

Procyclicality of Buffer Capital and Its Implications  
for Basel II: A Cross Country Analysis\*

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은행 자기자본의 경기순응성에 대한 국제비교분석과  
Basel II에 대한 시사점

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## ABSTRACT

This paper investigates the cyclical patterns of buffer capital using an unbalanced panel data for the banks in 30 OECD countries and 7 non-OECD Asian countries. We test whether the relationships between buffer capital and business cycle are systematically different across country groups controlling for other potential determinants of bank capital. We find that the correlation is positive for developed countries while it is negative for Asian developing countries. These findings suggest that, once Basel II is implemented, developing countries are more likely to observe an increase in output volatility. We then review the policy recommendations to mitigate the procyclicality problem of Basel II.

본 연구는 30개 OECD 회원국과 7개 아시아 국가 은행들의 재무제표를 통해 구축된 불균형 패널자료를 이용하여 은행 자기자본의 경기순환적 패턴을 살펴본 것이다. 특히 은행의 잉여자본과 경기순환 간의 관계가 다른 자기자본 결정요인들의 영향을 고려한 후에도 국가 그룹별로 체계적인 차이를 나타내는지 분석하였다. 실증분석 결과, 선진국 은행들에서는 잉여자본과 경기순환 간에 양(+)의 상관관계가 있으며,

아시아 개도국 은행들에서는 잉여자본과 경기순환 간에 음(-)의 상관관계가 있는 것으로 나타났다. 이는 신바젤자기자본협약(Basel II)이 도입될 경우 개도국에서 경기의 변동성이 더욱 확대될 가능성이 높음을 시사한다. 본 연구는 이와 같은 분석을 바탕으로 은행대출의 경기순응성 문제를 완화하기 위한 감독정책 방안들을 점검하였다.

## I. Introduction

The new Basel accord (Basel II) is expected to promote stability in banking system by providing guidance on key banking supervisory issues. The new approach to bank capital regulation, at the same time, raises concerns from a macroeconomic standpoint. In particular, it has been repeatedly pointed out that the new regulation framework is likely to amplify business cycle fluctuations. Under the new Basel II framework, the required capital is designed to be in relation to the risks that banks would encounter. In recessions, therefore, banks should hold more capital against the existing loan portfolio because higher credit risk downgrades existing borrowers. To the extent that financing external capital is costly, banks are forced to contract lending activity which, in turn, might exacerbate economic downturn. This multiplier effect is a financial regulation based propagation mechanism: an initial shock to the economy is amplified through a contraction in lending induced by bank capital regulations.

This argument focuses on the procyclicality of required capital, but most banks actually hold excess capital well above the required minimum. If excess capital or buffer capital fluctuates in a way that mitigates the multiplier effect, the concerns about procyclicality could be overstated. Previous research such as Ayuso, Perez, and Saurina (2004) contend that potential risks are increased during boom before they are materialized in recessions. They argue that a positive correlation between buffer capital and business cycle is consistent with forward-looking behavior of banks. Forward-looking banks increase buffer capital during booms as they properly take into account the potential risks that may accrue during booms. A negative correlation, in contrast, suggests that banks underestimate risks over the business cycle.

Motivated by Ayuso, Perez, and Saurina (2004), this paper investigates the cyclical patterns of buffer capital using an unbalanced panel data for the banks in 30 OECD countries and 7 non-OECD Asian countries. In particular, we test whether the relationships between buffer capital and business cycle are systematically different across country groups controlling for other potential determinants of bank capital. We find that, in the periods of high economic growth, the buffer capital ratio rises in developed countries while it declines in developing countries. These findings suggest that, once Basel II is implemented, developing countries are more likely to observe an increase in output volatility. Empirical evidence, therefore, offer a support to the presumption that developing countries need more careful policy responses than developed countries.

Indeed, the concerns about the adverse macroeconomic effects appear to be more serious in developing countries. Since capital market is less developed and thus firms are more bank-dependent in developing countries, it is more difficult for firms to find an alternative source of funds when the supply of bank credit decreases. In developing countries, therefore, the risk-sensitive capital regulation is likely to exacerbate economic recessions more severely. Moreover, banks' lending decisions

in developing countries are heavily dependent upon collateral values that borrowers can provide. As far as asset prices move along business cycle, asset prices and collateral values decrease in recessions, and thus, affect bank lending and business cycle.

This paper is organized as follows. Section II reviews the procyclicality issue of bank lending associated with financial regulation and provides background motivations in the context of Basel II. Section III presents the regression model and reports the empirical results. Section IV discusses the supervisory responses suggested in previous studies, and finally, Section V is the conclusion.

## II. Procyclicality of Bank Lending and Basel II

### 1. Procyclicality of Bank Lending and Financial Regulation

Bank lending is expected to exhibit procyclical behavior as the demand for and the cost of bank loans fluctuate over business cycle. The demand for bank loans should be procyclical as firms' production and investment and households' consumption are inherently procyclical. The costs to raise funds for lending fluctuate counter-cyclically, leading the supply of bank loans procyclical. Moreover, prudential regulation on financial institutions is also pointed out as another factor that reinforces the procyclicality of bank lending. In particular, the regulation of minimum capital requirement has been a long-standing concern for supervisory authorities in that the pressures on bank capital in recession could lead to further cutbacks in bank lending. On the relationship between capital regulation and bank lending, academics and policy circles point out that the impact of capital regulation on the procyclicality of bank lending depends on (i) the appropriateness of the risk assessment by banks over business cycle and (ii) the sensitivity of regulatory measures (e.g. minimum capital requirements) to the estimated risk.

First, if the assessment of risk fails to take into account its dynamic time-varying aspect at each point of time, bank lending would exhibit more procyclical behavior. When a short horizon is used for measuring risk, as in most internal rating models of banks, the estimated risk tends to be negatively correlated with business cycle. Therefore, the estimated risk is higher in recessions, which decreases loan supply. On the contrary, risk assessment with longer-term horizon would contribute to smoothing the estimated risk and the loan supply over business cycle (Borio *et al.*, 2001).<sup>1</sup>

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<sup>1</sup> It is known that there are at least two industry standard rating methods used by banks which may lead to a different amount of variability in ratings in a recession. One is the point-in-time (PIT) method and the other is the through-the-cycle (TTC) method (Borio *et al.*, 2001, Catarinew-Rabell *et al.*, 2003, Kashyap and Stein, 2004). First, under a rating scheme with the PIT method, the current equity price of the borrower and current information on the borrower's liabilities are used to calculate the probability of its default, therefore credit ratings may well show more variability as economic conditions change and the average rating of a bank's loan portfolio is likely to change over the course of business cycle. For

In addition, if bank lending is highly dependent upon collateral values, a decrease in collateral values reduces loan supply in recessions as far as asset prices fluctuate over business cycle. Likewise, higher loan-to-value (LTV) ratio is likely to cause larger swings in bank lending since higher LTV ratio implies greater changes in new lending given the changes in asset prices.

Second, in general, a more risk sensitive financial regulation results in more procyclical bank lending. In order to cover the expected loss (EL) of their loan portfolio, banks are required to make provisions which tend to show a cyclical pattern. Given the accounting and tax constraints along with the methodologies used to measure risk, banks increase provisions in economic downturns. Thus, the marginal cost of bank lending rises in recessions, which leads to more procyclical bank lending. To cover the unexpected loss (UL) in a certain time horizon, supervisory authorities require banks to hold sufficiently large amount of bank capital. In recessions, an increase in the cost of capital leads banks to cut back lending rather than to increase their own capital to meet the capital adequacy ratio. Thus, more risk-sensitive capital regulations have the potential to lead to larger changes in capital requirements and larger swings in bank lending over business cycle.<sup>2</sup>

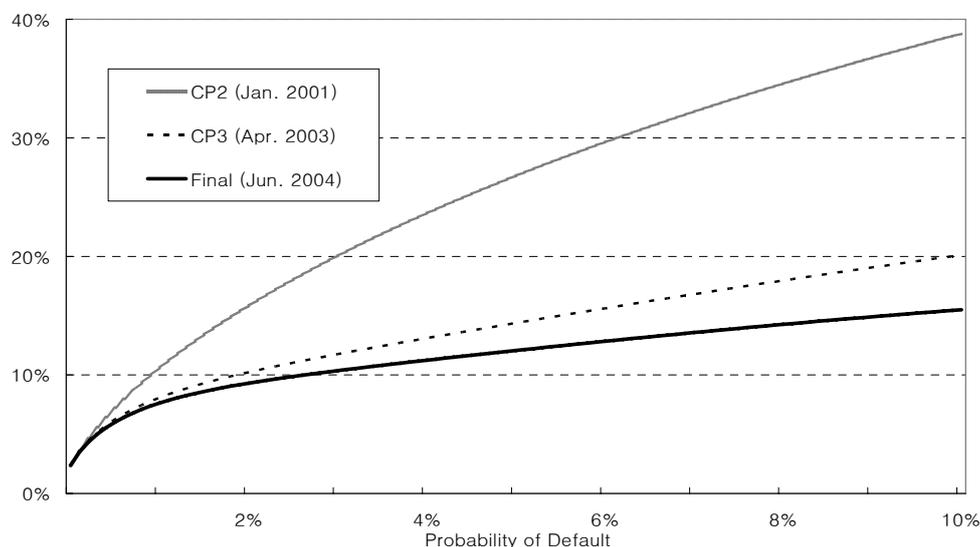
## 2. The Effect of Basel II on the Procyclicality of Bank Loans

The New Basel Accord (Basel II) reinforces the capital regulations by applying diversified risk weights according to the creditworthiness of the borrowers. One of the main objectives underlying the Basel II is, therefore, to substantially increase the risk sensitivity of the regulatory capital (that is, minimum capital requirements) for banks. Considering that credit risk of bank portfolio tends to increase during an

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example, when economic conditions are favorable, loans are likely to move up the rating scale to higher-ratings given that the probability of default in the next year (one year horizon) is relatively low. Thus the nature of PIT credit rating system means that it does not take possible changes in economic climate into account. As a result, measured risk would be negatively correlated with business cycle. Second, a rating scheme with the TTC method measures borrowers' probability of default in a constant hypothetical downside scenario and classifies borrowers with similar (stressed) probability of default to the same rating grade. Thus, credit ratings are likely to remain through the business cycle, which means that credit rating scheme designed to give less variability in ratings in response to changes in economic conditions. However, even with the TTC method, an economic downturn that is worse than expected (as in stress scenario) is likely to lead to overall ratings being downgraded simultaneously, and thus we cannot exclude the possibility that the procyclicality of bank lending significantly increases. Although some banks have chosen to adopt rating systems which are modeled on the approach taken by the rating agencies, most internal rating systems of banks tend to use the PIT method, and most credit rating agencies use the TTC (through-the-cycle) method.

<sup>2</sup> Even if capital requirement is not procyclical, bank capital ratios might still fall in boom and increase in recessions owing to market-based pressures (Borio et al., 2001). Banks believed that, after experiencing problems in particular, the banks needed to demonstrate their financial strength and their commitment to better risk management, and one way of doing so is to report high capital ratio, even if this meant severely cutting back the size of the balance sheet and sacrificing long-term banking relationships.

**[Figure 1] Capital Requirements for Corporate Exposures under Basel II**

- Note: 1) The Capital Requirements are calculated using the formula under the Advanced Internal Ratings Based (A-IRB) Approach
- 2) CP2 assumes that LGD is 50%, maturity is 3 years, 99.5% confidence level, following the calibration of the Second Consultative Paper (CP2), and includes Expected Loss (EL).
  - 3) CP3 assumes that LGD is 45%, maturity is 2.5 years, 99.9% confidence level, following the calibration of the Third Consultative Paper (CP3), and includes Expected Loss (EL).
  - 4) Final assumes that LGD is 45%, maturity is 2.5 years, 99.9% confidence level, following the calibration of the Third Consultative Paper (CP3), excludes Expected Loss (EL), and considers Unexpected Loss (UL) only.

economic downturn, the minimum required capital depends on the business cycle, especially when banks are under the risk-sensitive capital regulations such as Basel II (Catarinew-Rabell *et al.*, 2003). In recessions, as bank profitability decreases and the cost of raising new capital rises, an increase in capital requirement would force banks to reduce their lending or curtail the supply of new loans, thereby further deepening economic downturns or prolonging recessions. Thus, the procyclicality of bank lending appears to be more serious under Basel II.

Basel II offers two approaches for the setting of credit risk-based capital requirements: Standardized Approach and Internal-Ratings Based Approach. Under the Standardized Approach (SA), banks will be permitted to make use of external credit ratings provided by the acknowledged rating agencies, so called ECAI (external credit assessment institution), to apply different risk weights that ranges from 20% to 150%. Since rating agencies consider firms' profitability and growth potential, which are inherently procyclical, the ratings generally tend to move upward (downward) in expansions (recessions).

Under the Internal-Ratings Based (IRB) Approach, banks are allowed to use internal ratings of credit risk to calculate minimum required capital, which uses more sensitive risk weights ranging from as little as 3% to as much as 600% and more. As the risk factors including the probability of default (PD), loss given default (LGD), and exposure at default (EAD) tend to increase in expansions and decrease in recessions, it is quite natural to expect greater cyclicity of the minimum capital requirements. In further, since credit ratings measured by banks' internal model using PIT method are known to be more volatile than those by rating agencies using the TTC method over business cycle, more banks are expected to choose IRB Approach, and thus, bank lending is likely to become more procyclical.

At an earlier stage when the first draft of the Basel II was released, extensive debates have been prompted in policy circles concerning the potential procyclicality effect of bank loans due to the more risk sensitive capital requirements. For instance, Segoviano and Lowe(2002), Borio *et al.*(2001), and Turner(2000) argue that implementation of Basel II significantly extends the procyclicality of bank lending, and thereafter, economies are most likely to have larger swings in business cycle, which will negatively affect the stability of financial system.

Several studies also back up the argument by providing the simulation results that the minimum capital requirement may fluctuate more counter-cyclically under Basel II. The simulation results suggest that bank lending may become more procyclical. For example, Segoviano and Lowe (2002) use a transition matrix constructed with internal credit ratings of banks in Mexico to examine how capital requirements might have changed over time if Basel II's Foundation IRB (F-IRB) Approach had been in place. They conclude that minimum capital requirement could have increased significantly in the aftermath of the Peso Crisis in December 1994 and that if actual capital shows the same cyclical variation under the New Accord, business cycle fluctuations may be amplified.<sup>3</sup> Moreover, Catarinew-Rabell, *et al.* (2003) also examine the potential procyclicality of bank loans to find that the likelihood of sharp increase in capital requirements in recessions could be bigger under Basel II when rating schemes of banks are conditioned on the current point in the cycle (i.e. PIT type), but rating schemes designed to be more stable over the cycle (i.e. TTC type), akin to those of the external rating agencies, would increase procyclicality in a smaller scale.

Recognizing the importance of possible procyclical effects of the New Accord, the Basel Committee made various modifications to mitigate the problems. For example, the slope of risk-weight curve to the default probability of corporate loans had been lowered, which implies that the new capital requirements are less risk sensitive than earlier proposals. Banks are also allowed to treat some types of SME loans as retail loans, which need lower capital requirements and are less risk sensitive.<sup>4</sup> For the

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<sup>3</sup> According to Hong (2004), this result might be an overestimate as the proportion of rated corporate exposures in developing countries is reported as being close to 20% on average. In the result of the BIS's second Quantity Impact Study (QIS 2), the proportions of rated corporate exposures are reported as 29% for G10 and EU banks, but 19% for banks in other regions.

<sup>4</sup> The idea is that dispersion of small loans over many counterparties in the retail portfolio may have smaller credit risk than the same size of portfolio consisted of corporate loans.

banks to adopt the IRB Approach, it is recommended that they consider the business cycle effects when making decisions on the borrowers' credit ratings, which implicitly encourage banks to estimate TTC ratings instead of PIT ratings. In addition, the Committee has emphasized that adequate stress testing under the Pillar 2 would dampen the cyclical impact of Basel II since banks need to show that their capital is sufficient to cope with a recession without a reduction in their lending.

It is not still clear, however, whether these modifications would sufficiently reduce the procyclicality of bank lending in developing countries. The impact of the modification may differ across countries.<sup>5</sup> Compared to advanced countries, the sophisticated financial techniques are less developed and the risk profiles of asset portfolios are different in developing countries.<sup>6</sup> Extending the scope of Segoviano and Lowe (2002), Hong (2004) concludes that similar findings about procyclicality of bank lending under Basel II would hold in Korea. In utilizing corporate exposure data for a major Korean bank (including borrowers' internal ratings, credit scores, historical default rates, outstanding exposures, and overdue status), he found though the SA of Basel II is not likely to raise minimum capital requirements to any great extent in Korea, the capital requirements under the F-IRB Approach would have increased significantly in the recession after the 1997 Crisis, if Basel II had been in place in Korea. He argues that Advanced IRB (A-IRB) Approach with PIT type credit risk models is likely to lead to much more volatile capital requirements than the F-IRB Approach. He also argues that the potential impact of Basel II on the movement of capital requirements would be significant for developing countries in recessions and that the advanced approaches of Basel II may not provide incentives for the banks in developing countries to reduce regulatory capital requirements since the calibration and revisions of Basel II have not been based on a broader area of samples that include those banks.

Meanwhile, we observe that most banks maintain excess capital (buffer capital) over the required minimum. Using a large data set of OECD countries, Bikker and Metzemakers (2004) present that between 1994 and 2001, the median BIS ratio fluctuated for around 12.2%, an ample 50% above the minimum.<sup>7</sup> These observations underline that banks have incentives to set a target level of capital above the required one. Banks may assess the risk of their asset portfolio as being higher than the outcome of the Basel I scheme. Or they may be more risk averse and wish to hold capital buffers for funding at lower costs. Banks also have incentives to keep buffers above the required minimum capital adequacy ratios, both for their

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<sup>5</sup> Note, however, that Goodhart *et al.* (2004) find that procyclicality may well still be a serious problem with Basel II even after the smoothing of the risk curves using Moody's data for the USA from 1982 to 2003, for Norway from 1988 to 2001, and for Mexico from 1995 to 2000.

<sup>6</sup> Similar points about the impact of Basel II on developing countries were made by Powell (2002). He claims that developing countries are most likely to have difficulties in implementing Basel II because the calibration of capital requirements for IRB Approaches does not consider the risk profiles or lending practices of banks in those countries. Also see Segoviano and Lowe (2002).

<sup>7</sup> Under the Basel I, the first Basel Accord on minimum capital requirements for internationally active banks that introduced in 1988, a bank's actual capital as a percentage of its risk-weighted assets (BIS ratio) must not fall below 8%.

protection against sanctions taken by supervisory authorities and to satisfy rating agencies.

Given that most banks hold sizable buffer capital, the capital requirement under Basel II may not be a binding constraint on banks' lending operations. If banks' capital targets are generally well above the minimum requirements and the buffer capital fluctuates in a way that reduces the volatility of capital, the procyclicality of bank loans would be mitigated. If banks hold buffer capital to cover the risk more than implied by Basel I, the procyclicality would increase only to a limited degree under Basel II. Therefore, findings of previous studies based on the regulatory capital without any considerations on the buffer capital do not provide sufficient evidence to address the potential problems of the procyclicality. Therefore, it is important to investigate the movement of buffer capital as well as the minimum required capital since bank lending depends not only on the regulatory capital but also on the buffer capital.

### III. Empirical Analysis

#### 1. Motivation

This section empirically investigates the cyclical patterns of buffer capital using an unbalanced panel data for the banks in 30 OECD countries and 7 non-OECD Asian countries. For instance, the Ayuso, Perez, and Saurina (2004) contend that potential risks are increasing during booms before they are materialized in recessions. They argue that a positive correlation between buffer capital and business cycle is consistent with forward-looking behavior of banks. Forward-looking banks increase buffer capital during booms as they properly take into account the potential risks that may accrue during booms. A negative correlation, in contrast, suggests that banks underestimate risks over the business cycle. Accordingly, we may expect that the procyclicality issue is more serious if buffer capital fluctuates counter-cyclically.

Our main objective is to investigate whether the relationships between buffer capital and business cycle are systematically different across country groups controlling for other potential determinants of bank capital. In further, Ayuso, Perez, and Saurina found significant negative relationship using a sample of Spanish commercial and savings banks for the period of 1986-2000. Lindquist (2004) also reports that buffer capital is negatively correlated with economic growth in Norwegian bank-level panel data. As admitted in the previous research, however, it is difficult to generalize the conclusions from a single country study. To our knowledge, Bikker and Metzmakers (2004) is the only comparable study that uses an international data set, but their sample consists of the banks in advanced countries only.

Indeed, it is often argued that the adverse impacts of the new risk-sensitive bank capital regulation on business cycle fluctuations appear to be larger in developing countries. Since capital market is less developed and thus firms are more bank-dependent in developing countries, it is more difficult for firms to find an

alternative source of funds when the supply of bank credit decreases. Recently, Huizinga and Zhu (2006) examine how financial structure matters for macroeconomic volatility and find that aggregate output is more variable in case of heavy reliance on debt financing. Their study indicates that countries with less developed capital market would experience more volatile business cycle.

Moreover, we can imagine that asymmetric information problems between lenders and borrowers are severe in developing countries. Reliable information on firms' credit risk, in particular on small firms' risk, is not largely available in developing countries. Banks' lending decisions in these countries, therefore, depend heavily on collateral values that borrowers can provide. Theories on credit cycles predict that collateral-based lending practice can generate a finance-based propagation mechanism through which business cycle fluctuations are amplified. In recessions, a fall in asset prices lower the collateral values and thereby reduces the amount of bank loans. The decrease in bank loans, in turn, aggravates business cycle downturns. Pro-cyclical collateral values along with banks' lending practice intensify the concerns about the adverse impacts on business cycle.

## 2. Empirical Specification and the Data

Based on Ayuso, Perez, and Saurina (2004) and Bikker and Metzmakers (2004), we estimate the following reduced-form equation,

$$BUF_{ijt} = \alpha + \beta_1 BUF_{ijt-1} + \beta_2 ROE_{ijt} + \beta_3 NPL_{ijt} + \beta_4 SIZE_{ijt} + \beta_5 LOAN_{ijt} + \beta_6 ROA_{ijt} + \gamma GDP_{jt} + e_{ijt},$$

where  $i, j, t$  denote bank, country, and time, respectively. The dependent variable, BUF, is the buffer capital ratio defined as a bank's buffer capital (total capital less required capital) divided by its required capital. ROE is the return on equity and NPL is the ratio of non-performing loans (impaired loans) to total loans. SIZE denotes the log of total asset and LOAN is the loan growth rates. ROA denotes the return on asset. GDP is the deviation of GDP growth rate from its country specific average. Other than these variables, we also include country dummies and year dummies to control for idiosyncratic country characteristics and year specific global business cycle factors.

We define the buffer capital ratio in the same manner as in Ayuso, Perez, and Saurina (2004), while Lindquist (2004) uses a ratio of buffer capital to risk-weighted asset. Given that the required capital amounts to eight percent of risk-weighted capital, however, these two buffer capital ratios are essentially the same. Moreover, it is worthwhile to note that the buffer capital ratio, whether excess capital is normalized by required capital or risk-weighted capital, also corresponds to a simple transformation of BIS capital ratio (capital divided by risk weighted asset). Therefore, replacing buffer capital ratio with BIS capital ratio should yield the same empirical results qualitatively and thus economic interpretation on the behavior of buffer capital ratio should also be valid for the behavior of BIS capital ratio.

The empirical model in this paper is consistent with a simple partial adjustment model, in which a bank's current buffer capital ratio adjusts to its optimal level.

Motivated by real investment models, Ayuso, Perez, and Saurina (2004) provide a theoretical background derived from a cost minimizing problem of a representative bank. Estrella (2004) also presents a dynamic model of optimal capital in which banks minimize costs associated with failure, holding capital, and flows of external capital.

Following the previous literature, we also assume that a representative bank sets its optimal buffer capital ratio taking into account the trade-off between cost of capital and default probability. More capital incurs higher cost of holding capital. In addition, theories on asymmetric information predict that raising capital is more costly than other types of liabilities. More capital, on the other hand, may reduce the probability of failure, and thereby, reduce the bankruptcy costs. Moreover, if banks fail to meet capital requirements, supervisory authorities usually place some restrictions on bank's activity and thus banks might lose reputation.

We assume that the cost of capital is proportional to the level of capital and approximated by the returns on equity (ROE). To the extent that ROE reflects the cost of raising and holding capital, ROE has negative correlation with buffer capital ratio. We expect that NPL proxies for the risks that banks may face. Banks with higher probability of default may need to increase the buffer capital ratio. However, since NPL is an ex post measurement of the risks assumed by banks, banks with higher NPL need to hold more capital to keep their capital adequacy ratio above the required minimum and thus less buffer capital. Therefore, the expected sign of the coefficient on NPL is negative.

Additionally, we also consider a bank's size variable defined by the log of a bank's asset in the regression. Lindquist (2004) provides several channels by which bank size affects the buffer capital ratio. First, scale economies enable large banks to reduce monitoring and screening cost and thereby lower optimal level of capital. Second, large banks are generally able to easily diversify the risks and thus be able to keep buffer capital ratio lower than small banks. Third, according to the 'too big to fail' hypothesis, large banks may believe that they will receive support from the regulators.

In addition, we include loan growth rate and ROA in the regression. Suppose that total capital is constant or adjusting capital is very costly. Then, an increase in loans implies an increase in required capital and a decrease in buffer capital, which lowers buffer capital ratio. Therefore, as far as loan growth is procyclical, buffer capital ratio is likely to be negatively correlated with business cycle. Including loan growth rate allows us to examine additional cyclical pattern of buffer capital, controlling for this possibility of mechanical negative correlation. We include ROA for similar reason as ROA indicates the ability to retain earnings which is an important part of capital.

While these bank balance sheet variables characterize the factors that may affect optimal capital level, the lagged dependent variable captures the adjustment cost. Previous theoretical and empirical literature that studies procyclical aspect of bank capital use partial adjustment model to find a non-negligible adjustment cost.

Our main purpose of the regression analysis is to investigate the relationship between buffer capital ratio and the business cycle, controlling for other potential determinants of buffer capital ratio. The coefficient estimate on GDP growth

provides evidence on how the banks have changed buffer capital over the business cycle. We further investigate whether the cyclical pattern of buffer capital ratio is different between advanced countries and emerging market Asian countries. To do this, we construct regional dummy variables to test for the differential effect of business cycle on the buffer capital which include Asian countries include Hong Kong, Singapore, Taiwan, Thailand, Malaysia, Indonesia, Philippines, and Korea.<sup>8</sup> Among the OECD countries, we select and construct a dummy variable for Basel committee member countries which are believed to have more advanced banking industry.<sup>9</sup>

We obtain bank balance sheet data from the Bankscope database and GDP series from the International Financial Statistics. The sample consists of large commercial banks from 37 countries with valid information on capital, total asset, loans, ROE, ROA, non-performing loans over the 1995-2004 period.<sup>10</sup>

### 3. Estimation Results

Table 1 presents the sample mean of the bank characteristics for each country group. The average buffer capital ratio in our sample is 50.6% which is equivalent to 12.1% of BIS capital ratio. Banks in Asian countries maintain much higher buffer capital and BIS capital ratio than OECD countries during the sample period. The outbreak of East Asian financial crisis in 1997 and the subsequent restructuring of financial institutions in East Asia could cause higher buffer capital ratio in the region, yet the number is still above 70% over the period 2002-2004. Financial crisis also explains high non-performing loan ratio (NPL) in Asian countries.

The profitability of banks in Asian countries, however, is lower than OECD countries: ROE for the banks in Asian countries recorded 7.4% on average, which is lower than 11.3% in OECD countries and 15.6% in the US. Loan growth rate is also lower in Asian countries compared to other advanced countries.

We first examine how buffer capital ratio has changed over the business cycle on average. Table 2 reports the coefficient estimates on bank characteristics and GDP with the associated t-values. The second column shows the estimation results from pooled OLS with country dummy variables and year dummy variables. Since the correlation between GDP and year dummy variable may affect the coefficient estimate on GDP, we re-estimate the equation without year dummy variables. The result for this exercise is reported in the third column (Model II). We also attempt to estimate cyclical pattern of buffer capital ratio excluding loan growth which is also believed to be procyclical and thus affect the coefficient on GDP (Model III).

The coefficient on the lagged buffer capital ratio is estimated significantly,

<sup>8</sup> Although Korea is an OECD member, we classify Korea as an Asian country.

<sup>9</sup> Basel committee member countries are Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland, UK, and the US.

<sup>10</sup> Some outliers are excluded from the sample. The sample requires that BIS capital ratio is between 0 and 0.3, ROE is between -50% and 100%, NPL is less than 50%, and loan growth rate is between -100% and 100%.

**<Table 1> Sample mean of bank characteristics**

	Total	OECD	Basel	US	Other OECD	Asia
BUF	50.56	47.79	47.62	58.41	50.08	80.87
BIS	12.05	11.82	11.81	12.67	12.01	14.47
ROE	10.97	11.30	11.11	15.59	13.81	7.35
NPL	3.31	2.89	2.90	0.68	2.79	7.95
SIZE	8.66	8.66	8.57	8.54	9.87	8.70
LOAN	9.65	9.81	9.37	12.13	15.51	7.90
ROA	0.90	0.92	0.91	1.32	0.95	0.69

Source: Bankscope database

**<Table 2> Estimation results I**

	Model I	Model II	Model III
Constant	44.919 (2.22)**	44.202 (2.34)**	21.304 (1.19)
Lagged Dep. Var.	0.641 (9.65)***	0.641 (9.67)***	0.645 (9.67)***
ROE	-0.543 (-3.34)***	-0.534 (-3.34)***	-0.559 (-3.37)***
NPL	-0.281 (-1.61)	-0.277 (-1.60)	-0.032 (-0.18)
SIZE	-0.518 (-1.73)*	-0.539 (-1.75)*	-0.255 (-0.85)
LOAN	-0.298 (-9.71)***	-0.296 (-9.87)***	
ROA	10.030 (4.18)***	9.927 (4.18)***	9.859 (4.00)***
GDP	0.159 (0.75)	0.005 (0.03)	0.225 (0.97)
Country dummy	Yes	Yes	Yes
Year dummy	Yes	No	Yes
No. observation	3907	3907	3907
R <sup>2</sup>	0.70	0.70	0.69

Note: Numbers in parentheses are t-values. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% confidence levels.

suggesting a substantial adjustment cost. The coefficient estimate on ROE, a proxy for the cost of capital, is negative and statistically significant, implying that higher cost of capital has a negative impact on bank's capital accumulation. The buffer capital ratio, however, is not correlated with our risk proxies. The coefficient estimate on NPL has a negative sign as expected, though statistically insignificant.

Meanwhile, we find that the coefficient on SIZE is negative, though significant only at 10% level. It predicts that large banks are more likely to hold less buffer capital. As mentioned above, the negative size effect is consistent with economies of

scale, the ability to diversify risks, or 'too big to fail' hypothesis. Previous studies also report negative size effect. As expected, we find buffer capital ratio is negatively correlated with loan growth rate and positively correlated with ROA.

Now we turn to the estimated relationship between buffer capital and business cycle. Model I in Table 2 shows that coefficient estimate on GDP is 0.16, but not statistically significant, implying that, on average, buffer capital ratio is not correlated with business cycle. Since the estimation results in Model II and Model III are qualitatively the same, we conclude that year dummy variables or loan growth rate do not affect the estimated cyclical aspect of buffer capital ratio.<sup>11</sup>

The findings in Table 2 suggest that, in general, buffer capital ratio does not fluctuate systematically over the business cycle. Nevertheless, it is possible that buffer capital ratio shows procyclical or counter-cyclical patterns in some countries or regions. We attempt to find a heterogeneous behavior among country groups.

Table 3 presents the estimation results from the regression allowing for a possibility of different correlation between buffer capital ratio and business cycle across country groups. The second column in Table 3 reports the coefficient estimates on GDP along with other coefficient estimates for two country groups: Asian countries and OECD countries.<sup>12</sup> In contrast to Table 2, the estimation result in Table 3 tells a different story: buffer capital is positively correlated with GDP in OECD countries while negatively correlated with GDP in Asian countries. The coefficient estimate is 1.03 for OECD countries and it is statistically significant, but it is -0.55 for Asian countries with marginal significance.

Moreover, we further classify OECD countries into two groups, the Basel committee member countries and non-member OECD countries, to compare the procyclical aspects of the buffer capital ratio among OECD countries. The third column in Table 3 shows that buffer capital ratio is positively correlated with GDP for the Basel committee member countries. In contrast, the correlation is negative and not statistically significant for other OECD countries. These results tell us that the banks in the Basel committee member countries increase their buffer capital ratio in expansions while the banks in other countries do not increase or decrease the buffer capital ratio. In the fourth column in Table 3, we test whether the positive correlation is driven by the US. The results show that although the procyclicality of buffer capital appears to be stronger in the US banks, a statistically significant positive relationship between buffer capital ratio and GDP is estimated in the other Basel committee member countries as well.

The estimation results in Table 3 show different cyclical patterns of buffer capital across country groups. The buffer capital ratio rises in Basel committee member countries while it declines in Asian countries in the periods of high economic growth. These findings suggest that, once Basel II is implemented, Asian countries are more

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<sup>11</sup> Other balance sheet variables are also likely to be correlated with business cycle. For example, ROE tends to increase in expansionary periods while NPL rises in recessions. Excluding ROE and NPL, however, does not change the estimation results qualitatively. The estimated coefficients on GDP are 0.186, 0.049, and 0.232 with the associated t-values of 0.84, 0.29, and 1.00 for Model I, Model II, and Model III respectively from the regressions without ROE and NPL.

<sup>12</sup> Korea is a member of OECD, but is included in Asian country group.

&lt;Table 3&gt; Estimation Results II

	I	II	III
Constant	48.336 (2.38) **	44.114 (2.19) **	44.445 (2.20) **
Lagged Dep. Var.	0.640 (9.65) ***	0.640 (9.66) ***	0.640 (9.66) ***
ROE	-0.552 (-3.41) ***	-0.558 (-3.45) ***	-0.547 (-3.37) ***
NPL	-0.287 (-1.65) *	-0.293 (-1.69) *	-0.306 (-1.77) *
SIZE	-0.528 (-1.76) *	-0.551 (-1.84) *	-0.583 (-1.94) *
LOAN	-0.296 (-9.67) ***	-0.293 (-9.60) ***	-0.291 (-9.57) ***
ROA	10.058 (4.21) ***	10.061 (4.21) ***	9.974 (4.16) ***
GDP OECD	1.034 (2.38) **		
Basel		2.033 (5.27) ***	
USA			2.754 (4.40) ***
others			1.528 (3.40) ***
Non-Basel		-0.229 (-0.62)	-0.198 (-0.53)
Asia	-0.547 (-1.98) **	-0.490 (-1.78) *	-0.511 (-1.86) *
Country dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
No. observation	3907	3907	3907
R <sup>2</sup>	0.70	0.70	0.69

Note: Numbers in parentheses are t-values. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% confidence levels.

likely to observe an increase in output volatility.<sup>13</sup> The empirical findings reinforce the concern that developing countries are more likely to be influenced by the new bank capital regulation. Indeed, since bank credit is the more important source of funds in developing countries, a decrease in bank loans might exacerbate economic

<sup>13</sup> There could be an alternative interpretation of the estimation results in Table 3. The procyclical buffer capital ratios for the banks in the Basel committee member countries may imply that those banks are already operating as if they are under Basel II - that is, they are aligning capital with risk. During booms, for example, banks with advanced risk management system may become more likely to originate lower-quality loans since they can charge higher interest rates and earn bigger profits, and these banks may have to increase buffer capital knowing that the quality of their loan portfolios will be deteriorating fast in the near future. Based on this interpretation, one may say that positive correlation between buffer capital and business cycle is an evidence of more resilient risk management practices of banks under Basel I, and countries with such banks are more likely to have the procyclical bank lending problem. Evaluating this argument versus the forward-looking risk measurement story would be interesting, but due to the limitations of data availability we would like to leave it for the future research. The authors would like to thank the anonymous referee who suggested this alternative interpretation.

recession more severely. In advanced countries such as Basel committee member countries, in contrast, the procyclicality issue might not be a great concern. Nevertheless, it should be noted that the empirical results are from the regression using the sample observations under Basel I<sup>14</sup> and the predictions are based on the assumption that banks continue to maintain their behavior under Basel II. If banks change their behavior under Basel II, our predictions may be changed.

#### IV. Policy Implications

Empirical findings in this paper suggest that developing countries need appropriate policy responses to the potential procyclicality problems under Basel II. In what follows, we review some policy recommendations that have been discussed among academics and policy circles.<sup>15</sup>

First, the financial supervisory authorities need to encourage banks to have longer time horizon over which risk is measured and managed.<sup>16</sup> It is important to recognize that risk is actually building up in booms, and that bad loans are materialized in recessions, which does not necessarily imply an increase in risk. If banks do not under-estimate risks in booms and do not over-estimate risks in recessions, the potential problem of excessive business cycle fluctuation could be alleviated. For this purpose, the supervisory authorities can establish rules contingent to business cycle to promote long-horizon risk measurement. In fact, Basel Committee recommends banks to adopt the IRB Approach in the revised draft of the new accord, in which banks are encouraged to use forward looking TTC method instead of PIT ratings for their credit rating system.<sup>17</sup>

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<sup>14</sup> This may be a reason why the impact of the business cycle on the banks' buffer capital, despite being statistically significant, seems to be moderate in quantitative terms. That is, an increase of 1 percentage point in GDP growth rate for OECD countries, for example, increases the risk-based total capital ratio by only 0.08 percent. Also, the long-term semi-elasticity of the buffer capital relative to GDP growth, calculated at the sample buffer average, is only 6 percent that means when the GDP growth rates increases by 1 percent, the total capital ratio increases by 0.23 percent in the long-run. However, given the highly volatile GDP growth rates of Asian emerging markets, the magnitude of counter-cyclical changes in buffer capital can be economically significant under Basel II.

<sup>15</sup> Borio, Furfine, and Lowe (2001) provide a good reference on the policy options to the procyclicality problems

<sup>16</sup> If banks have excessively long horizon to the extent that the measured risk converges to the historical average, capital requirement would become less sensitive to risk. Thus, it should be addressed that excessively long horizon is not consistent with the main goal of Basel II to achieve the stability in banking system.

<sup>17</sup> Catarineu-Rabell *et al.* (2003) also concludes that, under the IRB Approach with PIT method where current information on borrowers' equity price and book liabilities is used to obtain estimates of borrowers' probability of default, and the risk weights determined based on this model are highly sensitive to current economic conditions since cyclical effects in asset valuation would be reflected in the default probabilities.

Second, the authorities can use its supervisory instruments in a discretionary fashion. For instance, the supervisory authorities can require banks to increase buffer capital during booms if they judge, based on all available evidence, that risks are under-estimated. Another example is that the supervisory authorities can change loan-to-value ratios in lending for real estate property. If the authorities could correctly evaluate risk arising from an excessive increase in property prices, the loan-to-value ratios might be lowered until the property prices are stabilized. This discretionary approach could prevent undesirable swings in property prices, and also could help accomplish the stability of collateral values and business cycle.

Third, the financial authorities in developing countries need to improve the infrastructure of financial system. Among others, creating and upgrading credit bureaus is crucial. If reliable credit information is largely available to banks, lending decisions would become less dependent upon collateral and thus the impact of asset price cycle on business cycle would decline. In addition, establishing a good accounting and governance standard is a prerequisite for better financial system.

## V. Concluding Remarks

As minimum requirements for bank capital will become more risk-sensitive and thus fluctuate more strongly with the business cycle under Basel II, it is widely expected that bank lending may be reduced during cyclical downturns and this could harm economic development if minimum capital requirements were binding. However, the question arises whether actual capital levels also become more cyclical under Basel II. As almost all banks have their capital well above the required minimum, more volatile regulatory capital would increase procyclicality of bank lending only to a limited degree in Basel II. Therefore, even if the minimum capital required by regulations fluctuate to a greater extent under Basel II, it is necessary to investigate the movement of buffer capital of banks.

To address this call, this paper empirically investigates the cyclical patterns of buffer capital using an unbalanced panel data for the banks in 30 OECD countries and 7 non-OECD Asian countries. The estimation results show systematically different cyclical patterns of buffer capital across country groups. The buffer capital ratio rises in Basel committee member countries while it declines in Asian countries during the period of high economic growth. These findings suggest that, once Basel II is implemented, Asian countries are more likely to observe an increase in output volatility. Furthermore, in some of the Asian countries where bank credit is the more important source of funds, a decrease in bank loans induced by the risk-sensitive capital regulation by Basel II might exacerbate economic recession more severely.

These findings suggest that some appropriate policy responses will be requested, especially in Asian developing countries. Regulatory authorities of these countries should keep in mind that the possibility of expanding procyclicality can be emerged as the most critical constraint on the economic policy planning, especially in a downturn. Therefore, successful implementation of the new capital standard will depend on how one might design a credible, transparent formula that links capital

requirements to some measure of aggregate economic conditions. This is a difficult question and one that we are not prepared to answer fully.

This paper reviews some of such policy responses commonly suggested in the previous literature and draws implications for Basel II implementation that it is important to balance the pros and cons of the measures for reducing procyclicality since some measures may not help the banking system to accomplish stability if they restrict risk assessment of banks too strictly.

Lastly, it should be noted that those predictions regarding procyclicality are from the regression using the sample observations under Basel I. It is not clear in advance whether banks will change their capital accumulation behavior after the implementation of Basel II. If banks change their behavior under Basel II, our predictions are not valid and we may reach different conclusions. Nevertheless, it is worth to investigate the cyclical behavior of banks over the last decade, since this behavior will probably also be typical after Basel II and the detected patterns also may be continued.

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