{-1} (y^\gamma - 1)$  with  $\gamma > 0$  and  $\gamma \neq 1$ . We follow Park and Qian (2006) and set  $\gamma = 1/2$ .<sup>19</sup> Comparing the  $m$ -month-ahead density forecasts ( $m = 1, \dots, 12$ ) obtained from the six models, we choose the model with the smallest distance measure and then count the number of times that particular model ( $i$ th model) being selected as the best model. We consider two target ranges,  $\pi \pm 0.5\%$  and  $\pi \pm 1\%$ , where  $\pi$  denotes actual national inflation rates.

Table 3: Evaluation of Density Forecasting

Panel A: target range $\pi \pm 0.5\%$												
Models	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
FAR	5	4	1	1	0	0	1	1	0	1	2	2
LAST	7	9	9	11	13	9	10	8	11	11	9	7
AVE	0	0	1	0	3	4	4	4	4	5	4	3
FAR-3m	<b>20</b>	<b>21</b>	<b>22</b>	17	14	17	17	<b>21</b>	<b>20</b>	15	18	<b>21</b>
DFAR	19	17	18	<b>22</b>	<b>21</b>	<b>21</b>	<b>19</b>	17	16	<b>19</b>	18	18
EWMAVE	0	0	0	0	0	0	0	0	0	0	0	0
Panel B: target range $\pi \pm 1\%$												
Models	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
FAR	5	1	2	2	0	0	0	0	0	1	2	3
LAST	8	12	10	10	11	10	8	8	13	11	9	9
AVE	0	0	0	0	2	5	5	5	5	5	4	3
FAR-3m	<b>21</b>	<b>21</b>	<b>20</b>	18	16	17	17	<b>21</b>	14	12	15	17
DFAR	17	17	19	<b>21</b>	<b>22</b>	<b>19</b>	<b>21</b>	16	<b>19</b>	<b>22</b>	<b>21</b>	<b>19</b>
EWMAVE	0	0	0	0	0	0	0	1	0	0	0	0

Numbers in the table denotes the number of  $i$ th model being selected as the best one.

The results presented in Table 3 indicate that FAR-3m and DFAR models dominate others and are selected as the best performing forecasts about 73% times. FAR-3m performs better over the short-term horizon (within three months) while the predictions based on DFAR become superior for the horizon longer than 3 months. The forecasting performance of AVE and FAR is disappointing and the poor performance can be related either to the

<sup>19</sup> If  $g$  is a natural-log function, it becomes the Kullback-Leibler divergence measure. The results based on alternative measures are qualitatively similar to those in what follow.

time-varying or to the near non-stationary behavior of the moments of aggregate inflation rates.<sup>20</sup>

For robustness of our findings, we further evaluate the performance of the density forecasts by employing the probability integral transformations (PIT) proposed by Diebold et al. (1998).<sup>21</sup> We estimate all six models over the period from January 1997 to December 2002, compute one-month-ahead density forecast of national inflation rates in each model, and repeat the process moving forward one month at a time, ending with forecasts for February 2008 based on models estimated over the period January 1997 - January 2008. Hence, we obtain a sequence of 62 one-step-ahead density forecasts for each of the six models. We then apply the Kolmogorov-Smirnov statistic to test the null hypothesis that the forecasted and the actual densities are equal for each model.<sup>22</sup> Table 4 summarises our findings. The AVE model is strongly rejected and our results suggest that the forecasted density functions of the national inflation rates provided by five other models are being close to its true density function.

Table 4: Test the Equality of Density Functions

	Models					
	FAR	LAST	AVE	FAR3M	DFAR	EWMAVE
K-S Statistics	0.094	0.067	0.218	0.085	0.074	0.086

Using the formula of Miller (1956, p116), we find critical values at 10%, 5% and 1% significance levels are 0.1307, 0.1453 and 0.1745, respectively. See Table 2 for the definition of the models.

Given the success with density forecasting evaluation exercise, we then conduct mean forecasting exercise with forecasting uncertainty associated with the mean in two ways, first, the mean forecasting with uncertainty bands (fan-chart type)<sup>23</sup> and next the inflation target forecasting in a probabilistic manner. We estimate all six models over the period from January 1997 to June 2006, and compute one-month to twenty-month-ahead density forecasts of national inflation rates. Figure 5 presents in-sample mean forecasting (dash line) and actual national inflation rate (solid line) with the confidence bands (shades).<sup>24</sup> Our focus is on the better performing models of FAR-3m and DFAR. A clear conclusion emerges: the realized national inflation rates are well within the bands over the whole forecast horizon. We provide the evidence that the uncertainty band is much tighter with our preferred models. The confidence bands of the combination model are much smaller

<sup>20</sup> AVE model does not accommodate the time-varying property and FAR model does not deal with non-stationary process.

<sup>21</sup> Clements (2004) has used PIT to evaluate BOE's density forecasts of year-ahead inflation over the sample 1997Q3- 2002Q1. Mitchell and Hall (2005) evaluate forecast performance of both the BOE and the National Institute of Economic and Social Research (NIESR) density forecast using Kullback-Leibler information criterion.

<sup>22</sup> The sequence of the PIT is obtained from the forecasts of the density function. A total number of observations of PIT is 1024, since the density function is approximated by the kernel density estimation on 1024 discrete supports. Using the change of variable formula for PIT, we then obtain 1024 densities of PIT, the cumulative density function of which is approximated by the middle Riemann sum.

<sup>23</sup> We use bootstrapping method to construct the uncertainty bands of the central forecasts using the residuals obtained from each of the estimated models. Drawing residuals with replacement we reestimate the density functions with 1000 iterations. Using 1,000 sample paths of the density functions of national inflation rates we draw uncertainty bands for each month by computing the respective quantiles.

<sup>24</sup> By descending order, each shade represents 97.5%-85%, 85%-50%, 50%-15% and 15%-2.5% band, respectively. Dot line stands for the median.

than the other models and therefore underestimates the true uncertainty. We note that with DFAR model, the empirical mean is larger than the empirical median thereby giving rise to positively skewed forecasted density functions. Here an increase in the variance of shocks has a larger effect on the right-hand than on the left-hand tail and would magnify the effect of skewness on the rate of inflation. Up to April 2007, the mean is smaller than the median for the FAR-3m model, suggesting that the forecasted density functions are negatively skewed. The realized national inflation rates are outside the bands provided by FAR due to the time-varying and nonstationary behavior of the moments.

Figure 5: In-Sample Pseudo Real Time Mean Forecasting

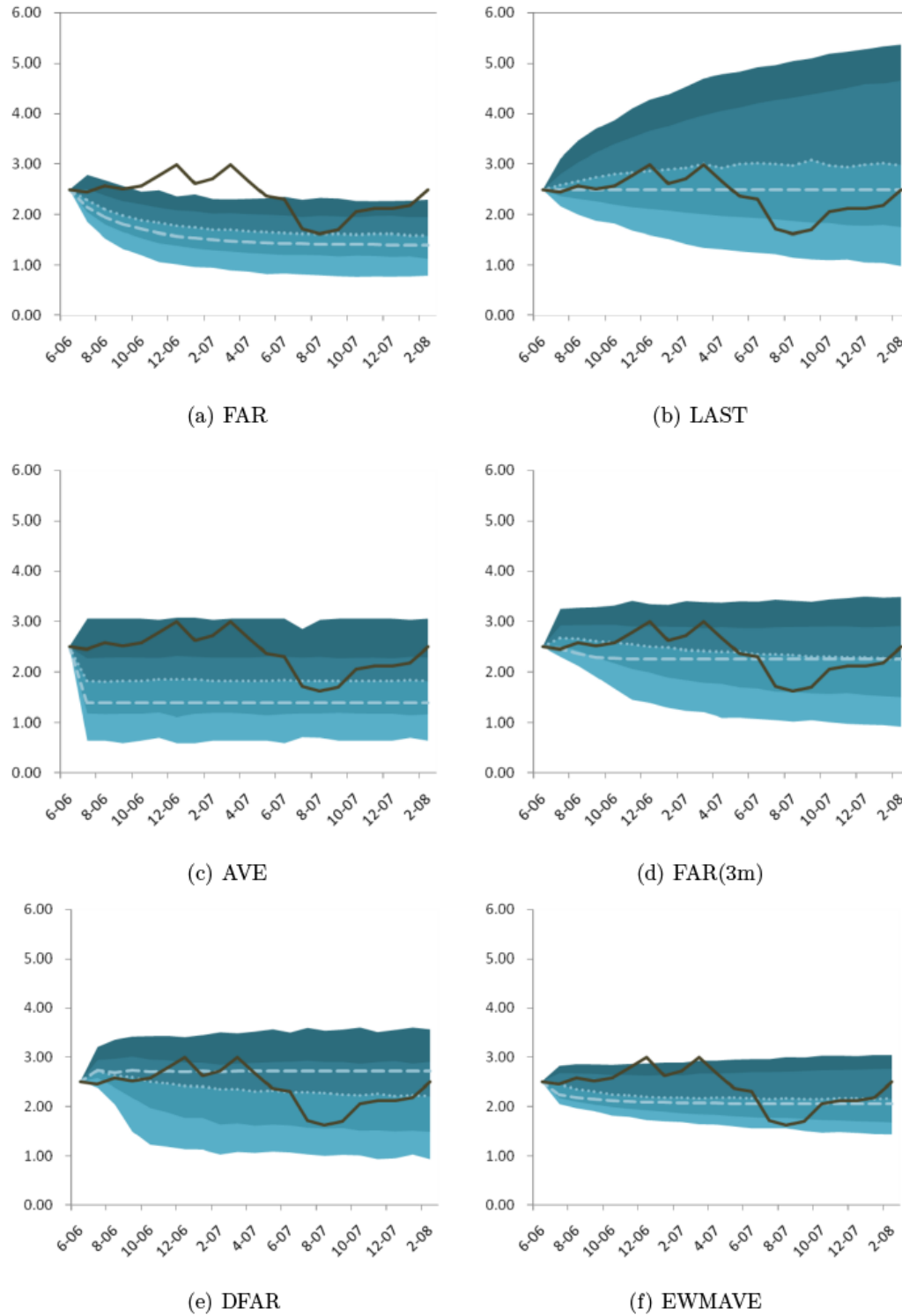
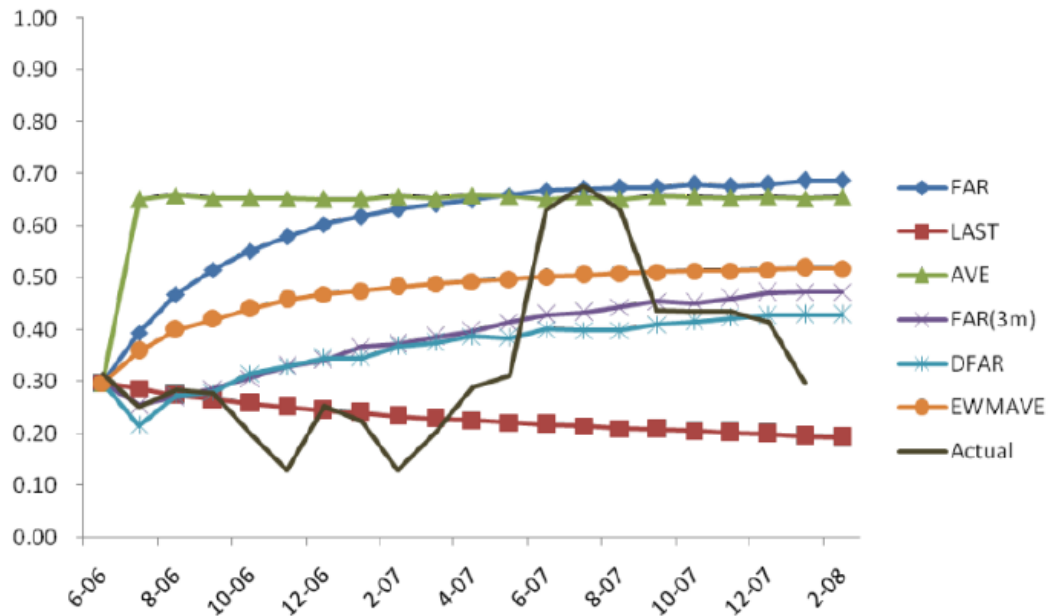
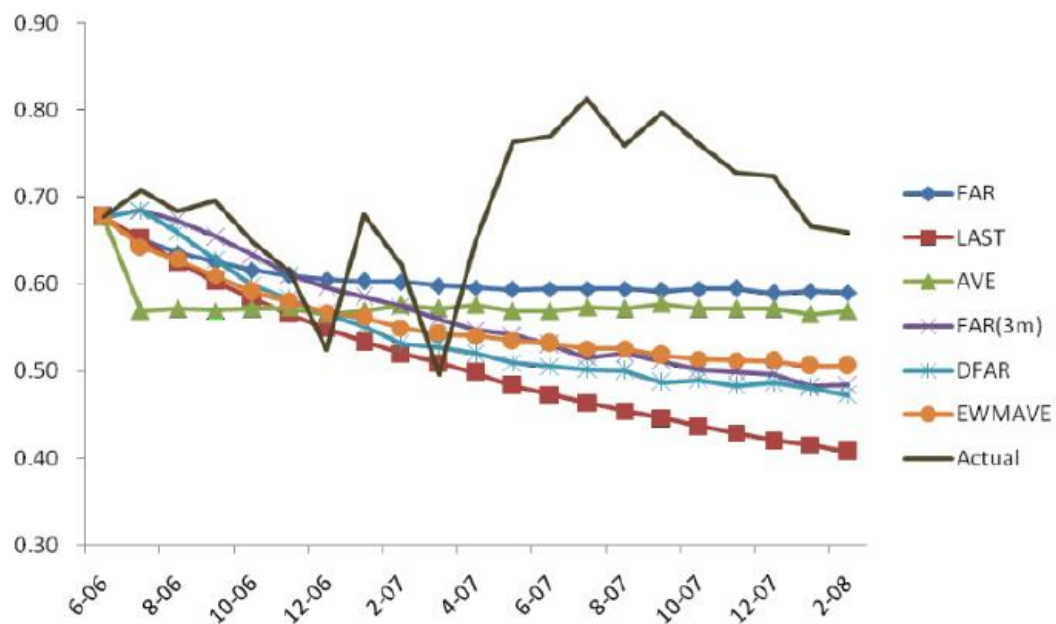


Figure 6 depicts the in-sample event probability forecasting along with the realized probability obtained from the actual density function. We consider two events: the probability that national inflation rate is less than 2% and the probability that inflation rate lies between 1% and 3%. These two events are closely related to the current inflation target of the Bank of England. The upper panel ( $\pi < 2\%$ ) shows that LAST model provides the lower bound while both FAR and AVE models provide the upper bound (ranging between 0.2 and 0.7). The probabilities of this event generated by FAR-3m and DFAR models are initially low, staying in the middle of bounds and then rises with an increase in the forecast horizon. Both the FAR-3m and DFAR models track the realized event probabilities fairly well except when the realized probabilities are alarmingly low (during November 2006 and April 2007). Turning to the lower panel ( $1\% < \pi < 3\%$ ) LAST and FAR models once again provide the lower and the upper bounds (ranging between 0.4 and 0.6). The event probabilities generated by FAR-3m and DFAR models are again successful in tracking the realized probabilities.<sup>25</sup>

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<sup>25</sup> We note that after April 2007 all the models under-predict the observed probabilities, although for all models except the LAST, they are still well above 0.5.

Figure 6: In-Sample Pseudo Real Time Event Probability Forecasting

(a)  $\mathbb{P}\{\pi < 2\%\}$ (b)  $\mathbb{P}\{1\% < \pi < 3\%\}$



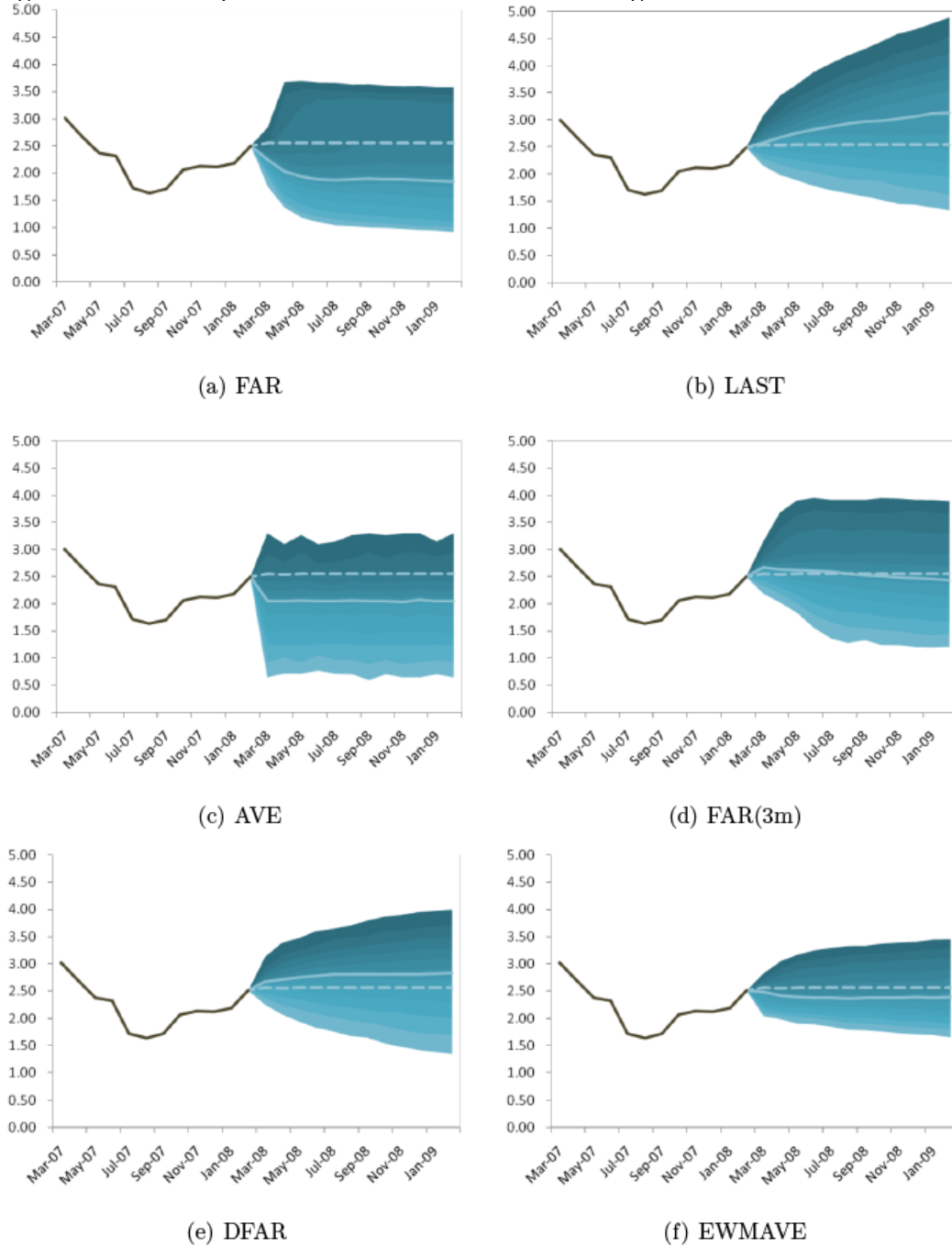
## 2. Out-of-Sample Forecasting

We provide two out-of-sample forecasting results; the central forecasting with uncertainty bands and the probability event forecasting of inflation targets as examined above. We estimate all 6 models over the period from January 1997 to February 2008 and compute one-month to twelve-month-ahead density forecasts of national inflation rates for March 2008 - February 2009. Figure 7 presents out-of-sample mean forecasting (dash line) with the confidence bands (shades). The patterns of out-of-sample forecasting results are somewhat similar to that of in-sample-based forecasting. Our focus is on the better performing FAR-3m and DFAR models.<sup>26</sup> Though the mean is projected to be stable around 2.5-2.6% over the period March 2008 - February 2009, uncertainty bands quickly widen within 3-4 months and stay between 1.5% and 4%. Note the current inflation rate as announced by the Bank of England is 3.1% lying well within our predicted band. Unlike the in-sample results, DFAR model predicts that the density functions will be negatively skewed while FAR-3m model suggests that the forecasted density functions are symmetric.

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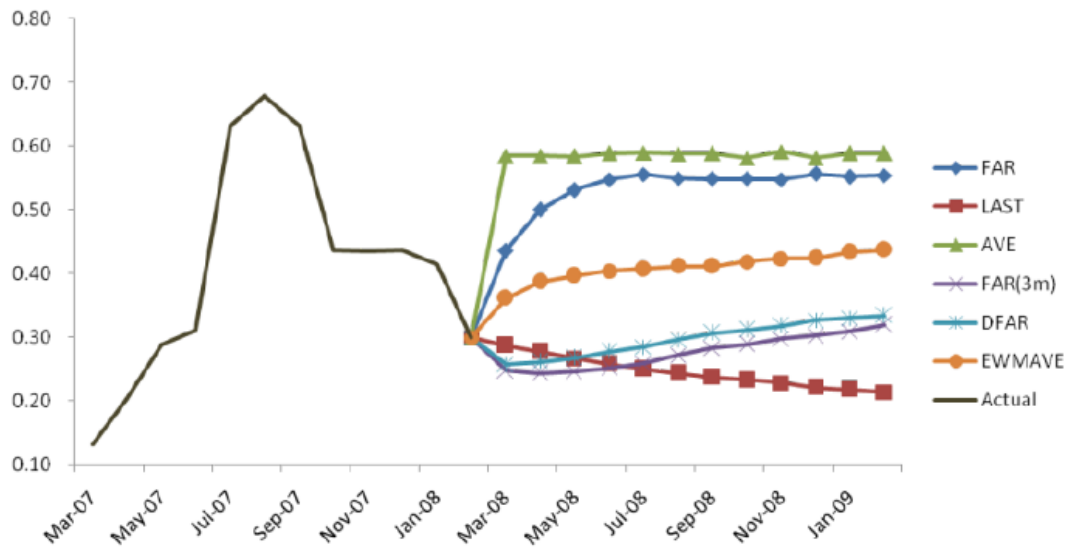
<sup>26</sup> Notice that the fan-charts of FAR-3m and DFAR in Figure 7 are strikingly similar to the fan-chart provided by the Bank of England obtained using the information up to February 2008.

Figure 7: Out-of-Sample Pseudo Real Time Mean Forecasting

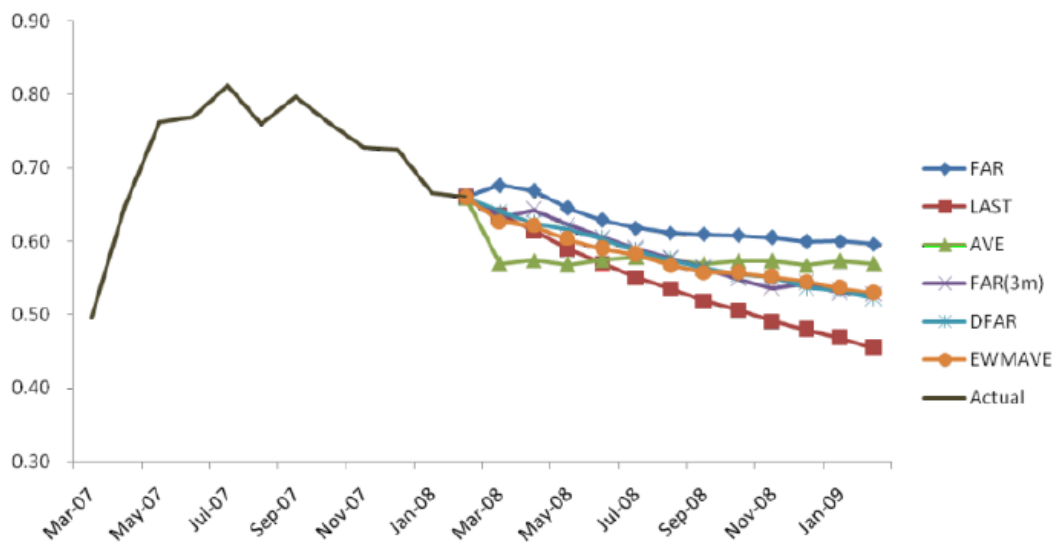


Finally, Figure 8 shows out-of-sample probability forecasting results for the six models. In general, the findings here are qualitatively similar to in-sample results. Again focusing on FAR-3m and DFAR models, we find that the probabilities of achieving the first target ( $\pi < 2\%$ ) over the one-year horizon are fairly low (around 30%) whereas the probabilities of achieving the second target ( $1\% < \pi < 3\%$ ) are initially high but keep decreasing as the horizon increases. Combining these results we conclude that the (recent) high inflationary pressure has been correctly predicted by our proposed approach.

Figure 8: Out-of-Sample Pseudo Real Time Event Probability Forecasting



(a)  $\mathbb{P}\{\pi < 2\%\}$



(b)  $\mathbb{P}\{1\% < \pi < 3\%\}$

In sum, we conclude that a through examination of the probability distributions of the cross-sectional inflation rates provides satisfactory performance based on both in-sample and out-of-sample forecasting exercise.<sup>27</sup> Furthermore, our modeling is parsimonious in nature and provides additional information in understanding the national inflation rates and the uncertainty associated with it.<sup>28</sup>

## V. Conclusion

In this paper, we use the semi-parametric functional autoregressive approach to model the time-varying distribution of the UK monthly inflation rates over the period January 1997- February 2008 using disaggregated cross-sectional data. Our approach exhibits several novel features. First, we allow for cross-sectional dependence and the impact of higher-order moments. Second, instead of using the SPF data, we are able to exploit the variation across sectors to construct our forecasts. Third, our approach can easily provide the time- varying moments obtained at each period which can help to analyze the descriptive features amongst all the moments. In our UK sample, we find that the relationship between variance and skewness seems to be stronger compared to those of mean and variance and mean and skewness. Finally and importantly, our modeling of the time-varying density of the inflation rates across sectors nonparametrically does not impose any assumptions on the class or structure of the density functions themselves, or the number of dimensions in which densities may vary.

Although our work is limited to UK data, we believe that this approach can be easily applied to various other countries. Two issues remain to be solved. First, in order to deal with the high and the low inflation regimes observed across most industrial countries since 1970's, one can construct a mixed model, where the time-varying mean inflation rates are modeled using AR type models (possibly with a structural break) in the first step, and one then applies FAR to the residuals and forecast uncertainty by bootstraps. Second, one can extend our proposed framework in a multi-dimensional context by adding some other macroeconomic and financial variables along with inflation. One feasible approach is to combine the marginal density functions of each series forecasted by the autoregressive density function using the Copulas approach. This would enable one to perform several multi-dimensional tasks, which would enhance our understanding of a range of macroeconomic stylised facts. However, these issues are left for future research.

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<sup>27</sup> Notice that Clements (2004) provides evidence that the MPC current and next quarter forecasts performs better based on mean square forecast error compared to no-change forecasts (based on Gaussian density with mean given by the actual rate of inflation in the last period), but not the year-ahead density forecasts. Based on our constructed model, we believe that we are able to offer more in this direction.

<sup>28</sup> Our approach is simpler compared to the system-based approach of Garratt et al. (2000). We note that Stock and Watson (2003) demonstrates the superior out-of-sample forecasting performance of univariate framework for inflation.

## References

- Balke, N.S. and M.A. Wynne (2000), \An equilibrium analysis of relative price changes and aggregate inflation", *Journal of Monetary Economics* 45, 269-292.
- Ball, L. and N.G. Mankiw (1995), \Relative-price changes as aggregate supply shocks", *Quarterly Journal of Economics* 1, 161-193.
- Bollerslev, T. (1986), \Generalized autoregressive conditional heteroskedasticity", *Journal of Econometrics* 31, 307-27.
- Bosq, D. (2000), *Linear Processes in Function Spaces*. New York: Springer.
- Brooks, C. (2005), \Autoregressive conditional kurtosis", *Journal of Financial Econometrics* 3, 399-421.
- Bryan, M.F., S.G. Cecchetti and R.L. Wiggins II (1997), \Efficient inflation estimation", NBER Working Paper Series, No. 5793.
- Clements, M.P. (2004) \Evaluating the Bank of England density forecasts of inflation", *The Economic Journal* 114, 844-866.
- Diebold, F.X., T.A. Gunter, and A.S. Tay, \Evaluating density forecasts with applications to financial risk management", *International Economic Review* 39, 863-883.
- Elliot, G., and A. Timmermann, \Economic forecasting", *Journal of Economic Literature* 46, 3-56.
- Engle, R.F. (1982), \Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation", *Econometrica* 50, 987-1008.
- Friedman, M. (1977), \Nobel Lecture: Inflation and unemployment", *Journal of Political Economy* 85, 451-472.
- Granger, C.W.J., and Pesaran, M.H. (2000), \Economic and statistical measure of forecast accuracy", *Journal of Forecasting* 19, 53-70.
- Garcia, J.A. and A. Manzanarez (2007), \What can probabilistic forecasts tell us about inflation risks?", European Central bank Working Paper.
- Garratt, A., K. Lee, M.H. Pesaran and Y. Shin (2006), *Global and National Macroeconometric Modelling: A Long-run Structural Approach*. Oxford University Press: Oxford.
- Hansen, B.E. (1994), \Autoregressive conditional density estimation", *International Economic Review* 35, 705-730.
- Harvey, C.R. and A. Siddique (2000), \Conditional skewness in asset pricing tests", *Journal of Finance* 55, 1263-1295.

- Hsiao, C., Y. Shen and H. Fujiki (2005), \Aggregate vs. disaggregate data analysis: a paradox in the estimation of a money demand function of Japan under the low interest rate policy", *Journal of Applied Econometrics* 20, 579-602.
- Jondeau, E. and M. Rockinger (2003), \Conditional volatility, skewness, and kurtosis: existence, persistence, and comovements", *Journal of Economic Dynamics and Control* 27, 1699-1737.
- Lahiri, K. and F. Liu (2006), \Modeling multi-period inflation uncertainty using a panel of density forecasts", *Journal of Applied Econometrics* 21, 1199-1219.
- Lahiri, K. and X. Sheng (2008), \Evolution of forecast disagreement in a Bayesian learning model", *Journal of Econometrics* 144, 325-340.
- Mitchell, J. and S.G. Hall (2005), \Evaluating, comparing and combining density forecasts using the KLIC with an application to the Bank of England and NIESR fan charts of inflation", *Oxford Bulletin of Economics and Statistics* 67, 995-1033.
- Park, J.Y. and J. Qian (2006), \Autoregressive modeling of time-varying densities in functional space", Working Paper, Texas A&M University.
- Pesaran, M.H. and R. Smith (1995), \Estimating long-run relationships from dynamic heterogeneous panels", *Journal of Econometrics* 68, 79-113.
- Roger, S. (2000), \Relative prices, inflation and core inflation", IMF Working Paper Series, No. 58.
- Silverman, B.W. (1986), *Density Estimation for Statistics and Data Analysis*, Chapman and Hall, New York.
- Stock, J.H. and M.W. Watson (2003), \Forecasting output and inflation: The role of asset prices", *Journal of Economic Literature* 41, 788-829.
- A. Ullah (1996), \Entropy, divergence and distance measures with econometric applications", *Journal of Statistical Planning and Inference* 49, 137-162.
- Wang, B. and X.Wang (2009), \Bandwidth selection for weighted kernel density estimation", Forthcoming in *Electronic Journal of Statistics*.
- Zarnowitz, V. and L.A. Llambrós (1987), \Consensus and uncertainty in economic prediction", *Journal of Political Economy* 95, 591-621.

## Discussions on “Forecasting Time-varying Densities of Inflation Rates: A Functional Autoregressive Approach”

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The work proposes a functional autoregressive model to forecast density function of inflation rates. Proposed methods and empirical results are quite solid and interesting in many aspects. In particular, two notable contributions are as follows. First, strong evidence is found that the distributions of inflation rates are time-varying. Conditional moments including mean, variance, skewness and kurtosis are found to be time varying and has a relationship each other. Given this, density functions are modeled as AR(1) process to reflect time-dependent structures. It offers how to estimate the functional autoregressive parameter. Second, the proposed method also considers cross sectional dependence, that is to say, aggregate inflation rates are represented as a weighted averages of micro-level sectoral inflations rates. Indeed, this approach is very insightful. Often, we only analyzed aggregated macroeconomic data, i.e., inflation rate in this case. Alternatively, Unequal weights for national inflation rates are introduced and well explained, which can lead to rich interpretations.

Proposed work presents interesting policy implications. In particular, probability of achieving certain inflation targets (e.g., 2% inflation rates) is computed, based on density forecasts out of models under consideration. Other analysis looking at the conditional density function can be made possible. This method can offer useful information for empirical researchers and policy makers.

While the paper provides a solid statistical method for density forecasts, I would like to raise some points for this work.

First, it is often reasonable to model conditional density of certain time series (e.g., inflation rates) as a function of other state variables including useful macroeconomic variables. For example, conditional quantiles are often modeled as a function of other variables. This point was indeed briefly mentioned in the paper. As another research direction, it may be interesting to consider Granger-causality in densities, which is related with forecasting issue. As the current paper mainly focuses on forecasting ability of the models, testing for Granger-causality seems an attractive task.

Second, all the proposed model generates too smooth forecasts, compared with the actual movements of the inflation rate. In other words, actual inflation rates are more volatile, thus there may be some rooms to refine the model, which can better catch up with the non-smooth behavior.

Third, if we focus on obtaining probability of attaining certain inflationary target-probability that the inflation rate is below 2%, conditional quantiles of the density function may be considered. In this sense, it seems useful to discuss possible advantages of dealing with conditional densities rather than conditional quantiles.

Lastly, statistical issue can be involved. In this work, stationarity of density function is assumed. If possible, formal testing for stationarity in densities can be considered. In fact, empirical results show near non-stationarity in some cases. Thus, suppose density function is modeled as, for instance, local to unity processes. Then, it is expected that the method to estimate the functional autoregressive parameter is not simply extendable. Thus, analysis in non-stationary case can be interesting work. Recent time series literatures try to work on nonparametric function of integrated processes. Combining such methods with the current works may be useful direction of future research.

## CHAPTER 4-1

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# Global Crisis, Official Bailout and the Long-run Demand for Official Lending

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## Abstract

This paper presents an analysis of official bailout and emerging market debt structures and uses the analysis to argue that even in the absence of moral hazard an increased supply of official lending may create its own demand in the long run by encouraging risky short-term debt. In the analysis, short-term debt runs the risk of a rollover crisis and inefficient default but cheaper than long-term debt. Official bailout helps prevent default but only at the expense of long-term investors whose claims are subordinated to senior official loans. By increasing the relative price of long-term debt, official bailout biases the debt structure of the country toward more short-term debt than otherwise. The bias increases with the size of official lending if the latter is initially small. These results suggest that the recent reform of IMF lending facilities and funding options could lead to a higher long-run demand for official lending than might be warranted by the fresh market perception of the risk of global liquidity shock.



## I. Introduction

The financial crisis of 2007-08 may well be characterized by a global sudden stop in capital flows with correspondingly global spillover effects across countries. A sharp curtailment in capital flows, together with a collapse in export demand, threatens the external sustainability of many emerging market countries. While some emerging market countries were ripe for a home-grown crisis after the end of an unsustainable domestic credit boom or fiscal spending, many were an innocent bystander caught in the storm. In the latter, money is leaving not because of a loss of confidence in the currency but because of global deleveraging by investors.

As a number of emerging market countries simultaneously fell victim to full-blown financial crises, there has been a renewed attention to the role of international financial architecture in addressing crises in global nature. At the center of such discussion were concerns about the appropriate modality of official bailout and the funding adequacy of official creditors, particularly the IMF. The traditional bailout package assembled by the IMF—which typically involves strong policy conditionality for adjustment but relatively small official financing—may be less appropriate for countries that were sound but nonetheless caught in a crisis because of global liquidity shock. Moreover, the IMF may not be adequately funded to deal with financial crises highly correlated across countries as it has been operating under the notion of global pooling of idiosyncratic country risks.

In response to these concerns, the IMF reformed its lending facilities in early 2009 by introducing a new lending facility and allowing larger and more upfront access by members to the existing facilities. The new facility, targeted for members with strong fundamentals and policy track, marks a significant departure from the past because unlike others, it involves neither policy conditionality nor any pre-specified access limit. In parallel, the IMF explored various funding options to expand its resource base, including the allocation of SDRs across the entire membership. As a result, the IMF is expected to be able to quadruple its resource base to about US\$1 trillion.

If not reversed soon, the reform will lead to a permanent increase in the supply of official lending at more favorable terms. While the steep increase in the demand for official bailout during the global crisis is temporary in nature, the post-crisis demand may nonetheless remain higher than the pre-crisis level as the risk of global crisis is no longer hypothetical but real. In this respect, the reform might be warranted. However, a permanent increase in the supply of official lending might have quite different long-run implications for international lending. Most importantly, the demand for official bailout itself may not be exogenous to the supply of official lending in the long run if the latter affects the incentives of investors and debtors systematically.

In this regard, two competing views are worthy of discussion. The first view stresses that bailout expectations may create moral hazard whereby debtor countries pursue excessively risky policies while investors under-price lending risks. According to this moral hazard view, the reform may have unintended consequences and eventually lead to a higher demand for official bailout than might be warranted by the fresh market perception of the risk of global financial crises. The second view highlights the positive role of official bailouts as public insurance. By reducing real hazard of a crisis *ex post*, official bailouts provide an *ex ante* insurance benefit to both investors and debtors and thus makes international lending less risky. As a result, international investors may lend more at lower interest rates while emerging market countries may take greater risks for higher returns.

than otherwise. According to this real hazard view, the recent reform of the IMF may lead to a higher demand for official bailout but as a result of an optimal response of investors and debtors to reduced riskiness of international lending.

The literature on financial crises does not provide a clear answer to which view should be considered more realistic. Corsetti et al (2006) and Morris and Shin (2006) analyze the catalytic role of the IMF using a global game framework and show that the liquidity support by the IMF may weaken policy effort for crisis prevention. However, Mussa (1999, 2004) argues that if the IMF does not make expected losses on its lending and the debtor government maximizes national welfare, then there can be no moral hazard. Intuitively, if the IMF does not make expected losses, there is no expected transfer from the IMF either to the borrowing country or to private investors. Without any expected transfer, ex ante incentives of both creditors and borrowers would not change, so there can be no moral hazard. This intuition is formalized by Jeanne and Zettelmeyer (2005) and Kim (2007).

Empirical evidence is also mixed at best. Lane and Phillips (2000) highlight that IMF resources are not large enough to create serious moral hazard and financial losses of creditors are far greater than the potential size of IMF loans. Zettelmeyer and Joshi (2005) show that implicit transfers in IMF lending to emerging market countries are negligibly small, a finding that lends some support for no IMF-induced moral hazard. In contrast, Dell'Ariccia, Schnabel and Zettelmeyer (2006) find that emerging market spreads are less differentiated across countries when bailout expectations are high. But this finding is consistent not only with the moral hazard view but also the real hazard view.

In any case, both views suggest the possibility that the demand for official bailout is endogenous with respect to the supply of official lending in the long run. More precisely, they suggest that the increased supply of official lending may have a self-fulfilling effect on the demand for official lending in the long run. The underlying mechanism could take various forms, ranging from excessive borrowing or weaker policy effort for crisis prevention to shorter maturities of external debt or lower foreign reserve holdings.

This paper presents an analysis of official bailout and emerging market debt structure in the context of a simple model of international lending, and uses the analysis to argue that even in the absence of moral hazard an increased supply of official lending may create its own demand in the long run by encouraging risky short-term debt. An important result arising from the model is that for countries with limited debt-servicing capacity, the optimal debt structure involves short-term debt only if official bailout is available. This result suggests that the availability of official bailout could be a reason for the emergence of short-term sovereign debt in the context of emerging market countries.

The model assumes that the country maximizes welfare by optimally choosing the debt structure but abstracts from the issue of incomplete information or strategic default. In this respect, the analysis of the paper is complementary to the existing literature on sovereign debt structures. Borrowing from the classic finance theory on the capital structure of banks or firms under incomplete information, the literature highlights the incentive effects of short-term or demandable debt in mitigating or resolving the commitment problem.<sup>1</sup> More recently, Jeanne (2008) presents a theory of the maturity of

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<sup>1</sup> See Sachs (1984), Rodrik and Velasco (2000), Diamond and Rajan (2001), and Tirole (2003). For the analysis on the capital structure at the bank or firm levels, see Calomiris and Kahn (1991), Berglöf and von Thadden (1994), Dewatripont and Tirole (1994), and Bolton and Scharfstein (1996).

international sovereign debt based on a model in which the need to roll over demandable external debt disciplines the policies of debtor countries for creditor rights. In his model, the country borrows long-term and achieves the first-best equilibrium if it can credibly commit to strong creditor rights but otherwise cannot borrow either short-term or long-term. In the laissez-faire equilibrium, demandable debt—a mixture of short-term and long-term debt—helps toughen up the country's incentive not to default strategically ex post and thus enables the country to borrow. As such, the emergence of short-term debt is a symptom of the commitment problem, which does not exist in our model.

The paper generates several other predictions that are worth highlighting. First, official bailout can have a crisis prevention effect as long as the country borrows in both short and long terms. This result follows because the efficiency gain from preventing inefficient default is optimally priced into a lower borrowing cost of the country which in turn leads to a lower likelihood of a crisis. A related result is that official bailout has a stronger crisis prevention effect if provided with conditional lending. Second, the conditionality of official lending matters for the optimal debt structure. Interestingly, conditional official lending encourages short-term borrowing more than does unconditional lending. Third, the risk of global liquidity shock reinforces the effect of official bailout on the debt structure.

Finally, the effect of official bailout on the emerging market debt structure would be most pronounced if official lending is limited in amount. More specifically, the model implies that an increase in the supply of conditional official lending from a low level leads to the same increase in short-term debt and thus the demand for official lending. This implication is taken to produce a crude, albeit speculative, estimate for the likely long-run effect on the demand for official lending of the recent reform of IMF lending facilities. The estimate suggests that the demand for IMF official lending could more than triple in the long run.

The remainder of the paper is organized as follows. Section II presents the basic setup of the model. Section III derives the equilibrium solutions of the model with and without the availability of official bailout. Section IV discusses how the availability of official bailout and the conditionality of official lending would affect the optimal debt structure of emerging market countries. Section V discusses the implications of the model on the long-run demand for official bailout and presents a crude estimate of the likely order of the increase in the long-run demand for official lending. Section VI concludes the paper.

## 1. Basic setup of the model

There are three periods denoted by  $t = 0, 1, 2$ . In period 0, the representative country invests  $k$  that yields an output  $y$  in period 2. The country has no wealth in period 0 so that the investment must be financed by external borrowing. The country can credibly pledge up to a fraction  $\alpha$  of output for debt services.<sup>2</sup> The country consumes only in period 2 and its utility function is  $V(c_2) = c_2$  where  $c_2$  represents consumption per each unit of initial investment.

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<sup>2</sup> This assumption effectively rules out the possibility of a strategic default due to the country's unwillingness to repay, which plays an important role in Jeanne (2009).

We assume that  $\delta k$  is financed by short-term debt maturing in period 1 and the remaining  $(1 - \delta)k$  by long-term debt that matures in period 2. Since the investment is illiquid and yields an output only in period 2, the country must roll over its short-term debt in period 1. The initial investment could be liquidated in period 1 by short-term investors up to their investment shares. The remaining investment still yields an output but only at a loss. Denoting by  $k_1$  the investment at the end of period 1, output in period 2 is characterized by

$$y(k_1) = \begin{cases} \theta k_1 & \text{if } k_1 = k \\ \rho \theta k_1 & \text{if } k_1 < k \end{cases}$$

where  $0 \leq \rho < 1$ , and  $\theta > 0$  is stochastic productivity distributed according to the cumulative probability distribution  $F(\theta)$  with  $E(\theta) > 1$ . For simplicity but without loss of generality,  $\theta$  is assumed to be publicly known with certainty in period 1. Since  $\rho < 1$ , liquidation is inefficient.

There is a continuum of private investors whose mass is normalized to one. As private investors are atomistic, coordination failure may occur and trigger a run by short-term investors. Upon a run, short-term investors exit by liquidating their share of investment unless the country finances debt outflows by official loans. For short-term investors, the liquidation value is  $\lambda = 1$  per each unit of investment.<sup>3</sup>

All investors are risk neutral in period 0 but their risk preference is uncertain in period 1. Specifically, each investor is risk averse with probability  $q$  in period 1 or risk neutral with probability  $1 - q$ . The preference shock is a *global* shock as it is perfectly correlated across investors—either all investors are risk averse or all investors are risk neutral. We do not model how the investor risk preference translates into a specific level of risk premium, which is beyond the scope of this paper. Instead, we capture the effect of the global shock in the simplest possible way by assuming that the expected rate of return required by investors jumps to  $s > 0$  when investors are risk averse while it is zero otherwise.

Finally, there is an official creditor who is senior to all private investors and lends in an amount of  $L$  at an actuarially fair interest rate provided that the country faces a rollover crisis and requests the official support. We consider two types of official lending: unconditional official lending (UOL) and conditional official lending (COL). COL enables the country to credibly pledge up to a larger fraction  $\beta (> \alpha)$  of output for debt services while UOL does not affect the country's debt-servicing capacity.<sup>4,5</sup> Since the country cannot

<sup>3</sup> As shown below, this assumption greatly simplifies the analysis without loss of generality. All results and intuition remain essentially unaltered except that the short-term interest rate is positive if  $< 1$ .

<sup>4</sup> There is a large literature on how the IMF can play a catalytic role in crisis prevention with particular emphasis on the role of conditionality and liquidity support. For recent theoretical studies, see Corsetti et al. (2006), Morris and Shin (2006), Kim (2006), and Penalver (2002). For empirical evidence, see Eichengreen and Mody (2000), Mody and Saravia (2003), and Eichengreen et al. (2006). Finally, Cottarelli and Giannini (2002) and Bird and Rowlands (2002) provides a survey of the empirical literature on catalytic effects of official lending.

be forced to repay more than contracted obligations, actual debt services are the smaller of pledged output and contracted debt obligations.

The assumption that the country maximizes national welfare, the production function is linear, and official lending is provided only at an actuarially fair interest rate rules out effectively the possibility of moral hazard associated with an official bailout. (Mussa, 1999, 2004). As a result, any effects of official bailout on the likelihood of a crisis or the welfare of the country should be associated with the role of official bailout in reducing real hazard of a crisis.

## 2. Equilibrium Solutions of the Model

In this section, we solve the model for given  $\delta$  leaving to the next section the discussion on the country's optimal choice of the debt structure. Equilibrium solutions of the model consist of the short- and long-term interest rates contracted in period 0, the rollover interest rate in period 1, and the interest rate of official lending.

Regardless of the availability of official bailout, the rollover interest rate for short-term debt should equal the required rate of return for private investors simply because productivity is known with certainty. In equilibrium, therefore, the rollover interest rate should be equal to  $s$  (with probability  $q$ ) or zero (with probability  $1-q$ ). Since short-term investors are risk neutral in period 0 and can freely exit at the liquidation value of unity or adjust the rollover interest rate as desired in period 1 under no uncertainty, the short-term interest rate contracted in period 0 must be zero in equilibrium. The same intuition suggests that the official creditor, if it lends, should lend at the zero interest rate in equilibrium because it faces no uncertainty regarding the debt-servicing capacity of the country and lends only at an actuarially fair interest rate.

This leaves only the long-term interest rate  $r$  for which the model is to be solved, where  $r$  is defined for convenience as the gross interest rate over two periods. Because long-term debt is locked in until period 2, long-term investors are exposed to an interest rate risk associated with the uncertain risk preference of investors in period 1. As a compensation for the risk, long-term investors should demand a positive expected rate of return for their lending to the country. By using the term structure relationship, it is straightforward to show that in equilibrium the required (gross) rate of return (over two periods) must be  $(1+qs)$  for long-term investors.

We also assume for the time being that the official creditor lends in the same amount as the outstanding stock of short-term debt,  $L = \delta k$ . Otherwise, official lending cannot help prevent inefficient default. This assumption is revisited in the next section where we discuss the country's optimal debt structure. For notational convenience, let us define  $R \equiv r(1 - \delta)$  which represents the country's long-term debt service obligation in period 2. In what follows, total investment  $k$  is normalized to unity without loss of generality.

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<sup>5</sup> Alternatively, COL could be modeled by assuming that conditionality requires policy effort by the country to raise productivity and that policy effort reduces the country's utility for given consumption. See Kim (2006) for a model along this line.

For ease of exposition, we first discuss the equilibrium solutions when the country borrows both short- and long-term ( $0 < \delta < 1$ ). We then look for the equilibrium solutions where the country borrows entirely in long term ( $\delta = 0$ ) or entirely in short term ( $\delta = 1$ ).

### 3. Country Borrows Both Short- and Long-Term

#### *Probability of a rollover crisis*

Short-term investors roll over their claims only if the country's pledged debt service is sufficient to meet all debt obligations in period 2. Otherwise, they run for the exit. Since the rollover interest rate is state dependent, so are the country's debt service obligations and the probability of a rollover crisis. Specifically, the country faces a rollover crisis in period 1 if  $\alpha\theta < \delta + R$  or if  $\alpha\theta < (1+s)\delta + R$  depending on whether the global liquidity shock occurs or not. Defining  $\theta^* = (\delta + R) / \alpha$  and  $\theta^q = ((1+s)\delta + R) / \alpha$ , the (ex ante) probability of a rollover crisis is characterized by

$$(1) \quad p = (1-q)p^* + qp^q$$

where  $p^* = F(\theta^*)$  and  $p^q = F(\theta^q)$ .

#### *Probability of inefficient default*

The probability of inefficient default equals the probability of a rollover crisis if official bailout is unavailable. Otherwise, it is smaller than the probability of a crisis because no inefficient default occurs whenever official bailout is provided. Given the assumed seniority of official loans, the official creditor does not compete with long-term investors for the country's debt services in period 2. As a result, it can lend up to the point where the country's pledged output is just enough to repay official loans. Let us define  $\theta^U = \delta / \alpha$  and  $\theta^C = \delta / \beta$ . The probability of inefficient default is then characterized by

$$(2) \quad p^N = p, \quad p^U = F(\theta^U), \quad \text{and} \quad p^C = F(\theta^C)$$

where superscripts N, U, and C are used to denote the case of no official bailout (NOB), UOL, and COL, respectively. Note that  $p^U$  and  $p^C$  are independent of  $R$  or  $q$ .

The country has always an incentive to request UOL whenever it faces a rollover crisis because it always yields higher ex post consumption. By contrast, COL is available to the country only at higher debt service burden for given output although it helps preserve output. Therefore, COL is in the interest of the country only if it yields higher ex post consumption than otherwise or, equivalently, only if

$$(1 - \beta) \geq (1 - \alpha)\rho(1 - \delta).$$

In order to ensure that this incentive condition holds at all levels of short-term debt, we assume that  $\beta \leq 1 - (1 - \alpha)\rho$ . Given these restrictions, official bailout is always in the interest of the country ex post even if it may not be so ex ante.

**Ex ante zero-profit conditions for long-term investors**

We assume for simplicity (but without loss of generality) that long-term investors are never fully repaid upon the country's default in period 1. To this end, we further restrict the value of  $\rho$  to satisfy that  $\rho < 1 / (1 + s)$ . Given this restriction, long-term investors are fully repaid with probability  $1 - p^N$  in the absence of official bailout but with probability  $1 - p^*$  for UOL and  $1 - p^{**}$  for COL where  $p^{**} = F(\theta^{**})$  and  $\theta^{**} = (\delta + R) / \beta$ .

For convenience, let us define  $X^j = E[\theta < \theta^j]$ . The expected payoff to long-term investors,  $Z^j$ , can be expressed as follows:

$$\begin{aligned} Z^N &= R(1 - p^N) + \alpha\rho(1 - \delta)X^N \\ (3) \quad Z^U &= R(1 - p^*) + \alpha(X^* - X^U) - \delta(p^* - p^U) + \alpha\rho(1 - \delta)X^U \\ Z^C &= R(1 - p^{**}) + \beta(X^{**} - X^C) - \delta(p^{**} - p^C) + \alpha\rho(1 - \delta)X^C \end{aligned}$$

where  $X^N = qX^q + (1 - q)X^*$ . For later purposes, we highlight the following properties:

$$\begin{aligned} (4) \quad Z^N : \quad & \partial Z^N / \partial \rho > 0, \quad \partial Z^N / \partial q < 0 \\ Z^j (j = U, C) : \quad & \partial Z^j / \partial \rho > 0, \quad \partial Z^j / \partial q = 0, \quad \partial Z^j / \partial R > 0, \quad \partial Z^j / \partial \delta > -1 \end{aligned}$$

In equilibrium,  $Z^j$  must equal the expected return demanded by long-term investors. The ex ante zero-profit conditions for long-term investors are thus characterized by

$$(5) \quad Z^j = (1 + qs)(1 - \delta), \quad j = N, U, \text{ and } C$$

**Equilibrium Solutions**

Let us denote by  $R^j$  the equilibrium solutions obtained by solving (5). While  $R^U$  and  $R^C$  always exist and are unique, neither the existence nor the uniqueness can be assured for  $R^N$ .<sup>6</sup> If  $R^N$  does not exist, the only option available to the country is to borrow entirely in long term or entirely in short term (see below). In case of multiple

<sup>6</sup> For given productivity distribution,  $R^N$  is less likely to exist the smaller are  $a$  or  $\rho$ . In a related context, Flood and Marion (2006) show that an emerging market borrower who might default can be shut out of international capital markets without warning even for a modest haircut on obligations.

solutions, the lowest one should be considered as the economically relevant one. Equations (4) and (5) imply that  $\partial R^j / \partial \delta < -(1 + qs)$  and  $\partial R^j / \partial q > 0$  for  $j = U$  and  $C$ . Consequently, in equilibrium with the availability of official bailout, the probability of a crisis is decreasing in short-term debt but increasing in the risk of global liquidity shock.

The following proposition summarizes the equilibrium solutions when the country borrows both short and long terms.

**Proposition 1** Suppose that  $R^N$  exists. Then,  $R^C \leq R^U \leq R^N$  for all  $\delta \in (0, 1)$  if  $\rho$  is sufficiently small.

**Proof.** See the appendix.

Since the probability of a rollover crisis is increasing in  $R$  for given debt structure, the result in Proposition 1 implies that official bailout can have a crisis prevention effect even if it is provided contingently, and that COL can have stronger crisis prevention effect than UOL. Key intuition behind this result is that the ex post efficiency gain from preventing inefficient default is optimally priced into a lower ex ante average borrowing cost of the country, which in turn leads to a lower likelihood of a crisis for given fundamentals. UOL effectively subsidizes the country that would otherwise have suffered from inefficient output (and consumption) loss while taxing long-term investors by diluting their claims.<sup>7</sup> COL has stronger crisis prevention effect than UOL because it taxes the country as well by forcing larger debt services at crisis than otherwise. As a result, ex post taxes on long-term investors are smaller than in UOL, which translates into a lower ex ante long-term interest rate and eventually into a lower likelihood of a crisis.

The model also suggests that the crisis prevention effect of contingent official bailout is stronger in the presence of the risk of global liquidity shock than otherwise. The risk of global liquidity shock leads to a higher probability of a crisis for given fundamentals. Starting from a higher probability of a crisis, therefore, official bailout—which provides full protection against the risk that global illiquidity translates into an inefficient default—results in a larger reduction in the probability of a crisis.

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<sup>7</sup> In the model, short-term investors incur no loss at any event because of the assumption that the liquidation value is unity. In a more general case where  $< 1$ , official lending also subsidizes ex post short-term investors by allowing them to exit at no cost.



#### 4. Country Borrows Either Short term or Long term

If the country borrows entirely in long term, there is no demand for official bailout simply because no crisis occurs. The ex post payoff to long-term investors is  $R$  if  $\alpha\theta > R$  and  $\alpha\theta$  otherwise. Defining  $\theta^0 = R / \alpha$ , the expected payoff  $Z^0$  is expressed by

$$Z^0 = R(1 - p^0) + \alpha X^0$$

where  $p^0 = F(\theta^0)$  and  $X^0 = E[\theta < \theta^0]$ . The ex ante zero-profit condition for long-term investors is then given by  $Z^0 = (1 + qs)$ . Let us denote by  $R^0$  the equilibrium solution. Since  $Z^0$  is strictly increasing in  $R$  and less than 1 at  $R = 1$ ,  $R^0$  always exists and is unique.

In the opposite case where the country borrows only in short term, the equilibrium solution always exists since the equilibrium short-term interest rate is already determined at zero. Substituting  $\delta = 1$  into (1) and (2) yields

$$p^q = F((1 + s) / \alpha), \quad p^* = p^U = F(1 / \alpha), \quad p^C = F(1 / \beta).$$

These results imply that official bailout has no crisis prevention effect (the probability of a crisis is independent of official bailout), and that UOL cannot help prevent inefficient default in a solvency crisis while COL can. The latter result follows simply because there is no long-term investor to tax under UOL while COL can still tax the country.

#### 5. Optimal Debt Structure

The analysis thus far is undertaken for given debt structure of the country. This section endogenizes the debt structure and discusses how the availability of official bailout would affect it. Before doing so, it should be useful at this juncture to remind that the possibility of moral hazard is ruled out at the outset. Therefore, any effect of official bailout on the emerging market debt structure implied by the model should be related to the positive role of official bailout in reducing real hazard of a crisis, not moral hazard.

In period 0, the country faces a basic trade-off between risky but cheaper short-term debt and safe but more expensive long-term debt. At the margin, the optimal debt structure is determined by balancing the tradeoff.<sup>8</sup> If the availability of contingent official bailout affects the relative price of long-term debt vis-à-vis short-term debt, it should also affect the tradeoff in an important way and thus the optimal debt structure.

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<sup>8</sup> When the country borrows in both short and long terms, the country and long-term investors bear ex post the cost of inefficient default while short-term investors incur no loss by assumption. However, it is the country that bears ex ante the entire cost of inefficient default because long-term investors are risk neutral in period 0 and optimally price the default risk in their lending rate.

The discussion in the previous section assumes that official lending is as large as the outstanding stock of short-term debt no matter how large is the latter, while in reality official resources are limited. If official lending is provided in a smaller amount than short-term debt, the insurance benefit of official bailout should be far smaller if not absent because the country cannot avoid inefficient default upon a crisis. For this reason, the discussion in what follows considers both unconstrained and constrained official lending.

## 6. Unconstrained Official Lending

Suppose that the amount of official lending is unconstrained and always as large as short-term debt. We begin by considering the corner solutions where the country takes the maximum risk by borrowing entirely in short term ("full risk-taking") or takes no risk at all by borrowing entirely in long term ("self-insurance").

The full risk-taking option yields the highest level of welfare at no crisis but the lowest level of welfare in the event of default as consumption falls to zero. By contrast, the self-insurance option fully insures the country against the risk of inefficient default but is costly as the country must pay insurance premium for the entire amount of borrowing.

Since official bailout plays no role in case of self-insurance, the associated expected utility is a natural benchmark against which welfare of alternative options can be evaluated. Let us denote by  $EV^0$  the expected utility under self-insurance. The zero-profit condition for long-term investors implies that  $EV^0 = E(\theta) - (1 + qs)$  in equilibrium. Since the country always has an option not to invest in which case the expected utility is simply zero, self-insurance would never be optimal if  $EV^0 < 0$ . Therefore, the risk of global liquidity shock could have a dramatic effect on long-term capital flows for countries where the investment is barely profitable (e.g.,  $E(\theta) \approx 1$ ) and self-insurance is optimal.

Given our focus on the optimal debt structure, we assume in what follows that  $EV^0 > 0$  so that the no-investment option is never optimal. Let us denote the net gain or loss in the expected utility associated with short-term borrowing by  $W^j(\delta) = EV^j - EV^0$  for  $j = N, U$ , and  $C$ . By definition,  $W^j(0) = 0$ . For  $\delta > 0$ ,  $W^j(\delta)$  can be characterized by

$$(6) \quad W^j(\delta) = \delta(p^j + qsp^q) - (1 - \rho(1 - \delta))X^j$$

The specification of  $W^j(\delta)$  has intuitive appeal. The first term reflects the expected benefit of short-term borrowing in terms of reduced debt services while the second term with negative sign corresponds to the expected welfare (or output) loss from inefficient default. To better understand the benefit of short-term borrowing, the first term in  $W^U(\delta)$  can be reformulated to yield,

$$\delta(p^j + qsp^q) = (1 + qs) - \{(1 + qs)(1 - \delta) + \delta(1 - p^j) + qs\delta(1 - p^q)\}.$$

The term  $(1+qs)$  represents the expected debt services under self-insurance while the expression inside of the bracket captures the expected debt services when the country borrows in short term. The first term in the bracket is the expected debt services to long-term investors while the second is the expected debt services to short-term investors or the official creditor when there is no global liquidity shock. Note that the country has debt service obligation neither to short-term investors nor to the official creditor in case of inefficient default which occurs with probability  $p^j$ . Finally, the last term in the bracket captures the expected value of the rollover premium that the country must pay at no crisis if the global liquidity shock is realized.

The optimal debt structure can be identified by the value of  $\delta$  that maximizes  $W^j(\delta)$ . We denote by  $\delta^j$  the unconstrained optimal level of short-term debt for  $j = N, U$ , and  $C$ .

#### *Optimal debt structure in the absence of official bailout*

Assuming that official bailout is unavailable, it turns out that it would never be optimal to borrow in both short and long terms if default is sufficiently inefficient. This result follows from the fact that the country's welfare does not depend on the efficiency cost of default at corner solutions with  $\delta = 0$  or 1.<sup>9</sup> The country's debt-servicing capacity turns out to be the determining factor for which corner solution to emerge as optimal. The following proposition summarizes the results for the optimal debt structure in the absence of official bailout.

**Proposition 2** If  $\rho < \alpha$ ,  $W^N(\delta) < \max[W^N(0), W^N(1)]$  for all  $\delta \in (0, 1)$ . There exists unique  $\alpha^*(q) \in (0, 1)$  such that  $\delta^N = 0$  if  $\alpha \leq \alpha^*(q)$  and  $\delta^N = 1$  otherwise.

**Proof.** See the appendix.

According to Proposition 2, in the absence of official bailout, countries with limited debt-servicing capacity are more likely to opt for self-insurance while those with stronger capacity are more likely to borrow entirely in short term. This result may appear counter intuitive at first glance.<sup>10</sup> Since the long-term interest rate is decreasing in  $\alpha$  in equilibrium, one may think that self-insurance is cheaper and hence more likely to be optimal the stronger is the country's debt servicing capacity. However, the expected utility at self-insurance  $EV^0$  is independent of  $\alpha$ .<sup>11</sup> By contrast, the expected utility under full

<sup>9</sup> By construction, there is no risk of inefficient default under self-insurance. In the opposite case with  $\delta=1$ , the country is fully exposed to the risk of inefficient default. But the inefficiency of default has no bearing on the welfare because output falls to zero anyway as no capital is left upon default.

<sup>10</sup> Proposition 2 is also in contrast to the first-best commitment equilibrium of Jeanne (2008) in which the country can afford long-term debt only if it commits to a high level of creditor rights or, equivalently, a higher level of debt services. Such difference between his and our models reflects different assumptions rather than different reasoning. In his model, private lenders simply cannot break even at a low level of creditor rights by assumption while no such restriction is imposed in our model.

<sup>11</sup> Under self-insurance, the country is not always better off ex post with stronger debt-servicing capacity despite that contracted debt obligations are smaller than otherwise. Note that consumption in period 2 is state-dependent:  $c_2 = y-R$  if  $ay > R$  while  $c_2 = (1-a)y$  if  $ay < R$ . An increase in  $a$  reduces  $R$  and increases consumption for given output

risk-taking increases with the debt-servicing capacity because the probability of a crisis is inversely related to  $\alpha$  at all positive levels of short-term debt.

In what follows, we take  $\delta^N = 0$  as the unique optimal solution for NOL by assuming that  $\alpha \leq \alpha^* = \min \alpha^*(q)$ . This assumption may well be justified for emerging market countries where the financial market is arguably less developed with relatively weak institutional capacity to support creditor rights. But there are also good theoretical reasons in the context of our model to rule out the case where  $\delta^N = 1$ . As discussed previously, in the model, the efficiency cost of default is irrelevant for welfare if the country borrows only in long term or only in short term. The irrelevance result makes intuitive sense for self-insurance because no default occurs. For the opposite case of full risk-taking, however, the irrelevance result is specific to the model and not robust to even a minor change of the model. To see this, suppose that the country has a small endowment in period 0 and use the endowment and external borrowing to finance investment. Then, liquidation is always partial and output never falls to zero upon default (except for  $\theta = 0$ ). Consequently, the efficiency cost of default does matter for welfare at all positive levels of short-term debt, rendering the corner solution with  $\delta = 1$  qualitatively no different from interior solutions.

For consistency and without loss of generality, we make additional assumptions formalized as follows.

**Assumption 1** The country's debt-servicing capacity satisfies that  $\rho < \alpha < \alpha^* = \min \alpha^*(q)$ , and that  $\beta = 1 - (1 - \alpha)\rho$ .

**Assumption 2**  $W^j(\delta)$ ,  $j = U$  or  $C$ , are single peaked for  $\delta > 0$ .

Assumption 1 ensures that  $\delta^N = 0$  is the unique optimal solution for NOB for all permissible  $q$ , while Assumption 2 is for sharper analytical results for the effects of official bailout on the optimal debt structure. In fact, Assumption 2 is not as restrictive as it appears because it holds for a wide range of probability distributions for  $\theta$ .

#### *Optimal debt structure with the availability of official bailout*

The availability of official bailout tips the balance toward borrowing more in short term and less in long term. By providing protection against the risk of inefficient default, official bailout reduces the riskiness of short-term debt at a given price. Moreover, it does so at the expense of long-term investors, adding a premium on the long-term interest rate. As self-insurance becomes relatively more costly, the country has an incentive to borrow in short term, implying that the optimal level of short-term debt is greater than or equal to 0 if official bailout is available.

It is useful to emphasize at this juncture that what matters for the optimal debt structure is not the relative price of long-term debt in nominal terms but the relative price

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if  $ay > R$ . But the same increase in  $a$  results in lower consumption otherwise. In equilibrium, these opposite effects are canceled out exactly, leaving the expected utility  $EV^0$  unchanged.

in risk-adjusted terms (or the relative price from the perspective of the debtor country). In nominal terms, the relative price of long-term debt is clearly at the highest under NOB (see Proposition 1). In risk-adjusted terms, however, the opposite is true. This is because in the model the fixed nominal price of short-term debt masks the underlying risk of inefficient default.

The model also implies that COL encourages short-term borrowing more than does UOL if the global liquidity shock is a tail risk. The intuition behind this result is similar to what explains the result in Proposition 2 because the key difference between COL and UOL is the ex post debt-servicing capacity. The country suffers at crisis more under COL than does under UOL because it must forego a larger fraction of output for debt services. This is the very aspect of COL that encourages the country to borrow more in short term. Specifically, the country has an incentive to be compensated for higher welfare loss at crisis with higher welfare gain at no crisis, which can be achieved by borrowing more in short term to reduce debt services. At the margin, the balance between the benefit (at no crisis) and the cost (at crisis) of short-term borrowing is achieved at a higher level of short-term debt under COL than under UOL.

The following proposition formally summarizes the discussion.

**Proposition 3** The optimal level of short-term debt is strictly positive for COL. If  $q$  is small, it is higher than the optimal level under UOL (i.e.,  $\delta^C > \delta^U \geq 0$ ).

**Proof.** See the appendix.

#### *Effect of global liquidity shock*

In the absence of official bailout, the risk of global liquidity shock reinforces the advantage of self-insurance and thus has no impact on the debt structure by Assumption 1. With the availability of official bailout, however, it encourages short-term borrowing unless the global liquidity shock is a significant risk.

Regardless of the availability of official bailout, the global liquidity risk raises the long-term interest rate by directly increasing the expected rate of return demanded by long-term investors. This direct effect should ceteris paribus strengthen the incentive to borrow in short term. The same risk also leads to a higher probability of a crisis for given fundamentals but does not cost the country if official bailout is provided. However, the global liquidity shock does cost the country at no crisis by increasing the rollover premium. This effect should work as a disincentive to borrow in short term, rendering ambiguous the net effect of the risk of global liquidity shock on the debt structure. The model suggests that the net effect should be positive if the global liquidity shock is a rare event and constitutes a tail risk (with possibly large  $s$  but small  $q$ ). This implication is formalized in the following proposition.

**Proposition 4** Suppose that  $\delta^U > 0$  when  $q = 0$ . The risk of global liquidity shock leads to a higher level of short-term debt for both COL and UOL if  $q$  is small.

**Proof.** See the appendix.

## 7. Constrained Official Lending

Now we consider the case of constrained official lending which takes the center stage in the discussion of the post-crisis demand for official lending in the next section. Suppose that official lending is limited at or less than  $\bar{L}$  where  $0 < \bar{L} < 1$  so that  $L = \min[\delta, \bar{L}]$ . Obviously, the optimal debt structure remains the same as the unconstrained optimum if  $\bar{L} > \delta^j$  for  $j = U, C$ . Otherwise, limited official lending becomes an important determinant of the optimal debt structure.

Let us denote by  $\bar{W}^j(\delta)$  and  $\bar{\delta}^j$ , respectively, the net expected utility and the constrained optimal level of short-term debt associated with limited official lending. Using the same intuition as before,  $\bar{W}^j(\delta)$  can be written for  $\delta > 0$  as follows:

$$(7) \quad \bar{W}^j(\delta) = \begin{cases} W^j(\delta) & \text{if } \delta \leq \bar{L} \\ \bar{W}^N(\delta) + \bar{L}(\rho X^\Omega - p^\Omega) & \text{otherwise} \end{cases}$$

where  $\bar{W}^N(\delta) = W^N(\delta, \bar{R}^j)$ ,  $X^\Omega = E[\theta \in \Omega]$  and  $p^\Omega = \Pr[\theta \in \Omega]$ , and  $\Omega$  is a set of  $\theta$  for which official bailout is provided in equilibrium.

If short-term debt is less than or equal to  $\bar{L}$ , official lending is always as large as short-term debt and thus yields the same expected utility as that of unconstrained official lending. If short-term debt is larger than  $\bar{L}$ , official bailout is of no help in preventing inefficient default as in case of NOB. This is why the term  $\bar{W}^N(\delta)$  appears for  $\delta > \bar{L}$ . By augmenting capital, however, official bailout leads to higher output than otherwise and benefits the country to the extent that increased output yields higher consumption after paying off official loans. This (limited) benefit of official bailout is captured by the term,  $\bar{L}(\rho X^\Omega - p^\Omega)$ .

The following proposition formally summarizes the optimal debt structure under constrained official lending.

**Proposition 5** Suppose that  $L = \min[\delta, \bar{L}]$  where  $0 < \bar{L} < \delta^j$ . If  $\bar{L}$  or  $\rho$  is sufficiently small,  $\bar{\delta}^C = \bar{L}$  and  $\bar{\delta}^U \leq \bar{L}$ .

**Proof.** See the appendix.

The results in Proposition 5 imply that the constrained optimal level of short-term debt never exceeds  $\bar{L}$  if  $\bar{L}$  is small or default is sufficiently inefficient. Moreover, an increase in COL leads to an equal increase in short-term debt at the margin (i.e.,  $\partial \bar{\delta}^C / \partial \bar{L} = 1$ ). The same increase in UOL may or may not affect the level of short-term debt. If it does, however, the resulting increase in short-term debt could be even higher than the increase in

UOL particularly if the optimal level of short-term debt was initially zero. These results have an important bearing on predicting the long-run demand for official lending following the recent reform of IMF lending facilities, which is discussed in the next section.

## 8. Long-run Demand for Official Lending

The analysis thus far could usefully be applied to predicting the long-run demand for official lending that would emerge following the 2007-08 global crisis, and to evaluating the long-run funding adequacy of the IMF. To this end, we highlight two factors that the model suggests should be an important determinant of the post-crisis demand for official lending: (1) risk of global liquidity shock of the similar scale to what was observed in the 2007-08 crisis and (2) recent reform of IMF lending facilities.

### *Risk of global liquidity shock*

The fresh market perception of the risk of major global liquidity shock (with large  $s$  but small  $q$ ) will result in a systematic increase in the emerging market spread and the likelihood of a crisis for given fundamentals. The model further suggests that the emerging market debt structure would evolve toward shorter maturities in the long run in response to the higher cost of external borrowing. These market developments will eventually lead to a higher demand for official lending than before.

### *Reform of IMF lending facilities*

The recent reform of IMF lending facilities may create an additional incentive for emerging market countries to increase short-term debt. As discussed previously, key ingredients of the reform are the introduction of an unconditional lending facility (named as Flexible Credit Line (FCL)), granting a greater access to IMF official financing in the existing facilities, and the general allocation of SDRs which can be freely used by members just like foreign reserves. Since traditional IMF lending has been conditional, the model predicts that the introduction of the FCL and the allocation of SDRs may lead to a lower level of short-term debt than otherwise. At the same time, however, the model also predicts that a greater access to IMF official financing would yield the opposite result leading to a higher level of short-term debt. Thus, the net effect of the recent reform on the demand for official lending is ambiguous, and depends on which factor—new availability of unconditional lending or a general increase in access limit—dominates.

There are good reasons to expect a positive net effect though. First, the analysis in the previous section suggests that an increase in access to IMF official financing may result in an increase in short-term debt if the initial access were limited in size imposing a binding constraint on the optimal debt structure of emerging market countries. In this regard, the fact that IMF lending has typically been small relative to short-term debt of the borrowing country is highly suggestive of the possibility that an increased supply of official lending creates its own demand in the long run.<sup>12</sup>

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<sup>12</sup> According to the model official lending should be equal in size to short-term debt under the constrained optimum, which is clearly at odd with the fact that IMF official lending has typically been small relative to the stock of short-term debt of the borrowing country. The key insight of the model could nonetheless be made valid if short-term debt is interpreted as the external financing gap. In reality, IMF official lending and conditionality for policy adjustment are simultaneously determined. By design, however, the size of IMF official lending is always equal to the projected financing gap remaining after policy adjustment. For given policy adjustment, therefore, a higher access to IMF official financing implies that the borrowing country can be bailed out for a larger initial financing gap. If the external financing gap is generally increasing in short-term debt and the existing level of short-

Second, the availability of unconditional lending is unlikely to be a determining factor of the debt structure unless conditional lending is completely taken off the table. If both types of official lending are available, the country will seek access to unconditional official resources before requesting conditional lending.<sup>13</sup> Therefore, the most plausible post-reform scenario would be that the IMF will continue to lend with conditionality in the majority of emerging market crises while unconditional lending is limited to the case where the country is deemed fundamentally sound but nonetheless faces a crisis because of temporary and self-reversing illiquidity. In the context of the model, this post-reform lending scenario may be best characterized by the following cases:

- The country chooses between UOL and COL to its best interest, or
- The official creditor provides UOL for a pure liquidity crisis and COL for a solvency crisis.

The first case proxies well the incentive structure created by the allocation of SDRs while the second is consistent with the basic presumptions underlying the creation of the FCL.

Interestingly, the expected utility in both cases has the same expression with that of COL shown in (6). If the risk of global liquidity shock is ruled out ( $q = 0$ ), the expected utility becomes identical to that of COL and so does the optimal debt structure. In a more general case with  $q > 0$ , the calibration results (not reported) confirm that the optimal level of short-term debt remains almost identical to  $\delta^C$  as long as the global liquidity shock constitutes a tail risk. These results suggest that the availability of UOL alone would have only limited impact on emerging market debt structures.

#### *Post-crisis long-run demand for official lending*

What would be the likely order of the increase in the long-run demand for official lending following the 2007-08 global crisis and the recent reform of IMF lending facilities? Albeit any estimates should necessarily be speculative, a simple calculation may shed light on this question. To this end, we introduce the following simplifying assumptions: (1) productivity is uncorrelated across a large number of emerging market countries, (2) IMF official lending to a crisis country has and will be limited in size imposing a binding constraint on the choice of optimal debt structure, and (3) post-crisis IMF lending is characterized by the scenario discussed above. The first assumption allows us to substitute the probability of a crisis of the representative country for the proportion of emerging market countries that face a crisis at any given moment. The last assumption allows us to focus on COL for both periods before and after the 2007-08 global crisis.

Given these assumptions and normalizing the number of emerging market countries to one, the demand for official lending  $L^D$  can be expressed as follows:

$$L_0^D = (p_0^* - p_0^C) \bar{L}_0 \quad \text{and} \quad L_1^D = (p_1^q - p_1^C) \bar{L}_1$$

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term debt is suboptimally low, the country would increase short-term borrowing in response to an increase in access to IMF official lending.

<sup>13</sup> The primary effect of the allocation of SDRs is to augment foreign reserves because the allocated SDRs are at free disposal of members (until it is canceled by the IMF) at any time. Therefore, emerging market countries are likely to exhaust the allocated SDRs before seeking financial support from the IMF. The total amount of SDRs to be allocated to the emerging market as a whole is about US\$100 billion which, in per country terms, is small or modest at best relative to foreign reserves or the external financing gap typically observed during a capital account crisis. Consequently, the demand for IMF official lending may not be affected much.



where subscripts 0 and 1 are used to denote the period before and after the 2007-08 global crisis, respectively, and  $\bar{L}$  represents the (fixed) supply of official lending. The specification simply states that the demand for official lending is determined by the probability of official bailout and the size of official lending. In fact, a number of studies estimate the aggregate demand for IMF official resources by estimating the probability of a balance of payments crisis and the size of approved access to IMF resources conditional upon program approval.<sup>14</sup>

Note that  $L_0^D$  assumes no risk of global liquidity shock while  $L_1^D$  represents the demand for official lending upon the realization of the global liquidity shock which is higher than the ex ante post-crisis demand,  $L_1^{DE} = (p_1 - p_1^C)\bar{L}_1$ . We focus on  $L_1^D$  instead of  $L_1^{DE}$  because it is the appropriate level of the demand against which the funding adequacy of the IMF should be assessed. The ratio  $L_1^D / L_0^D$  is a natural metric for the order of the increase in the long-run demand for official lending. Assuming that the probability of inefficient default is negligibly small (relative to the probability of a crisis),<sup>15</sup> the ratio can be simplified to yield

$$(8) \quad \frac{L_1^D}{L_0^D} = \left( \frac{p_1^q}{p_0^*} \right) \times \left( \frac{\bar{L}_1}{\bar{L}_0} \right)$$

For the calculation of the ratio, plausible estimates of the crisis probabilities and the size of official lending are required.

Unfortunately, the model is too simplistic to produce any realistic estimates of the crisis probabilities. For this reason, the calculation turns to historical data. A crude estimate of the probability ratio,  $p_1^q / p_0^*$ , is obtained by using the financial market data on the EMBI or CDS spread (under a certain assumption for the recovery value) observed during the peak of the 2007-08 global crisis. To be specific, we assume that the global liquidity shock increases the crisis probability and the default probability implied by the spread in the same proportion:

$$\frac{p_1^q}{p_0^*} = \frac{p_1^{Market}}{p_0^{Market}}$$

<sup>14</sup> See Ghosh et al (2007) and the references therein. They employ a two-step approach to estimate the expected aggregate use of IMF resources by members. In the first step, a logit model is used to estimate the likelihood that a member will experience balance of payments difficulties requiring an IMF-supported program. In the second, a regression model is used to calculate the expected approved access to IMF resources with the inverse Mills ratio from the logit estimation controlling for the sample selection bias.

<sup>15</sup> There are only a few cases where the IMF denied the request for support by a crisis country. The calibration results of the previous section also show that the probability of default is small relative to the probability of a crisis.

where  $p^{Market}$  is the default probability implied by the financial market data. The average CDS spread for emerging markets rose to XX basis points at the peak of the global crisis, up from YY basis points at the start of the crisis. Assuming the recovery ratio of 40 percent, the observed change in CDS spread yields  $p_1^q / p_0^* = [1.5]$ . According to the model, this estimate may overstate the long-run probability ratio because no adjustment is made with regard to the effect on the crisis probability of the endogenous changes in the emerging market debt structure. At the same time, however, it may understate the long run probability ratio if a global crisis is highly contagious or productivity is correlated across countries.

Finally, the ratio,  $\bar{L}_1 / \bar{L}_0$ , is estimated by assuming that the supply of IMF lending is proportional to the resource base of the IMF. While a higher access limit does not necessarily mean that the IMF should lend more than before, it should be almost isomorphic to higher official lending at least with regard to the use of newly allocated SDRs for which the IMF has no say. Since the stipulated SDR allocation alone is expected to roughly double the resource base of the IMF, the lower bound for the ratio  $\bar{L}_1 / \bar{L}_0$  should be 2. If all other measures to increase the funding base of the IMF are taken into account, the ratio could be as high as 4.

Collecting all these numbers, the long-run demand for IMF official lending could more than triple following the 2007-08 global crisis and the reform of IMF lending facilities. If the "stock" demand for IMF resources is proportional to the "flow" demand for official lending, the IMF may have to triple its resource base or more. In view of these estimates, the planned quadrupling of the resource base of the IMF appears broadly adequate.

## 9. Conclusion

The 2007-08 global financial crisis is likely to result in a lasting change in the international financial architecture. Although it is hard to foretell what the post-crisis world would or should look like, it is not difficult to expect that the risk of global financial crises would no longer be considered hypothetical in international lending. As the risk is better priced in emerging market lending, the demand for official bailout may not return to the pre-crisis level even after the current global crisis is fully resolved. In this respect, the recent reform of IMF lending facilities—geared toward increasing the supply of official lending at more favorable terms—may appear to be warranted.

In the long run, however, the increased supply of IMF official lending may create its own demand by encouraging short-term debt even in the absence of moral hazard. Key insight behind this result is that an increased availability of official bailout provides greater protection against the risk of inefficient default associated with short-term debt. As an optimal response, emerging market countries are likely to take better advantage of cheaper short-term debt. Although the model abstracts from foreign reserves, the same insight suggests that the likely response of emerging market countries would be the combination of more short-term debt and lower foreign reserve holdings (or reduced pace of reserve accumulation) than before. When this implication is taken to predict the long-run demand for official lending, a crude—albeit speculative—estimate suggests that the demand for IMF resources could more than triple in the long run.

## Appendix

**Proof of Proposition 1.** We show that there exists  $0 < \bar{\rho} \leq 1/(1+s)$  such that  $Z^N \leq Z^U \leq Z^C$ . Define  $Z_0^N \equiv Z^N(q=0) < Z^N(q>0)$  and  $H(\rho) = Z^U - Z_0^N$ . It is straightforward to show that  $H(0) > 0$  and  $H' < 0$ . Thus, there exists  $\bar{\rho}_1 > 0$  such that  $H(\rho) \geq 0$  for all  $\rho \leq \bar{\rho}_1$ .

Now define  $G(\rho; \beta) = \partial Z^C / \partial \beta$ . It is easy to show that  $G(0; \alpha) > 0$  and  $G'(\rho; \alpha) < 0$ . Therefore, there exists  $\bar{\rho}_2 > 0$  such that  $G(\rho) \geq 0$  for all  $\rho \leq \bar{\rho}_2$ . Then, defining  $\bar{\rho} = \min[\bar{\rho}_1, \bar{\rho}_2, 1/(1+s)] > 0$  completes the proof. *Q.E.D.*

**Proof of Proposition 2.** Assume that  $\rho < \alpha$ .

Define  $G(\delta, \theta) = (1+s)\delta - \{1 - \rho(1-\delta)\}\theta$  and  $H(\delta, \theta) = \delta - \{1 - \rho(1-\delta)\}\theta$ . For all  $\delta \in (0, 1)$ ,

$$(A1) \quad G(\delta, \theta) < \begin{cases} G(1, \theta) & \text{if } \theta \leq (1+s)/\alpha \\ 0 & \text{otherwise} \end{cases},$$

$$H(\delta, \theta) < \begin{cases} H(1, \theta) & \text{if } \theta \leq 1/\alpha \\ 0 & \text{otherwise} \end{cases}$$

**Rewrite  $W^N(\delta)$  for  $\delta > 0$  as follow:**

$$(A2) \quad W^N(\delta) = W_1^N(\delta) + W_2^N(\delta)$$

$$W_1^N(\delta) = q \int_0^{(1+s)/\alpha} G(\delta, \theta) dF(\theta) + (1-q) \int_0^{1/\alpha} H(\delta, \theta) dF(\theta)$$

$$W_2^N(\delta) = q \int_{(1+s)/\alpha}^{\theta^q} G(\delta, \theta) dF(\theta) + (1-q) \int_{1/\alpha}^{\theta^*} H(\delta, \theta) dF(\theta)$$

By (A1) and (A2),  $W_1^N(\delta) < W_1^N(1)$  and  $W_2^N(\delta) < W_2^N(1) = 0$  for all  $\delta \in (0, 1)$ . It immediately follows that  $W^N(\delta) \leq W^N(1)$  for all  $\delta \in (0, 1)$ . This proves the first result.

Since  $W^N(0) = 0$  by definition,  $\delta^N = 0$  if  $W^N(1) < 0$  and  $\delta^N = 1$  otherwise. By using the fact that  $W^N(1) = W_1^N(1)$ , it is easy to show that

$$\lim_{\alpha \rightarrow 0} W^N(1) < 0, \quad \lim_{\alpha \rightarrow 1} W^N(1) > 0, \quad \partial W^N(1) / \partial \alpha > 0$$

where the first inequality follows from the assumption that  $E(\theta) > (1 + qs)$ . These results ensure that there exists a unique  $\alpha^*(q) > 0$  such that  $W^N(1) < 0$  if  $\alpha < \alpha^*(q)$  and  $W^N(1) \geq 0$  otherwise. Q.E.D.

**Proof of Proposition 3.** Rewrite  $W^j(\delta)$  in (6) for  $\delta > 0$  as follow:

$$(A3) \quad W^j(\delta) = W_0^j(\delta) + qs\delta p^q(\delta), \quad j = U, C$$

where  $W_0^j(\delta) = \delta p^j - (1 - \rho(1 - \delta))X^j$ . By Assumption 1,  $W_0^C(\delta) > 0$  for all  $0 < \delta \leq \alpha$ . This completes the proof that  $\delta^C > 0$ . The inequality  $\delta^C > \delta^U$  holds trivially if  $\delta^U = 0$ . Otherwise, differentiating  $W^U(\delta)$  with respect to  $\delta$  and evaluating at  $\delta' = (\alpha / \beta)\delta^C$  yields

$$W^{U'}(\delta') = -G(\delta^C) + qsH(\delta', \delta^C)$$

Where

$$G(\delta^C) = \alpha^{-1}(\beta - \alpha)(1 - \rho)X^{C'}(\delta^C) > 0$$

$$H(\delta', \delta^C) = p^q(\delta') - p^q(\delta^C) + \delta'(\partial p^q(\delta') / \partial \delta') - \delta^C(\partial p^q(\delta^C) / \partial \delta^C)$$

It follows from Assumption 2 that  $\delta^C > \delta^U$  if  $W^{U'}(\delta') < 0$  which is satisfied automatically if  $q = 0$  or  $H(\delta', \delta^C) \leq 0$ . Otherwise,  $W^{U'}(\delta') < 0$  for all  $q < q^* = G(\delta^C) / sH(\delta', \delta^C)$ . Q.E.D.

Proof of Proposition 4. Let us define  $\delta_0^j = \arg \max W_0^j(\delta)$ , which is positive by assumption. Differentiating (A3) with respect to  $\delta$  and evaluating at  $\delta_0^j$  yields

$$(A4) \quad W^{j'}(\delta_0^j) = q s M^j(s), \quad j = U, C$$

where  $M^j(s) = p^q(\delta_0^j) + \delta_0^j(\partial p^q / \partial \delta_0^j)$ . It is straightforward to show that  $M^j(0) > 0$  and  $\partial M^j / \partial s > 0$  if  $q < 1 - p^*(\delta_0^j)$ , implying that  $W^{j'}(\delta_0^j) > 0$  if for small  $q > 0$ . By Assumption 2,  $\delta^j \geq \delta_0^j$ . Q.E.D.

**Proof of Proposition 5.** Let us define  $\bar{\delta}_1^j = \arg \max \bar{W}^j(\delta)$  for  $\delta \leq \bar{L}$ . By Proposition 3 and Assumption 2,

$$(A5) \quad \bar{\delta}_1^C = \bar{L}, \quad \bar{W}^C(\bar{\delta}_1^C) > 0 \quad \text{and} \quad \bar{\delta}_1^U = \bar{L} \text{ or } 0, \quad \bar{W}^U(\bar{\delta}_1^U) \geq 0$$

If  $\bar{R}^j$  does not exist for  $\delta > \bar{L}$ ,  $\bar{\delta}^j = \bar{\delta}_1^j$ . Otherwise,  $\bar{R}^j > R^j > (1 - \delta)$  by Proposition 1. It follows from the proof of Proposition 2 that  $\bar{W}^N(\delta) < 0$  for all  $\delta > \bar{L}$ . Since  $\bar{L}(\rho X^\Omega - p^\Omega) < \rho \bar{L} E(\theta)$  by construction, there always exists  $\varepsilon > 0$  such that for all  $\delta > \bar{L}$ ,

$$(A6) \quad \bar{W}^j(\delta) < 0 \quad \text{if} \quad \rho \bar{L} \leq \varepsilon$$

The results in (A5) and (A6) together complete the proof. Q.E.D.

## References

- Berglöf, E., von Thadden, R., 1994. Short-term versus Long-term Interests: Capital Structure with Multiple Investors. *Quarterly Journal of Economics*, 109, 1055-1084.
- Bird, G., Rowlands, D., 2002. Do IMF Programs Have a Catalytic Effect on Other International Capital Flows? *Oxford Development Studies*, 30, 229-249.
- Bordo, M., Mody, A., Oomes, N., 2004. Keeping Capital Flowing: The Role of the IMF. IMF Working Paper 04/197 (Washington: International Monetary Fund).
- Bolton, P., Scharfstein, D., 1996. Optimal Debt Structure. *Journal of Political Economy*, 104, 1-25.
- Bolton, P., Jeanne, O., 2007. Structuring and Restructuring Sovereign Debt: the Role of a Bankruptcy Regime, *Journal of Political Economy*, 115(6), 901-924.
- Corsetti, G., Guimaraes, B., Roubini, N., 2006. International Lending of Last Resort and Moral Hazard: A Model of IMF's Catalytic Finance. *Journal of Monetary Economics* 53 (3), 441-471.
- Chang, R., Velasco, A., 1999. Liquidity Crises in Emerging Markets: Theory and Policy. *NBER Macro Annual*, Ben Bernanke and Julio Rotemberg eds., Cambridge: MIT Press.
- Cottarelli, C., Giannini, C., 2002. Bedfellows, Hostages, or Perfect Strangers? Global Capital Markets and the Catalytic Effect of IMF Crisis Lending. IMF Working Paper No. 02/193 (Washington: International Monetary Fund).
- Dell'Ariccia, G., Schnabel, I., Zettelmeyer, J., 2006. How Do Official Bailouts Affect the Risk of Investing in Emerging Markets? *Journal of Money, Credit and Banking* 38 (7), 1689-1714.
- Diamond, D., Dybvig, P., 1983. Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, 91, 401-419.
- Dreher, A., 2004. Does the IMF Cause Moral Hazard? A Critical Review of the Evidence. Available via the Internet: <http://ssrn.com/abstract=505782>.
- Eichengreen, B., Mody, M., 2000. What Explains the Changing Spreads on Emerging Market Debt? In: Edwards, S. (Ed.), *The Economics of International Capital Flows*, University of Chicago Press, Chicago, IL.
- Eichengreen, B., Kletzer, K., Mody, A., 2005. The IMF in a World of Private Capital Markets. IMF Working Paper no. 05/84. Washington, DC.
- Eichengreen, B., Gupta, P., Mody, A., 2006. Sudden Stops and IMF Programs. IMF Working Paper no. 06/101. Washington, DC.
- Flood, R., Marion, N., 1998. Perspectives on the Recent Currency Crisis Literature. NBER Working Paper No. 6380.

- Flood, R., Marion, N., 2006. Getting Shut Out of the International Capital Markets: It Doesn't Take Much. IMF Working Paper 06/144 (Washington: International Monetary Fund).
- Frankel, J., 2005. Contractionary Currency Crashes in Developing Countries. IMF Staff Papers 52.
- Ghosh, A., Christofides, C., Kim, J., Papi, L., Ramakrishnan, U., Thomas, A., Zaldendo, J., 2005. The Design of IMF-Supported Programs. IMF Occasional Paper No. 241. Washington, DC.
- Ghosh, A., Gorretti, M., Joshi, B., Thomas, A., Zaldendo, J., 2007. Modelling Aggregate Use of Fund Resources – Analytic Approaches and Medium-Term Projections. IMF Working Paper 07/70 (Washington: International Monetary Fund).
- Haldane, A., 1999. Private Sector Involvement in Financial Crises: Analytics and Public Policy Approaches. Financial Stability Review, November.
- Jeanne, O., 2008. Debt Maturity and the International Financial Architecture. Forthcoming in American Economic review.
- Jeanne, O., Zettelmeyer, J., 2005. The Mussa Theorem (and Other Results on IMF-Induced Moral Hazard). IMF Staff Paper, Vol. 52, Special Issue (Washington: International Monetary Fund).
- Kamin, S., 2002. Identifying the Role of Moral Hazard in International Financial Markets. International Finance Discussion Papers, No. 736 (Washington: Board of Governors of the Federal Reserve System).
- Kim, J., 2006. IMF-Supported Programs and Crisis Prevention: An Analytical Framework. IMF Working Paper 06/156 (Washington: International Monetary Fund).
- Kim, J., 2007. Unconditional IMF Lending and Investor Moral Hazard. IMF Working Paper 07/156 (Washington: International Monetary Fund).
- Lane, T., Phillips, S., 2000. Does IMF Financing Result in Moral Hazard? IMF Working Paper 00/168 (Washington: International Monetary Fund).
- Mody, A., Saravia, D., 2006. Catalyzing Private Capital Flows: Do IMF Programs Work as Commitment Devices? Economic Journal, 116, 843-867.
- Morris, S., Shin, H., 2004. Coordination Risk and the Price of Debt. European Economic Review, vol. 48, pp133-153.
- Morris, S., Shin, H., 2006. Catalytic Finance: When Does It Work? Journal of International Economics, 70, 161-177.
- Mussa, M., 1999. Reforming the International Financial Architecture: Limiting Moral Hazard and Containing Real Hazard. In: Gruen D., Gower, L. (Eds.), Capital Flows and the International Financial System. Reserve Bank of Australia, Sydney, pp. 216-36.

- Mussa, M., 2004. Reflections on Moral Hazard and Private Sector Involvement in the Resolution of Emerging Market Financial Crises. In: Haldane A. (Ed.), *Fixing Financial Crisis in the Twenty-first Century*. Routledge, London, pp. 33-51.
- Penalver, A., 2002. How can the IMF Catalyze Private Capital Flows? A Model. Bank of England.
- Ramakrishnan U., Zaldendo, J., 2006. The Role of IMF Support in Crisis Prevention. IMF Working Paper 06/75 (Washington: International Monetary Fund).
- Rodrick, D., 2006. The Social Costs of Foreign Exchange Reserves. *International Economic Journal*, 20 (3), 253-266.
- Rodrik, D., Velasco, A., 1999. Short-term Capital Flows. NBER Working Paper No. 7364, National Bureau of Economic Research.
- Tirole, J., 2003. Inefficient Foreign Borrowing: A Dual- and Common-Agency Perspective. *American Economic Review*, 93 (5), 1678-1702.
- Zettelmeyer, J., Joshi, P., 2005. Implicit Transfers in IMF Lending: 1973-2003. IMF Working Paper 05/8 (Washington: International Monetary Fund).



## 외환관리 정책의 재조명과 바람직한 외환정책

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### Abstract

As Korea's current account deficit swelled in 2008, global financial market anxiety stemming from the US subprime crisis deepened and a dollar liquidity crunch hit Korea's foreign exchange (FX) market. The won/dollar rate in turn shot up, as did exchange rate volatility.

In fact, though the currencies of most emerging market economies were weakened by the crisis-induced global liquidity crunch, Korea saw both the largest spike in its CDS premium and the most severe devaluation of its currency. It is thus viewed as having had much higher FX market instability than other countries.

The external shock of the global crisis was in part, of course, beyond the control of domestic policy makers and financial markets. Nonetheless, it is highly likely that Korea's greater instability relative to other emerging market economies was to a degree rooted in the side effects of Korea's dramatic shift in FX policy following the 1997 currency crisis.

Korea's post-currency crisis policies encouraged currency inflows through capital market opening and FX market liberalization. From 2006, however, these policies were reversed to combat the excessive strengthening of the won.

Especially, at the time currency outflow policies were adopted, Korea's current account surplus had been declining and there was a massive exodus of non-debt foreign equity capital. In addition, there was a large inflow in foreign debt capital, such as foreign investment in domestic bonds and short-term borrowing. However, the currency outflow policy focused on increase to investment of non-debt equity capital in abroad. In a result, after the crisis, debt capital owned by foreign investors was easy to be outflowed but non-debt capital owned by domestic investors was not and foreign exchange liquidity got tightened.

In light of the recent global financial crisis, some have asserted that Korea need over US\$300 billion of currency reserves to stabilize foreign exchange market. However, any discussion about the appropriate amount of currency reserves should, however, take the follow items into consideration.

First, although greater currency reserves may bolster the capacity to deal with a crisis and boost overseas credit ratings, the costs and benefits of doing so must be weighed. Second, artificially replenishing currency reserves to keep them at a specific level may induce speculative trading and is thus considered to be inappropriate. Therefore, it will be necessary to let currency reserves rise naturally from the rise in currency reserves from sterilization policy, increased central bank profits and etc.

Desirable exchange policies must have FX market stability, that is, rate stability, as the goal. To achieve this, Korea should consider the following measures over market intervention.

First, to stabilize currency liquidity, currency swaps and other forms of international cooperation should be strengthened, in addition to bolstering economy fundamentals. Second, so as not to stray from market opening and liberalization, FX measures related to boosts domestic currency outflows must be reexamined and inflow of foreign long-term investment must be attracted through incentives and grants. Third, to ensure that foreign debt does not rise as a result of excessive financial institutions' competition for asset growth, it will be necessary to regulate the oversight of currency soundness. Finally, in the long term, the internationalization of the won must continue to be pursued through expanding local settlement in won and through other measures.

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## I. 서론

서브프라임 발 글로벌 금융위기에서 비롯된 국제금융시장 불안 및 세계경제 침체로 인해 우리나라 경제도 심각한 어려움을 겪고 있다. 특히 우리나라의 경우 국내 외국인 투자자금의 대규모 유출, 국내은행들의 외화자금조달의 어려움 등으로 국제금융시장의 신용경색 현상이 외화유동성 문제로 과급되며 일각에서는 외환위기 재발 우려마저 제기될 정도로 상황이 악화되는 현상을 보였다.

사실 이번 글로벌 금융위기에서 비롯된 글로벌 유동성 경색현상으로 대부분 신흥시장국의 통화가 약세를 보인 것이 사실이다. 그러나 다른 신흥국과 비교할 때 우리나라 CDS 프리미엄이 상대적으로 큰 폭으로 상승함과 동시에 원화 가치 절하폭도 가장 컸던 것으로 나타나 우리나라의 외환시장 불안정성이 여타 국가들에 비해 매우 높았던 것으로 평가된다.

물론 글로벌 금융위기라는 외적 충격은 국내 정책당국이나 국내 금융시장이 통제할 수 없는 부분이지만, 우리나라가 97년 외환위기를 경험했음에도 불구하고 충격 발생시 여타 신흥시장국들보다 상대적으로 크게 불안정한 모습을 보인 데에는 외환위기 이후 급속히 변화되어온 우리나라 외환정책 등의 부작용에 일부 기인하였을 개연성이 높다.

그러므로 외환위기 이후 진행되어온 외환자유화 과정이나 금융위기 이전 일각에서 지속적으로 과도하다고 비판받아온 외환보유액 규모 등이 이번 글로벌 금융위기로 인한 외환시장 불안 확대와 어떠한 연관성을 가지고 있는지 등을 보다 면밀하게 살펴볼 필요가 있을 것이다.

본고에서는 97년 외환위기 극복 이후 글로벌 금융위기로 외환시장이 매우 불안하였던 '09년 1/4 분기까지의 외환 유출입 및 환율 동향을 살펴본 후, 정부의 외환관리 정책의 변화가 외환시장에 미친 영향들을 재조명하고, 이를 통해 향후 위기재발시 적절히 대응할 수 있는 바람직한 외환관리 정책을 모색하여 보고자 한다.

## II. 외환위기 이후 우리나라 외환시장 동향

### 1. 외환위기 이후 외화 유출입 동향

#### 가. 경상 수지 동향

우리나라의 경상수지는 '98년~'07년 중 지속적으로 흑자기조를 유지하다 글로벌 금융위기의 영향으로 '08년에 64억 달러 적자로 전환되었다. 상품수지는 외환위기 직후 수입급감에 힘입어 대규모 흑자를 기록한 이후 흑자규모가 감소추이를 보인다. '01년 이후 세계경제호조에 힘입어 수출이 급증하며 다시 급격히 확대된 이후 '04년~'07년 중 대규모 흑자를 지속적으로 기록하였다. 다만 '08년 들어 글로벌 금융위기의 영향으로 상품수지 흑자폭이 급감하는 현상이 나타났다. 한편 서비스수지는 '05년부터 큰 폭의 적자를 기록하고 있는데 이는 당시 환율이 큰 폭으로 하락하며 여행수지 적자가 크게 증가한 데 기인하는 것으로 평가되고 있다.

Figure 1. Current Account

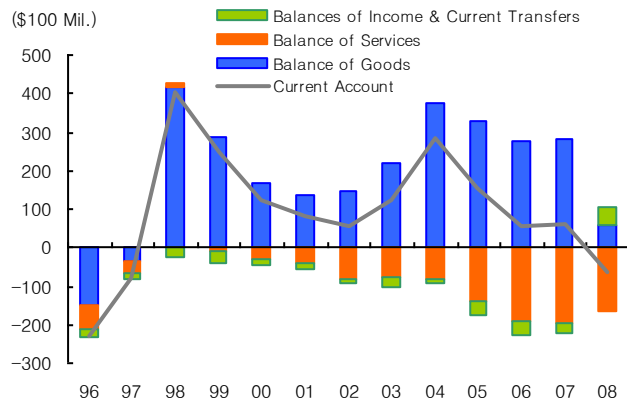


Figure 2. Goods Account and Imports

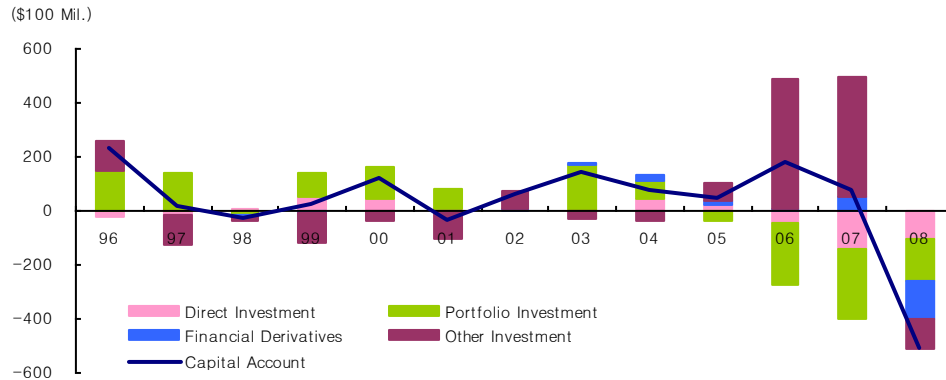


Source: Bank of Korea

#### 나. 자본수지 동향

자본수지는 외환위기 이후 '07년까지 대체로 유입초과를 기록하다 '08년 글로벌 신용경색 여파로 큰 폭의 자본유출을 기록하였다. '99년부터 '07년까지 자본수지상 총 초과유입액이 684억 달러 정도였던 것으로 기록되는데 '08년 한해 동안 509억 달러 유출초과가 나타나 외환위기 이후 초과 유입된 외화의 대부분이 '08년 한해에 유출된 것으로 평가된다.

Figure 3. Fluctuations in Capital Account



Source: Bank of Korea

자본수지의 세부 항목별로 그 추이를 살펴보면 유입초과를 기록했던 99년~07년 기간중 전반기인 99년~04까지는 외국인의 주식, 채권 등 포트폴리오 투자가, 후반기인 05~07년에는 단기외채 등 기타투자가 외화 유입을 주도하였던 것으로 분석되었다.

Table 1. Balance of Major Capital Account Items by Period

(Unit: \$100 million)

	'99~'04	'05~'07	'08
Portfolio Investment	+ 523	- 528	- 154
Other Investments	- 250	+ 992	- 106

Note : (+) denotes amount of inflow, (-) amount of outflow

한편 포트폴리오투자 수지는 외국인주식 및 채권투자 패턴과 내국인 주식 및 채권투자 패턴에 의해 크게 영향을 받았는데, '99~'04년에는 국내자본시장 개방 등 외화유입촉진을 위한 외환자유화정책과 국내주식의 상대적인 저평가 등의 영향으로 외국인 주식투자자금이 대거 유입되었던 것으로 평가되고 있다. 반면 '05~'07년에는 주식투자자금은 차익실현매도 등으로 유출되었으며, 특히 해외펀드 비과세정책과 해외주가 강세 등으로 인해 내국인의 포트폴리오투자자금 유출이 크게 증가하는 가운데 차익거래유인 등으로 인해 외국인 채권 투자자금이 대거 유입되었던 것으로 평가되었다. 그리고 '08년에는 글로벌 신용경색현상 심화에 대응하여 글로벌 투자은행들이 유동성 확보를 목적으로 국내에 투자하였던 자금을 대거 회수한 반면, 내국인 해외투자자금의 국내 유입은 주가하락에 따른 손실급증과 과도한 환헤지의 영향으로 소폭에 그침에 따라 대규모 자금의 유출이 포트폴리오 투자에서 나타났다.

Table 2. Balance of Major Portfolio Investment Items by Period

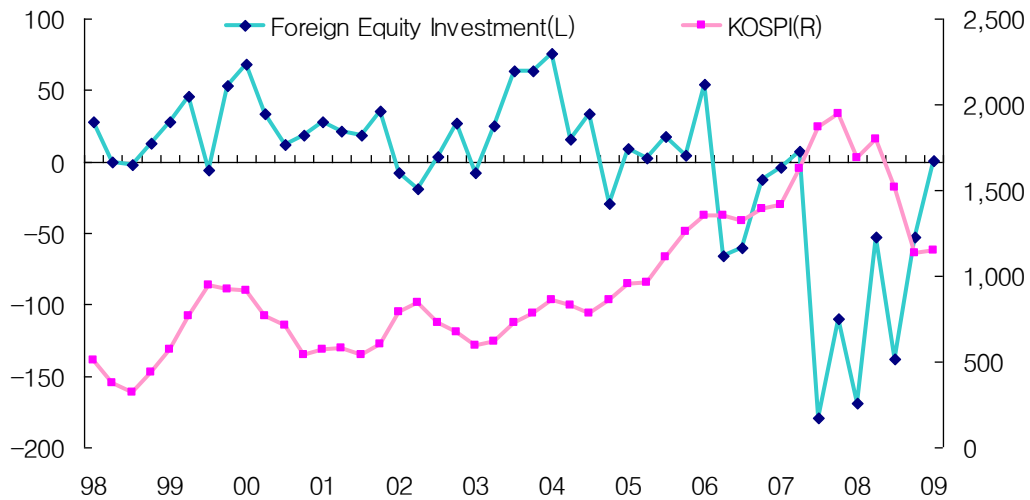
(Unit: \$100 million)

		'99~'04	'05~'07	'08
Foreign	Equities	+ 597	- 338	- 412
	Debt	+ 196	+ 964	+ 28
Domestic	Equities	- 83	- 715	+ 64
	Debt	- 187	- 339	+ 167

Note : (+) denotes amount of inflow, (-) amount of outflow

특히 외국인 국내 주식투자는 외환위기 직후 국내주가가 상대적으로 낮았던 시기에 유입된 이후 '05 년 하반기부터는 국내 주가의 대폭 상승과 환율하락 기대에 따른 차익실현과, BRICS 등 여타 신흥시장국으로의 투자자금 이동 등에 기인하여 순매도 기초를 유지하였다. 그리고 글로벌 금융위기가 본격화된 '07 년 하반기 이후 순매도 규모가 대폭 확대되었던 것으로 평가되고 있다.

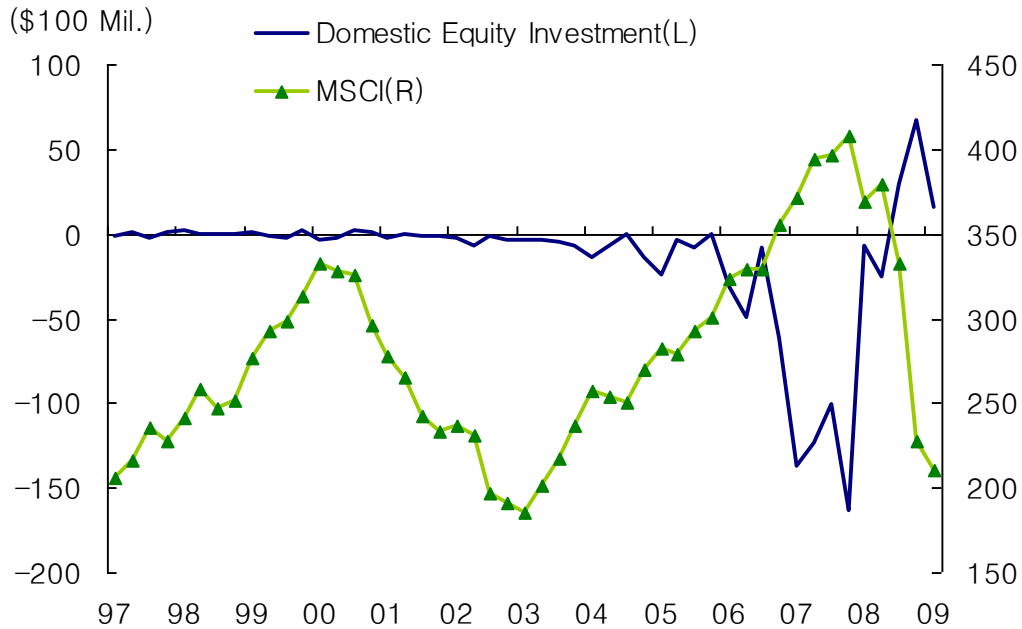
Figure 4. Foreign Equity Investment and the KOSPI Index



Source: Bloomberg

반면 내국인 해외주식투자는 '03 년말 당시 동북아 금융허브 추진 전략의 일환으로 투자목적의 건전한 외화유출을 최대한 허용하는 금융시장 선진화 방안이 발표되며 내국인주식투자가 증가하기 시작하였는데, 이후 외환규제완화와 해외증권투자비과세 등 해외투자유출촉진정책이 본격화되고 당시 세계주가급등과 함께 높은 수익률에 대한 기대가 형성되며 '06 년 이후 해외주식투자가 급증하였다. 그리고 '06~'07 년 사이에 크게 유출되었던 내국인의 해외주식투자는 '08 년 중 해외주가가 급락세를 보임에 따라 소폭 유입된 것으로 나타났다.

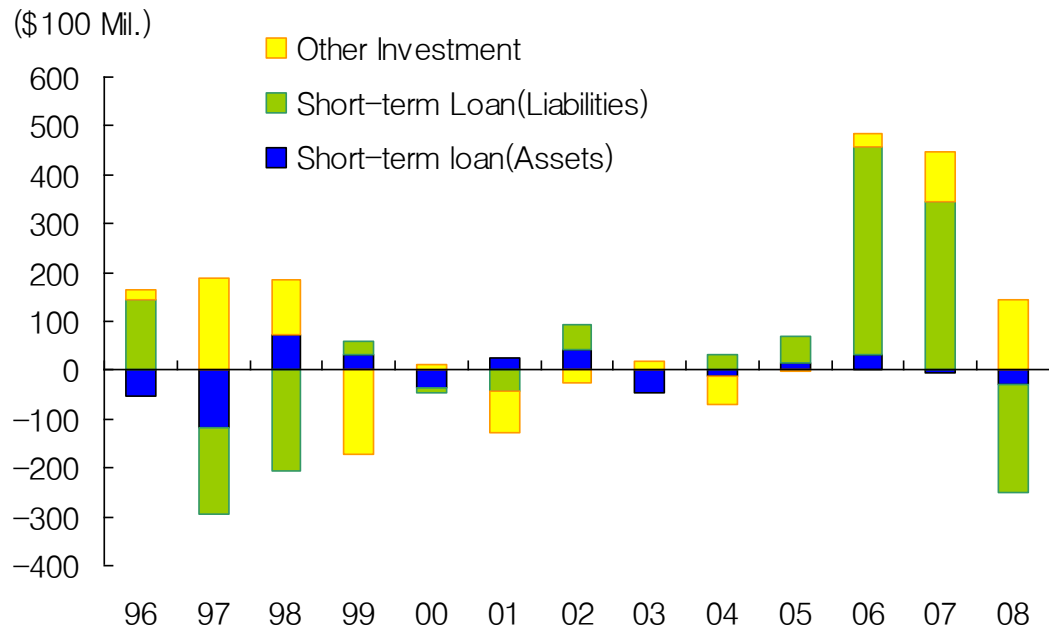
Figure 5. Domestic Equity Investment and the MSCI Index



Source: Bloomberg

한편 '06~' 07 년 사이 기타투자수지에서 큰 폭의 외화자금이 유입되었는데 이는 주로 단기외채 급증에 주로 기인한 것으로 분석되었다. 특히 ' 06 년(424 억 달러) 과 '07 년(345 억 달러) 중 수출 기업 및 해외투자펀드 관련 대규모 선물환매도로 인해 포지션관리를 위한 은행의 단기외채가 급증하였던 것으로 나타났다.

Figure 6. Trends in Other Investment Account by Item



Note: Bank of Korea Economic Statistics System

Figure 7. Banks' Net Short-Term External Debt

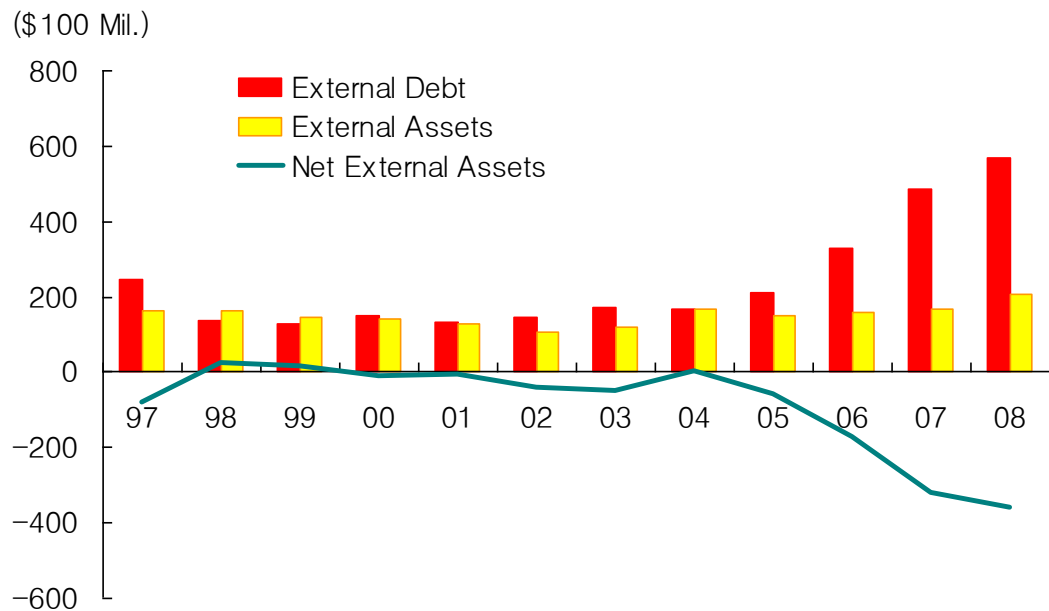




Table 3. Forward Swap Position of Corporate

(unit: 100 million US\$)

	2003	2004	2005	2006	2007	2008
Short Position in Forward Swap(A)	387	621	717	997	1,260	1,366
Long Position in Forward Swap(B)	231	303	425	509	542	746
A-B	156	318	292	493	718	620

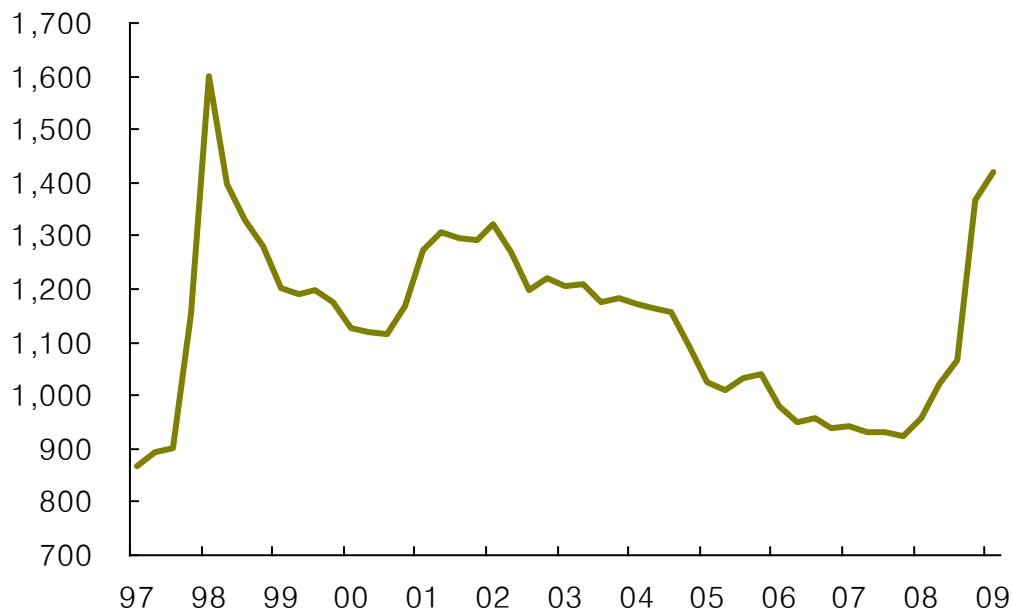
Source: Bank of Korea

## 2. 환율 및 외환보유고 동향

### 가. 환율 동향

원화의 대미 달러 환율은 '98 년 이후 일부 기간을 제외하고는 '07 년말까지 전반적인 하락세를 지속하다 금융위기 여파로 '08 년부터 급등하였다. 특히 '07 년까지 경상 및 자본수지가 모두 흑자를 보이며 원화강세가 급속히 진행되었는데 원화 절상폭은 여타 신흥시장국에 비해서도 매우 컸던 것으로 분석되고 있으며, 반대로 '08 년에는 경상 및 자본수지가 모두 적자를 기록하며 원화 절하폭이 여타 국가들보다 크게 나타난 것으로 분석되었다.

Figure 8. Won/Dollar Rate Trends



Source: Bank of Korea Economic Statistics System

Table 4. '00~'06 Major Asian Currencies vs. Dollar

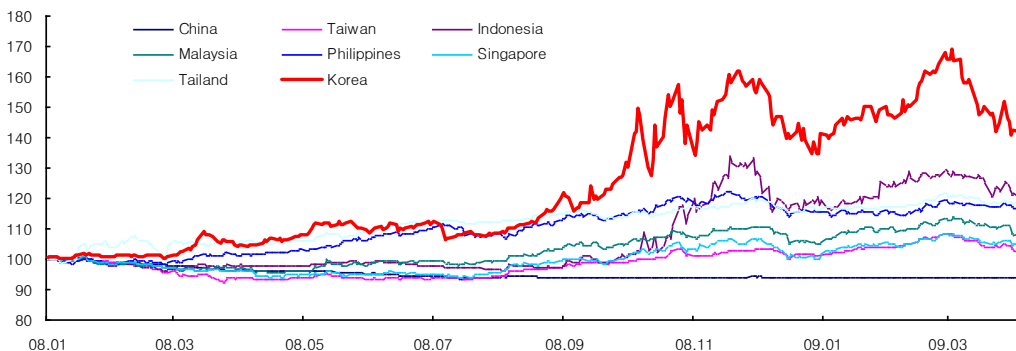
(Unit: y.o.y, %)

Major Currencies	2000	2001	2002	2003	2004	2005	2006
Korean Won	-4.98	14.13	-3.12	-4.71	-4.03	-10.46	-6.75
Thai Baht	6.18	10.72	-3.37	-3.44	-3.03	0.02	-6.23
Taiwanese Dollar	-3.15	8.23	2.14	-0.38	-2.87	-3.73	1.21
Hong Kong Dollar	0.43	0.09	0.00	-0.16	0.02	-0.14	-0.11
Indonesian Rupiah	7.10	22.02	-9.15	-8.02	4.26	8.68	-7.24
Malaysian Ringgit	0.00	0.00	0.00	0.00	0.00	-0.35	-3.39
Philippine Peso	13.21	15.18	1.22	5.05	3.39	-1.80	-7.17
Singapore Dollar	1.78	3.91	-0.09	-2.69	-3.00	-1.51	-4.72

Note: 1) (+) denotes rise in price and (-) a decline, 2) Based on average annual rate

Figure 9. '00~'06 Major Asian Currencies vs. Dollar

(2008.01.03=100)



Source: Bloomberg

시기별로 주요 특징을 살펴보면 IT 버블 붕괴로 인한 세계경제 혼란이 안정화된 이후인 '02 년 이후부터 원화절상압력이 거세지기 시작하였다. 그리고 '02 년 하반기부터는 환율안정을 위한 정책당국의 적극적인 시장개입이 실시되었음에도 불구하고 이는 환율절상속도를 둔화시킬 수 있었을 뿐 추세를 전환시키기에는 역부족이었다.

특히 '03 년 들어 계속적인 시장개입으로 외화자금의 부족해진 정책당국은 '03 년 9 월 투기세력에 대응코자 역외선물환시장에 대규모 시장개입을 실시하기도 하였는데 무리한 시장개입을 단행하였음에도 불구하고 이러한 시장개입이 환율절상속도를 둔화시킬 수 있었을 뿐 환율 하락세를 막지 못함에 따라 1.8 조원의 국고손실이 발생하였고 이로 인해 '04 년 국정감사에서 정부의 외평기금 운용 및 시장개입에 대한 비판이 크게 제기되기도 하였다. 이로 인해 정부는 적극적인 외환시장 개입을 중단하

었고 '04 년 11 월부터 환율이 큰 폭으로 절상되기 시작하여 '05 년중에는 신흥시장국에서 가장 큰 폭의 절상율을 기록하게 되었다.

한편 글로벌 금융위기 발생 이후에는 여타 신흥시장국 통화보다 원화가 상대적으로 큰 폭으로 절하되었는데 이는 대규모 외국인투자자금 유출, 경상수지 적자전환, 높은 단기외채비율 등에 기인한 것으로 분석되고 있다. 특히 단기외채 중심으로 외채가 급증하면서 우리나라의 외환보유액 대비 단기외채 비중이 다른 신흥시장국보다 상대적으로 높아짐과 동시에 2007 년말 우리나라 은행권의 예대율은 135.5%로 아시아 주요국 중에서 가장 높은 것으로 나타나<sup>1</sup> 향후 경기둔화 시 부정적 영향을 미칠 수 있다는 우려도 대두되며 우리 경제에 대한 외국인의 부정적인 평가가 빠르게 확산되었던 것으로 평가되고 있다.

Table 5. Recent Net Equity Purchases by Foreigners in Major Asian Markets

(Unit: \$100 million, %)

	Taiwan	India	Thailand	Indonesia	Philippines	Korea
Share of Foreign Ownership	28.2	8.3	31.0 (End Sept.)	21.2 (End ' 05)	10.9 (End ' 05)	27.4
2007 Net Purchases	4.8	173.6	19.0	31.4	145.0	-290.9
2008 Net Purchases	-163.6	-133.4	-49.4	18.0	-149.1	-367.4

Source: Bloomberg, country stock exchanges, International Finance Center

Table 6. Short-Term External Debt/FX Reserves by Country

(Unit: %)

	Brazil	Indonesia	Japan	Korea	Malaysia	Mexico	Russia
2005	35.3	33.3	122.0	31.3	24.0	26.9	24.9
2006	23.9	29.7	105.8	47.6	19.9	27.7	19.2
2007	21.7	33.9	110.4	61.1	22.4	27.2	22.8
2008.1Q	20.1	35.8	131.0	66.8	28.0	30.6	19.5
2Q	20.7	37.2	122.9	68.1	31.2	28.6	18.6

Source: IMF

<sup>1</sup> 2007 년말 현재 우리나라, 중국, 대만, 인도, 태국의 예대율은 각각 135.5%(14.8%p), 69.3%(1.1%p), 68.2%(3%p), 92.0%(5.3%p), 104.1%(-1.2%p)이었다.

### 나. 외환보유액 동향

외환보유고는 '98 년 이후 급증세를 지속하다 ' 08 년 1/4 분기 이후 감소세로 전환되었다. 외환보유고는 97 년말 외환위기 직후에는 적극적인 외환보유고 확충정책으로, '02 년 하반기 이후부터 ' 08 년 1/4 분기까지는 정책당국의 적극적인 외환시장 개입의 영향으로 지속적으로 증가하여 '97 년말 204 억 달러였던 외환보유액이 ' 08 년 1/4 분기말 2,642 억 달러까지 증가하였다. 다만 금융위기로 인해 외화유동성 경색 현상이 심화된 2008 년 이후에는 환율 안정을 위한 시장개입, 금융기관 및 수출입기업에 대한 유동성 공급 등으로 외환보유액이 급속히 감소함에 따라 '09 년 1/4 분기말 2,063 억 달러까지 감소하였다.

Figure 10. FX Reserves

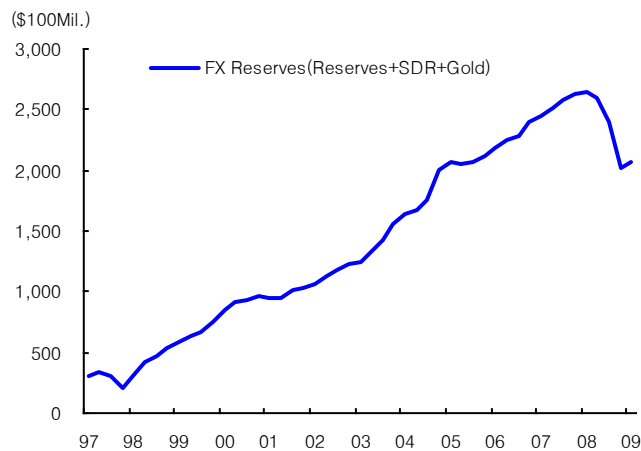
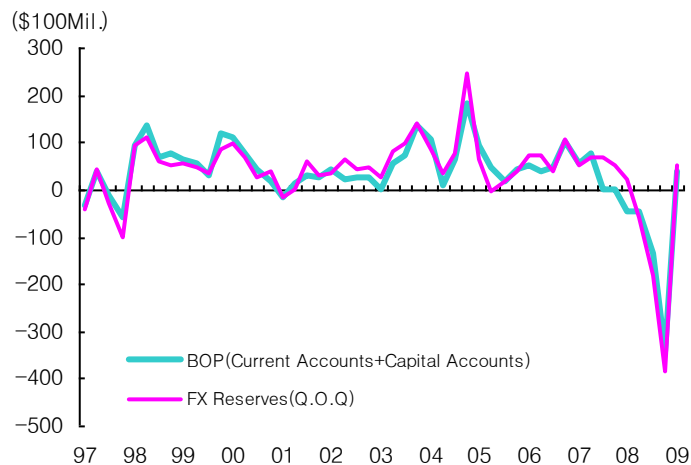


Figure 11. Fluctuations in FX Reserves and Balance of Payments



### III. 외환위기 이후 외환관리 정책 평가

#### 1. 주요 외환관리 정책

우리나라 외환정책의 방향은 외환위기 직후에는 자본시장 개방, 외환자유화 촉진 등 외화유입 중심이었으나 '06 년 이후에는 과도한 원화강세 억제를 위해 외화유출 중심으로 전환되었다.<sup>2</sup>

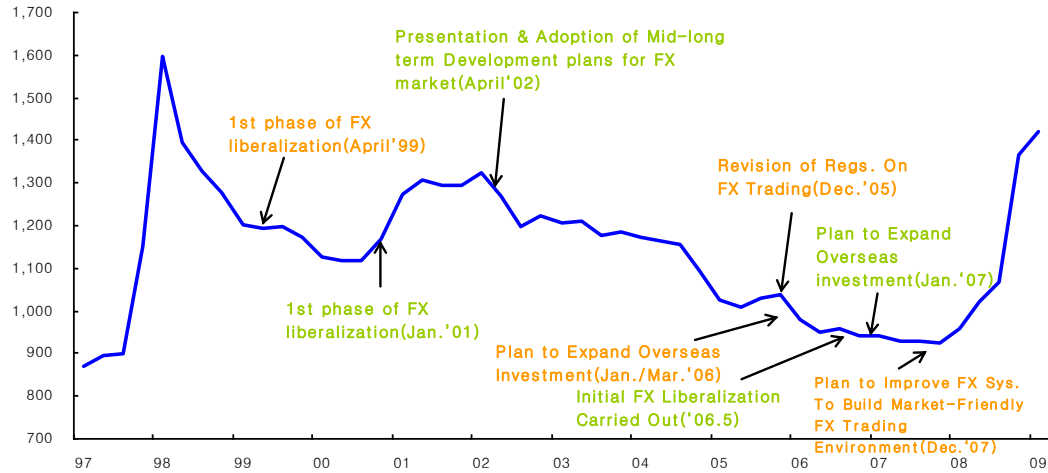
Table 7. Significant Post-1997 FX-Related Policies

Initiative	Kim Daejung Administration	Roh Moohyun Administration	Lee Myungbak Administration
Capital Market Opening	<ul style="list-style-type: none"> <li>- Full opening of bond market to foreigners(Dec.'97)</li> <li>- Expansion of permitted scope of securities investment by foreigners(May'98)</li> <li>- Full opening of securities markets to foreigners (July'98)</li> </ul>	<ul style="list-style-type: none"> <li>- Regulations relaxed on foreign company issuance of bonds in Korea(Jan.'03)</li> </ul>	
FX Liberalization	<ul style="list-style-type: none"> <li>- 1<sup>st</sup> phase of FX liberalization measures (April '99)</li> <li>- 2<sup>nd</sup> phase (Jan. '01)</li> <li>- Presentation and adoption of mid-, long-term development plans for FX market (April '02)</li> </ul>	<ul style="list-style-type: none"> <li>- Revision of regs. on FX trading (Dec. '05)</li> <li>- Plan to expand overseas inv. (Jan./Mar. '06)</li> <li>- Initial FX liberalization carried out (May '06)</li> <li>- Plan to expand companies' presence abroad and to expand overseas investment (Jan. '07)</li> <li>- Plan to improve FX system to build market-friendly FX trading environment (Dec. '07)</li> </ul>	<ul style="list-style-type: none"> <li>-Reg. revisions to facilitate FX trading (May '08)</li> </ul>
Financial Hub Drive		<ul style="list-style-type: none"> <li>- Northeast Asian financial hub strategy adopted (Dec. '03)</li> <li>- Northeast Asian financial hub strategy adopted (Dec. '03)</li> <li>- Fin. regs. relaxed for hub plan (April '05)</li> </ul>	

Source: Bank of Korea, Financial Supervisory Service, Ministry of Strategy and Finance

<sup>2</sup> 한편 참여정부 출범 이후 외환보유액 규모가 증가하면서 외환보유액 활용방안이 활발히 논의되었는데 특히 동북아 금융허브 육성 전략이 추진됨에 따라 한국투자공사 설립되어 외환보유액 일부를 고위험 고수익 투자를 함으로써 외환보유고의 수익성을 제고하려 노력하기도 하였다.

Figure 12. Exchange Rate Trends against Timeline of Significant FX-Related Policies



## 2. 외환관리 정책 평가

### 가. '97 말~ '05 년: 외자유입촉진 위주의 외환자유화정책 시기

외환위기 직후에는 외환보유액 확대를 목표로 자본시장 완전개방 등의 조치를 신속하게 진행시켜 나갔다. 그리고 이를 바탕으로 외국인 주식투자자금이 크게 유입되고 경상수지도 계속해서 흑자를 기록하자 대규모 외화자금의 유입이 계속되었다. 이에 따라 원화절상압력이 거세지며 거시경제에 큰 부담으로 작용하기 시작하였다. 또한 환율 하락에 대응한 적극적인 시장개입과 불태화정책은 한국은행이 통화관리를 함에 있어 상당한 장애요인으로 작용하였다. 즉, 외환보유액 급증에 따른 통안채 발행으로 통안채 이자비용이 '02 년 이후 지속적으로 증가하여 '05 년에는 6 조원을 상회하였는데 이는 본원통화 잔액의 15% 내외로 당시 본원통화 증감액을 크게 초과하는 규모였다.

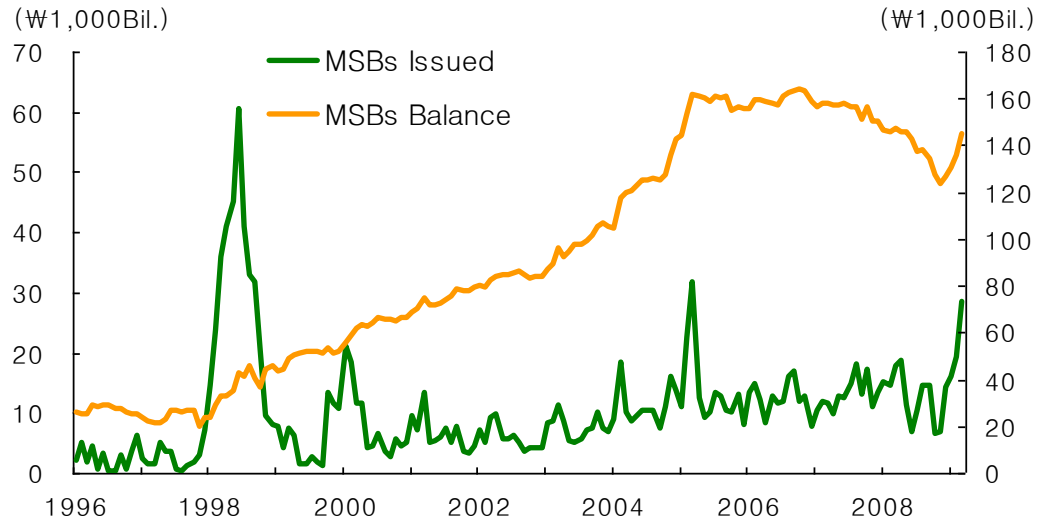
Table 8. FX Reserves

(Unit: Trillions of won)

	'02	'03	'04	'05	'06	'07
Monetary Stabilization Bond Rates	4.8	5	5.6	6.1	6.8	7.5
Change in Reserve Base (Average)	4.2	2.2	1.5	1.5	2.9	6.9
Reserve Base (Average)	33.6	35.8	37.3	38.8	41.7	48.5

Source: Bank of Korea

Figure 13. MSBs Issued and Balance



Source: Bank of Korea

또한 적극적인 시장개입의 결과 외국환평형기금의 누적적자 규모가 기하급수적으로 증가하였다. '02 년 이후 외평기금의 누적적자가 크게 증가하여 '01 년 0.7 조원에 불과하였던 적자규모가 '06 년 26 조원에 이르게 되었는데 이로 인해 정부재정지출 대비 외평기금 누적적자 규모의 비중은 '02 년 1.8%에서 '06 년 12.6%로 급증하였다. 특히 누적적자의 급속한 확대가 정부의 무리한 시장개입때문이라는 비판이 국회 등에서 거세게 제기되며 정책당국에 상당한 부담으로 작용하였던 것으로 평가된다.

Table 9. Yearly FX Equalization Fund Cumulative Deficit and Scale of Fiscal Expenditures (Unit: Trillion Won)

	2002	2003	2004	2005	2006
FX Equalization. Fund Cumulative Deficit (A)	2.5	2.8	15.4	18.9	26.0
Fiscal Expenditures (B)	136	164	173	188	206
Weighting (A/B)	1.8	1.7	8.9	10.0	12.6

Source: Ministry of Strategy and Finance

이와 아울러 학계 및 정치권 등에서 외환보유액 과다보유 논의가 제기되면서 외환보유액의 효율적 운용 및 금융허브정책 수행을 위한 목적으로 외환보유액의 일부를 효율적으로 활용해야 한다는 주장이 지속적으로 제기 되었다. 특히 이들은 당시 외환보유액 수준이 수출입 거래 및 단기외채 등을 고려한 필요외환보유액 수준을 크게 상회한다는 점에서 우리나라 외환보유액 수준이 과도하다고 주장하였다.

이처럼 외환시장 개입과 외환보유액 급증의 부작용이 부각되며 비판여론이 거세지자 정책당국은 직접적인 외환시장 개입을 자제하는 한편 환율 관리를 위한 다른 방법을 찾기에 이른 것으로 보인다.

#### 나. '06 년~금융위기 이전: 외자유출촉진 위주의 외환자유화정책 시기

'06 년부터 정부는 과도한 원화절상압력을 완화하기 위해 직접적인 외환시장 개입 대신 외화자금유출 정책을 적극적으로 시행하여 외환수급을 조절하고 환율을 안정화시키고자 노력하였다. '06 년에는 해외투자촉진방안으로 해외직접투자 완전자유화, 거주자의 주거용 해외부동산 취득 자유화, 개인의 외국증권 투자대상 제한 폐지 및 국내펀드의 해외펀드 투자제한 완화 등 해외포트폴리오 투자 활성화 등이 실시되었고, '07 년부터는 해외주식투자 비과세, 투자목적 부동산 취득한도 상향조정 등을 통해 해외주식 및 부동산 투자 촉진 정책 등이 실시되었다.

그러나 환율절상압력 완화를 위한 해외증권투자 비과세 조치 등은 해외증권투자 자금의 대부분이 환헤지와 함께 이루어짐으로써 환율하락압력 완화에는 크게 기여하지 못한 반면 오히려 단기외채증가의 주요 요인으로 작용한 것으로 평가된다.<sup>3</sup> 당시 해외증권 투자금액의 약 80% 정도를 선물환매도의 방법으로 헤지하는데, 이러한 헤지 과정에서 단기 외채가 증가한 것이다.

Table 10. Fluctuations in Overseas Equity Investment and Short-Term External Debt  
(Unit: \$100 Million)

Category	2004	2005	2006	2007	2008
Overseas Equity Investment	95	111	232	471	-165
Changes in Short-Term External Debt	55	96	478	465	-92

Source: Bank of Korea

즉, 결과적으로 당시 국내로 유입되는 해외자금의 대부분은 단기외채였던 반면, 해외로 유출된 내국인 자금은 수익률 위험이 크고 위기시 국내로의 환입에 어려움이 존재하는 환헤지된 해외주식투자였다는 것이다. 이에 따라 금융위기 이후 단기외채의 연장이 어려워지자 국내 외환시장의 유동성 사정은 급격한 어려움에 직면한 반면 내국인 해외주식투자는 큰 폭의 손실을 기록함과 동시에 환헤지로 인하여 환차익을 얻지도 못하여 국내로 재유입되는 자금의 규모가 매우 제한적이었던 것으로 평가된다.

더욱이 해외증권투자 관련 선물환 헤지는 금융위기 이후 환율상승시기에 환율 상승폭을 보다 확대시키는 요인으로 작용하기도 하였다. 금융위기 이전 원화강세기에 해외유출된 해외투자펀드에 대해 '다이나믹 헤지'를 하였던 자산운용사들의 달러수요가 해외주가 급락과 함께 환율급등에 따른 환손실 우려로 급등하며 환율 추가상승 압력으로 작용하였던 것이다.

한편 해외부동산 투자의 경우 정부의 규제완화에 따라 규모가 급증하긴 하였지만 규모가 가정 컸던 '07 년의 부동산 취득관련 유출규모가 11.7 억 달러에 그쳐 사실 그 절대 규모는 크지 않았던 것으로 평가된다.

<sup>3</sup> 물론 당시 원화 추가 강세에 대한 강한 기대감이 형성되며 해외투자펀드뿐만 아니라 조선업 체 등 수출기업들의 선물환매도가 급증한 것도 단기외채 급증의 주요 요인으로 작용하였다.



Table 11. Residents' Overseas Real Estate Acquisitions

Category	2006	2007	2008
Number	1,317	2,803	1,227
Amount (\$100 million)	7.4	11.7	4.7

Source: Ministry of Strategy and Finance

그럼에도 불구하고 이번 글로벌 금융위기와 함께 부동산 가격이 급락함에 따라 투자손실이 급증하고 이는 추가적인 외화유출을 유발하여 외화유동성 사정을 악화시켰을 가능성을 배제할 수 없다. 즉, 부동산 구매가 일반적으로 모기지 대출 등 레버리지 거래에 의존하고 있음을 고려할 때 해외부동산투자의 규모 자체는 10 억 달러 내외로 작다고 하더라도 손실규모는 이보다 클 가능성이 매우 높기 때문이다.

나아가 동북아 금융허브 추진과 외환보유액의 수익성 제고를 위해 '06 년 7 월 설립된 한국투자공사는 ' 08 년부터 본격적인 주식직접투자에 나섰는데 금융위기를 맞아 손실이 급증하며 결과적으로 외환보유액 감소를 초래하였던 것으로 나타났다. 한국투자공사에는 현재 외환보유액 중 300 억 달러(한국은행 외환보유액 170 억 달러 + 외평기금 130 억 달러)가 위탁되어 운용되고 있는데, 특히 설립이후 '08 년 1 월 처음으로 메릴린치에 20 억 달러를 직접 투자하였는데 메릴린치가 BoA 에 매각된 후 '09 년 2 월말 현재 투자액의 90%인 약 18 억 달러의 평가손을 기록한 것으로 알려져 있다. 또한 초기에 간접투자된 200 억 달러에서도 상당한 손실이 났을 가능성이 있다는 우려가 금융위기 발생이후 지속적으로 제기되고 있는 현실이다.

결국 당시 경상 및 자본수지의 동시흑자로 인한 원화절상압력에 대응하기 위해 시행되었던 해외투자 촉진정책은 당시 외화유출입 자금의 구체적인 성격을 고려하지 못했다는 점에서 자성의 여지가 있을 것으로 보인다. 즉, 기본적으로 일본 등의 예에서 보듯이 수출의존도가 높은 국가의 경우 경상수지 흑자와 함께 자본수지가 적자를 기록하며 국제수지가 균형을 이루고 외환시장 안정을 유지하는 것이 바람직한 것으로 인식되어 정책당국이 해외투자촉진정책을 적극적으로 시행하였다는 점에서는 큰 문제가 없어 보인다. 그러나 당시 우리나라는 경상수지 흑자폭이 감소추세에 있었고, 비외채성 자금인 외국인 주식투자자금은 대거 유출되고 있었던 반면, 자본수지 흑자의 대부분은 외채성 자금인 외국인의 국내채권투자와 단기외채로 구성되어 있었음을 간과하였던 것은 문제점으로 지적할 수 있다.

Table 12. Fluctuations in External Debt

(Unit: \$100 Million)

Category	2004	2005	2006	2007	2008
Current Account	282	150	54	59	-64
Capital Account	76	48	180	71	-509
Foreign Equity Investment Inflows	95	33	-84	-287	-412
Foreign Debt Investment Inflows	89	108	164	591	28
Inflow of Short-Term Loans	33	57	424	345	-220

Source: Bank of Korea

### 3. 글로벌 금융위기 이후 외환정책 대응 및 평가

이명박정부가 출범한 이후에는 정책당국이 시장 불개입 원칙을 천명하면서 시장에서는 정책당국이 환율상승을 선호한다는 인식이 확대되었고 이러한 정책 시그널로 인하여 시장참가자들 사이에서 환율상승에 대한 기대가 형성되고 거래가 급감하는 동시에 투기적인 매매도 활성화되었던 것으로 평가된다.

그러나 당시 국제금융시장에서는 이미 신용경색 및 유동성부족 현상이 심화되어 국내에 유입되어 있던 해외투자자금이 대거 유출되고 예상보다 큰 폭으로 환율이 급등하였다. 특히 당시 해외펀드에서의 손실을 커버하기 위한 일부 투신사들의 달러화 매입수요 증대로 원화약세를 가중시키는 한 원인이 되었다. 환율급등이 당시 고유가로 인한 물가급등 현상을 가중시키자 '08년 5월이후 정책당국은 환율안정을 위해 적극적으로 시장에 개입하기 시작하였다. 즉, 정부의 환율상승 용인 등으로 인해 '08년 1월 평균 944 원에서 5월 1,038 원까지 급등하였던 원/달러 환율은 정책당국의 적극적인 시장개입의 영향으로 일시적으로 하락하며 7월에는 1,018 원을 기록하였다. 반면 정책당국의 시장개입과 함께 '08.3월말 2,642 억 달러였던 외환보유액이 리먼사태 직전인 8월말에는 2,432 억 달러로 약 210 억 달러 감소하였다.

Table 13. Pre-Lehman Brothers FX Market Interventions

2008	Rate	Government Market Interventions
Feb. 29	939.0	No country leaves their exchange rate entirely up to the market (Minister of Finance, Kang Mansoo)
March 4	947.2	To maintain price stability and a strong won, the central bank will counter government's FX policy (Minister Kang Mansoo)
March 17	1,029.2	1 billion US\$ in net sales
March 25	976.3	By factoring in the current account deficit, where the rate must go speaks for itself (Minister Kang)
March 26	986.8	700 million US\$ in net purchases
April 4	973.8	200 million US\$ in net purchases
April 15	986.9	For the macro economy, the current account is the number one task (Minister Kang Mansoo)
April 16	989.5	The exchange rate critically affects not just the goods account, but also the service account (Minister Kang)
May 14	1,047.2	100 million US\$ in net sales
May 15	1,045.1	100 million US\$ in net sales
May 21	1,042.5	500 million US\$ in net sales
May 27	1,037.7	1 billion US\$ in net sales
June 12	1,034.0	Price stability takes priority over growth (Minister Kang Mansoo)
July 7	1,042.9	After govt. and central bank announced aggressive measures, large-scale market intervention was done

한편 9 월 중순 리먼사태 이후 국제금융시장의 신용경색이 정점에 달하며 국내 외화유동성 사정이 크게 악화되자 정책당국은 시장개입을 최대한 자제하는 대신 금융기관이나 수출입기업 등 외화자금에 필요한 부분에 직접적으로 유동성을 공급하는 외환관리 정책을 실시하였다.<sup>4</sup>

리먼 사태 이후 정부와 한국은행의 외환정책은 외화유동성 규모와 시기 등의 측면에서 볼 때 적절하였다고 평가할 수 있다. 특히 외화유동성이 부족할 때 적절한 규모의 유동성 공급이 이루어졌는데 특히 단기자금을 공개입찰형식으로 시장금리 기준으로 공급한 것은 시장친화적인 정책이었다.

<sup>4</sup> '08 년 하반기 이후 정부와 한국은행은 1,450 억 달러 규모의 외화유동성 공급을 발표하고, 이중 30.9%(448 억 달러)를 집행는데, 정부와 한국은행의 외화유동성 공급은 크게 주요국과의 통화스왑을 통한 외화공급과 무역금융지원, 시중 외화유동성 공급 등으로 구분된다. '09 년 1/4 분기까지 미국, 일본, 중국과 체결한 통화스왑 규모는 총 900 억 달러 중 한·미 통화스왑자금(300 억)에서 150 억 달러(50%)가 집행되었고, 무역금융지원은 정부의 수출환어음재할인 및 수출금융지원으로 106 억 달러, 한국은행의 수출입금융지원은 1.5 억달러(1.5%)가 집행되었다. 또한 시중 외화유동성 공급은 정부의 외평기금을 통한 외화스왑시장 공급과 한국은행의 경쟁입찰식 스왑거래가 100% 모두 집행된 상태인 반면 정부의 경쟁입찰 무담보 대출은 92 억 달러(65.7%)가 집행된 것으로 알려져 있다.

Table 14. Bank of Korea' s FX Liquidity Injections and Amount Recalled

Oct. 2008~mid-Mar. 2009	Initial Date of Adoption	Total Supplied (A)	Recalled (B)	Net Amount Supplied (A-B)
Competitive Bid Method Swap Transactions	Oct. 21 2008	102.7	49.7	53.0
Competitive Bid Method FX Loans <sup>1)</sup>	Dec. 2 2008	163.5	3.5	160.0
Export bill guarantee loans	Dec. 10 2008	1.5	0.5	1.0
Total		267.7	53.7	214.0

Note: 1) US Federal Reserve' s Currency Swap System

다만 2008 년 초 환율상승을 유도한 초기대응은 시장기대를 한 방향으로 쏠리게 함으로써 이후 환율안정을 위한 시장개입의 효과를 제한하였다는 점에서는 부적절하였던 것으로 평가된다. 즉, 시장의 기대가 환율 상승으로 쏠리게 만듦으로써 이후 환율안정을 위해 상당한 규모의 외환보유액을 소진하는 적극적인 개입을 하였음에도 불구하고 환율 안정 효과를 제한하는 쪽으로 작용하였던 것이다.

## IV. 향후 외환정책 방향 검토

### 1. 외환보유액 확대

자본 및 외환시장이 개방된 소규모 개방경제에서 급격한 자본유출입에 대한 대응 방안으로 먼저 거론될 수 있는 방안이 외환보유액 확대이다. 즉, 외환보유액이 적절한 수준까지 확대될 경우 원화의 과도한 평가절하를 우려한 투기적 자산매각 및 자본유출을 방지할 수 있고 이를 통하여 다시 자산 가격을 안정시키는 선순환이 가능하다는 것이다. 반대로 외환보유액이 충분하지 않다면 사소한 대내외적 충격에도 급격한 자본유출이 발생함으로써 환율급등, 금융기관 부실화, 외환위기 발생 가능성 우려가 존재한다.

그러므로 기본적으로 위기대응능력과 대외신인도 제고 등을 위해 외환보유액은 많을수록 좋다. 하지만 외환보유액 확대는 그에 따른 편익과 비용을 비교하여 적절한 규모로 이루어져야 한다. 외환보유액 확대는 통화공급 확대에 따른 인플레이션(또는 불태화정책에 따른 통안증권 이자비용 증가), 수입물가 상승, 외환시장에서의 외화유동성 감소 등을 통해 금융기관, 기업, 가계에 여러 가지 비용을 발생시킬 수 있다.

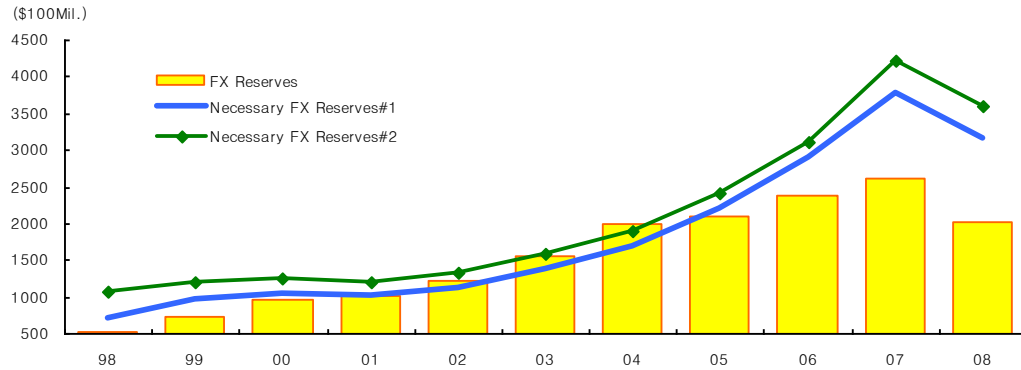
이를 고려한 필요외환보유액의 규모에 관해서는 수출의 변동에 대비하기 위하여 3개월 정도의 수출입 규모에 해당하는 외환보유가 필요하다는 주장, 차환리스크가 있는 단기·유동부채의 규모를 감안하여 외환보유액을 축적하여야 한다는 주장, 무역량 및 단기외화부채의 규모뿐만 아니라 은행시스템의 크기(M2)와 포트폴리오 투자의 잠재유출 규모를 감안하여야 한다는 주장 등 다양한 주장이 존재한다.

이러한 주장중 우리나라와 같이 자본시장이 자유화되고 발달하면서 포트폴리오 투자의 잠재유출 규모 및 이에 따른 리스크가 상당히 큰 국가에서는 자본유출입에 대한 외환·금융시장의 변동성을 줄이기 위하여 향후 예상되는 포트폴리오 투자자금 유출규모를 바탕으로 필요외환보유액을 유지하는 것이 적절할 것으로 판단된다.

실제로 경상거래 및 외국인 주식투자자금의 차익실현분 등 자본거래를 모두 감안하면 대략 2005년 이후부터는 외환보유액 규모가 과도하진 않았던 것으로 평가되기도 한다. 예를 들어 3개월 수입규모, 유동외채(100%), 그리고 외국인 포트폴리오 투자의 1/3<sup>5</sup>을 합한 규모를 필요외환보유액으로 볼 경우 우리나라의 필요외환보유액 규모는 2008년말 현재 3.5천억 달러 전후로 추산된다.

<sup>5</sup> 과거 위기의 경험에 따르면 급속히 유출될 가능성이 있는 핫머니성 단기자금은 외국인 포트폴리오 자금의 약 30% 정도인 것으로 추정하였다.

Figure 14. Estimate of Requisite FX Reserves for Korea



Note: necessary FX reserves # 1: (3 months worth of imports) + (amount of foreign portfolio investment/3) + (short-term external debt) necessary FX reserves # 2: (3 months worth of imports) + (amount of foreign portfolio investment/3) + (current external debt)

Source: Bank of Korea Financial Statistics System, KITA trade statistics, FSS' s foreign investment trends report

다만 특정 규모의 외환보유액을 목표로 하여 인위적으로 외환보유액을 확충하는 것은 적합하지 않다. 왜냐하면 특정 수준으로의 외환보유액 확충을 목표로 시장개입을 하는 외환정책은 환율의 방향성에 대한 투기적 거래를 유발시켜 오히려 시장불안 요인으로 작용할 수 있기 때문이다. 그러므로 향후 경상수지 흑자 지속 등을 통한 국내 실물경기 성장을 통하여 외화자금사정이 개선시키고 불태화 정책에 의해 외환보유액이 자연스럽게 증가되도록 유인해 나가야 하겠다. 즉, 이번 금융위기의 원인 중 하나가 금융시장 발전과 실물경제 발전의 괴리에 기인하고 있듯이 우리나라 외환시장의 안정 또한 외환유출입 규모를 안정화시킬 수 있을 만큼 경상수지 흑자가 안정적으로 유지되고 이로 인해 충분한 외환보유고가 확보되도록 노력해 나가야 할 것이다.

## 2. 외화건전성 개선

이번 금융위기기간 중 은행들의 원화 및 외화 유동성 리스크가 급증하면서 국내 금융시장 내 신용경색현상이 매우 심화되었다. 이에 대응하여 정책당국은 은행들의 외채에 대한 지급을 보증하는 한편, 외평기금 투입 및 미연준과의 스왑계약 등을 통해 외화 유동성을 공급하였으며, 한은 RP 대상 채권에 은행채를 편입하고 원화 유동성 비율 규제를 완화하는 등 은행들의 유동성 리스크를 줄이기 위한 일련의 조치들을 취하였다. 그러나 이러한 조치들은 위기대응을 위한 임시방편일 뿐이며 향후 유사한 상황이 반복되지 않도록 하기 위해서는 보다 중장기적인 대책이 필요한 것으로 판단된다.

특히 이번 금융위기 기간 중 최근 단기간에 급증한 은행들의 외채규모, 그리고 외화자산부채의 만기불일치에 대한 우려가 외환시장의 주된 불안요인으로 작용하였던 점을 주목할 필요가 있다.

국내은행들의 외화자산 및 부채현황을 살펴보면, 외화자산은 주로 선물환 매입 및 무역여유 할인, 외화대출 등으로 운용되고 있으며 외화 부채는 차입에 의한 외채가 대부분을 차지하고 있다. 그런데 국내은행들이 수출기업 및 해외투자 펀드의 선물

환 매도를 매수하는 과정에서 매입한 선물환은 상대적으로 장기자산인 반면 포지션관리를 위해 차입한 달러자금은 대부분 단기외채로 이루어짐에 따라 외채가 급증함과 동시에 외화자산·부채간 만기불일치 문제가 크게 유발된 것이다. 또한 '06~' 07 년 국내은행의 대외채무 급증기에 단기채무가 상대적으로 크게 증가하며 2005 년말 47.9% 였던 단기채무비중이 2008 년 하반기말 51.8%로 크게 증가하며 채무의 만기구조는 단기화되었던 반면, 2006 년 이후 증가폭이 확대된 외화대출은 2007 년 8 월 국내시설자금으로의 외화대출용도 확대 등을 바탕으로 일반적으로 만기가 30 년 이상인 시설자금대출이 급증하여 외화대출에서 시설자금대출이 차지하는 비중이 2006 년말 22%에서 2008 년 9 월말 46%까지 증가함에 따라 대출의 만기구조가 장기화되었다. 이는 선물환 매수에 의해 발생한 만기불일치 문제를 더욱 심화시키는 요인으로 작용하였다.

Table 15. Domestic Bank External Debt

(Unit: \$100 Million)

	End 2005	End 2006	End 2007	End 2008
Overseas Debt	583.9 (100.0)	821.1 (100.0)	1,089.6 (100.0)	1,234.8 (100.0)
Short-Term Debt	279.7 (47.9)	442.6 (53.9)	546.4 (50.1)	656.1 (53.1)
Long-Term Debt	304.2 (52.1)	378.5 (46.1)	543.2 (49.9)	578.7 (46.9)

Note: 1) ( ) denotes share of the total (%)

Source: Bank of Korea

Table 16. Domestic Bank FX Loan Trends

(Unit: \$100 Million)

	End 2005	End 2006	End 2007	End 2008.9 Balance
FX Loans	256.6 (100.0)	38.9 (100.0)	43.2 (100.0)	501.6 (100.0)
Facilities Loans	69.9 (27.3)	71.0 (22.2)	66.7 (35.8)	230.7 (46.0)
Working Capital	235.8 (52.9)	42.7 (62.4)	37.1 (47.8)	181.9 (36.3)
Other	50.9 (19.8)	10.6 (15.4)	13.6 (16.4)	89.0 (17.7)

Note: 1) ( ) denotes share of total (%)

Source: Bank of Korea

그럼에도 불구하고 국내은행들의 외화유동성 비율, 1 개월 갭 비율, 7 일갭 비율 등은 금융위기간 내내 감독당국의 지도비율을 현격히 상회하였는데, 이는 이러한 지도비율이 평잔이 아닌 말잔기준으로 이루어졌기 때문이다. 즉, 금융기관들이 월말에 무리한 자금조달을 통해서라도 지도비율을 맞추었기 때문인데, 이는 월말 외화시장의 수급을 왜곡시키는 요인으로 작용하기도 하였다. 그러므로 외화 유동성리스크를 전반

적으로 줄이기 위해서는 유동성비율 규제를 말잔기준에서 평잔기준으로 변경하거나 상시화시키는 방안을 고려할 필요가 있다.<sup>6</sup>

한편 외환시장의 잠재적 불안 요인으로 매년 언급되는 외채 관리를 위해, 금융기관들의 실수요가 아닌 외형확대 경쟁 등에서 발생하는 단기외채에 대한 규제를 외화건전성 감독 차원에서 강화할 필요도 있을 것이다. 또한 최근 주요국들의 금융개혁 보고서 등에서 제시되는 방안 중 하나인 동태적 대손충당금제도를 외화자산에 도입하여 경기호황기에 외화대출에 대한 대손충당금을 늘림으로써 외화대출의 경기순응성을 줄여나가는 것도 은행의 외화건전성 개선에 도움이 될 것으로 보인다.<sup>7</sup>

나아가 금융시장에서 투기자본보다는 건전한 외화의 유입을 유인하는 것도 전반적으로 우리나라에 유입되는 외화자산의 건전성 확보에 도움이 될 것으로 판단된다. 즉, 해외연기금 펀드 등 장기투자펀드에게 인센티브를 부여하는 방안 등 단기투기자본의 유출입보다는 장기투자자금 유입이 촉진될 수 있는 방안들의 시행을 고려해 볼 필요가 있다.

마지막으로 해외증권투자, 해외부동산투자 등 과거 환율 안정을 목표로 마련되었지만 이번 금융위기기간 중 외환시장 안정성에 부정적인 영향을 주었던 외화유출촉진 정책들을 재검토하여 외환시장 안정성을 높일 수 있는 방향으로 수정하여 나갈 필요도 있을 것으로 사료된다.

### 3. 원화 국제화

외환위기 직후 우리나라는 외국인 투자자금 유치에 의하여 자본시장 완전개방 등 자본시장을 선진국 수준으로 개방하였다. 이와 함께 외국인 주식투자자금이 대규모로 유입되었음에도 불구하고 국제금융시장에서 원화 거래량은 선진국에 비해 매우 작아 외국인 투자자금 유출입에 외환시장이 크게 흔들릴 수 있는 리스크가 내재되어 있었던 것으로 판단된다.

따라서 원화에 대한 국제적 수요를 충분히 높이는 등 원화 국제화를 이루는 것은 원화 거래량 증가를 통해 외환시장 안정에 도움을 줄 것이다. 원화 국제화를 위해서는 관련 제도의 개선과 함께 원화에 대한 수요 결정요인을 분석하여야 하는데, 원화 수요 증가를 위해 역내 무역대금 지급시 원화의 직접 결제를 늘리는 것도 하나의 방안이 될 것이다.

현재 국내 수출 및 수입에 있어 대부분의 결제통화는 미국 달러화인데, 2008 년 현재 우리나라 수출 결제통화 중 미국 달러화의 비중은 81.6%에 달하고 있고, EU 유로화가 7.6%, 일본 엔화가 4.7% 정도이다. 특히, 우리나라와의 무역규모가 매우 큰 중국과 일본의 경우에도 무역 결제가 대부분 미국 달러화로 이루어지고 있는데, 수출결제통화중 중국 위안화의 비중은 2008 년 현재 0.005% 정도의 아주 미미한 수준이고, 일본 엔화의 비중 또한 2008 년 현재 4.7% 정도에 머무르고 있다. 일본의 경우는 수출결제통화중 2008 년 현재 미국 달러화의 비중이 49.8% 정도인 반면 엔화 비중이 39.4%

<sup>6</sup> 외화와 함께 원화 유동성 비율 규제 또한 평잔기준이나 상시적으로 이루지도록 유인함으로써 월말 원화유동성 비율을 맞추기 위하여 외환시장에서 자금을 조달하는 과정에서 외환시장이 왜곡되는 경향 또한 사전에 방지할 필요가 있다. 한국은행은 금융안정보고서(제 12 호)에서 은행들이 원화 유동성비율을 맞추기가 어려워지자 선물환 매도(만기시 달러매도/원화매입) 거래 등 파생거래를 일시적으로 크게 늘려 원화유동성 비율을 제고하기도 하였다고 평가하였다.

<sup>7</sup> 이처럼 금융기관 등 경제주체들의 외화 유동성 및 건전성이 개선되면 상대적으로 우리나라의 필요 외환보유액이 줄어들 수 있을 것으로 기대된다.



정도에 달해 우리나라와 큰 차이를 보이고 있다. 우리나라의 수입결제통화 또한 비슷한 양상을 보이고 있어서 우리나라의 무역대금 결제관련 미국 달러화 의존도는 매우 높은 상황인 것이다.

Table 17. Settlement Currency for Korean Exports

(Unit: %)

	US Dollar	EU Euro	Japanese Yen	Korean Won	Chinese RMB	Other
2002	85.0	5.5	5.4	0.4	0.002	3.7
2003	83.6	6.5	5.6	0.4	0.002	3.9
2004	82.3	7.3	5.6	0.4	0.002	4.3
2005	79.1	8.4	5.6	0.5	0.003	6.4
2006	79.6	8.8	5.0	0.6	0.002	6.0
2007	77.2	9.6	4.8	0.7	0.003	7.7
2008	81.6	7.6	4.7	0.8	0.005	5.2

Source: Ministry of Knowledge and Economy

Table 18. Settlement Currency for Korean Imports

(Unit: %)

	US Dollar	EU Euro	Japanese Yen	Korean Won	Chinese RMB	Other
2002	78.2	5.4	13.2	1.4	0.002	1.8
2003	76.7	5.9	14.5	1.4	0.003	1.4
2004	77.2	5.5	14.6	1.4	0.003	1.2
2005	79.3	5.4	12.6	1.6	0.003	1.1
2006	80.9	5.2	11.2	1.7	0.004	1.0
2007	80.7	5.6	10.8	1.8	0.008	1.0
2008	82.0	5.8	9.7	1.6	0.011	0.8

Source: Ministry of Knowledge and Economy

그러므로 중국 및 일본 등 우리나라와 무역규모가 큰 역내 교역국들과의 무역대금 지급을 원화 또는 해당국 통화로 직접 결제함으로써 미국 달러화에 대한 의존도를 줄이는 것은 외환시장 안정에 도움이 될 것이다.

## V. 결론 및 시사점

2008 년 들어 우리나라의 경상수지 적자가 확대되는 가운데 미국 서브프라임 발 글로벌 금융시장 불안이 심화되며 국내 외환시장에서는 달러 유동성 경색 현상이 나타났다. 이로 인해 원/달러 환율이 급등하는 등 환율의 변동성이 큰 폭으로 확대되었다. 예를 들어 2008 년 1/4 분기까지 분기 평균 900 원대를 기록하던 원/달러 환율은

리먼 파산 이후 대내외적인 신용 및 유동성 경색에 대한 우려가 최고조에 달하였던 2008년 4/4 분기와 2009년 1/4 분기 중 평균 1,364.31 원, 1,418.30 원으로 상승하였다.

이번 글로벌 금융위기에서 비롯된 글로벌 유동성 경색현상으로 대부분 신흥시장국의 통화가 약세를 보였으나, 우리나라의 외환시장이 여타 국가들에 비해 매우 불안정한 모습을 보였다. 이러한 현상이 나타났던 직접적인 원인은 경상수지 적자 확대로 경제 펀더멘털이 약화된 가운데 높은 예대율이나 단기외채 비율 등으로 인하여 은행 등 금융기관, 나아가 우리나라 리스크가 상대적으로 크게 상승하였기 때문인 것으로 평가할 수 있다. 또한 이러한 우리나라 리스크 상승과 함께 안전자산 선호경향이 강화되며 대규모 외국인 투자자금이 유출되었고 이는 우리나라 외화수급 상황을 크게 악화시켰던 것으로 보인다.

물론 글로벌 금융위기라는 외적 충격은 국내 정책당국이나 국내 금융시장이 통제할 수 없는 부분이지만, 충격 발생시 여타 신흥시장국들보다 더 크게 불안정한 모습을 보인 데에는 외환위기 이후 지속적으로 급속히 변화되어온 우리나라 외환정책 등의 부작용에 일부 기인하였을 개연성이 높은 것으로 판단된다.

우리나라의 외환관리 정책의 방향은 대체로 외환위기 직후에는 자본시장 개방, 외환자유화 촉진 등 외화유입 중심이었으나 2006년 이후에는 과도한 원화강세 억제 등을 위해 외화유출 중심으로 전환되어 진행되어 왔다.

외환위기 직후에는 외환보유액 확대가 가장 큰 목표였던 우리나라는 외국인 투자자금 유치에 위하여 자본시장 완전개방 등 자본시장을 선진국 수준으로 개방하였다. 이와 함께 외국인 주식투자자금이 대규모로 유입되어 KOSPI 시가총액의 30~40% 정도를 외국인이 보유하게 되었음에도 불구하고 국제금융시장에서 원화 거래량은 선진국에 비해 매우 미미한 수준에 그침으로 외국인 투자자금 유출입에 외환시장이 크게 흔들릴 수 있는 리스크가 내재되어 있었던 것으로 판단된다.

특히 당시 지속적인 외국인 투자자금 유입으로 원화절상압력이 거세지며 경상수지 흑자폭 감소 등 환율이 거시경제에 미치는 부정적인 영향이 가시화되자 환율절상에 대응한 대규모 시장개입이 지속되었다. 그러나 무리한 시장개입은 외평기금 누적 적자 확대, 통안채 이자비용 상승에 따른 한국은행의 통화관리 어려움 등을 유발하였으며 이와 함께 당시 외환보유액 규모가 과다하다는 비판이 일각에서 제시되었다. 이로 인해 2006년 이후 외환당국은 시장개입보다는 해외부동산투자 규제완화와 해외주식투자 비과세 등 외화자금유출 정책을 적극적으로 시행함으로써 환율절상에 대응하게 된다.

그러나 해외주식투자 비과세 조치 등으로 확대된 해외주식투자의 대부분이 환헤지와 함께 이루어짐에 따라 원화약세에는 크게 기여하지 못한 반면 오히려 단기외채 증가의 주요 요인으로 작용하였다. 더욱이 해외증권투자 관련 선물환 헤지는 금융위기 이후 해외주가 급락과 함께 환율급등에 따른 환손실 우려 등으로 달러수요를 증가시켜 환율 상승폭의 확대 요인으로 작용하였던 것으로 평가되고 있다.

특히 외화유출촉진 정책 실행 당시 우리나라는 경상수지 흑자폭이 감소추세에 있었고, 비외채성 자금인 외국인 주식투자자금은 대거 유출되고 있었던 반면, 외화유입의 대부분은 외국인의 국내채권투자와 단기차입 등 외채성 자금이었음에도 내국인 자금이 비외채성 자금으로 유출되도록 유인하였던 것은 금융위기사 외화수급을 보다 타이트하게 만드는 원인이 된 것으로 평가된다.

최근 미국발 금융위기를 계기로 향후 위기재발과 외환시장 불안에 대비하여 외환보유액을 3,000억 달러 이상 수준으로 확충할 필요가 있다는 의견들이 나오고 있다. 적정 외환보유액을 통상적인 기준보다 보수적으로 접근하여 3개월치 상품수입액과

유동외채 전액, 그리고 외국인의 주식 및 채권투자의 일정부분을 합하여 계산할 경우 3,000 억 달러 이상이 필요할 것으로 추정된다. 이는 우리가 경험한 9 월 위기설, 3 월 위기설 등 급격한 자본유출 가능성을 우려한 금융·외환시장의 불안과 외화유동성 부족 상황들을 감안할 경우 어느 정도 설득력 있다.

그러나 적정 외환보유액을 논의하는 데 있어서는 다음과 같은 몇 가지 사항들이 고려되어야 한다. 첫째, 위기대응능력과 대외신인도 제고 등을 위해 외환보유액은 많을수록 좋겠지만 외환보유액 확대가 낳는 편익과 비용을 비교하여야 한다. 둘째, 특정 규모의 외환보유액 확충을 목표로 시장개입을 하는 외환정책은 환율의 방향성에 대한 투기적 거래를 유발시켜 오히려 시장불안 요인으로 작용할 수 있다. 외환보유액 확충은 투기적 거래로 인해 발생하는 급격한 환율변동을 막는 미조정(smoothing operation) 과정에서 이루어져야 한다.

바람직한 외환정책은 금융시장내의 불안정성으로 인하여 자본의 유출입이 확대되거나 환율이 불안정해지는 상황이 발생하지 않도록 유지하는 것을 목표로 하는 것이다. 그러므로 기축통화를 발행하지 못하는 우리나라가 외환보유액을 수단으로 시장에 직접 대응하는 것은 외환시장의 지속적인 안정이라는 목표를 달성하기도 어려울 뿐만 아니라 비용도 크기 때문에 바람직한 방향이 아닌 것으로 판단되며 이보다는 다음과 같은 대책들을 지속적으로 강구해 나갈 필요가 있을 것으로 판단된다.

경상수지 흑자 유지 등 실물경제의 펀더멘탈을 튼튼히 함과 동시에 국내 금융시장이 건전하게 유지되도록 노력할 필요가 있다. 특히 우리나라도 위기 이전부터 자산가격 버블에 대한 우려가 지속되고 있으며, 위기극복을 위한 재정지출로 향후 재정건전성 악화에 대한 우려도 부각되고 있는 상황이다. 또한 가계나 중소기업 등에 대한 과잉 대출 및 이에 따른 부실확대 우려 등도 지속적으로 제기되어왔다. 그러므로 향후 우리나라도 최근 국제적으로 논의되고 있는 금융규제 강화 방안 등을 참고하여 금융규제 및 감독 등을 재정비하는 한편 재정 건전성이나 적정 유동성 규모 유지를 위한 통화 및 재정정책 방향 정비 등을 통하여 금융시장을 보다 안정적으로 유지할 필요할 있다. 한편 이러한 실물 및 국내 금융시장 안정에도 불구하고 이번 금융위기처럼 외부로부터 발생하는 충격에 대응하기 위하여 외화유동성 측면에서 통화스왑 확대 등 국제공조를 강화하는 것이 가장 바람직하다. 또한 현재 외화수급 상황을 기초로 시장개방과 자유화 기조에 역행되지 않는 범위 내에서 해외증권투자, 해외부동산투자 등 외화유출과 관련된 외환자유화 조치를 재검토하고 인센티브 또는 관세 부여 등으로 장기투자자금 유입을 촉진하고 단기투기자본 유출입을 억제할 필요가 있다. 한편 외환시장의 잠재적 불안 요인으로 매번 언급되는 외채 관리를 위해, 금융기관들의 실수요가 아닌 외형확대 경쟁 등에서 발생하는 단기외채는 외화 건전성 감독 차원에서 규제할 필요가 있다. 마지막으로 대외적으로는 원화의 국제화를 추구하는 한편 중국 및 일본 등 우리나라와 무역규모가 큰 역내 교역국들과의 무역대금지급을 원화 또는 해당국 통화로 직접 결제함으로써 미 달러화에 대한 의존도를 줄일 필요가 있다.

## <부록> 외환위기 이후 외환관리 정책 주요 내용

### 1. 자본시장 개방

- 외국인에 대한 채권시장 전면 개방('97.12 월)
  - 1 인당 채권투자한도 및 외국인 전용수익증권 발행한도 등 폐지
- 외국인 유가증권 투자허용 범위 확대('98.5 월)
  - 거래소 시장 : 외국인의 상장주식투자한도 폐지 및 외국인에 대한 신용공여 제한 폐지
  - 코스닥 시장 : 외국인의 협회등록주식 취득한도 확대(전체한도 15%→55%, 1 인한도 5%→50%)('98.4 월), 협회 등록 주식시장 완전 개방(전체 및 1 인 한도 폐지)
  - 채권시장 : RP 거래 및 상장채권의 장외거래 허용
  - 주가지수선물·옵션시장 : 주가지수선물·옵션시장 투자한도 폐지
  - 외국인에 대한 국내 유가증권시장 완전 개방('98.7 월)
    - 비상장주식·채권, 출자증권, 신탁회사발행 수익증권, 외국법인발행 DR 이외 유가증권의 투자허용
- 외국기업의 국내채권 발행에 대한 규제 완화('03.1 월)
  - 외국기업이 국내에서 원화표시채권을 발행하는 경우 국제적으로 인정되는 회계기준(IAS 및 US GAAP)에 따라 재무제표를 작성·제출한 때에는 우리나라 회계처리기준과의 차이 및 그 영향을 설명하는 추가정보(비교 요약재무제표 등)의 제출의무를 면제

### 2. 외환자유화

- 2 차례에 걸친 외환자유화 계획의 추진으로 금융기관·기업 등의 대외 경제활동과 관련된 대부분 규제가 폐지
- 제 1 차 외환자유화 계획( '98 ~ ' 01)
  - 여행경비 한도폐지 등 경상지급에 대한 규제를 완전 자유화하고, 자본 거래도 '원칙자유·예외규제(Negative System)' 으로 개편
- 제 2 차 외환자유화 계획( '02 ~ ' 09)
  - 거래 규제를 단계적으로 자유화하여 당초 2011 년으로 되어 있던 자유화 일정을 2 년 앞당겨 2009 년까지 완료로 수정
  - 3 단계에 걸쳐 단계적으로 추진하되 자본거래의 신고제 전환 등 자본 거래 자유화에 중점
  - 원화의 국제화, 해외부동산 취득 등 내국인의 외환거래 자유화, 금융기관의 외환업무취급자유화 등이 주요내용

Table 19. Forex Liberalization Policy

Category	Phase 1 (2002-2005)	Phase 2 (2006~2007)	Phase 3 (2008~2009)
Trade	. Simplifying methods of settlement i.e. allowing multi-netting	. Exempting debt recovery obligation: licensing → reporting system	. Abolishing debt recovery obligation (regulation through safeguards)
Non-Trade Payments	. Abolishing Confirmation System for Large Individual Overseas Payments	-	-
Capital Transactions	. Relaxed licensing and reporting systems (i.e., expanded limits for won funding by non-residents)	. Licensing system → reporting (repair) system	Abolishing reporting system (maintained for non-resident won funding etc.)
Secondary Markets	. Expansion of FX business scope (i.e. allowing participation in intra-bank market)	. Liberalization of FX business (excepting remittance)	-
Overseas Investment		. Liberalization of overseas real estate ownership	-
Won- Denom. Exports	. Export limits raised	. Licensing → reporting system	. Limits on won-denominated exports to be abolished

### 가. 참여정부 이후 외환자유화 조치

- 외국환 거래규정 개정('05.12 월)
  - 자본거래 허가제 폐지 : 전면 신고제로 전환
    - 외국환은행의 외화차입 규제 완화 : 신속한 의사결정이 필요한 외화차입의 경우 사후에 신고할 수 있도록 규제 완화
    - 자산운용사의 외화표시 간접투자증권 발행 허용 : 외화표시 간접투자증권의 발행 및 모집을 허용
    - 실수요 목적의 해외 부동산 취득제도 보완 : 한국은행의 내부 심사기준을 개정하여 해외거주요건을 완화
- 해외투자 촉진방안('06.1 월)
  - 해외직접투자의 완전 자유화 : 해외직접투자한도의 300 만달러→1,000 만달러로 확대(즉시 시행) 및 연내 폐지
  - 거주자의 주거용 해외부동산 취득 자유화 : 취득한도의 50 만달러→100 만달러로 확대(즉시 시행) 및 연내 폐지
- 외환거래 규제완화 방안('06.3 월)
  - 해외직접투자의 규제완화 : 개인의 해외직접투자한도 폐지
  - 거주자의 주거용 해외부동산 취득 자유화 : 한도제한 폐지
    - 해외 포트폴리오 투자 활성화 : 개인의 외국증권 투자대상 제한 폐지 및 국내펀드의 해외펀드 투자제한 완화
    - 대외채권 회수의무제도의 완화 : 의무면제금액의 상향조정(건당 10 만달러→50 만달러)
    - 해외예금 등 국세청 통보제도 완화 : 해외예금 통보금액을 연간 1 만달러→50 만달러로 상향조정
    - 외환시장 심화를 위한 외국환포지션 한도 확대 : 전월말 자기자본의 20%→30%로 상향조정
- 외환자유화 계획 조기추진('06.5 월)
  - 당초 '11 년 완료였으나, '09 년까지 2 단계(1 단계 : '06 년~'07 년, 2 단계 : '08 년~'09 년)에 걸쳐 완료
  - 투자목적 해외부동산 취득 허용(한도 100 만달러)
- 기업의 대외진출 및 해외투자 확대 방안('07.1 월)
  - 금융기관 등의 해외진출 확대를 위한 절차 및 신고수리 기준 완화
    - 해외 포트폴리오 투자 활성화 방안 : 해외주식투자에서 발생한 양도차익 분배금에 대해 한시적(3 년)으로 비과세, 해외자산운용사의 펀드판매에 대한 규제완화, 해외증권 취득관련 기관 투자가 범위확대 등
  - 투자목적 부동산 취득한도 상향조정(100→300 만달러) 및 절차규제 완화
- 시장친화적 외환거래시스템 구축을 위한 외환제도 개선방안('07.12 월)
  - 1 단계 외환자유화 계획의 차질없는 완료
    - 금액기준 자본거래 신고면제 제도 도입(연간 5 만달러 한도) 및 외환거래 증빙서류 제출의 완화

### 나. 이명박정부 이후 외화관련 조치

- 외환거래 편의제고를 위한 외국환거래규정 개정('08.5 월)
  - 투자목적 해외부동산 취득한도 폐지(현행 3 백만달러를 초과하면 한국은행에 신고수리)
  - 기업의 해외 자금통합관리한도를 1 천만달러→3 천만달러로 확대
    - 국내에 거주하는 외국인의 신용카드 사용을 1 회 1 만달러→5 만달러로 확대

## 3. 금융허브 추진

- 동북아 금융허브 추진 전략('03.12 월)
  - 금융허브 달성을 위한 7 대 추진과제 수립
    - 추진전략 중 금융시장 선진화 방안의 일환으로 실질적인 외환규제 완화, 외환거래의 연속성 확보 등을 실시
      - 투자목적의 건전한 외화유출을 최대한 허용하며 정부는 환율, 외환보유액 등 거시적 사항의 관리에 집중하는 대신 환위험 및 외환 건전성은 기업, 금융기관 등에서 자율관리토록 유도
        - \* 외국환은행에 대한 레드 테이프 폐지 또는 완화, 대기업의 무역대금 결제 등 지속, 반복적인 외환거래에 대한 절차적 제한을 전면 폐지, 전면 Negative 시스템으로 외국환거래법령 체계 개편
          - 외환시장 개폐장 시간 확대, 외환 중개시장 참여 폭 확대, 증권사 단기 외화자금시장 참여로 외환거래의 효율성 제고
      - 또한 한국투자공사를 설립하여 외환보유액 중 일부 등 국가여유자금 운용을 통한 수익성 제고, 국내 자산운용업 활성화 등을 유인
- 동북아금융허브 추진을 위한 금융규제 완화('05.4 월)
  - 국내금융기관(은행, 증권, 보험 등)의 해외진출 규제 완화

## References

- Bank of Korea, 'Financial Stability Report', No. 12, November 2008.
- KCIF, "Won Hedging by Overseas Investment Funds: Impact and Improvement Scheme", January 2008.
- KIF, "Impact and Policy Implications of the Tax Exemption for Overseas Funds", May 2007.
- KIF, "Won/Dollar Exchange Rate: Causes behind Recent Surge and Outlook ahead", mimeo, April 2008.
- KIF, "Managing Sharp Swings in Capital Flows", mimeo, April 2009.
- Korea Center for International Finance (KCIF), "Recent Tasks and Trends in Korean Overseas Fund Investment, January 2007.
- Ministry of Strategy and Finance (MOSF), "Forex Liberalization," February 1999.
- MOSF, "Second Phase of Forex Liberalization: Implementation and Support Measures", Press Release, October 2010.
- MOSF, "Mid- and Long-Term Development of the Forex Market in Korea", April 2002.
- MOSF, "Plan for Advancing the Forex System", June 2002.
- MOSF, "Northeast Asian Financial Hub Strategy", December 2003.
- MOSF, "Regulatory Easing to Become a Northeast Asian Financial Hub", April 2005.
- MOSF, "Revision of 'Foreign Exchange Transactions Act' etc.", December 2005.
- MOSF, "Conference on Exchange Rate Policy Measures, and Scheme for Promoting Overseas Investment", January 2006.
- MOSF, "Easing Regulations on Forex Trading", February 2006.
- MOSF, "Instituting Forex Liberalization", May 2006.
- MOSF, "Policy Scheme for Expanding Overseas Investment and Corporate Presence", January 2007.
- MOSF, "Revision of 'Foreign Exchange Transactions Act' to Facilitate Forex Trading", Press Release, May 2008.



## Comments on " A Reevaluation of Foreign Exchange Policy and Future Policy Direction"

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### 1. Overview of the paper

As the title of the paper suggests, this paper overviews Korea's foreign exchange market development and related policies. In this respect, the paper is informative for those readers who are layman in this area. However, my impression is that the paper touches upon too many issues and not enough depth in any one particular area.

The paper is organized in two parts. The first part briefly documents Korea's foreign exchange market development since the currency crisis. Most discussion in this part is factual, which can hardly invite any dissention. The second part, however, proposes future policy directions, which can potentially be controversial. Basically motivated by the fact that the Korea's currency value was depreciated more than other currencies during the recent global financial crisis, the authors argue for the following policy directions: (i) Increase currency reserves to over US\$300 billion; (ii) Seek alternative emergency measures for foreign currency liquidity such as currency swap; (iii) Maintain strong economic fundamentals such as current account surplus; (iv) Re-examine the capital account liberalization policy particularly for capital outflow; (v) Encourage long-term capital inflow and suppress short-term capital flow; (vi) Regulate the short-term foreign debt that is increased in the process of size competition by financial institutions; and (vii) Reduce the reliance on the US dollar by directly paying in local currencies for intra-regional trades with, for example, China and Japan. Among these policy suggestions, I agree with some, disagree with others, and would like to hear more elaboration for the rest.

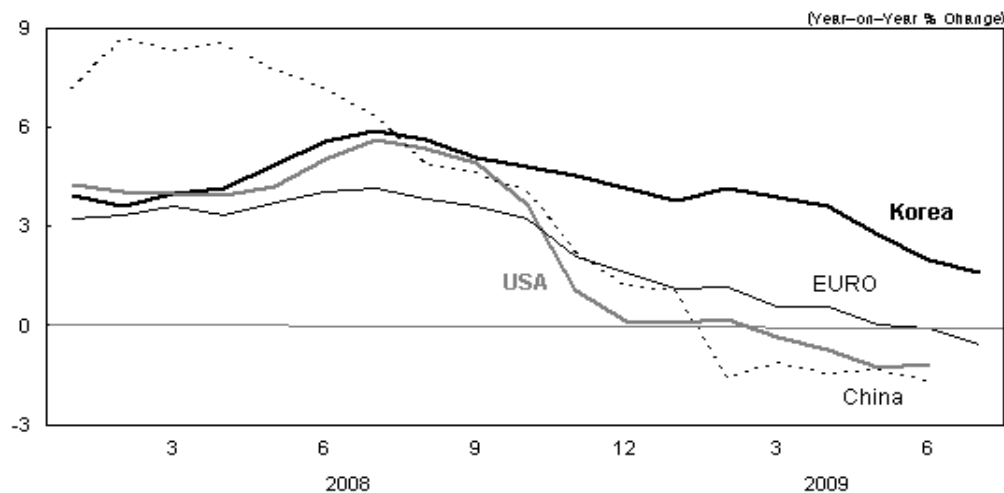
### 2. Policy Goal

First, let me begin with a very basic and fundamental question: how important is it to stabilize the exchange rate itself? This question is extremely important, because all of the policy suggestions in the paper aim at this goal. The authors explicitly write, "Desirable exchange policies must have FX market stability, that is, rate stability, as the goal." (Abstract) In general, it is probably better than not, to have a stable economic environment including price variables such as exchange rates. However, what about the case when the economy is hit by an unexpected shock? Recall that the whole macroeconomics about short-run fluctuations hinges upon the assumption about "price stickiness" of some sort. That is, most economists seem to believe that the real sector of the economy fluctuates more with "sticky" prices than with "flexibly responsive" prices to shocks. We know, for example, that one of the most important causes of the Great Depression was the too rigid (or too "stable"?) exchange rate between gold and money.

It is a fact that the Korean won was severely depreciated with respect to the recent global shock triggered by the Lehman Brothers bankruptcy. But it is never clear how harmful this depreciation was for the Korea's macroeconomic stability. We heard many unhappy stories like the KIKO scandal that would not have taken place if the exchange rate had been stable. However, we also heard that the currency depreciation was one of the most important reasons for the relatively rapid recovery of the Korean economy in the swirl of the global crisis. Though not often mentioned, it is also definitely true that the currency

depreciation guarded the Korean economy from the external shock of deflation. While most developed countries are still striving to fight deflation, the Korean economy is almost free from such apprehension. Considering all of these aspects, I am not sure how harmful the exchange rate fluctuation with respect to the unstable global environment was for the Korea's macroeconomic stability. Tossing a coin, I would bet on the side that the Korean economy would have suffered more from the global depression pressures if the exchange rate had been "too stable."

Figure 15. Inflation Trends of Selected Countries



Then what was the problem? I think it was the abrupt capital flow itself, rather than the responded exchange rate fluctuation. Clearly, a sudden withdrawal of capital creates financial market instability, which would probably disturb real sectors as well, although the internal price mechanism such as currency depreciation would dampen real sector fluctuations. An extreme case of this situation may be financial market panic on the country's capacity for foreign currency settlement, a trauma of the Korean economy from the Asian crisis period. This perception of the problem suggests a different perspective about the policy goal from the authors' --- foreign exchange policy should aim more on a broader sense of financial market stability rather than exchange rate stability itself.

### 3. Policy Suggestions

#### (1) Foreign Exchange Reserve

Even from the financial market perspective, there is no doubt that foreign exchange reserve is necessary to protect the market from a panic, just as deposit insurance is needed to keep the market from bank-runs. Controversy, however, is always about its size. As the authors properly point out, cost and benefit should be compared to grope for the "optimal" size of reserves. To be honest, however, I am skeptical about practically convincing estimation of "optimal" size. The paper's estimation of "US\$350 billion" was not based on explicit analysis of cost and benefit either.

A rule-of-thumb guideline is provided by the IMF, which categorizes a country with short-term foreign debt (liquid foreign debt) less than 60 percent (100 percent) of foreign

exchange reserve as a "stable" country. According to this guideline, Korea's foreign exchange reserve was not sufficient from sometime in 2006 as a result of rapid increase of short-term foreign debt. In order to regain the position of a "stable" country given US\$150 billion of short-term debt at the end of 2008, Korea needs "over US\$250 billion," far smaller than the paper's estimate.

Figure 16. Short-term Foreign Debts relative to Foreign Reserve



Although no one could pin down an "optimal size" of reserves, it seems true that Korea needed to either expand reserves since 2007 given the explosive increase of short-term foreign debt, or reduce incentives for the accumulation of short-term foreign debt. Looking forward as well, it seems desirable to connect the reserve policy with the short-term foreign debt accumulation, as far as the purpose of reserve is to protect the country from the default risk. However, I do not understand why one has to care so much about portfolio investment, most of which are local currency denominated unlike foreign debt. Unless one believes that the government should protect foreign investors from the exchange rate risk, there seems to be no compelling reason to take into account portfolio investment in estimating "necessary" reserves.

## (2) Financial Supervision

Another dimension of foreign currency liquidity discussion is the allocation of responsibility between the public and private sectors. Basically, the financial liberalization process is the transfer of both freedom and responsibility from the public to private sectors. Therefore, as the financial market becomes liberalized, private sectors should be more responsible for their own foreign currency transactions rather than relying on government's reserves (or taxpayers' money).

Financial supervision of the government to reduce moral hazard of private sectors is very important in this regard. During the recent foreign exchange crunch period, for example, Korean banks faced with abrupt withdrawal of short-term foreign debt could not appropriately countermove by acquiring foreign currency liquidity even though their short-term foreign asset sizes were reported to exceed those of their short-term foreign

liabilities. This phenomenon clearly suggests that the supervision process for foreign currency liquidity needs to be improved.

As the paper suggests, it seems necessary to change the supervisory criterion of financial institutions' foreign currency positions from the end-of-month balance to the monthly average balance. In addition, it seems desirable to explicitly recognize different liquidities of foreign assets by assigning differentiated weights according to the liquidity. For example, short-term trade credit, a substantial portion of Korean banks' short-term foreign assets, should be given a very low weight if it is difficult to sell off during a crisis period. Using this line of supervisory policies, the government can indirectly induce private sectors to either hold more liquid foreign assets, or reduce short-term foreign debts. The more foreign currency liquidity is held by private sectors, the less government reserves will be needed.

### **(3) Sound Fundamentals**

I was very pleased that the authors mentioned economic fundamentals. I truly agree that maintaining sound economic fundamentals is the ultimate key for foreign exchange market stability. However, I was disappointed to find that the "sound economic fundamentals" that authors had in mind was the maintenance of current account surplus.

I do not want to give any value judgment on current account surplus or deficit. Current account can be in surplus or in deficit as a result of market's optimal responses to various economic situations. Unless too wide surplus or deficit continues for a substantial period of time, I do not think that the current account fluctuation is problematic. More importantly, current account itself is not a policy measure, and the paper does not provide any clue to policy-makers about what to do even though they agree that maintaining current account surplus is desirable.

"Sound economic fundamentals" I have in mind are financial market soundness regarding debt leverages, asset price bubbles, government debt, and so on. Having these variables in mind, we can probably think about financial regulations, monetary or fiscal policies. Perhaps, the discussion on these policies has remote implications about current account, because current account deficit is usually the result of over-stretched financial market that blows domestic demand over domestic production. Nevertheless, setting current account surplus itself as a policy target is likely to mis-guide policy directions.

### **(4) Re-examination of capital outflow liberalization policies**

The authors seem to feel uncomfortable with the capital outflow liberalization policies that the Korean government has pursued. However, isn't the portfolio diversification one of the most important benefits of capital account liberalization? If Korea keeps maintaining current account surplus as the authors hope for, but at the same time if capital outflow is suppressed, how can Korea manage extra foreign assets? Should Korea keep accumulating foreign exchange reserves? What about internationalization of the Korean won that the authors hope for in the long run? Suppression of capital outflow is compatible with this policy direction?

Probably the authors are worried about the possibility that capital outflow of domestic agents can deepen the crisis through capital flight. At least during the recent crisis, however, that did not happen. During October 2008, the month of most severe foreign exchange crunch, saw foreigners withdrawing US\$ 8 billion from their portfolio investment in Korea, while Koreans withdrawing US\$ 13 billion from their portfolio investment abroad. Having foreign assets helped, rather than hurt, stabilizing Korea's foreign exchange market during the global financial crisis.

Of course, as the capital account becomes more liberalized, maintaining sound economic fundamentals becomes more critical. Monetary, fiscal and financial policies should be more effectively aligned for this goal not to lose investors' confidence on the Korean economy.

#### **(5) Other Policy Suggestions**

The paper also proposes other policy suggestions. However, many of those do not seem to be concrete enough to actually implement. For example, the paper writes, "it is necessary to regulate short-term foreign debts that are not based on real demand but on size-competition" in the conclusion, but does not provide any guidance on how to identify short-term foreign debts based on real demand from those based on size-competition. These policy suggestions could have been far more productive if the ideas had been more elaborated.

## 자본시장의 글로벌화와 한국 통화정책의 독립성\*

김소영†     신관호††

### Abstract

This paper empirically examines whether Korean monetary policy is independent of U.S. monetary policy during the post-crisis period in which capital account is liberalized and floating exchange rate regime is adopted and during the pre-crisis period in which capital mobility is restricted and tightly managed exchange rate regime is adopted. Before capital account liberalization, monetary autonomy can be achieved in view of the trilemma, even under tightly managed exchange rate regime, as capital mobility is restricted. On the other hand, for the period after capital account liberalization, monetary autonomy can be also achieved in view of the trilemma, as exchange rate stability is given up. Securing monetary autonomy, however, may not be easy under liberalized capital account for a small open economy like Korea. Huge capital movements can generate excessive instability in foreign exchange and asset markets. Strengthened international economic linkages may also be another factor to prevent monetary policy from being independent. Using block-exogenous structural VAR model, the effects of U.S. monetary policy shocks on Korean economy are examined. Empirical results show that Korean monetary policy is not independent of U.S. monetary policy for both periods before and after capital account liberalization. For the period after capital account liberalization, Korea does not seem to have implemented floating exchange rate policy in practice, which may lead Korean monetary policy to be dependent on U.S. monetary policy. For the period after capital account liberalization, portfolio flows respond dramatically to the U.S. monetary policy, which may also keep Korean monetary policy from being independent.

**Keywords:** Capital Market Globalization, Monetary Policy Autonomy, VAR, Exchange Rate Regime, Monetary Policy Shocks

**JEL Classification:** E52, F42, F31, F32

## I. 서론

1990년대 이래 자본시장의 글로벌화는 급격히 진행되었다. 특히 한국을 비롯한 아시아의 신흥시장국가들은 1990년대 이래 자본시장의 대외적 개방을 꾸준히 진척시켜 왔고 이에 따라 해외자본이 급속하게 유입되었다. 1997년 외환위기는 이러한 과정에서 겪었던 커다란 시련이었다. 자본시장의 개방 과정에서 외환위기를 겪었음에도 불구하고 정책당국자는 외환위기 이후 자본시장을 보다 전면적으로 개방하는 선택을 하였다. 그 이유는 외환 위기 이후 진행된 IMF 프로그램의 영향도 있었지만 자본시장의 개방에 의한 편익이 비용을 능가한다고 판단하였기 때문이라고 생각된다. 현재 자본시장은 대외적으로 거의 완전한 개방에 이른 상태이다.

1997년 외환위기를 겪으면서 환율정책과 통화정책에도 심대한 변화가 있었다.<sup>1</sup> 무리한 환율방어가 외환위기의 원인 중 하나였다는 반성의 결과로 환율정책은 적어도 공식적으로는 완전한 변동환율제를 표방하였다. 또한 통화정책과 금융감독 및 안정정책을 분리하여 한국은행은 금융감독 기능을 상실하였고 한국은행의 정책목표로 물가안정만을 명시하였다. 이러한 변화는 자연스럽게 통화정책이 물가 안정 목표제(inflation targeting)로 전환하는 계기가 되었다.

환율정책과 통화정책의 변화는 자본시장의 개방과 밀접한 관련이 있다. 자본시장이 완전히 개방된 경우, 환율안정과 통화정책의 독립성(independence)을 동시에 추구하기는 어렵기 때문이다. 즉 자본을 통제하지 않는 한 환율을 안정시키기 위해서는 통화정책을 사용할 수밖에 없는데, 이와 같이 환율통제를 위해 통화정책을 활용하게 되면 외부로부터 독립하여 국내경제 상황에 대응한 독자적인 통화정책을 집행할 여력이 없게 되는 것이다. 이러한 문제는 개방경제가 직면한 “트릴레마(trilemma)”라고 불리며 Mundell 이 지적한 이래 많은 연구자들에 의해 지지되고 있다. 즉 (1) 자본시장의 개방 (2) 환율 안정성 (3) 독자적인 통화정책의 세 가지 조건은 동시에 만족될 수 없으며 적어도 한 가지는 희생될 수밖에 없다는 것이다. 한국경제의 경우 자본시장은 이미 거의 완전하게 개방되었으므로 자본개방을 되돌리는 선택을 하기는 어렵다. 따라서 환율안정성과 독자적인 통화정책 사이에 양자택일을 하여야 한다. 이러한 선택의 문제에 봉착한 한국경제는 대다수의 신흥시장국가들과 마찬가지로 인플레이션 타겟팅을 채택하여 독자적인 통화정책을 추구하면서 환율제도는 변동환율제를 채택하고 있다. 변동환율제는 환율의 결정이 시장에 의해 이루어지도록 하는 제도로서 통화당국이 환율시장에 개입하지 않은 것을 원칙으로 한다. 결국 자본이동을 비롯한 외부충격을 환율의 자유로운 움직임에 의해 해결함으로써 통화정책은 국내문제에 전념할 수 있게 하는 것이다.

하지만 트릴레마에 대한 해석에는 이견도 존재한다. 삼위일체 불가능성은 세 가지 극단적인 경우가 동시에 성립할 수 없음을 의미한다. 하지만 극단적인 선택을 하지 않는다면 여러 가지의 혼합된 선택도 가능할 수 있을지 모른다. 예를 들어 완전히 독자적인 통화정책을 추구하지 않는다면 자본시장이 완전히 개방되어 있다고 하더라도 어느 정도 외환시장에 개입하여 환율을 통제하려는 시도를 할 수 있을지도 모른다. 또한 자본시장을 어느 정도 불완전하게 개방한다면 독자적인 통화정책을 추구하면서도 외환시장에 어느 정도 개입할 수 있을지도 모른다. 이러한 견해를 가진 대표적인 경제학자로는 Frankel 을 들 수 있다.

사실 변동환율제를 통해 독자적 통화정책을 집행할 수 있다는 견해는 자본의 이동에 의해 생기는 문제점을 환율의 변동을 통해 완전히 해결할 수 있다고 볼 때에 가능하다. 하지만 대부분의 소규모 개방 경제 국가들의 경우 자본이동이 급격하게 혹은

<sup>1</sup> 외환위기 이후 한국의 통화 및 환율정책에 대한 평가는 신관호(2007)을 참조하라.

지속적으로 이루어지는 경우 이를 환율변화에 의해 전적으로 대응하기 어려울 수 있다. 예를 들어 자본이 지속적으로 유입되는 경우 국내유동성이 증가하게 되어 자산 시장이 활황이 되기 쉽다. 이에 대해 통화정책이 적절하게 대응할 필요성이 생긴다. 또한 자본유입에 따라 환율은 절상압력을 받게 되는데, 이를 용인하는 경우 경상수지의 악화를 초래할 수밖에 없다. 경상수지의 악화는 대외부채를 증가시키는데, 대외부채가 적정 수준을 넘어서게 되면 국가부도의 위험이 커질 수밖에 없고, 이러한 위험이 부각되기 시작하면 자본유입이 갑자기 중단되면서 위기가 시작되기도 한다.<sup>2</sup> 따라서 상당 수 국가들은 자본유입에 따라 환율이 지나치게 절상되는 경우에 이에 개입하기도 하는데 그 과정에서 통화정책의 독립성이 훼손될 수 있다.

특히 최근 글로벌 금융위기의 한 원인으로서는 미국의 지속적인 저금리 정책을 지적하는 견해가 있다. 이러한 견해에 따르면 미국의 확장적 통화정책이 타국에 전파되어 타국의 통화정책도 확장적으로 운용되게 함으로써 전세계적인 유동성이 팽창되는 과정이 금융 위기의 전초 단계를 마련하였다고 한다. 결국 자본의 글로벌화가 진전됨에 따라 각국의 통화정책이 완전히 독립적으로 운용되기 어려워졌다는 것이다.

한국의 경우 외환위기 전에 비하여 대외자본개방은 보다 확대되었고 환율의 변동성도 증가하였다. 전자는 통화정책의 독립성을 저해하지만 후자는 통화정책의 독립성 확보에 도움이 된다. 본 연구는 이러한 한국의 정책적 변화와 관련하여 외환위기 이후 한국 통화정책의 독립성에 어떠한 변화가 있었는지 분석하고자 한다.

한국의 통화정책이 외부의 모든 충격에 대해 독립적으로 행해졌는지는 실증분석하는 것은 현실적으로 매우 어려운 일이다. 왜냐하면 외부의 충격은 매우 다양하여 이를 일일이 식별하여 이에 대해 한국의 통화정책이 독립적인지를 검증하는 것은 무리이기 때문이다. 따라서 본 연구에서는 외부로부터의 충격을 미국의 통화 정책 충격에 국한하여 한국의 통화 정책이 미국 통화 정책으로부터 독립적으로 수행되었는가를 실증분석하였다. 이러한 분석이 의의를 가지는 이유는 이미 지적한 바와 같이 최근 미국의 통화정책이 타국에 영향을 미쳐 전세계적인 유동성 증가를 초래했다는 주장이 제기되고 있기 때문이다. 따라서 한국의 통화정책이 미국의 통화정책으로부터 독립적이었는지를 분석하는 것은 최근의 한국통화정책을 이해하는데 중요한 의미를 갖는다. 이를 위해 본 논문은 미국의 외생적인 통화정책 충격을 식별하고(identify), 이에 대하여 한국통화정책이 어떻게 반응하였는지 분석한다. 예를 들어 미국의 정책 금리가 외생적으로 상승한 후 한국의 정책 금리도 상승하는지 아니면 반응하지 않는지를 실증 분석 한다. 이를 통해 한국의 통화 정책의 독립성에 대해 추론하려고 한다.

본 논문의 구성은 다음과 같다. 2 절에서는 대외자본개방이 거시경제 전반에 미치는 효과에 현황 중심으로 살펴 보고 이에 대한 정책적 대응의 어려움을 설명한다. 3 절에서는 실제로 외환위기 이후 한국 통화정책의 독립성에 어떠한 변화가 있었는지 실증 분석한다. 4 절은 본 논문의 결론이다.

<sup>2</sup> 또한 최근의 글로벌 금융위기와 관련하여 주목되고 있는 사실은 자본유출이 해당국가의 문제에서 발생하기도 하지만 글로벌요인에 의해서도 발생한다는 사실이다. 즉 1997 년의 외환위기는 한국의 경제기초가 악화된 것이 어느 정도 관련을 가지며 발생하였지만 2008 년에 촉발된 한국의 외환위기는 한국의 경제기초와 관련 없이 글로벌 요인에 의해 발생한 것이다. 사실 한국의 경우는 1997 년 외환위기 이후 많은 노력을 통해 제도적인 정비를 하였고 보다 철저한 자본개방을 시도하였다. 그럼에도 불구하고 발생한 최근의 위기는 오히려 자본개방이 너무 진행되어 글로벌 자본시장과 보다 밀접한 관계를 가진 결과 발생했다고 볼 수 있다.



## II. 해외자본유입에 대한 정책대응

### 1. 최근 현황

1990년대 이래 아시아 지역에는 두 번에 걸쳐 큰 규모의 자본유입이 있었다. 한국에 대한 자본유입도 아시아 지역 전체와 같은 양상을 보인다. <Figure 1>은 한국에 대한 자본의 유입과 유출을 나타낸 것이다. 그림에서 자산은 외국자산 즉 자본유출을 나타내며 부채는 외국에 대한 국내부채, 즉 자본유입을 나타낸다. 1990년대 중반에 첫 번째 최고점에 달했던 자본유입은 1997년 외환위기를 겪으면서 급속하게 줄어 들었다. 하지만 2003년부터 다시 대규모 2차 유입이 시작되어 줄곧 가파르게 늘어나 1차 유입 때보다 더 큰 규모의 자본유입이 2007년까지 지속되었다.<sup>3</sup> 특히 2002년 이후는 자본유입이 자본유출을 초과하여 자본의 순유입이 지속되었다.

이와 같이 큰 규모의 자본 순유입이 한국과 같은 아시아의 신흥시장국가에 이루어진 이유는 이들 국가에 투자할 기회가 늘어난 측면도 있지만 미국을 비롯한 선진국에서 2002년 이래 저금리정책을 지속적으로 유지하였기 때문이다. <Figure 2>는 미국의 정책금리를 나타낸 것이다. 그림에서 알 수 있듯이 미국의 정책금리는 정보통신 분야의 거품이 붕괴된 직후인 2002년 초부터 3여 년간에 걸쳐 1%대의 낮은 수준을 유지하였다. 그림에는 표시하지 않았지만 5년 만기 국채이자율은 대략 비슷한 방향으로 변화하여 한때 2%대까지 하락하였다. 영국을 비롯한 다른 선진국에서도 비슷한 양상을 보였으며 이에 따라 선진국에서의 높은 투자수익률을 기대하기 어렵게 되자 보다 높은 수익률을 쫓아 신흥시장국가들로 자본이 이동하기 시작한 것이다.

이렇게 늘어난 자본유입은 한국 환율의 지속적인 절상을 초래했을 뿐 아니라 주식시장과 부동산 시장에서의 자산가격 폭등으로 이어졌다.<sup>4</sup> 환율은 1997년 외환위기 때 급속히 상승하여 1998년 후반기에 안정화되었지만 2001년까지 상승과 하락을 반복하였다. 하지만 2002년 초부터는 추세적으로 하락하여 최근 금융위기 직전까지 지속적으로 절상되었다. 환율에 영향을 주는 요인들은 다양하지만 환율이 절상하기 시작한 시점은 미국의 금리가 하락하고 자본의 유입이 본격화된 시점과 정확히 일치한다.

환율의 절상 움직임에 대응하여 정책당국은 꾸준히 개입하여 외환보유고를 증가시켜 왔던 것으로 보인다. <Figure 3>은 한국이 보유한 외환보유고를 나타낸다. 외환보유고는 외환위기 직전에 거의 바닥이 보일 수준으로 하락하였다가 그 후 꾸준히 증가하였다. 외환보유고의 증가속도는 2001년 들어서 약간 주춤하였으나, 2002년 중반부터는 다시 매우 빨라졌으며 최근 위기를 겪으면서 음수로 전환하였다. 외환시장에 개입하는 경우 한국은 불태화(sterilization)정책을 원칙으로 하므로 통화량에 영향을 주지 않아야 한다. 하지만 현실적으로 외환보유고의 증가는 통화량의 증가를 초래하기 쉽다. 왜냐하면 외환개입시 늘어난 통화량을 채권발행을 통해 당장은 흡수하더라도 추후에 필요한 만큼 채권발행이 이루어지지 않는다면 장기적으로는 불태화정책이 반드시 성립한다고 볼 수 없기 때문이다. 실제로 외환개입이 통화량 증가에 얼마나 공

<sup>3</sup> 이러한 추세는 2007년까지 지속되며 그림에는 나타나지 않았지만 2008년 글로벌 금융위기를 겪으면서 다시 급속하게 감소하였다.

<sup>4</sup> Kim and Yang (2009)는 외환 위기 이후 자본 유입이 한국의 자산 시장에 미치는 영향을 실증적으로 분석하고, 자본 유입 충격이 한국의 주식 시장에 유의한 영향을 미치는 것으로 보고하고 있다.

힌했는지는 엄격한 분석을 통해 살펴 보아야 할 것이다. 단지 <Figure 3>에서는 한국의 M2는 외환보유고와 함께 꾸준히 증가한 것을 알 수 있다.

통화량 증가가 수반되는 경우 이자율도 그대로 유지되기는 어렵다. <Figure 2>에는 한국의 정책금리도 함께 나타내었다. 한국의 정책금리는 외환위기 이후 5% 선에서 꾸준히 유지되었으나 2001년 하반기부터 추세적으로 감소하기 시작하여 2005년 중반기에는 3% 선까지 하락하였다. 이러한 정책금리의 변동성은 미국 정책금리의 변동성에 비하면 매우 작은 수준이다. 하지만 한국정책금리의 변화 방향은 미국 정책금리의 변화 방향과 정확히 일치함을 알 수 있다. 즉 미국의 정책금리가 2001년 6%대에서 2004년 1%로 대폭 하락하는 과정에서 한국의 정책금리도 같은 기간 동안 5.3%에서 3.3%로 하락하였다. 또한 2004년 이래 미국의 정책금리가 상승할 때에도 약간의 시차는 있었지만 한국의 정책금리는 곧 이어 상승을 시작하였다.

이상과 같은 통화량 증가와 이자율 하락은 일반적으로 물가상승률을 높이는 것이 보통이다. 하지만 한국의 소비자물가상승률은 외국자본의 유입이 본격화되기 이전인 2001년에 4%를 넘어섰을 뿐 그 후에는 2008년을 제외하고 줄곧 2-3%대에서 안정적으로 유지되었다. 외국자본의 유입이 물가에 제한적인 영향을 미친 이유는 성공적인 물가 안정 목표제의 운용과 관련이 있을 수도 있지만 2000년대 초반의 유가, 원자재 가격의 하락, 저렴한 중국 상품의 수입 등 상대적으로 유리한 경제 여건도 중요한 역할을 했다고 보여진다 (Kim and Park, 2006). 반면 통화량 증가와 이자율 하락은 자산시장 가격에 집중적으로 영향을 미쳤다. <Figure 4>는 한국의 종합주가지수와 주택매매가격지수를 나타냈다. 한국의 월평균 주가지수는 2003년 3월 550에서 급속하게 상승하여 2007년 1월 2000을 넘어섰다. 서울의 주택매매가격지수도 2001년 5월 월간 상승률이 1%를 넘어선 이래 급속도로 증가하였으며 그 후 2003년 10월부터 2005년 1월까지 잠시 주춤하였다가 최근 위기 직전까지 다시 급속히 증가하였다. 자산시장의 가격도 다양한 요인에 의해 결정되지만 상승시점을 고려할 때 선진국가들의 저금리와 한국으로의 자본유입이 매우 중요한 영향을 준 것은 확실해 보인다.

## 2. 정책적 대응의 어려움

최근 많은 연구들이 자본의 글로벌화와 관련하여 거시경제정책의 어려움을 지적하고 있다. 이러한 연구들은 외국자본이 급격하게 들어오는 경우 정부정책이 매우 제한적이 됨을 지적한다. 외국자본의 유입에 따라 환율이 절상된다면 순수출은 줄어 경상수지가 악화되기 때문이다. 만약 자본이 지속적으로 유입되어 경상수지 적자 상태가 지속된다면 경제의 펀더멘탈이 악화되고, 결국 자본의 급격한 유출과 그에 따른 위기를 초래할 수 있다. 실제로 외환위기 직후 1998 년 최고점에 달했던 한국의 경상수지는 2002 년까지 줄곧 감소하였다가 세계경제가 호전되면서 다시 증가하였지만 2004 년 이후로는 지속적으로 감소하고 있다. 한국의 경상수지는 세계경제의 흐름에 보다 직접적인 영향을 받고 있는 듯 보인다. 하지만 최근 위기 직전에는 세계경제의 성장이 지속되었음에도 경상수지가 급격히 악화되었는데 이에겐 환율절상이 어느 정도 역할을 한 것으로 보인다.

따라서 많은 국가들이 외환시장에 개입하여 환율절상을 막으려는 유혹을 느끼게 된다. 하지만 정부당국이 환율의 절상을 막기 위해 외환시장에 개입하여 외환을 매입한다면 그 과정에서 국내 유동성 공급이 증가된다. 따라서 국내 이자율은 하락하게 된다. 이는 국내 자산가격의 상승을 초래하고 물가상승을 유발할 수 있다. 결국 외부의 자본유입의 충격에 대응하는 과정에서 불필요한 통화공급이 늘어나고 통화정책의 독립성이 훼손되는 것이다. 사실 물가상승이 현실화되면 실질환율의 절상을 초래하기 때문에 정부가 소기의 목적을 달성하지도 못한 셈이 된다. 외환시장에 개입하여 명목 환율의 절상을 막을 수는 있어도 물가상승에 따른 실질환율의 절상을 막기는 어려운 것이다. 따라서 외환시장에 개입하든 하지 않든 실질환율이 절상되기 마련이며 경상수지는 악화된다.

이러한 문제에 봉착한 정부는 외환시장에 개입함과 동시에 늘어난 유동성을 국내 채권시장에서 채권을 발행하여 흡수한다. 이러한 정책을 일반적으로 불태화정책(sterilization)이라고 부른다. 하지만 IMF(2007)는 불태화정책의 효과가 의문시되며 오히려 바람직하지 않은 결과를 초래할 수도 있음을 경고한다. 즉 불태화정책을 하지 않는 경우에 비해 국내이자율의 하락이 제한되기 때문에 해외자본의 유입은 더욱 커질 수 있는 것이다. 또한 불태화정책은 이자율이 낮은 외환보유고의 보유를 늘리고 대신 높은 이자율을 지불하는 국내부채를 부담하게 함에 따라 정부의 재정적 부담을 늘린다. 따라서 불태화정책은 장기간 지속되기 어렵다.

이상과 같이 자본자유화에 따른 자본의 급격한 유출입은 정책당국자의 대응을 매우 어렵게 한다. 또한 자본의 유출입 과정에서 환율의 급격한 변화를 겪게 되어 외환시장에 개입할 유혹을 느끼기 쉽다. 완전한 변동환율제를 유지하기 어렵게 된다면 결국 독자적인 통화정책에 훼손이 생기는 것이다. 이러한 문제는 선진국에도 예외가 아니다. Taylor(2007)는 미국과 ECB(European Central Bank)의 이자율정책을 상호 비교한 결과 미국이 보다 확장적인 통화정책을 집행하는 경우 ECB 도 이를 따라 보다 확장적인 통화정책을 집행하는 경향이 있다고 주장하였다. 또한 Eichengreen (2008)은 2008 년 초 아시아국가들이 겪었던 높은 인플레이션은 미국의 통화정책 때문이라고 주장한 바 있다. 즉 2007 년 여름에 서브프라임 위기에 대응하여 미국이 매우 빠른 속도로 이자율을 내리자 아시아국가들은 환율의 절상을 막기 위해 이자율을 내릴 수밖에 없었고 이러한 잘못된 통화정책이 높은 인플레이션의 원인이라고 주장한 것이다.

이와 같이 아무리 변동환율제를 유지하더라도 외국의 통화정책에 완전히 자유롭기는 어렵다. 특히 미국의 통화정책은 많은 국가에 영향을 주고 있는 듯 보인다. 다음 절에서는 보다 정치한 모형을 이용하여 미국의 통화정책의 변화가 한국 통화정책에 어떠한 영향을 주었는지 분석할 것이다. 이를 통해 한국의 통화정책이 어느 정도 독자적으로 운용되고 있는지 평가할 것이다.

### III. 통화정책의 독립성에 대한 실증분석

#### 1. 실증 분석 모형

원칙적으로 해외충격을 환율의 변화를 통해 완전히 흡수할 수 있다면 통화정책은 국내충격에 대해서만 반응할 수 있을 것이다.<sup>5</sup> 이러한 경우에 우리는 통화정책이 해외충격으로부터 독립적이라고 간주할 수 있다. 하지만 한 국가의 통화정책이 해외충격으로부터 독립적인지를 검증하기 위해서는 “경험분석을 위한” 정의가 선행되어야 할 것이다. 왜냐하면 해외의 모든 충격을 식별하기도 어렵고 설혹 식별이 가능하다고 하더라도 모든 충격에 대해 한국의 통화정책이 독립적인지를 분석하기도 쉽지 않을 것이다. 따라서 본 논문에서는 해외충격을 미국의 외생적인 통화정책으로 국한하고자 한다. 미국의 외생적인 통화정책에 대해서는 아래에서 정확히 정의할 것이다. 결국 본 논문에서는 미국의 외생적인 통화정책의 변화에 대하여 한국의 통화정책이 반응하였는지 여부를 통해 한국 통화정책의 독립성 여부를 판단하고자 한다.

미국의 외생적인 통화정책의 변화가 한국 통화정책에 어떠한 영향을 주었는지 분석하기 위해 다음과 같은 실증 분석 모형을 이용한다. 먼저 대규모 국가인 미국의 변수들이 소규모 개방 경제인 한국의 변수들에 대해 외생적이라고 할 수 있으므로 이러한 두 국가간의 관계를 반영할 수 있는 구조 블록 외생성(Block-Exogenous) VAR(vector auto-regression) 모형을 이용하였다.

또한 외생적인 미국의 이자율 정책 충격을 식별하기 위하여 Christiano, Eichenbaum, and Evans (1999)가 제시한 방법을 이용하였다. 미국의 통화 정책과 한국의 통화 정책이 미국 혹은 세계 구조 충격에 내생적으로 반응할 수 있으므로 단순히 미국의 통화 정책 지표와 한국의 통화 정책 지표의 관계를 분석하여 미국이 한국의 통화 정책에 반응하는지 추론하기 어렵고, 외생적인 미국 통화 정책 충격을 분석하는 것이 중요하다. 예를 들어 세계적인 인플레이션 충격이 있는 경우 물가 상승을 제한하기 위해 미국과 한국이 동시에 정책 금리를 상승시킬 수 있다. 이러한 경우 미국과 한국의 정책 금리는 (+)의 상관 관계를 보일 수 있으나 한국의 통화 정책이 미국의 통화 정책에 반응하는 것이라고 보기는 어렵다.

실증 분석 모형은 다음과 같다. 일반적으로 경제를 다음과 같은 구조방정식시스템으로 나타낼 수 있다.

$$G(L)y(t) = e(t) \quad (1)$$

여기서,  $G(L)$ 는 시차 연산자(lag operator)  $L$ 에 대한 행렬 다항식(matrix polynomial)이고  $y(t)$ 는  $m \times 1$  데이터벡터(data vector)이며,  $m$ 은 모형에 포함된 변수의 개수이다. 그리고,  $\text{var}(e(t)) = \Lambda$ 로  $\Lambda$ 는 대각행렬(diagonal matrix)로써 대각 원소들은 구조적 교란(structural disturbances)에 대한 분산(variances)을 의미한다.

<sup>5</sup> 최근 Kim and Lee(2008)는 한국의 경우 변동환율제를 도입한 이후 한국의 이자율이 국제이자율에 반응하는 정도가 줄어들어 어느 정도 통화정책의 독립성이 신장된 증거가 있다고 주장하였다. 반면 Calvo and Reinhart(2002)는 동아시아국가를 비롯한 신흥시장국가 대부분의 경우 변동환율제를 도입한 후에서도 실제로는 환율개입을 통해 환율안정으로 피함으로써 통화정책의 독립성이 보장되기 어려움을 시사하고 있다. 보다 다양한 경험분석에 대한 논의는 Kim and Lee(2008)를 참조하라.

이제 (1)의 방정식시스템을 다음과 같이 분할 할 수 있다고 가정한다.

$$y(t) = \begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix}, G(L) = \begin{bmatrix} G_{11}(L) & 0 \\ G_{21}(L) & G_{22}(L) \end{bmatrix}, e(t) = \begin{bmatrix} e_1(t) \\ e_2(t) \end{bmatrix} \quad (2)$$

$y_1(t)$ 와  $e_1(t)$ 는  $m_1 \times 1$ ,  $y_2(t)$ 와  $e_2(t)$ 는  $m_2 \times 1$ ,  $G_{11}(L)$ 은  $m_1 \times m_1$ ,  $G_{21}(L)$ 은  $m_2 \times m_1$ ,  $G_{22}(L)$ 은  $m_2 \times m_2$  이다.

우리는  $G_{12}(L)=0$  라고 가정할 것이다. 이는 블록 외생성(block-exogeneity) 제약으로  $y_1(t)$ 를 설명하는데  $y_2(t)$ 의 금기 자료뿐 아니라 과거의 시차 자료도 필요하지 않음을 의미한다. 본 연구에서는  $y_1(t)$ 는 미국 경제 변수들,  $y_2(t)$ 는 한국 경제 변수들로써, 미국 경제 변수들을 설명하는데 소규모 개방경제인 한국의 경제 변수들이 필요하지 않다는 것을 의미한다.

미국 부문에서 미국 이자율 충격을 식별하기 위하여 Christiano, Eichenbaum, and Evans (1999)가 제안한 방법을 이용하였다.  $y_1(t)$ 는 [IP\_US, CPI\_US, CMP, FFR, NBR, M]'로 IP\_US는 산업생산 (Industrial Production), CPI\_US는 소비자 물가지수 (Consumer Price Index), CMP는 상품가격 (Commodity Price), FFR은 미국 연방 기금 금리 (Federal Funds Rate), NBR은 비차입 지준금 (Non-Borrowed Reserves), M은 통화량이다. 미국 부문의 당기 구조 계수  $G_{11}(0)$ 에 대해서는 Christiano, Eichenbaum, and Evans (1999)를 따라 IP, CPI, CMP가 FFR의 변화에 대해 당기적으로 반응할 수 없고 FFR이 NBR과 M의 변화에 대해 당기적으로 반응할 수 없다는 제약을 부가하였고, FFR충격을 금리정책 충격으로 식별하였다.<sup>6</sup>

한국 변수 ( $y_2(t)$ )로는 먼저 기본 변수로 소비자 물가지수 (CPI), 산업생산 (IP), 콜금리 (CR), 대미환율 (ERA)을 고려하였다. CPI와 IP는 물가와 생산수준을 나타내는 주요 경제 변수들이고 CR와 ERA는 한국의 금리 정책과 관련된 주요변수이므로 기본 변수에 포함시켰다. 추정기간이 상대적으로 짧기 때문에 그 외의 변수들은 기본 변수에 포함시키지 않았다. 기본변수만을 통한 분석 외에도 추가적인 분석을 위하여 다양한 변수들을 고려하였다. 즉 통화량 (M1), 한국 주가 지수 (KOSPI), 순자본유입 (CAP), 포트폴리오 관련 순자본유입 (PORT) 등 관심 변수들을 기본 모형에 하나씩 추가하여 분석을 확장하였다.<sup>7</sup>

위와 같은 모형을 추정하기 위하여 다음과 같은 방법을 이용하였다. 축약형(reduced form) 블록외생성 VAR 모형의 경우 추정식의 우변의 변수가 동일하지 않으므로 OLS를 이용한 추정치는 비효율적(inefficient)이다. 따라서 SUR(Seemingly Unrelated Regression)로 추정한 후, 구조 VAR 모형으로 변환하는 방법을 사용하였다.

<sup>6</sup> 미국 자료는 Federal Reserve Bank of St. Louis 웹 페이지에서 구했다. 상품가격을 나타내는 변수로 생산자 가격 중 중간재 가격(intermediate material price)을 이용했다. 상품가격을 나타내는 변수와 통화량으로 다양한 변수를 고려해 본 결과 중간재 가격과 M1을 이용했을 때 물가 퍼즐(price puzzle) 등 이상현상이 상대적으로 덜 나타나므로 이러한 변수를 사용하였다. 이러한 변수선택 방법에 관해서는 Kim (2001)을 참조할 것. 이자율 이외의 변수들은 로그를 취한 값에 100을 곱하여 이용했다.

<sup>7</sup> 한국의 자료들은 한국은행 경제 통계 시스템에서 구했다. KOSPI, ERA 등은 월 평균 자료를 이용하였다. 이자율과 순자본유입, 포트폴리오 자본 유입을 제외한 변수들은 로그를 취한 값에 100을 곱하여 이용했다. 순자본 유입과 포트폴리오 순자본 유입은 달러 단위 변수를 한국의 트랜드 GDP(달러단위)에 대한 %를 사용했다.

추정 기간이 짧아 월별 자료를 이용하였고, 추정기간은 자본 자유화 이전 기간인 1982년 10월부터 1991년 12월, 그리고 자본 자유화 이후 기간인 1999년 1월부터 2007년 6월까지 두 기간이다. Strongin (1995) 등은 1982년 10월부터 미국의 통화 정책이 비지준 차입금 중심의 정책으로부터 금리 위주 정책으로 변경되었다고 주장하고 있고, Clarida, Gali, and Gertler (1999)을 비롯하여 1982년 10월 이후 미국의 통화 정책이 변화 되었다는 연구들이 많으므로 1982년 10월 이후를 추정하였다. 또한 1992년 1월 한국의 주식 시장이 외국인에게 개방되는 등 중요한 정책적 변화가 있었으므로 자본 개방화 이전 기간으로는 1991년 12월까지만 한정하였다. 자본 개방화 이후 기간으로는 자본 시장 개방이 완전히 진행되었고 외환 위기에서 벗어나 금리 위주의 통화 정책을 도입하고 인플레이션 타게팅이 도입된 1999년 1월부터 글로벌 금융위기 전 기간인 2007년 6월로 했다.<sup>8</sup> VAR 모형에 상수항을 가정했고 2개의 시차를 가정했다.<sup>9,10</sup>

<Figure 5>와 <Figure 6>은 한국의 자본 자유화 이전 기간과 이후 기간에 미국 금리 정책 충격이 미국의 변수들에 미치는 영향을 보여준다. 먼저 자본 자유화 이전 기간을 보면 금리 상승 충격이 있을 때 금리가 상승하고 비지준 차입금이 감소하는 것을 볼 수 있고 이러한 변화는 95% 확률 이상으로 0과 다른 것을 볼 수 있다. 또한 M1이 충격 후 바로 약간 증가하기는 하나 이후 감소하고 충격 후 7-9개월 후의 M1의 감소가 95% 확률 이상으로 0과 다르다. 소비자 물가 지수가 초기에 약간 증가하는 물가 퍼즐 현상을 볼 수 있으나 그 이후의 반응은 확률 밴드가 상당히 넓다. 산업생산 지수와 상품 가격의 반응은 확률 밴드의 크기를 볼 때 명확하지 않다. 자본 자유화 이후 기간을 보면 금리 상승 충격이 있을 때 금리가 상승하고 지급 준비금과 M1이 감소하는 것을 보다 명확히 볼 수 있다. 소비자 물가 반응은 넓은 확률 밴드를 고려할 때 명확하지 않고, 생산지수와 상품가격은 초기에 상승하나 장기적으로 감소하는 것을 볼 수 있다. 전반적으로 산업생산과 물가의 반응이 명확하지 않거나 약간의 이상현상을 보이는 경우가 있기는 하지만 외생적인 통화 긴축 정책 시 정책 금리가 상승하고 지급 준비금과 통화량이 감소하는 현상이 나타나야 하는데 전반적으로 이러한 현상을 볼 수 있으므로 본 모형을 식별된 통화 정책 충격이 어느 정도는 외생적인 통화충격을 잘 반영하고 있다고 생각된다.

## 2. 실증 분석 결과

<Figure 7>은 기본 모형에서 미국 금리 정책 충격에 대한 미국 연방 기금 금리 (FFR)과 한국 콜 금리 (CR)의 4년 동안의 충격반응함수를 보여준다. 점선은 90% 확률 밴드이다. 첫번째 열의 그림들은 자본 자유화 이전 기간의 충격반응함수이고, 두번째 열의 그림들은 자본자유화 이후 기간의 충격 반응함수이다.

자본 자유화 이전 기간을 보면, 충격 후 약 3개월 정도 미국 연방 기금 금리가 약 0.25%-0.3% 정도 증가하고 이후 증가 폭이 줄어들어 약 9개월 후 원래 수준과 비슷한 수준으로 돌아간다. 한국의 콜금리도 증가하는데, 충격 후 첫 번째 월에 약간 증가하고 2-3개월째에 약 0.18% 정도 증가한 후 약 6개월 후에 원래 수준으로 돌아간

<sup>8</sup> 한국의 자본 자유화 과정에 대해서는 Kim, Kim, and Wang (2004)를 참조할 것.

<sup>9</sup> Akaike criterion를 적용하여 기본 모형의 최적 시차를 분석한 결과 2개로 나타났다.

<sup>10</sup> 본 논문의 연구방법은 베이지언 (Bayesian) 추론 방법에 근거하므로 자료에 non-stationarity가 있는 경우에도 문제가 되지 않는다. Sims (1988), Sims and Uhlig (1991) 참조.

다. 한국의 2-3 개월째 금리 상승은 95% 확률로 0 과 다르다고 할 수 있다. 결국 미국의 금리 증가에 따라 한국의 금리도 증가하는데 2-3 개월째를 기준으로 보면 미국 금리 상승의 1/2 이상 한국의 금리도 증가하는 것을 볼 수 있다.

자본 자유화 이후의 기간을 보면 미국의 금리 정책 충격 후 미국 연방 기금 금리가 상승하기 시작하여 약 3 개월 후에는 0.2% 가량 증가한다. 한국의 콜 금리도 상승하는데 약 3-4 개월 후 0.05% 가량 증가하고 이러한 한국의 금리 상승은 95% 확률로 0 과 다르다. 한국의 금리 상승은 미국 금리 상승의 약 1/4 정도라고 할 수 있다. 자본 자유화 이전의 기간과 이후의 기간을 비교해보면 자본 자유화 이전 기간에 미국 정책 금리의 변화에 대해 한국 금리가 보다 순응적으로 반응했음을 볼 수 있다.

일반적으로 통화 정책의 변화는 이자율의 변화뿐 만 아니라 통화량의 변화로부터도 어느 정도 추론할 수 있다. 본 연구의 추정 기간 동안 미국의 경우 이자율을 주요 정책 지표로 이용했으므로 미국의 정책 금리의 변화를 주요 지표로 이용하여 미국의 통화 정책의 변화를 추론하고 있으나, 한국의 경우 자본 자유화 이전 기간에는 통화량 중심의 통화 정책을 수행했고 자본 자유화 이후 기간에는 이자율 중심의 통화 정책을 수행했으므로 이자율의 변화만을 이용하여 두 기간을 비교하는 데는 문제점이 있을 수 있다. 이러한 이유로 미국의 금리 정책 충격 후 통화 정책의 주요 변수인 통화량의 반응도 비교 분석했다.

<Figure 8>은 미국의 금리 정책 충격 후 미국과 한국의 통화량(M1)의 반응을 보여준다. 앞에서 이용한 기본 모형으로부터 이전과 같은 미국 금리 정책 충격 후 미국 통화량의 반응을 계산했고, 한국 통화량의 충격 반응 함수는 기본 모형에 한국의 통화량을 추가한 확장 모형에서 미국 금리 정책 충격에 대한 반응함수를 계산했다.<sup>11</sup>

자본 자유화 이전 기간의 경우 미국의 통화량은 시간이 지남에 따라 감소하여 충격 후 약 8 개월이 지나면 0.4% 가량 하락하고 약 35 개월 후 원래 수준으로 돌아온다. 한국의 통화량은 약 2-3 개월 후 0.4% 정도 하락한 후 충격 후 48 개월 후 원래 수준으로 돌아온다. 하지만 한국의 통화량의 반응은 통계적으로 유의하게 나타나지 않는다. 자본 자유화 이후의 기간의 결과를 보면 미국의 통화량은 서서히 감소하여 충격 후 약 10 개월이 지나면 0.3% 정도 감소하고, 한국의 경우 충격 후 약 4 개월이 지나면 0.7% 정도 감소한다. 자본 자유화 이전 기간과 마찬가지로 한국 통화량의 반응이 통계적으로 유의하게 나타나지는 않는다.

이상의 결과들을 정리해 보면 자본 자유화 이전 기간에는 미국의 금리 정책 충격 후 미국의 금리 변화에 대해 한국의 금리 정책은 크게 반응하는 반면 자본 자유화 이후 기간에는 한국의 금리 정책이 상대적으로 적게 반응한다고 할 수 있다. 이러한 결과를 토대로 자본 자유화 이후 기간에 한국의 금리 정책이 완전하지는 않으나 상대적으로 더 독립성을 갖게 되었다고 볼 수도 있을 것 같으나, 통화량의 변화를 보면 오히려 자본 자유화 이후 상대적으로 더 많이 반응하므로 명확한 결론을 내리기는 어렵다. 최소한의 결론은 자본 자유화 이전과 이후 기간 모두 미국의 금리 정책 변화 충격에 대해 한국의 금리 정책이 어느 정도 종속적으로 움직였고, 한국의 금리 정책이 미국의 금리 정책에 대해 완전히 독립적이었다고 보기는 어렵다는 것이다.

다음 대미 환율 (ERA), 자본 순유입 (CAP), 포트폴리오 순유입 (PORT), 주가 지수(KOSPI)에 대한 효과를 분석한다. <Figure 11>과 <Figure 12>는 각각 미국 금리 정책 충격에 대한 대미 환율, 자본 순유입, 포트폴리오 순유입, 주가 지수의 충격 반응함수

<sup>11</sup> 미국의 경우 추정 기간 동안 이자율 중심의 통화 정책을 이용하였으므로 앞에서와 마찬가지로 미국 통화 정책 충격을 미국의 금리 정책 충격으로 식별하였다.

를 보여준다. 대미 환율에 대한 효과는 기본 모형을 이용하여 분석하였고, 나머지 변수들에 대한 효과는 기본 모형에 각 변수를 하나씩 추가한 확장 모형을 이용하여 분석하였다.

먼저 대미 환율의 반응 (<Figure 9>)을 보면, 미국 금리 정책 충격의 환율에 대한 효과는 단기적으로 유의하지 않게 나타나는데 이는 미국 금리 상승 시 한국 금리도 상승하는 효과 때문에 미국 금리 상승의 환율에 대한 효과가 어느 정도 상쇄되었다고 볼 수 있다. 또한 외환 시장 개입도 환율에 대한 효과가 유의하게 나타나지 않게 만들었으리라고 생각된다. 관리 변동 환율 제도를 선언한 자본 자유화 이전 기간에는 환율의 변화가 장 단기에 걸쳐 유의하게 나타나지 않는 반면, 변동 환율 제도를 선언한 자본 자유화 이후 기간에는 약 10 개월 정도 이후부터 환율이 상승하기 시작하는데 이는 외환 시장 개입 효과가 단기적으로만 유효하게 나타나기 때문에 생긴 현상일 수도 있다.

한편 두 기간 모두 순자본 유입(<Figure 9>)과 주가지수(<Figure 10>)의 반응은 확률 밴드를 참고할 때 크게 유의하게 나타나지 않는 것으로 보인다. 하지만 포트폴리오 자본 순유입(<Figure 10>)의 경우 두 기간 모두 자본 순유입의 감소가 95% 확률로 0 과 다르다. 자본 자유화 이전 기간의 경우 충격 후 첫 월에 자본 순유입이 GDP 추세(trend) 대비 약 0.07% 정도 감소하고, 자본 자유화 이후 기간의 경우 충격 후 두 번째 월에 자본 순유입이 GDP 추세(trend) 대비 약 0.35% 정도 감소한다. 결국 미국의 금리 상승으로 미국의 금리가 상대적으로 더 높아지고 이에 따라 포트폴리오 관련 자본 유출이 나타나는 것으로 생각된다. 자본 자유화 이후에 자본 유출의 정도가 4 배 이상 증가한 것을 볼 수 있는데 이는 자본 이동이 보다 자유로워짐에 따라 유출 폭이 더 많아진 것으로 생각된다.

다음 본 연구에서 사용된 실증 분석 모형과 그 결과의 안정성에 관한 여러가지 분석을 하였다. 먼저 기본 모형에 다양한 변수를 하나씩 추가하여 분석하였는데 이러한 확장 모형에서 한국 콜금리의 반응이 크게 달라지지 않는지를 검토하였다. <Figure 11>은 결과를 보여준다. 각 그림열의 위에 어떤 변수를 추가한 모형인지를 표시했다. 이러한 확장모형에서 한국 콜금리의 반응이 크게 변하지 않고, 특히 주요결론에 영향을 미치지 않는다.

다음 분석기간이 변화할 때 실증 분석 결과의 안정성을 검토하였다. 실증 분석기간을 정할 때 동질적인 정책이 실행된 기간을 선택하였고, 그 기간이 별로 길지 않기 때문에 분석기간 중 처음 1 년을 제외한 기간을 대상으로 한 분석 그리고 나중 1 년을 제외한 기간에 대한 분석을 했다. <Figure 12>는 그 결과를 보여준다. "Before Lib: post," "Before Lib: pre," "After Lib: post," "After Lib: pre"는 각각 자본 자유화 이전 기간에서 나중 1 년, 처음 1 년, 자본 자유화 이후 기간에서 나중 1 년, 처음 1 년을 제외한 기간을 대상으로 했음을 의미한다. 분석기간이 변화할 때 기본 모형에서 미국 연방 기준금리와 한국 콜금리의 반응, 그리고 한국 M1 을 추가한 모형에서 미국 M1 과 한국 M1 의 반응이 별로 변화하지 않음을 볼 수 있고, 특히 주요 결론이 변화하지 않음을 볼 수 있다.

다음 기본 모형에 자본 순유입, 포트폴리오 순유입, 주가 지수, M1 중 2 가지 변수를 추가하여 분석하였는데 실증 분석 결과가 별로 달라지지 않았다. <Figure 13>은 자본 순유입과 M1 2 변수를 추가한 모형과 포트폴리오 순유입과 주가지수 2 변수를 추가한 모형에서 자본 순유입, M1, 포트폴리오 순유입, 주가지수의 반응을 보여준다.



#### IV. 결 론

본 논문은 한국이 1997 년 외환위기 이후 변동환율제 도입과 더불어 자본자유화로 자본시장의 글로벌화된 상황에서 독립적인 통화정책을 유지할 수 있었는지 분석하였다. 한국은 1990 년대 초 본격적인 자본자유화가 진행되기 전에는 환율시장에 적극적으로 개입을 해도 이론적으로 독립적인 통화정책을 유지할 수 있는 여지가 있었다. 하지만 자본자유화가 진행되면서 더 이상 독립적인 통화정책과 적극적인 환율개입을 동시에 수행하기 어렵다는 사실을 깨닫게 되었다. 따라서 환율정책은 적어도 공식적으로는 완전한 변동환율제로 전환하게 된다. 환율에 대한 개입을 더 이상 하지 않음으로써 통화정책의 독립성을 유지하고자 도모한 것이다.

하지만 현실적으로 어떤 국가도 완전한 변동환율제를 유지하기는 어렵다. 특히 소규모 개방 경제의 경우 자본 시장 개방으로 막대한 양의 국제 자본 유출입이 있는 경우 환율과 자산 시장의 심각한 불안정성을 초래할 수 있고 이러한 상황을 간과하기 어렵다. 또 환율의 결정을 시장에 전적으로 맡기더라도 자본시장이 완전히 개방되어 있는 상태에서 급속한 자본시장의 글로벌화는 국가간의 연계성을 강화하기 마련이다. 특히 최근의 몇몇 연구는 미국의 팽창적인 통화정책이 많은 다른 국가의 통화정책에 영향을 줌으로써 전세계적인 인플레이션 및 자산시장의 버블 형성에 기여했다고 주장하고 있다. 따라서 한국의 경우도 이와 같이 미국의 통화정책에 어떠한 영향을 받았는지를 분석하는 것을 매우 흥미로운 일이다. 즉 한국의 경우 비록 변동환율제를 표방하고 있지만 외국의 통화정책과 자본흐름에 과연 자유로운 통화정책을 집행할 수 있었는지를 분석할 필요가 있는 것이다.

본 연구는 자본 자유화 이전과 자본 자유화 이후의 두 기간으로 나누어 각 기간에서 미국의 통화정책이 한국의 통화정책에 어떤 영향을 주었는지 실증 분석하였다. 자본자유화 이전과 이후 기간은 환율제도에 있어서도 뚜렷한 차이를 보인다. 즉 자본자유화 이전 기간에는 관리변동환율제이었던 반면 이후 기간에는 적어도 공식적으로는 완전변동환율제를 표방하였다. 따라서 외환이전 기간에 비해 이후 기간은 자본자유화가 진전되었다는 면에서 독립적인 통화정책이 운용되기 어려워진 반면 변동환율제를 채택하여 독립적인 통화정책에 유리한 환경이 조성하였다.

실증분석결과에 따르면 한국의 통화정책이 자본자유화 이전과 이후 두 기간 모두에서 미국의 통화정책에 대해 완전히 독립적으로 운용되지 못하였던 것으로 보인다. 특히 자본자유화 이후 기간에서도 완전한 변동환율제를 실제로 운용하기는 어려웠고 이는 필연적으로 한국의 통화정책도 외부의 충격에 완전히 자유롭지 못하도록 강요한 것으로 해석할 수 있다. 또한 미국의 이자율이 변화하는 경우 포트폴리오 자본의 유출입이 자본자유화 이후 기간에 이전 기간에 비해 매우 민감하게 변화하여 통화정책의 운영에 있어서 어려움을 초래한 것으로 보인다.

앞으로 자본의 글로벌화 경향은 최근의 위기에도 불구하고 쉽게 후퇴하지는 않을 것으로 생각된다. 따라서 이러한 자본의 글로벌화에 효과적으로 대응하면서 통화정책을 독립적으로 유지할 수 있는 정책의 틀을 개발하는 것이 시급하다고 하겠다.

## References

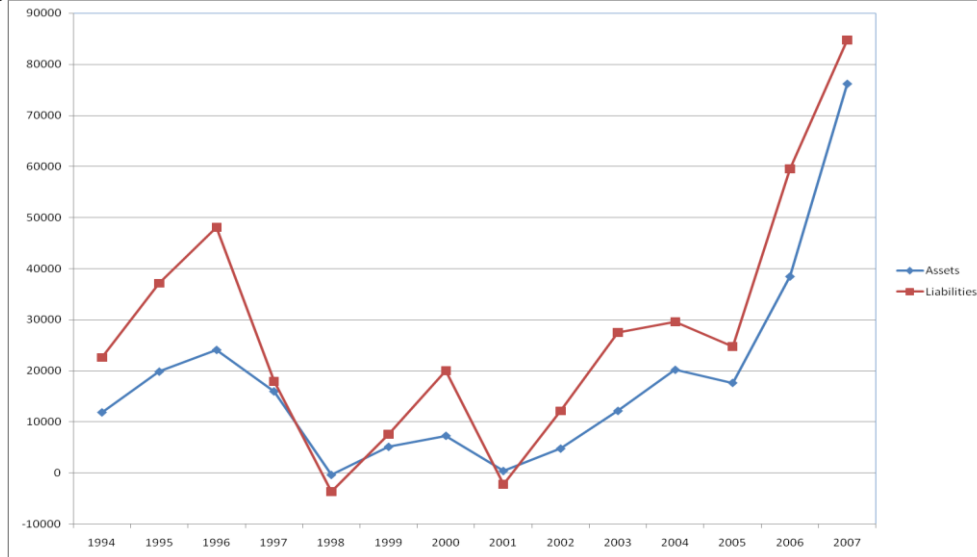
- 신관호, 외환위기 이후 통화 및 환율정책의 평가, 경제학연구, 제 55 집 제 4 호, pp. 275-312, 2007.
- Backus, David K., Patrick J. Kehoe, and Finn E. Kydland, "International Real Business Cycles," *Journal of Political Economy*, Vol. 100, No. 4, pp. 745- 775. 1992.
- Bekaert, Geert, Campbell R. Harvey and Christian Lundblad, "Financial Openness and Productivity," NBER Working Paper #14843, 2009.
- Calvo, **Guillermo A.** and **Carmen M.** Reinhart, "Fear of Floating," *Quarterly Journal of Economics*, Vol. 117, No.2, pp. 379- 408, 2002.
- Christiano, Lawrence J., Eichenbaum, Martin, and Charles L. Evans, "The Effects of Monetary Policy Shocks: Evidence from the Flows of Funds," *The Review of Economics and Statistics*, Vol. 78, pp. 16-34, 1996.
- , "Monetary Policy Shocks: What Have We Learned and to What End?" in J. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1A, Amsterdam, Elsevier North-Holland, pp. 65-148, 1999.
- Clarida, Richard, Jordi Gali, and Mark Gertler, "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," *Quarterly Journal of Economics*, Vol. 115, No. 1, pp. 147-180, 2000.
- Cole, Harold L. and Maurice Obstfeld, "Commodity Trade and International Risk Sharing: How Much Do Financial Markets Matter?" *Journal of Monetary Economics*, Vol. 28, No. 1, pp. 3- 24, 1991.
- Eichengreen, Barry, *International Monetary Arrangements for the 21<sup>st</sup> Century*. Brookings Institution, Washington DC, 1994.
- , "Monetary and Exchange Rate Policy in Korea: Assessments and Policy Issues" , mimeo, 2004.
- , "[Asia and Global Stagflation.](#)" In VoxEU.org, 19 June 2008.
- Fischer, Stanley, "Capital Account Liberalization and the Role of the IMF," speech at the IMF seminar on Asia and the IMF, Hong Kong SAR, September 19, 1997. Available via the Internet: <http://www.imf.org/external/np/speeches/1997/091997.htm>.
- , "Exchange Rate Regimes: Is the Bipolar View Correct?" *Journal of Economic Perspectives*, Vol. 15, No. 2, pp. 3—24, 2001.
- Frankel, Jeffrey, "No Single Currency Regime is Right for All Countries," testimony before the House Committee on Banking and Financial Services, May 21, 1999.

- Glick, Reuven, Xueyan Guo, and Michael Hutchison, "Currency Crises, Capital Account Liberalization, and Selection Bias," *Review of Economics and Statistics*, Vol. 88, pp. 698-714, 2006.
- Gourinchas, Pierre-Olivier and Olivier Jeanne, "The Elusive Gains from International Financial Integration," *Review of Economic Studies*, Vol. 73, No. 3, pp. 715- 741, 2006.
- International Monetary Fund, "Managing Large Capital Inflows," Chapter 3 in *World Economic Outlook, October 2007: Globalization and Inequality*, World Economic and Financial Surveys (Washington), 2007.
- Kim, Chang Jin and Jong-Wha Lee, "Exchange Rate Regime and Monetary Policy Independence in East Asia," *Pacific Economic Review*, [Vol. 13, No. 2](#), pp 155 – 170, 2008.
- Kim, Soyoung, "International Transmission of US Monetary Policy Shocks: Evidence from VAR' s," *Journal of Monetary Economics* Vol. 48, pp. 339-372, 2001.
- , "What is Learned from Crisis, Fear of Floating or Hollow Middle? Identifying Exchange Rate Policy in Recent Crisis Countries," Working Paper, Korea University, 2005.
- Kim, Soyoung, Kim, Sunghyun H., and Yunjong Wang, "Macroeconomic Effects of Capital Account Liberalization: The Case of Korea," *Review of Development Economics*, Vol. 8, No. 4, pp. 624-639, 2004.
- , "Fear of Floating in East Asia?" Vol. 14, No. 2, pp. 176-193, *Pacific Economic Review*, 2009.
- Kim, Soyoung, and Doo Yong Yang, "Do Capital Flows Matter to Asset Prices? The Case of Korea," *Asian Economic Journal*, forthcoming, 2009.
- Kim, Soyoung, and Yung Chul Park, "Inflation Targeting in Korea: A Model of Success?" BIS Paper 31, 2006.
- Kose, Ayhan, Eswar Prasad, Kenneth Rogoff, and Shang-Jin Wei, "Financial Globalization: A Reappraisal," IMF Working Paper 06/189, International Monetary Fund, 2006.
- Lee, Jong-Wha and Kwanho Shin, "Welfare Implications of International Financial Integration," ADB Working Paper 2008-12-05, 2008.
- Lucas, Robert E., "Why doesn't Capital Flow from Rich to Poor Countries?" *American Economic Review*, Vol. 80, pp. 92-96, 1990.
- Ötger-Robe, Inci, and others, "Coping with Capital Inflows: Experiences of Selected European Countries," IMF Working Paper 07/190, Washington: International Monetary Fund, 2007.
- Reinhart, C.M., and K.S. Rogoff, "The Modern History of Exchange Rate Arrangements: A Reinterpretation," *Quarterly Journal of Economics*, 2004.

- Sims, A., "Bayesian Skepticism on Unit Root Econometrics," *Journal of Economic Dynamics and Control*, Vol. 12, pp. 463-474, 1988.
- Sims, C.A., and H. Uhlig, "Understanding Unit Rooters: A Helicopter Tour," *Econometrica*, Vol. 59, pp. 1591-1599, 1991.
- Strongin, S., The identification of monetary policy disturbances: Explaining the liquidity puzzle, *Journal of Monetary Economics*, Vol. 35, pp. 463-497, 1995.
- Taylor, John, "Globalization and Monetary Policy: Missions Impossible," in Mark Gertler and Jordi Gali (Eds.) *The International Dimensions of Monetary Policy*, National Bureau of Economic Research, 2007.
- Tytell, Irina, and Shang-Jin Wei, "Does Financial Globalization Induce Better Macroeconomic Policies?" IMF Working Paper 04/84, Washington: International Monetary Fund, 2004.

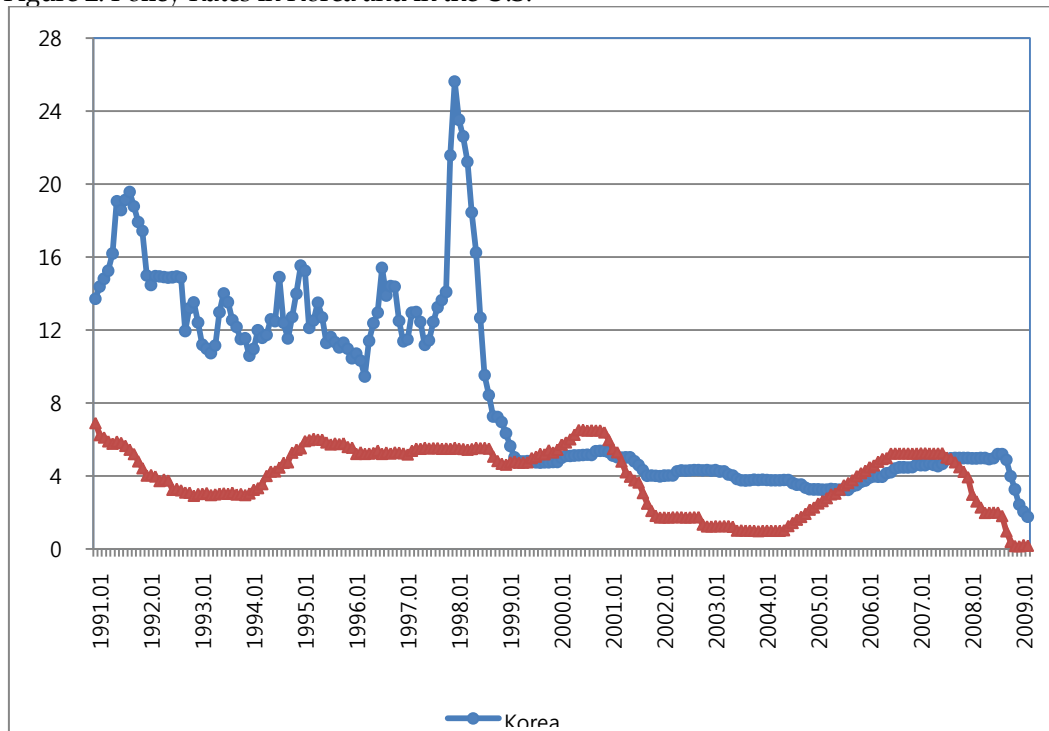
Figure 1. Capital Inflows and Outflows in Korea

Unit: million US dollars



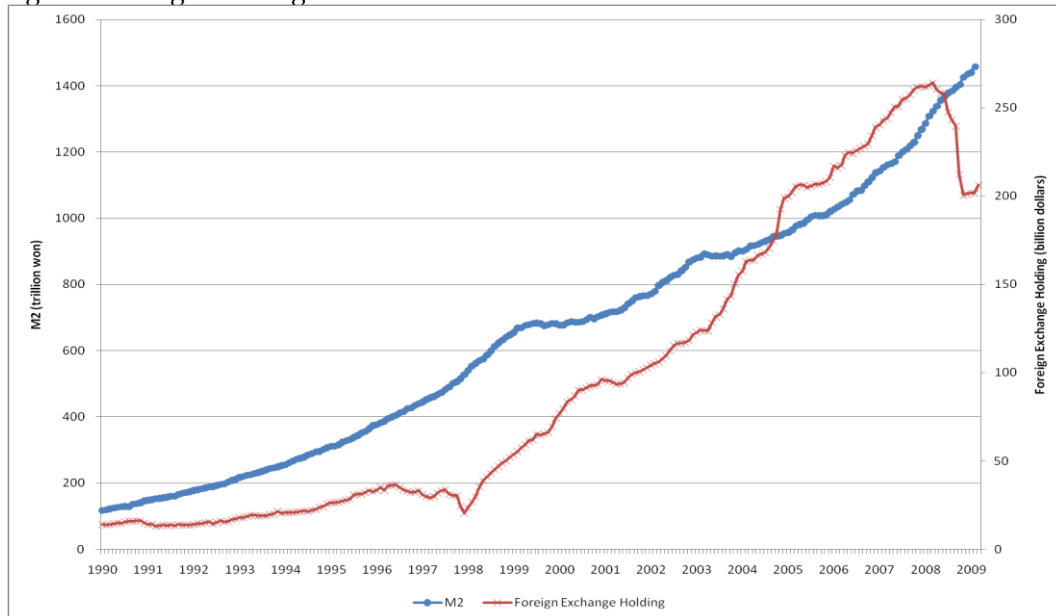
Note: Data are obtained from IMF's Balance of Payments Statistics.

Figure 2. Policy Rates in Korea and in the U.S.



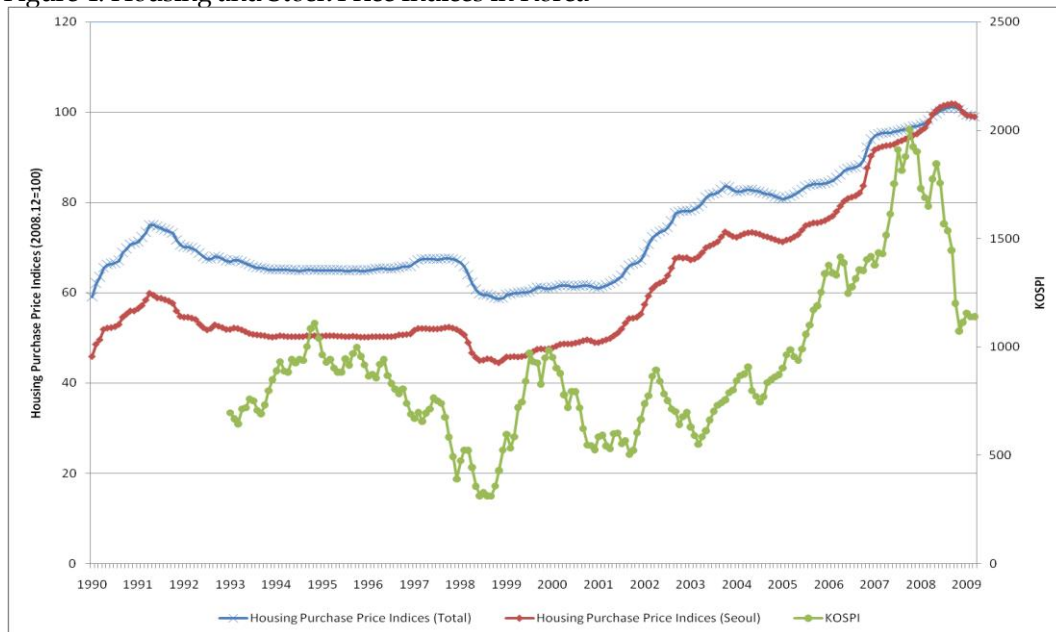
Note: As policy rates we used Federal Funds rate for the U.S and uncollateralized call rate (all transactions) for Korea. Data are obtained from FRED, Federal Reserve Bank of St. Louis and the Bank of Korea respectively.

Figure 3. Foreign Exchange Reserves and M2 in Korea



Note: Data are obtained from the Bank of Korea.

Figure 4. Housing and Stock Price Indices in Korea



Note: Data are obtained from the Korea Stock Exchange and Kookmin Bank Research Institute.

Figure 5. Impulse Responses of U.S. Variables to U.S. Monetary Policy Shocks: Pre-Liberalization Period

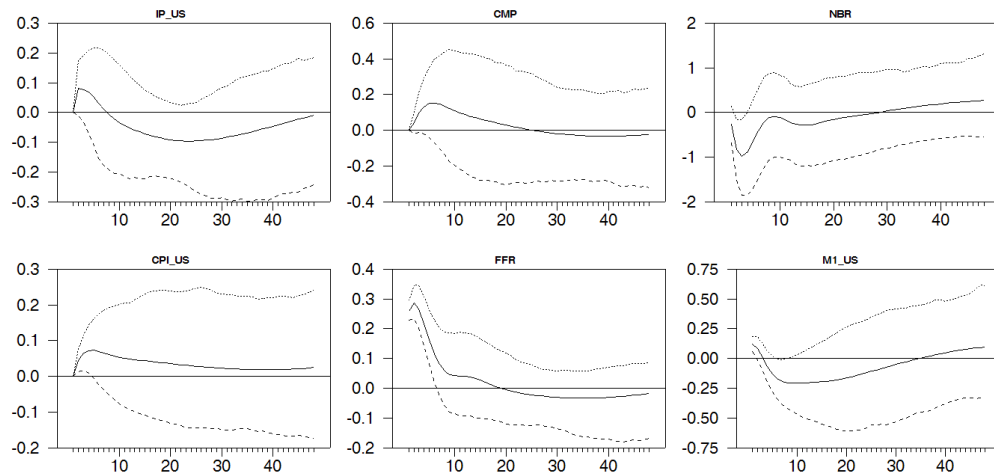


Figure 6. Impulse Responses of U.S. Variables to U.S. Monetary Policy Shocks: Post-Liberalization Period

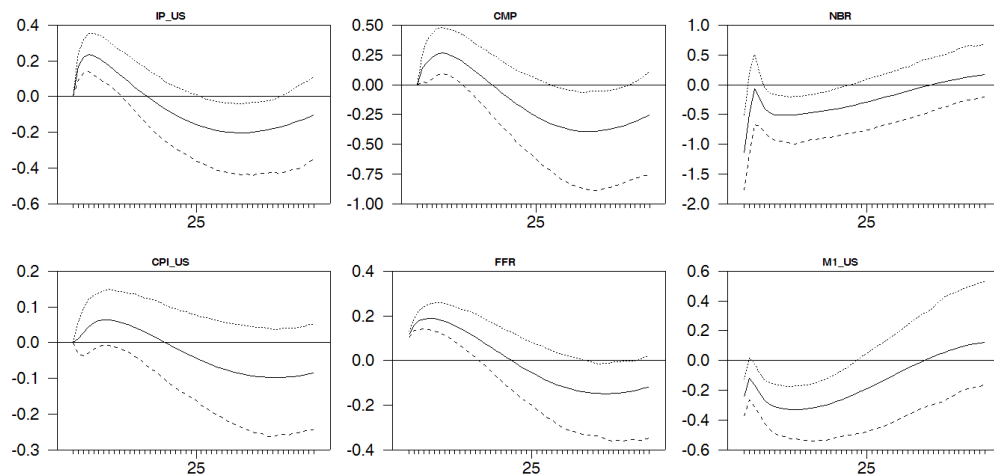


Figure 7. Impulse Responses of Federal Funds Rate and Korean Call Rate to U.S. Monetary Policy Shocks in the Basic Model

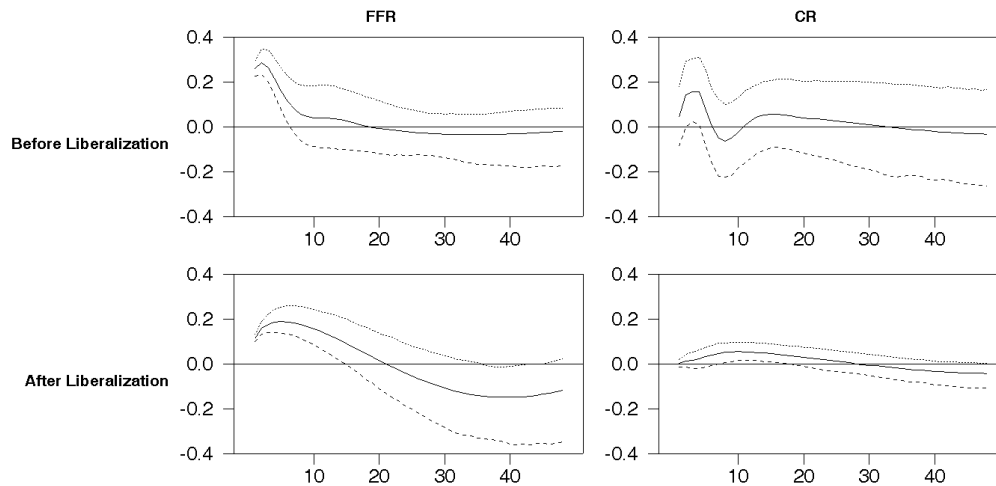


Figure 8. Impulse Responses of the U.S. and Korean M1 to U.S. Monetary Policy Shocks

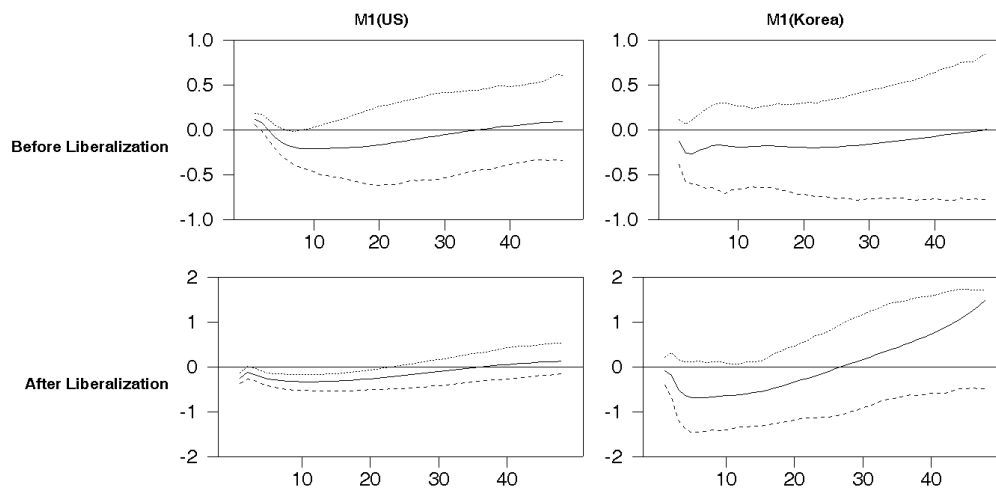




Figure 9. Impulse Responses of the Won-Dollar Exchange Rate and Korean Net Capital Inflows to U.S. Monetary Policy Shocks

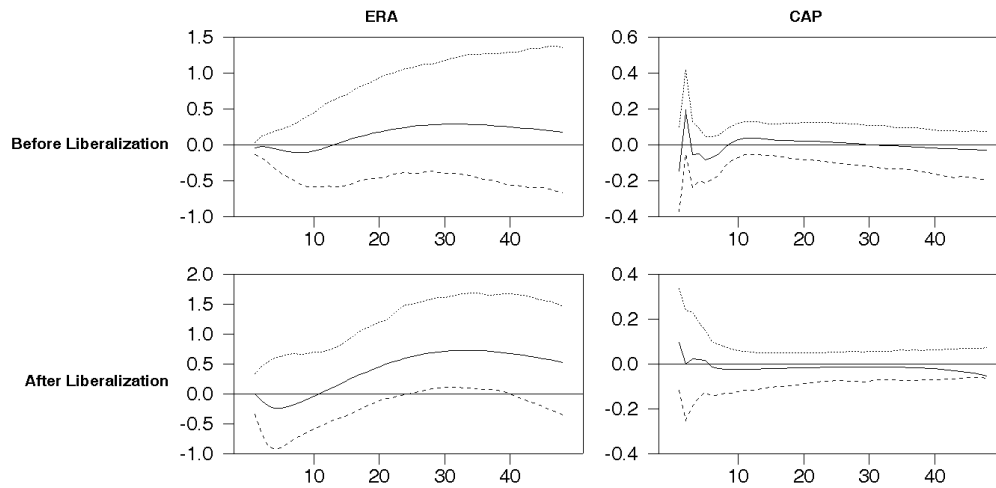


Figure 10. Impulse Responses of Korean Net Portfolio Inflows and KOSPI Index to U.S. Monetary Policy Shocks

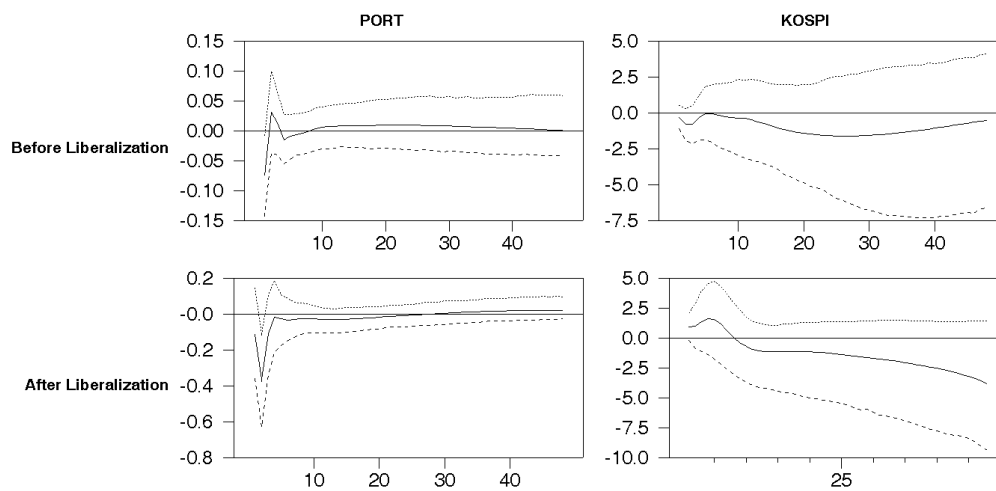


Figure 11. Impulse Responses of Korean Call Rate to U.S. Monetary Policy Shocks in the Extended Models

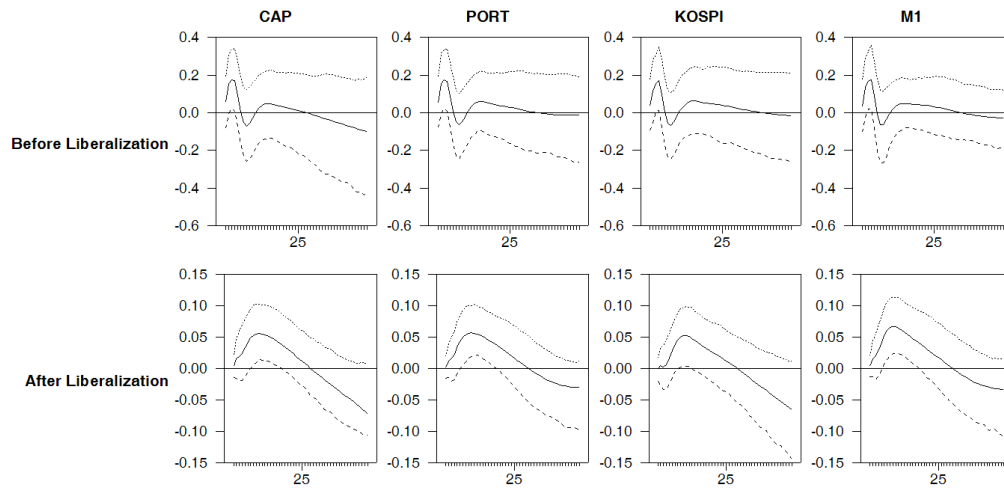


Figure 12. Impulse Responses to U.S. Monetary Policy Shocks for Various Sample Periods

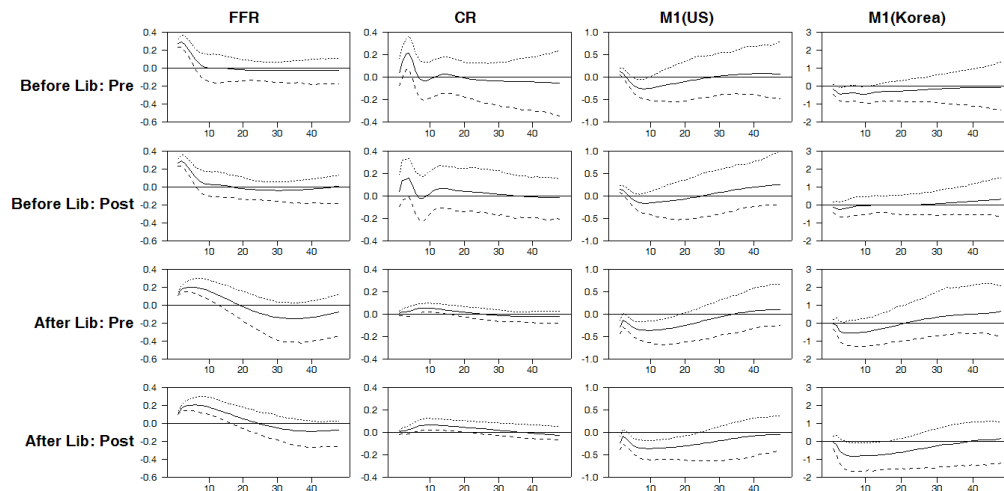
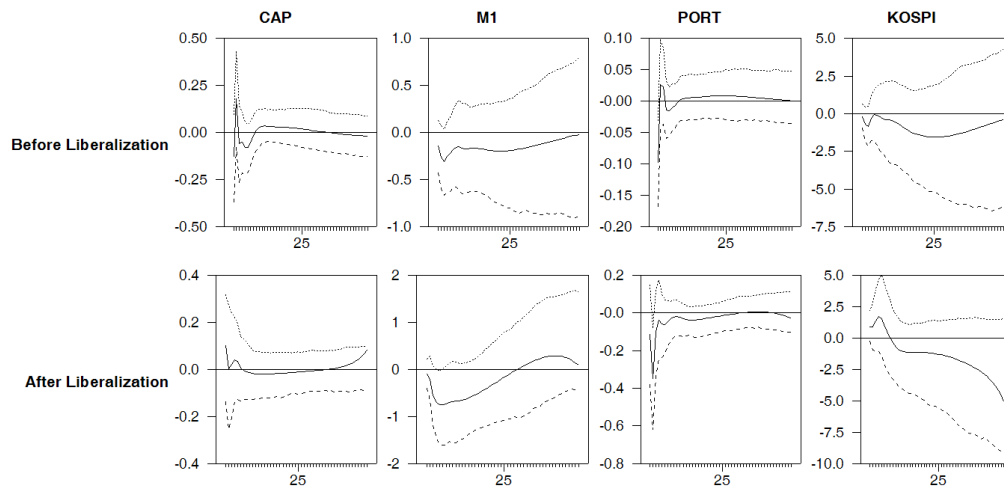


Figure 13. Impulse Responses to U.S. Monetary Policy Shocks in the Model with Two Additional Variables



## Discussions on "Capital Market Globalization and Monetary Policy Independence in Korea"

Wooheon Rhee  
Kyunghee University

Trilemma: complete capital mobility, stable exchange rate, independent monetary policy

After Asian currency crisis: Korea adopts free capital mobility, independent monetary policy (inflation targetting), It implies that it should let the exchange rate fluctuate in the market (flexible exchange rate system).

Frankel: possible combination of complete capital mobility + not completely indep monetary policy + partial control of exchange rate  
incomplete capital mobility + indep monetary policy + partial control of exchange rate

reality: inflow of capital -> appreciation of exchange rate -> interference (hard to do exercise indep monetary policy) -> increase in foreign reserve globalization of capital market -> hard to exercise indep monetary policy

US monetary policy shock (interest rate) -> Korean monetary policy (interest rate, exchange rate, capital mobility)

Since 2002, US interest rate goes down. Capital inflow to Korea. Korean Won appreciates. Foreign reserves increase. Sterilization should not change the domestic money supply. However, M2 in Korea increases. Call rate and TBill rates secularly decline. However, inflation rate did not rise. Why? It may be due to the decrease in oil price, commodity price, cheap import from China in addition to the successful monetary policy by the BOK. (However, if inflation rate rises, the real exchange rate appreciates, and the BOK fails in stabilizing the exchange rate. It interferes into the foreign exchange market, and tries to counteract the appreciation of the nominal exchange rate, but fails to stop the appreciation of the real exchange rate. Accordingly, the current account exacerbates.)

Low interest rate and rising liquidity raise the stock price and housing price.

Sterilization may not be desirable. It restricts the fall in interest rate than it is otherwise, and encourages the inflow of capital. In addition, sterilization increases the foreign reserve with low interest rate and increases domestic debt with high interest rate. It increases the burden of the government debt.

Appreciation of Won cause the current account deficit -> capital outflow -> financial crisis

Kim and Shin performs the structural block-exogenous VAR analysis.

World-wide inflation shock may cause both the US and Korea to increase the policy interest rate in order to combat against the inflation. In this case, the correlation between US and Korea interest rates is positive. But, it does not mean the Korea monetary policy is dependent upon US policy. So, we have to identify exogenous US monetary policy shock.

1982:10-1991:12, 1999:01-2007:06 monthly,

US: ip, cpi, commodity price, ffr, non borrowed reserve, M

Korea: ip, cpi, call rate, ex rate, capital inflow, portfolio related capital inflow, KOSPI

Before the capital market liberalization:

call rate rises about more than half of the rise in US rate in 2-3 months.

cumulative response is 0.46 during the first 6 months

cumulative response is 0.28 during the first 12 months

cumulative response is 0.6 during the first 24 months

After the currency crisis:

call rate rises about more than one quarter of the rise in US rate in 3-4 months.

cumulative response is 0.13 during the first 6 months

cumulative response is 0.22 during the first 12 months

cumulative response is 0.35 during the first 24 months

Korea interest rate respond more to US policy change before the crisis than after the crisis. However, in both cases Korean monetary policy was not completely independent of the US policy.

the response of the exchange rate is not significant. It may be because Korea interest rates rise in response to a rise in US interest rate and interference in the foreign exchange market.

the response of the portfolio related capital inflow is significantly negative.

It decreases by about 0.07% and 0.35% in the first month before and after the capital market liberalization.

Full fledged DSGE model for a small open economy:

36 equations, 7 shocks, modified BOK dsge model

foreign interest rate shock causes initial increase in domestic interest rate, exchange rate, inflation rate, and output. (net export? bond?)

## **Financial Market Integration in East Asia: Status and Options**

*Woosik Moon\**

### **ABSTRACT**

As cross-border capital movements are expanding, financial markets in East Asia are becoming increasingly integrated. This paper attempts to investigate the current state of financial market integration in East Asia by measuring interest differentials among 10 East Asian countries along with various factors that determine these differentials. According to this paper, there is increasing interest rate convergence in East Asia although the interest deviations remain high compared to Europe. Also, the predominant obstacle preventing further integration is the increasing level of exchange rate fluctuations in East Asia. Given that successful financial market integration necessitates exchange rate stability, it is essential to establish an effective regional monetary institution in East Asia.

Key Words: East Asia, financial integration, Interest differential, interest rate parity condition

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## I. Introduction

Despite temporary disruptions caused by the currency crisis in 1997, East Asian countries have experienced growing intra-regional trade as their economies have become increasingly interdependent. Along with this real integration, financial linkages have also been established at an accelerating rate, especially in response to financial liberalization and capital market openings. Indeed, increasing short-term capital flows have strengthened the financial links among East Asian countries as well as to the US (Moon & Rhee (2009), Cowen et al.(2006)).

The growing trade and capital flows in Asia highlights the desirability of stable exchange rates within the region. Stable intra-regional exchange rate is important too, because Asian countries compete with one another in the world markets. The experience of Europe is especially illuminating because its real integration has led to financial integration, ending up with the introduction of a single currency, the Euro, which eventually eliminated the problem of exchange rate fluctuation entirely.

Largely based on this European experience, many studies were conducted to measure the extent of financial market integration (See for example Adams et al. (2002), Baele et al. (2004) and Laura Vajanne (2006)). A majority of these studies have concluded that money market integration was completed within Europe in 2002 while integration in other financial markets has been still lacking. However, studies examining East Asian financial markets have been relatively rare.

This paper aims to examine the extent of financial market integration in East Asia, particularly focusing on money market. Though there are numerous ways to examine money market integration, one well-established method is to rely on the interest parity condition and measure the interest rate differentials between home and foreign countries. (Cavoli et al. (.2004) and Ito. & Chinn (2007)) This paper measures money market interest differentials among East Asian countries and compares the interest deviations observed in East Asia to deviations in Europe. Finally, this paper examines factors that can explain such interest rate differentials and draws implications for future efforts in monetary cooperation.

This paper finds evidence of increasing interest rate convergence in East Asia, although deviations in Asia remain substantial. To further financial market integration in Asia, there is a need for closer cooperation to stabilize exchange and establish effective regional monetary institutions.

The contents of this paper are as follows. Section II begins by introducing a method for measuring financial market integration in East Asia. With this method established, trends in money market interest rate differentials will be examined between the years 1991 and 2008. Section III examines determinants of such interest rate differentials in East Asia. Section IV discusses policy options for furthering Asian financial integration. Section V concludes.

## II. Interest differentials in East Asia

### 1. Methodology

The interest rate parity condition states that if the domestic interest rate is higher than the foreign interest rate, the domestic currency can be expected to appreciate until the interest rate at home equals the foreign interest rate adjusted for the exchange rate changes. Specifically, the covered interest rate parity condition implies that the home interest rate should be equal to foreign interest rate plus forward premium. Any violation of this relationship suggests that the financial markets in question are not well integrated.

Let  $r_i$  represent the interest rate of country  $i$  at time  $t$ . Then the return a typical investor expects to earn at period  $t+1$ , investing 1 US dollar in country  $i$ , is:

$$R(i, t) = (1 + r_{it}) * S_{it} / F_{it}$$

where  $r_{it}$  is the money market interest rate of country  $i$ ,  $S_{it}$  is the spot exchange rate of currency  $i$  against the US dollar, and  $F_{it}$  is the 3 month forward exchange rate of currency  $i$  against the US dollar.

Now we can define the interest differential between country  $i$  and country  $j$  at time  $t$ ,  $Dif(i, j, t)$ , by the absolute value of  $R(i, t) - R(j, t)$ .

$$\begin{aligned} Dif(i, j, t) &= |\ln R(i, t) - \ln R(j, t)| \\ &= |(r_{it} - f_{it}) - (r_{jt} - f_{jt})| \end{aligned}$$

where  $f_{it} = (S_{it} - F_{it}) / F_{it}$  and  $f_{jt} = (S_{jt} - F_{jt}) / F_{jt}$

If the financial markets of country  $i$  and country  $j$  are fully integrated, then we expect arbitrage by the investors to drive the interest deviation down to zero. In reality, however, there are many impediments preventing financial arbitrage, such as differing macroeconomic policies and regulations, capital controls, and political risks. These impediments are especially significant for developing countries and therefore substantial interest deviations can be expected for developing countries. However, as Ito and Chinn (2007) revealed, interest deviations do not vanish even among developed nations.

Since most East Asian currencies are not internationally exchanged and the US dollar is accordingly used as a vehicle currency to mediate financial transactions between national currencies, East Asian financial markets are closely linked to the US market and indirectly connected to each other. Then we can rewrite the interest deviation as  $|(r_{it} - f_{it} - r_{ust}) - (r_{jt} - f_{jt} - r_{ust})| < |(r_{it} - f_{it} - r_{ust})| + |(r_{jt} - f_{jt} - r_{ust})|$ . Thus, if countries  $i$  and  $j$  are closely linked to US financial markets, they are also closely integrated to each other.

To measure the overall degree of money market integration in East Asia, we take the average value of 45 interest differentials,  $AD$ .

$$AD(t) = \sum_{i=1} \sum_{j \neq i} Dif(i, j, t) / 45$$

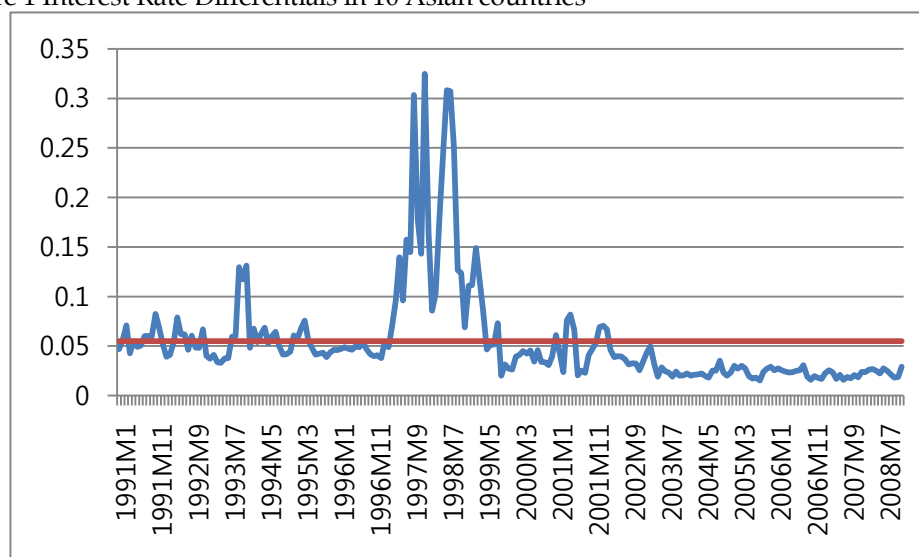
This basic methodology was first used by Pasely & Wei to measure goods market integration and subsequently expanded upon by Moon & Yoon (2006). Since we consider 10 East Asian countries including Korea, Japan, China, Hong Kong, Taiwan, Indonesia, Malaysia, Philippine, Singapore, and Thailand, there are 45 country pairs when determining bilateral interest rate differentials. The value of  $AD$  for the 10 East Asian countries during the period 1991-2008 was based on 3 month money market rates obtained from International Financial Statistics, IMF and spot and forward exchange rates from Bloomberg.



## 2. Trend

Figure 1 shows trends in interest differentials among the 10 East Asian countries.

Figure 1 Interest Rate Differentials in 10 Asian countries

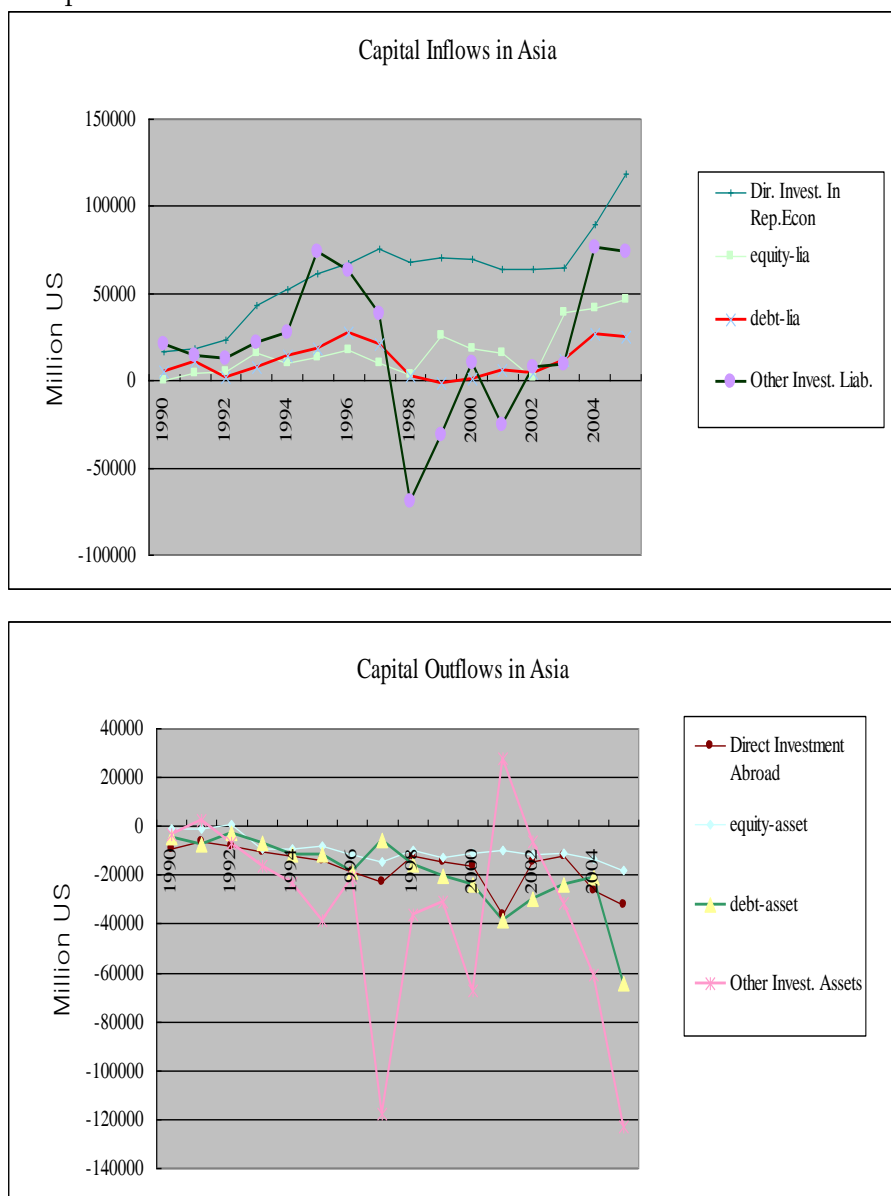


Source: International Monetary Fund, *International Financial Statistics*, and Bloomberg

Three facts are worth noting. First, there are considerable gains to be reaped through financial arbitrage in East Asia as the average interest differential from 1991 to 2008 on a monthly money market rate basis was 5.4% (0.053). Secondly, the interest rate differentials between East Asian countries were greatly affected by the financial crisis and resultant exchange rate volatilities. It can be assumed that wide fluctuation in the exchange rate would not wipe out gains from arbitrage. However, during the currency crisis period, exchange rate volatility was so large that it discouraged any arbitrage trade. Indeed, Asian countries saw their interest rate differentials widened during the period of financial market turbulence. Thirdly, despite the currency crisis, interest differential seemed to be decreasing over time, thereby suggesting the possibility of interest rate convergence in East Asia. In fact, interest differentials in the post-crisis era were notably lesser than those observed in pre-crisis period.

Perhaps in response to important opportunities for interest arbitrage, short-term capital movements increased substantially as well. Figure 2 shows capital inflows and outflows in eight East Asian countries (Korea, Japan, China and advanced ASEAN 5 countries).

Figure 2: Capital Flows in East Asia 1990-2008



Note: Other investment liabilities and assets consist largely of commercial borrowings and loans.

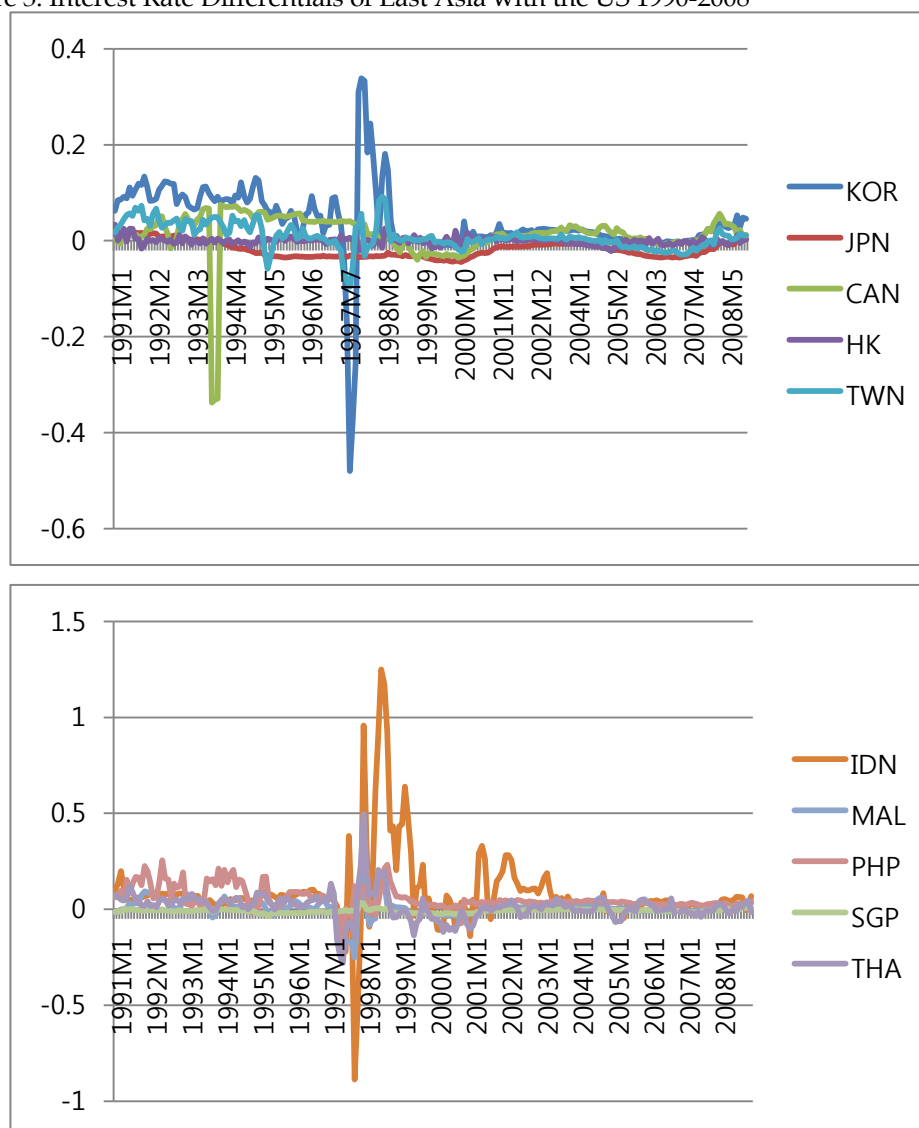
Source: International Monetary Fund, *International Financial Statistics*.

Cross-border bank loans were the most important component of these flows. Loans rose sharply following the crisis, partly as a reaction to their collapse in the previous period. This rebound was subsequently followed by an equally sharp increase in cross-border debt and equity flows. Japan was a major lender, generating massive capital flows known as the yen carry trade. In fact, Japanese banks could fund themselves at a very low interest cost and use the proceeds to invest in assets denominated in other higher-yielding Asian currencies. To be sure, capital controls maintained by some countries such as China and

Malaysia limited portfolio flows and financial-market integration to lower levels than would have prevailed otherwise. Nonetheless, given the search for yield, market participants found various ways around these controls. (See, for example, Goodfriend and Prasad (2005) and Ma and McCauley (2007)).

These developments not only deepened financial links among East Asian countries but also expanded East Asian links to the United States and major world markets, as evidenced by the substantial fraction of inter-regional capital flows. Furthermore, as previously mentioned, East Asian countries had maintained close financial linkages with the US because the US dollar was the most important vehicle currency in the region. Figure 3 shows the trend in interest differential for 10 East Asian countries vis-à-vis the US market.

Figure 3: Interest Rate Differentials of East Asia with the US 1990-2008

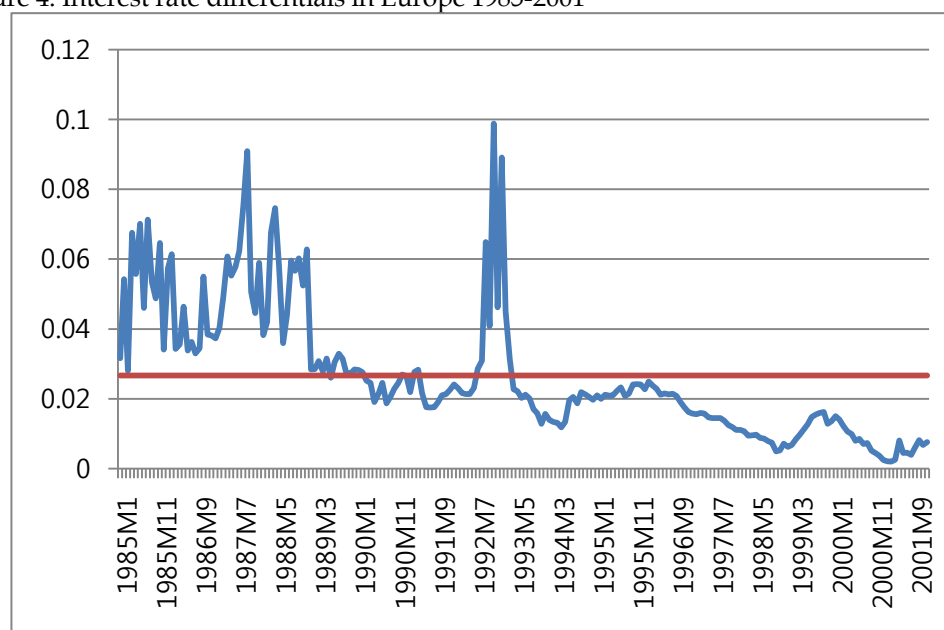


Source: International Monetary Fund, *International Financial Statistics*, and Bloomberg

### 3. Comparison with Europe

To comprehend how extensively money markets in East Asia are integrated, we compare interest rate differentials in Asian and European countries. 10 European countries (including Germany, France, Netherlands, Belgium, Denmark, Finland, Portugal, Ireland, Spain and Italy) are considered. Figure 4 shows the degree of money market integration as measured by the average of 45 bilateral interest rate differentials among 10 European countries until the introduction of the single currency.

Figure 4: Interest rate differentials in Europe 1985-2001



Source: International Monetary Fund, *International Financial Statistics*, and Bloomberg

The average interest differential for the 10 EU countries from 1985 to 2002 on a monthly money market rate basis was 2.6% (0.0266), less than half of the average differential for the 10 Asian countries. Also, the interest differentials appeared to rapidly decrease over this period and nearly approached zero by the end of 2001. Therefore, even before completing the integration process by introducing the Euro and abolishing national currencies, financial market integration was much deeper in Europe compared to East Asia.

The comparison with the Europe suggests that exchange rate stability may be the most critical factor in accelerating financial market integration. Similar to Asia's experience during the 1997 currency crisis, European interest rate differentials widened during the 1992-1993 ERM crisis. The excessive exchange rate volatility hurt intra-regional capital markets as well as intra-regional trade.

### III. Determinants of Interest Differentials

#### 1. Model and data.

To identify the determinants of the interest differentials in East Asia and see how the interest differentials were determined, we consider the following model.

$$Dif(i,j,t) = c + \beta_1(exvol(i,j,t)) + \beta_2(infla(i,j,t)) + \beta_3(IP(i,j,t)) + \beta_4(Dis(i,j)) + \beta_5(rating(I,j,t)) + \beta_6Crisis + \beta_7Time$$

$Dif(i,j,t)$  : absolute value of the interest rate difference between country i and j at time t.

$exvol(i,j,t)$  : standard deviation of absolute value of the log changes in monthly exchange rate of country i against country j over the time period of 12 months around time t

$infla(i,j,t)$  : absolute value of the inflation rate difference between country i and j at time t. Alternatively,  $m(i,j,t)$ , as the absolute value of money stock growth rate differentials between country i and j, could be used to substitute  $infla(i,j,t)$  in estimating the model

$IP(i,j,t)$  : absolute value of the industrial production growth rate difference between country i and j at time t.

$Dis(i,j)$  : log distance between country i and j.

$Rating(i,j,t)$ : absolute value of the difference in the credit rating scores between country i and j.

$Crisis$ : dummy variable that has a value of 2 if a pair of countries experience financial crisis, 1 if one country has a financial crisis and the other does not, and 0 if both countries do not experience crisis.

$Time$ : time dummy

This model was modified from Moon and Yoon (2006), which originally tried to explain goods price differentials on the basis of exchange rate volatility, distance and income difference between a pair of countries. Given that the interest rate differential is now the dependent variable, we assume that it is affected by inflation differentials as well as the exchange rate volatility. Distance was included in the model to see whether it affects movements of financial capital as well as the movement of goods. Income difference was replaced by the differential of industrial production growth rate. The difference in credit rating scores was newly added to reflect differences in the political and credit risk structure of the two countries in question. Credit rating scores provided by the Standard and Poor's Corporation were transformed into numerical values (See Annex). Higher values for this credit rating difference reflect larger differences in credit risk between the two countries and greater difficulties in arbitraging interest rates between two countries.

In addition, two dummy variables were used. First, countries are separated based on whether they had undergone a financial crisis. If a pair of countries had experienced a crisis, the financial dummy was assigned a value 2, and if one country had a crisis while the other did not, the variable was given a value of 1. The financial dummy had a value of 0 if neither country had experienced a crisis. Secondly, the time variable was included to test whether the interest differentials tended to increase or decrease over time. If the coefficient for this

variable was negative, it meant that the interest deviation was decreasing over time, thus suggesting interest rate convergence.

Data was collected from 1990 Q1 to 2008 Q4 and a detailed description for the data used is as follows. Interest differentials were calculated on the basis of three month money market rates or call rates. For Korea, China, Hong Kong, the Philippines, and Thailand, IFS provided 3 month money market rates while 3 month treasury rate were used for Malaysia. All data was obtained from IFS except for data on Taiwan, which came from the Central Bank of Taiwan.

Data for exchange rates were obtained from Bloomberg. The spot rate was obtained for all Asian countries but the forward rate could not be found for all Asian countries. For instance, the forward rate could not be obtained for Indonesia or the Philippines, and consequently the future spot rate was used instead. Data for credit rating scores of Standard and Poor's Corporation for each Asian country were obtained from Bloomberg. Figures for distance were acquired from the website of John Haveman. Inflation differentials and industrial production differentials were calculated based on monthly growth rates for consumer price and industrial production indices, which were obtained from Global Insight. Finally, M2 data was obtained from IFS.

Table 1. Basic Statistics

	mean	SD	Max	Min	Number of Obs.
Dif(i,j,t)	0.053	0.088	0.950	0	3240
exvol(i,j,t)	0.020	0.029	0.251	0	3240
infla(i,j,t)	0.014	0.028	0.493	0.	3240
m(i,j,t)	0.029	0.031	0.282	0	3231
IP(i,j,t)	0.048	0.056	0.558	0	3119
Rating(I,j,t) <sup>1</sup>	1.774	1.305	9	0	2949

Note 1; The number 9 means AAA while the number 0 means D/SD in the rating.

## 2. Basic Regression Result

Table 2 shows basic estimation results for interest rate differentials. The estimation was conducted by means of OLS estimation with and without the time dummy. Since the time dummy was included to capture the time effect on interest rate differentials and to inspect convergence patterns in interest differentials over time, the OLS estimation with the time dummy ended up being more significant.

Table 2. Basic Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
constant	0.0025 (0.14)	-0.0096 (-2.83)	-0.0151 (-4.29)	6.0406 (10.78)	6.0353 (10.77)	5.4430 (9.52)
exvol	1.4053 (30.40)	1.4026 (30.44)	1.3125 (32.47)	1.3185 (28.63)	1.3163 (28.68)	1.4423 (31.15)
Infla	0.5460 (11.37)	0.5450 (11.36)		0.5878 (12.44)	0.5869 (12.43)	
m			0.1743 (3.85)			0.1717 (3.85)
Dis	-0.0015 (-0.71)			-0.0012 (-0.58)		
IP	-0.0935 (-3.17)	-0.0919 (-3.66)	-0.0339 (-1.35)	-0.0719 (-2.90)	-0.0706 (-2.86)	-0.0102 (-0.41)
Rating	0.0107 (10.28)	0.0056 (10.32)	0.0120 (11.37)	0.0111 (10.87)	0.0111 (10.90)	0.0125 (12.00)
Crisis	0.0101 (4.96)	0.0101 (4.96)	0.0111 (5.35)	0.0106 (5.30)	0.0106 (5.30)	0.0116 (5.70)
Time				-0.0030 (-10.78)	-0.0030 (-10.79)	-0.0027 (-9.55)
R2	0.38	0.38	0.35	0.40	0.40	0.37

Note: The figure in ( ) denotes the t-value.

As expected, the distance variable was not significant and implied that distance was not a meaningful proxy for transportation costs related to financial flows as it had been for goods market integration (Parsley and Wei (2001) & Moon and Yoon (2005)). Thus, once we focus on regression results that exclude the distance variable, all variables were significant. The interest rate differential between two countries was significantly affected by their credit rating score difference as wider differences in two countries' risk structure prevented arbitrage transactions and allowed both countries to maintain separate interest rate policies. The interest rate differential was also affected by inflation rate and production activity differences as well as exchange rate volatility. Reducing exchange rate variability was particularly important to decreasing interest rate differentials. For instance, according to column 2, reducing monthly exchange rate variability from the sample average 0.020 to zero would reduce interest rate differential by 0.028 ( $=1.4026 \times 0.020$ ), while an increase of exchange rate variability to its maximum value 0.251 would bring about an increase in price differentials by 0.324 ( $=1.4026 \times (0.251 - 0.020)$ ). Furthermore, the interest rate differential increased when country pairs showed a larger inflation gap. All these variables generally exhibited correctly signed positive coefficients. However, the coefficient of industrial production gap did not appear positive, although its significance was small compared to those of other variables. Since it is likely that the negative coefficient for production activity was due to its close negative correlation with inflation rate difference, we replaced inflation rate difference by the growth rate difference of money stock and re-estimated the

regression equation. Then, as seen in column 3 and 6, production growth difference lost its explanatory power.

In addition, two dummy variables were significant. The positive sign for the crisis dummy implied that countries experiencing currency crisis showed larger interest rate differentials. In fact, in the case of Korea, there was a sharp rise in short term interest rate due to induce foreign capital and under such situation it is extremely difficult to expect a regular arbitrage transaction. Lastly, the time dummy appeared to be very significant and the negative coefficient for the dummy meant that interest rate differentials tended to decrease over time. Indeed, financial markets in East Asia have become increasingly integrated to each other as well as to global markets.

### 3. Non-linearity Check

To consider possible non-linear effects of exchange rate volatility and differences in the credit ratings between two countries, we included the squared values of these variables as additional regressors. The estimation results presented in Table 3 suggest that these additional variables did not substantially improve the fitness of the model but the squares of exchange rate volatility and credit rating difference were nevertheless significant. The negative sign of the square of exchange rate volatility means that higher exchange rate volatility was associated with larger interest rate differentials but the incremental effect became smaller as volatility increased. In contrast, the positive sign of the square of credit rating difference and the consequent negative sign of the credit rating difference means that credit rating differences only widened interest rate differentials when the ratings difference was appreciably large.



Table 3. Non-linear Regression Results

	(1)	(2)	(3)	(4)
constant	5.9097 (10.66)	6.1121 (11.04)	5.4765 (8.96)	5.7934 (9.50)
exvol	2.2131 (19.79)	1.2949 (28.52)	2.2006 (19.83)	1.4042 (29.81)
(exvol)2	-4.4116 (-8.19)		-4.3457 (-7.66)	
Infla	0.6213 (13.25)	0.5966 (12.79)		
m			0.2607 (5.48)	0.2230 (4.75)
IP	-0.0694 (-2.84)	-0.0736 (-3.01)	-0.0054 (-0.21)	-0.0106 (-0.41)
Rating	0.0098 (9.64)	-0.0072 (-3.07)	0.0113 (10.59)	-0.0059 (5.18)
(Rating)2		0.0036 (8.63)		0.0036 (8.22)
Crisis	0.0096 (4.85)	0.0099 (5.03)	0.0101 (4.84)	0.0108 (9.51)
Time	-0.0029 (-10.69)	-0.0030 (-11.03)	-0.0027 (-9.00)	-0.0028 (-2.37)
R2	0.42	0.42	0.39	0.39

Note: The figure in ( ) denotes the t-value.

#### IV. Implication for Regional Monetary Cooperation

The preceding results suggest that East Asia economies have become increasingly integrated with one another as well as to world markets, and highlight the general importance of exchange rate stability. In reality, achieving exchange rate stability in relation to the US, and with Asian countries as a consequence, has been a critical priority of economic policy for a long time. To prevent excessive volatility in exchange rate changes and to cope with unforeseen crises, East Asian nations had to accumulate massive amounts of foreign reserves, which were eventually invested by Asian countries in U.S. government and agency securities. When U.S. banks subsequently recycled these investments by making their own bank loans to East Asia, they perpetuated a process that increasingly integrated the various financial markets of East Asia.

Thus, financial market integration would not have been possible without exchange rate stability. The so-called impossibility trinity theorem, however, states that individual efforts will not be enough to stabilize exchange rate. Moreover, the cost of intervening in exchange rate markets is huge and intervention itself can be dangerous as witnessed in 1997 and the more recently global financial crisis. Indeed, emerging countries like Korea are ever more

vulnerable to ebbs and flows in capital flows, which can be caused by investors' whims. For these reasons, international economic crises can be predicted to occur in the future as they have in the past.

While collective action for self-protection is a possible alternative to crisis in the current world of financial integration, such action requires one pre-condition: In case of financial turbulence, central banks need to acquire an emergency fund. One fundamental question in this regard is whether a special role for regional financial arrangement exists in addition to international systems such as the IMF. The onset of the current global financial crisis underscored the limits of the IMF as an international lender of last resort as the IMF's financial resource were limited to 250 billion US dollars and liquidity provisions coordinated by IMF came after the system's collapse as opposed to preempting large currency swings. Finally, harsh conditionality was another factor making access to the IMF very difficult.

Indeed, the stigma that only those Asian nations that failed in their economic policies borrowed from the IMF in the past now prevents these countries from utilizing similar funds to stabilize their economies. Korea's recent experience is a good example. In Korea, IMF emergency fund did not serve to stabilize the exchange market. In contrast, the October 2008 bilateral swap concluded by the Bank of Korea with the FRB in response to the global currency crisis proved to be more appropriate and effective.

Figure 5. IMF loan (27 Billion \$) to Korea

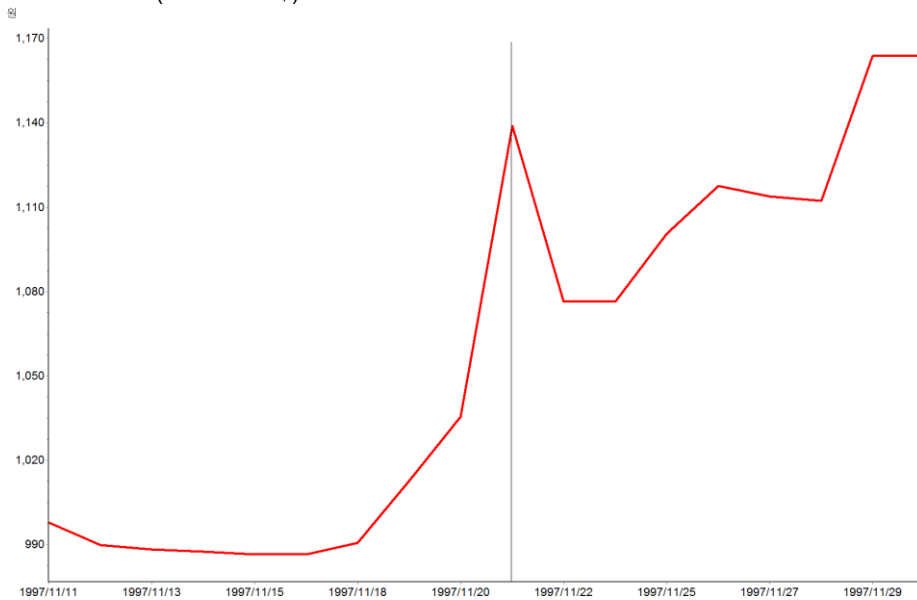
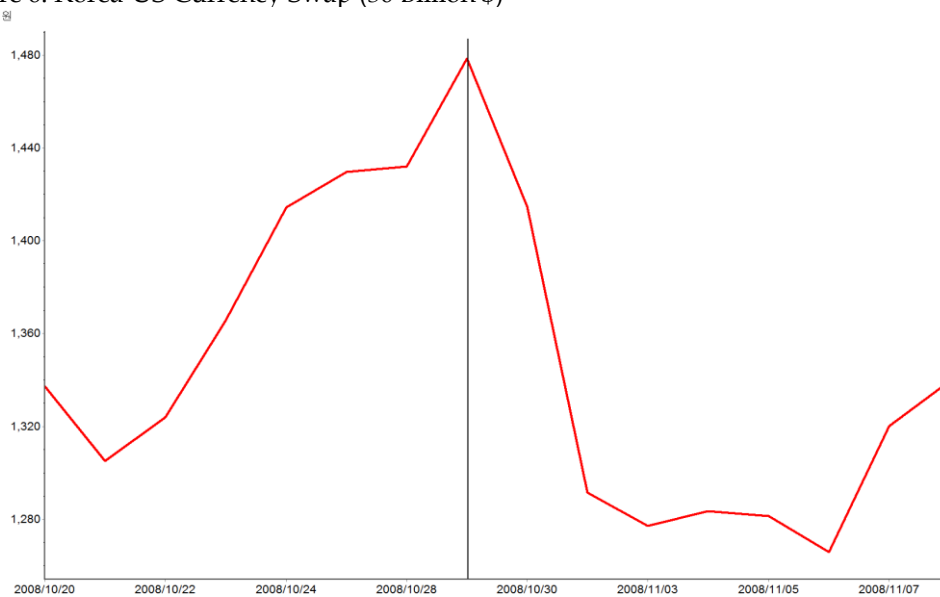


Figure 6. Korea-US Currency Swap (30 Billion \$)



At the G20 summit meeting held in London on April 2, 2009, the consensus was reached to reform the lending and conditionality framework of the IMF, increasing the financial resources of the organization to 750 billion dollars and introducing Flexible Credit Line as a new lending facility. Notwithstanding these measures, however, it is not apparent whether East Asian countries should continue to rely on the IMF. At least three arguments can be provided for a regional lender of last resort in East Asia. One is that international activity is not speedy enough to nip problems in the bud before crisis ensues. Furthermore, transaction costs in arranging a cooperative response may be lower at the regional level because the number of participating governments is smaller and the countries involved are more cohesive in nature. When significant problems appear within a region, these problems are often clustered because of intra-regional interdependence and regional institutions could redirect necessary resources more efficiently than an international institution with a broader range of tasks. Secondly, financial assistance from an international organization is usually not ample enough to achieve what ought to be achieved. For example, as evidenced by the recent global crisis, there was a shortage of disposable funds at the IMF, which eventually led to urgent increases in funding through the G-20 meetings. Thirdly, the activities and procedures of international institution are based on general rules and fail to give appropriate attention to regional peculiarities. To the extent that the unique characteristics of East Asian economies matter, a case can be made for regional arrangements (Eichengreen (2001)).

East Asian countries have endeavored to set up such arrangement. Known as the Chiang Mai Initiative (CMI), Asian countries have decided to initiate a swap arrangement between central banks in the region. The current Chiang Mai swap arrangement, however, is too limited to play an independent role apart from the IMF in helping Asian countries stabilize their currencies and defend speculative attacks. The IMF, moreover, controls 80% of the CMI's funds, thereby making the provision and distribution of funds impossible without prior IMF approval. It implies that the CMI is far from being a sovereign institution, and the recent agreement on CMI multi-lateralization, which may re-label the CMI as the CMIM or AMF, is only an intermediary step towards eventually establishing an effective regional lender of last resort.

Regional lender and global institutions can co-exist. The benefit of having a regional monetary institution is two-fold. First, it will free East Asian countries from the IMF's current monopoly over emergency loans. This competition would almost assuredly have valuable effects, as demonstrated by Europe's two parallel systems for supplying liquidity: The European Central Bank and the IMF. Second, the presence of a regional body would surely solidify the positions of individual Asian countries in international financial institutions. It should be noted, however, that the establishment of regional systems calls for a clear division of labor and responsibilities with the IMF. It would be desirable for the IMF to coordinate and supervise the financial authorities of each country while regional institutions focus more on supplying liquidity (See for example Wing Thyo Woo (2008))

## **V. Conclusion**

This paper examines financial integration in East Asia by measuring money market interest rate differences among 10 East Asian countries. Generally speaking, we could say interest rate convergence is gradually occurring in East Asia, although this trend was momentarily disrupted by the 1997 currency crisis. Korea's post-1997 experience was particularly interesting as Korea dramatically moved to open the capital account following the crisis, which led to burgeoning short-term capital inflows and interest arbitrage by foreign bank subsidiaries and domestic banks as well as some non-residents. All these contributed to financial market integration in Asia.

Nevertheless, there is considerable room for further regional financial integration since the degree of integration in East Asia remains far lower than that of Europe. The main impediment preventing future progress in East Asia is exchange rate volatility, which suggests that exchange rate stability is an important precondition for successful money market integration. In the present world of financial globalization, however, individual efforts to stabilize exchange rate will not be enough and collective action for self-protection will be the only possible alternative. This collective action is above all to establish a regional monetary institution. Through it, Asian countries could acquire an emergency fund in case of financial crises and a regional lender of last resort would be a desirable if not essential system coexistent with global institutions such as IMF. Europe's two systems for supplying liquidity, the European Central Bank and the IMF, could be a good model for East Asia to consider.

## References

- Adam, K., Jappelli T., Menichini A. M., Padula M., and M. Pagano (2002), "Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union," Report to the European Commission
- Baele, L., A. Ferrando, P. Hordahl, E. Krylova and C. Monnet (2004), "Measuring Financial Integration in the Euro Area," Occasional Paper no. 14, European Central Bank, April.
- Cavoli, T., R.S. Rajan and R. Siregar (2004), "A Survey of Financial Integration in East Asia; How Far? How Much Further to Go," Center for International Economic Studies, University of Adelaide Discussion Paper No. 0401
- Cheung, Y.S and Chinn & Fuji (2003), "China, Hong Kong and Taiwan: A Quantitative Assessment of Real and Financial Integration," *China Economic Review* 14, pp. 281-303:
- Cowen, D. et al. (2006), "Financial Integration in Asia: Recent Developments and Next Steps," IMF Working Paper, WP/06/196
- Flood, Robert P. and Andrew K. Rose (2001), "Uncovered Interest Parity in Crisis: The Interest Defense in the 1990s",
- Ito, H. and M. Chinn (2007), "Price-Based Measurement of Financial Globalization: A Cross-Country Study of Interest Rate Parity", *Pacific Economic Review*, Vol. 12, Issue 4, pp. 419-444
- Laura Vajanne (2006), "Integration in euro area retail banking markets - convergence of credit interest rates," Working Paper 8-2006, Bank of Finland
- Martin, M. (2008), "East Asia's Foreign Exchange Rate Policies," CRS Report for Congress, April 10
- Moon, W. and Y. Rhee (2009), "Financial Integration and Exchange Rate Coordination in East Asia", in D.K. Chung and B. Eichengreen (eds.) *Fostering Monetary and Financial Cooperation in East Asia*, April. World Scientific Publishing Co.
- Moon, W. and D. Yoon (2005), "Market Integration and Price Convergence in East Asia", *Journal of Korean Economic Analysis*, vol. 12, No.3 (In Korean)
- Parsley, D. and Shan-Jin Wei (2001), "Limiting Currency Volatility to Stimulate Goods Market Integration: A Price Base Approach," NBER Working Paper, no 8468.
- Parsley, D. and Shan-Jin Wei (2003), "How Big and Heterogeneous Are the Effects of Currency Arrangements on Market Integration? A Price Based Approach," September
- Rajan, Ramkishan S. (2006), "Asian Exchange Rate Regimes Since the 1997-8 Crisis," Background paper for the Institute of Policy Studies, Singapore, September

- Rogers, John H. (2000), "Price Level Convergence and Inflation," mimeo, Washington D.C., Board of Governors of the Federal Reserve System
- Soesastro, Hadi (2006), "Regional Integration in East Asia: Achievements and Future Prospects," Asian Economic Policy Review. 1. 2006
- Wing Thye Woo (2008), "What the US and Asia should do: Establish a global financial crisis secretariat and an Asian Financial Facility," downloaded from [www. brookings.edu](http://www.brookings.edu)

### Annex: Table for transforming the S&P ratings into numerical values

AAA	9.00	B	4.00
AA+	8.33	B-	3.66
AA	8.00	CCC+	3.33
AA-	7.66	CCC	3.00
A+	7.33	CCC-	2.66
A	7.00	CC+	2.33
A-	6.66	CC	2.00
BBB+	6.33	CC-	1.66
BBB	6.00	C+	1.33
BBB-	5.66	C	1.00
BB+	5.33	C-	0.33
BB	5.00	D/SD	0.00
BB-	4.66		
B+	4.33		



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