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Effects of Small Business Support Projects: Evidence from Korea†

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On average, small business support projects appear to improve beneficiary sales, and the growth effect is obvious when supporting young or growing firms. However, the effect is largely offset by sales reductions due to overcrowding. Small business support projects must be operated in two ways to alleviate the overcrowding of businesses in a few industries and to enhance the overall effectiveness of the support programs.

Key Word: Small Business Owner, SME, Support Policy, Support Project, Overcrowding
JEL Code: C13, D40, L10, L20

I. Introduction

In recent decades, small business budgets have increased rapidly. An examination of the small business budget of the Ministry of SMEs and Start-ups (henceforth 'MSS') shows that it increased from 0.6 trillion won in 2007 to 2.1 trillion won in 2017. As a result, the proportion of small business budgets for the MMS's total budget rose from 11% to 26%.

In addition, administrative promotion efforts by the Ministry have led to strengthened budget coordination outcomes and enforcement system, and small business policies are being used as important tools to support the government's income-driven growth strategy. Therefore, budgets and policies for small businesses are likely to expand in the future.

This trend would have been possible because small businesses are an important part of the national economy. Small businesses form the basis of the industrial ecosystem, accounting for 84% of domestic establishments and 34% of the number of employees. Moreover, because companies usually start out as small businesses

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and then go through a wide range of experiences to become larger companies, the growth of small businesses is essential for enhancing the sustainability of our economy. Furthermore, small businesses provide long-term and short-term labor opportunities for job seekers, unemployed people and retirees, and these functions of economic and social safety nets reinforce the need for government support.

Despite the fact that support for small businesses has expanded, assessments of whether supporting policies are achieving their intended goals have been insufficient. This may be due to low data availability and to a situation in which performance evaluations of ministries has little to do with the effectiveness of projects carried out by the ministries. Nevertheless, as budgets are expanding, evaluating project performance outcomes and attempting to improve the efficiency of projects should not be neglected.

Based on this perception, this study investigates the Korean small business industry and presents an overview of government policy and budget trends. In addition, the paper analyzes the impact of small business projects on beneficiary growth and then proposes policy recommendations.

II. Related Literature

It's nothing new for small businesses to struggle with low profitability, perhaps because start-ups tend to be concentrated in a few industries, causing excessive competition, and because underperforming firms are likely to remain in the market with government support rather than leaving or switching to other industries.

This implies that there is an overcrowding phenomenon in which the number of businesses exceeds an appropriate scale for the market size. With emphasis on this aspect, a group of studies estimated the appropriate number of small businesses that the domestic market can afford and calculated the degree of overcrowding.

Noh *et al.* (2009) compiled panel data from 30 OECD countries (2000-2007) on income levels, income tax rates and unemployment rates to perform a regression analysis. Estimates of pooled OLS and random-effects models show that the excess of those self-employed reaches approximately 510,000 in wholesale and retail, close to 220,000 in food and hospitality, and 1.9~2.2 million in all industries. Suh *et al*. (2013) also estimated the appropriate self-employment size using data from 30 OECD countries. In addition to the variables used in Noh *et al.* (2009), their study also considered consumer prices, amounts of exports and imports, and bankruptcy rates as independent variables. By estimating with the random-effects model, they reported that the number of domestic self-employed was in excess of 3.4~3.7 million. A similar study by Suh and Kim (2012) showed that the share of the self-employment in the domestic retail industry was relatively high compared to those in Japan and OECD countries. These studies overall reveal that the domestic small business industry is facing an oversupply. However, given that the excessive scale fluctuates considerably depending on model used, it appears to be necessary to discover additional determinants of self-employment and to estimate the excessive scale more accurately.

Meanwhile, other studies qualitatively discuss the direction of the improvement of small business policies. Yuck and Ryu (2004) pointed out that many public

organizations carried out start-up supporting projects indiscriminately, resulting in severe similarity and duplication issues. Regarding these findings, the study suggested that a small business development center should be developed as a dedicated organization responsible for all start-up projects. The issue of similarity between projects was also discussed in Lee and Ko (2009). They identified subjects and types of each SME support project and divided them into ten sectors. Based on a comparative analysis, their study noted that the degree of similarity was generally high in the areas of funding, exports, outlets, and technology development, mainly because the support agents were not integrated.

Another group of studies evaluated the performance of small business projects. In order to verify the effectiveness of the projects, a researcher must obtain a list of beneficiaries and their performance information. However, until recently, it was difficult to obtain objective data. Accordingly, previous studies conducted surveys of beneficiary companies. Kim *et al.* (2012) analyzed the effects of small-business policy funds by comparing 500 beneficiaries with 500 non-beneficiaries, finding that with greater fund support, higher revenue growth rate of beneficiaries resulted. On the other hand, Yun (2013) used data from the Korea Credit Guarantee Foundation to identify the beneficiaries of SME policy funds and found that policy funds did not have a significant impact on the sales growth of the beneficiaries.[1]

Compared to previous studies, the present study attempts to identify the causal impact of supporting projects. Past research is commonly vulnerable to the possibility that the estimates cannot be viewed as akin to causal effects because they focused on only one project without controlling for others being supported simultaneously. In contrast, the present study controls for not only the MSS's projects but also for other central and local governments' types of support to improve the causality link.

In addition, this study identifies the underlying factors that influence the effectiveness of support projects and provides policy implications regarding the criteria to be considered when selecting beneficiaries.

III. Aspects of the Small Business Industry

Looking at the domestic small business industry, we find that there are several factors which limit the success and growth of these businesses. This chapter examines the structural aspects and problems of the small business industry considering the following aspects: 1) the high frequency of start-ups in times of depression, 2) large numbers of firms concentrated in a few industries, and 3) the prevalence of unprepared start-ups.

A. *Start-ups in Times of Depression*

As of 2015, there were 3.24 million small businesses, accounting for 83.7% of the total number of establishments (3.87 million) in Korea. According to Figure 1, the

[1]Other studies which analyzed effects of small business support projects include Kim (2015), Jun *et al*. (2005), and Hwang *et al.* (2016).

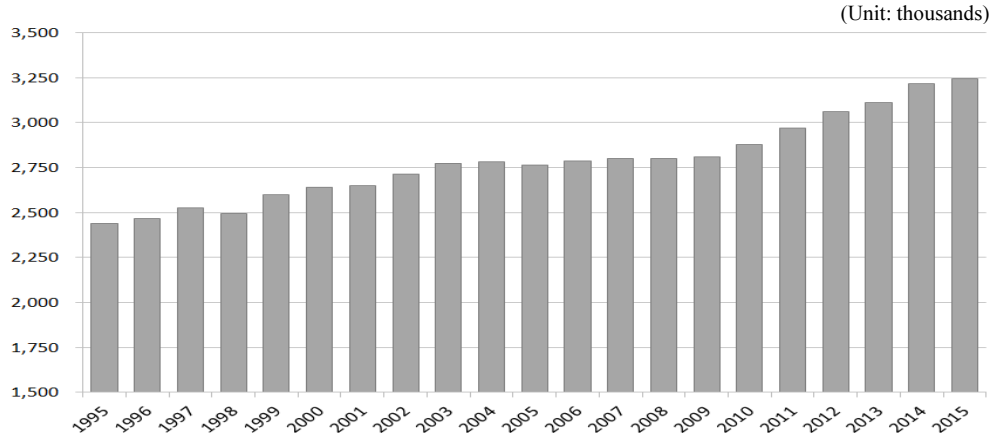

FIGURE 1. NUMBER OF SMALL BUSINESSES

Source: Based on Statistics Korea, "Census on Establishments," 1995-2014; "Economic Census," 2015.

number of small business owners increased during the period of 1995~2015, but sharp increases occurred after the Asian financial crisis and after the later global financial crisis.

In five years following the Asian financial crisis and after the global financial crisis, the number of small businesses owners increased by approximately 280,000 (during 1999-2003) and by nearly 400,000 (during 2010-2014), respectively. These two increases in sum account for 85% of the increase over the last two decades. This implies that small business start-ups tend to be particularly active when a crisis or recession arrives in our economy.

Small business start-ups can occur at any time, at the will of the founders. However, the fact that start-ups stand out when consumer sentiment is frozen and market demand stagnates can be a concern because it can intensify oversupply and lower the profitability of businesses.

B. *Bulk of Firms in a Few Industries*

Figure 2 shows that 86-88% of small business owners are engaged in the service industry. Moreover, focusing on service sectors as shown in Figure 3, 80% to 85% exist in the four sub-sectors of wholesale & retail, lodging & restaurants, transportation, and associations & personal services, with more than 50% engaged in wholesale & retail and lodging & restaurants.

Business concentration in these sectors appears to be a consistent trend in our economy, and this trend has been maintained because additional entries of small businesses are also concentrated in the four aforementioned service sectors. From 1995 to 2015, the number of small businesses increased by as much as 803,000, of which 656,000 (81.6%) were concentrated in the service industry and 441,000 (54.8%) were in the four service sectors above. That is, small businesses tended to start in a few sectors that are easy to enter, inducing overcrowding.

Most companies born during a recession are typically self-employed start-ups, as corporate restructuring shifts workers from the wage work environment to the small

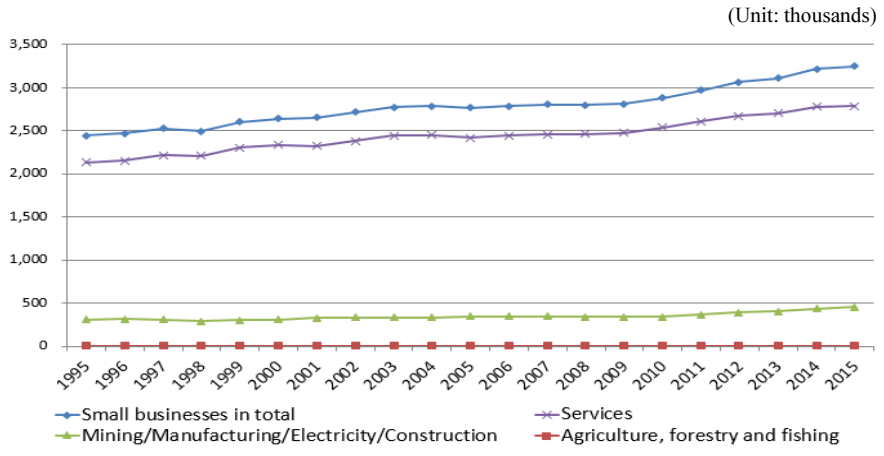

FIGURE 2. NUMBER OF SMALL BUSINESSES BY INDUSTRY AND YEAR

Source: Based on Statistics Korea, "Census on Establishments," 1995-2014; "Economic Census," 2015.

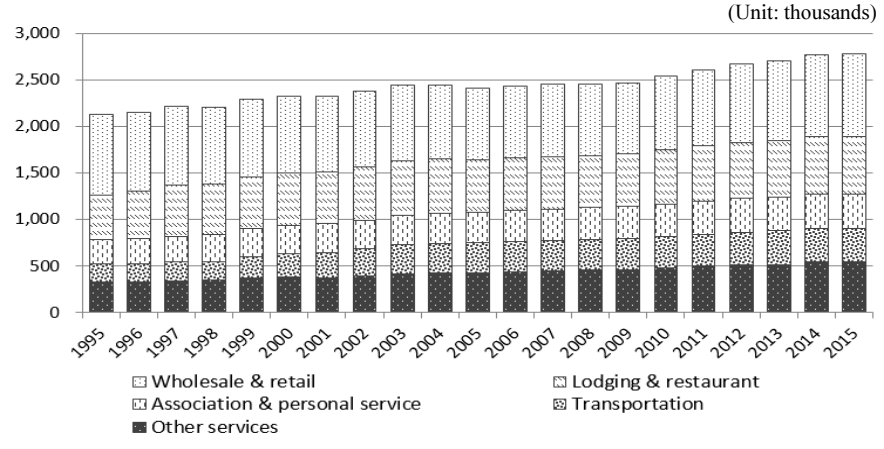

FIGURE 3. NUMBER OF SMALL BUSINESSES IN THE SERVICE SECTOR BY INDUSTRY AND YEAR

Source: Based on Statistics Korea, "Census on Establishments," 1995-2014; "Economic Census," 2015.

business industry. These self-employed companies are heavily constrained with regard to their earning a living and therefore tend to engage in a business that can be started quickly with a small amount of capital. In addition, the recent rapid growth of the franchise market in Korea has made it easier to start small businesses in the wholesale & retail and lodging & restaurants sectors.

C. *Prevalence of Unprepared Start-ups*

Small business owners' choices over which sector to enter can be influenced by various conditions, such as their motivation and the preparation period for starting a business.

According to the Small Business Survey (see Table 1), 82.6 percent started their own business to make a living without other alternatives. On the other hand, only

TABLE 1—MOTIVATION FOR FOUNDING A SMALL BUSINESS

Motivation	Percentage
To make a living (without other alternatives)	82.6
Seeing the possibility of success	14.3
For business succession	1.3
Etc.	1.8

Source: Based on Ministry of SMEs and Start-ups, "National Small Business Survey," 2013.

TABLE 2— PREPARATION PERIOD FOR SMALL BUSINESS START-UP

less than 1 month	less than 3 months	less than 6 months	less than 1 year	less than 2 years	2 years or more
10.8	23.9	26.2	12.7	10.3	16.2

Source: Based on Ministry of SMEs and Start-ups, "National Small Business Survey," 2013.

14.3 percent of start-ups were hoping for success. In other words, the majority of small business start-ups are likely to be created so that their proprietors can make living rather than out of a business vision or due to the potential for success.

In addition, when looking at the preparation period for small businesses (see Table 2), 74% of start-ups prepared for less than one year, and 61% prepared for less than six months. The percentages of start-ups with less than three months and even less than one month of preparation were 35% and 11%, respectively.

While most small business owners open their shops to earn a living, they are not ready to be as competitive as possible before entering the market and tend to choose industries that are relatively easy to enter. Under these circumstances a vicious cycle (insufficient preparation – overcrowding in a few sectors – low profits and high closure rates) is likely to continue.

IV. Projects and Budget for Small Businesses

A. *Analysis Scope for Support Projects*

Before analyzing small business support projects, we should initially define which of the government's policies are applicable to small business owners. At the narrowest level, we can focus on projects undertaken by the MSS's Small Business Policy Office and on projects of Small Business Market Promotion Funds commissioned by the Small Business Market Agency. Because these projects are only for small business owners, they can suitably define the scope of small business support projects.

On the other hand, there is a wide variety of programs that assist SMEs from which small businesses satisfying certain requirements can also benefit. Hence, the scope of small business projects may include those by other offices of the MSS, programs of the SME Start-up and Promotion Fund (consigned by the Small and Medium Business Corporation), and other central or local government-related

<table>
<tr><td>Projects by Small Business Policy Office
in Min. of the MSS
+
Projects of the Small Business Market Promotion Fund</td><td><Policy Group A>
Only for
small businesses
(Min. of MSS)</td><td rowspan="2"><Policy Group B>
For small businesses &
SMEs
(Min. of MSS)</td></tr>
<tr><td>Projects by other offices in the MSS
+
Projects of the SME Start-up and Promotion Fund</td><td></td></tr>
<tr><td>Projects by other central governments</td><td colspan="2" rowspan="2"><Policy Group C>
For small businesses and SMEs
(other central & local governments)</td></tr>
<tr><td>Projects by local governments</td></tr>
</table>

FIGURE 4. SCOPE OF SUPPORT POLICY FOR SMALL BUSINESSES

programs. In short, there is a narrow group of support projects from which only small business owners can receive assistance, and a broad group of projects where small businesses as well as SMEs can benefit, as shown in Figure 4.

In this section of the overviewing small business projects and budgets, we will focus on a narrow group of policies (policy group A). Because small business budgets are concentrated in the MSS and programs are mostly carried out by the Small Business Policy Office and Small Business Market Promotion Fund, this approach is suitable for identifying the trends of related policies and budgets.[2]

On the other hand, Chapter 5, which assesses the impact of small business projects, extends the scope of the analysis to policy group B while controlling for other projects in policy group C.

B. *Projects and Budget for Small Businesses: Total*

When looking at the expenditures by the MSS based on Open Fiscal Data,[3] the figure rose from 5.5 trillion won in 2007 to 8.2 trillion won in 2017 (see Table 3).

TABLE 3— YEARLY SPENDING BY THE MSS

(unit: 100 million won)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR ('07-'17)
Total (A)	54,831	52,532	123,542	59,721	59,762	61,547	78,787	70,166	93,299	98,299	81,900	4.1
Spending for small businesses (B)	6,001	5,701	19,758	6,150	7,737	7,746	15,317	13,324	24,241	23,468	21,327	13.5
Ratio (B/A)	0.11	0.11	0.16	0.10	0.13	0.13	0.19	0.19	0.26	0.24	0.26	-

Note: Figures in 2009, 2013, 2015 and 2016 include supplementary budgets.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

[2]One may consider Policy Group B as the subject of the project and budget analysis. However, it is difficult to identify the percentage of the budget executed only for small businesses accurately.

[3]Open Fiscal Data are accessible at http://www.openfiscaldata.go.kr.

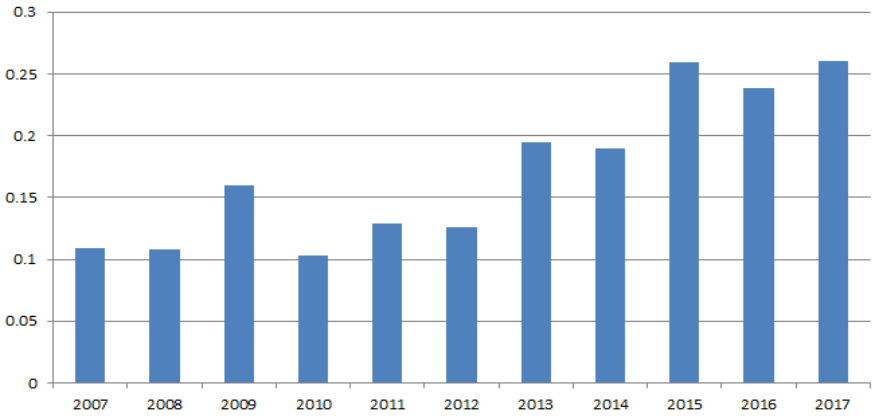

FIGURE 5. RATIO OF SMALL BUSINESS EXPENDITURES TO THE MSS'S BUDGET

Note: Figures in 2009, 2013, 2015 and 2016 include supplementary budgets.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance), Overview of Budget and Fund Management Plan (2007-2017, MSS)

Especially in 2009, 2013, 2015, and 2016, supplementary budgets were formed in response to the economic recession, which led to a significant increase in spending, whereas relatively steady increases were observed in other years.

Focusing on small business support projects, the budget increased from 0.6 trillion won in 2007 to 2.13 trillion won in 2017, increasing at an annual average rate of 13.5%. Overall, small business budgets have grown to more than a quarter of spending for SMEs (see Figure 5).

Figure 5 also shows that the ratios of small business budgets tended to increase significantly when the supplementary budgets were implemented. This means that additional budget funds tended to be used actively for small business projects in response to the economic downturn.

C. *Projects and Budgets for Small Businesses: by Category*

Small business support programs by the MSS can be broadly divided into financial projects, ordinary projects, and traditional market support programs. Of these, the budget for financial projects is the largest, accounting for 1.7 trillion won (78.4%) out of 2.1 trillion won in 2017 (see Table 4).

There is the opinion that small business budgets must shift their focus from financial support to indirect program support, but the former still maintains a high proportion at 73~79% after the global financial crisis.

Earlier, we saw a significant increase in spending by the MSS during the years when supplementary budgeting was carried out. A closer look shows that approximately 20% of the supplementary budget has led to an increase in MSS budgets, while close to 20% of the increase in the MSS budgets has been used to support small businesses (see Table 5).

It is also noteworthy that most of the small business budget increase was used to expand the financial projects. Financial support would have been the easiest and quickest means by which the government could execute supplementary budgets

TABLE 4— BUDGET TRENDS FOR SMALL BUSINESS SUPPORT BY SECTOR

(Unit: 100 million won)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR (07-17)
Small business budget	6,001	5,701	19,758	6,150	7,737	7,746	15,317	13,324	24,241	23,468	21,327	13.52
Financial projects	3,716 (0.62)	3,220 (0.56)	17,267 (0.87)	3,500 (0.57)	4,650 (0.60)	4,550 (0.59)	11,600 (0.76)	9,713 (0.73)	19,156 (0.79)	18,248 (0.78)	16,727 (0.78)	16.23
Ordinary projects	321 (0.05)	156 (0.03)	452 (0.02)	684 (0.11)	877 (0.11)	978 (0.13)	1,380 (0.09)	1,425 (0.11)	1,704 (0.07)	1,603 (0.07)	1,138 (0.05)	13.51
Traditional market support programs	1,965 (0.33)	2,324 (0.41)	2,039 (0.10)	1,967 (0.32)	2,210 (0.29)	2,219 (0.29)	2,338 (0.15)	2,186 (0.16)	3,380 (0.14)	3,617 (0.15)	3,462 (0.16)	5.83

Note: 1) Figures in 2009, 2013, 2015 and 2016 include supplementary budgets, 2) Numbers in parentheses are relative to the total small business budget.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

TABLE 5— ALLOCATIONS OF SUPPLEMENTARY BUDGETS

(Unit: 100 million won)

	Y2009		Y2013		Y2015		Y2016	
	Increase in budget	Ratio	Increase in budget	Ratio	Increase in budget	Ratio	Increase in budget	Ratio
National budget (A)	177,000	-	70,000	-	93,000	-	122,000	-
▪ MSS budget (B)	43,291	0.24 (B/A)	12,555	0.18	14,439	0.16	17,376	0.14
・Small businesses (C)	6,081	0.14 (C/B)	3,173	0.25	3,633	0.25	2,428	0.14
-Ordinary projects (D)	114	0.02 (D/C)	100	0.03	-146	-0.04	-71	-0.03
-Financial projects (E)	**5,967**	**0.98 (E/C)**	**3,000**	**0.95**	**3,245**	**0.89**	**2,100**	**0.86**
-Traditional market support programs (F)	0	0.00 (F/C)	73	0.02	534	0.15	399	0.16

Note: Figures in 2009, 2013, 2015 and 2016 include supplementary budgets.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

within months. In addition, beneficiary companies may prefer direct funding to indirect support because they can use the funds for a variety of purposes.

Looking at more detailed programs (see Table 6), financial projects provide direct funding using small business loans, as well as indirect financing through reassurance of the regional credit guarantee foundation or local credit guarantee support.

On the other hand, ordinary projects indirectly help small business owners through various training and participation programs, such as education, information provision, consulting, marketing, and organization efforts (see Table 7). There are

TABLE 6— SUB-PROGRAMS IN SMALL BUSINESS FINANCIAL PROJECTS

(Unit: 100 million won)

Subprograms	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	3,716	3,220	17,267	3,500	4,650	4,550	11,600	9,713	19,156	18,248	16,727
Small business loans*	3,457	2,890	10,967	3,000	4,450	4,250	10,500	9,165	18,095	17,550	16,250
Reassurance for Local Credit Guarantee Foundation	105	330	2,600		200	300	1,100	548	600	600	387
Local Credit Guarantee Support	154		3,700	500							
Support the interest difference									101	98	90
Donate Sunshine loan									360		

Note: 1) Figures in 2009, 2013, 2015 and 2016 include supplementary budgets, 2) Small business loans are composed of the Growth Foundation Fund and the Management Stabilization Fund.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

TABLE 7— SUB-PROGRAMS IN SMALL BUSINESS ORDINARY PROJECTS

(Unit: 100 million won)

Subprograms	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	321	156	452	684	877	978	1,380	1,425	1,704	1,603	1,138
Start-up support	5	5	25	61	132	105	104	104	305	190	131
Growth Support	10	6	73	183	295	397	610	481	486	449	508
Revival Support							30	30	61	141	100
Specialized Support for Small Manufacturer						10	21	28	348	348	320
knowledge & service company support	5	4	104	99	210	200	305	422	403	403	
Infrastructure Support	300	142	250	341	240	266	310	361	102	73	78

Note: Figures in 2009, 2013, 2015 and 2016 include supplementary budgets.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

many detailed programs that constitute ordinary projects, but the budget is mostly small and only accounts for 5% of the overall small business budget.

However, recent budget increases are evident. The budget for ordinary projects was 32.1 billion won in 2007, but it increased rapidly to 113.8 billion won in 2017, showing an annual average growth rate of 13.5%.

The last group in the small business support category consists of traditional market

TABLE 8— SUB-PROGRAMS IN THE TRADITIONAL MARKET SUPPORT PROGRAM

(Unit: 100 million won)

Subprograms	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	1,965	2,324	2,039	1,967	2,210	2,219	2,338	2,186	3,380	3,617	3,462
Traditional Market / Distribution & Logistics Support	1,606	1,930	1,720	1,568	1,751	1,683	1,540	1,365	778	774	722
Traditional Market / Distribution & Logistics Support (Jeju)	50	42	32	29	48	47	51	58	44	42	40
Traditional Market / Distribution & Logistics Support (Sejong)											2
Improvements of the Parking Environment for Traditional Markets									965	1,001	998
Market Management Innovation Support	308	353	287	369	411	488	747	763	1,593	1,800	1,701

Note: Figures in 2009, 2013, 2015 and 2016 include supplementary budgets.

Source: Open Fiscal Data (2007-2017, Ministry of Economy and Finance); Overview of Budget and Fund Management Plan (2007-2017, MSS).

support programs. This group can be divided into two subgroups (see Table 8). One group of programs consists of programs aimed at the modernization of outdated facilities in traditional markets and the construction of public parking lots and distribution centers. The second group (market management innovation support) handles indirect programs such as education, marketing, consulting, and coordination for merchants.

Most of the budget increases with regard to traditional market support projects are associated with the second group: from 30.8 billion won in 2007 to 170 billion won in 2017, indicating that the focus of traditional market support is shifting from hardware building to software improvements.

V. Evaluation of the Effectiveness of Small Business Support Projects

We have seen that support budgets for small businesses have expanded, but it has been difficult to evaluate the effectiveness of these projects mainly due to the lack of data pertaining to the details of this support. This study specifically assesses the effectiveness of small business projects through a micro-econometric analysis based on a support history database and on business performance data.

A. *Data overview*

Essentially, two data groups are required to analyze the effectiveness of a support project. First, we need specific information about when and from which program beneficiaries received support. This study obtained detailed information about project contents, departments in charge, beneficiary companies, and the timing of the benefit from the SME Support History Database (SSHD).

Table 9 shows the amounts of support by central and local governments in 2010

and 2015. Because the database contains SME-supported projects, the MSS accounts for about half of the total.

In addition to the MSS, many central and local governments have also conducted SME support projects. This suggests that when assessing the effectiveness of small business support projects, these central and local government projects must also be controlled for in an appropriate manner.

The second set of data necessary contains the business performance outcomes of beneficiaries and non-beneficiaries. Accordingly, this study uses Korean Enterprise Data (2010-2015, henceforth 'KED'), which covers the annual performance information of SMEs and small businesses.

After merging SSHD and KED according to the business identification information

TABLE 9—AMOUNTS OF SUPPORT AS IDENTIFIED IN THE SSHD

Related Ministries		Year 2010		Year 2015	
		Frequency	Ratio	Frequency	Ratio
Central governments	Min. of SMEs & Start-ups	270,982	47.3	372,295	49.3
	Min. of Employment & Labor	81,079	14.1	100,852	13.4
	Min. of Agriculture, Food & Rural Affairs	86,002	15.0	75,964	10.1
	Min. of Trade, Industry & Energy	6,560	1.1	8,539	1.1
	Defense Acquisition Program Admin.	3,201	0.6	7,417	1.0
	Min. of Culture, Sports & Tourism	2,070	0.4	4,870	0.6
	Min. of Food & Drug Safety	383	0.1	2,024	0.3
	Min. of Science & ICT	589	0.1	1,627	0.2
	Min. of Environment	398	0.1	1,532	0.2
Local governments	Seoul	6,737	1.2	9,131	1.2
	Busan	265	0.0	1,338	0.2
	Daegu	807	0.1	722	0.1
	Incheon	1,775	0.3	1,762	0.2
	Gwangju	2,563	0.4	1,942	0.3
	Daejeon	3,242	0.6	5,202	0.7
	Ulsan	7,935	1.4	11,005	1.5
	Sejong	32,274	5.6	40,084	5.3
	Gyeonggi	3,651	0.6	13,605	1.8
	Gangwon	566	0.1	1,048	0.1
	Chungbuk	1,618	0.3	1,962	0.3
	Chungnam	3,673	0.6	7,154	0.9
	Jeonbuk	38,366	6.7	32,870	4.4
	Jeonnam	7,781	1.4	19,226	2.5
	Gyeongbuk	2,351	0.4	6,714	0.9
	Gyeongnam	701	0.1	3,202	0.4
	Jeju	7,476	1.3	22,527	3.0
Total		573,045	100	754,614	100

Source: Korea Small Business Institute (2010-2015)

and support year, only those establishments that meet small business standards were left in the final sample, while other SMEs and large enterprises were removed to account for heterogeneity by company size.[4] Table 10 shows descriptive statistics pertaining to the variables used in the regression analysis.

TABLE 10— DESCRIPTIVE STATISTICS OF THE VARIABLES

Variables	No. of observations	Mean	Std. Deviation	Min.	Max.
Sales (million won)	483,321	1,269	1,324	0.00	11,999
Operating profit (million won)	483,321	61.35	104.50	-417.39	700.39
Net profit (million won)	483,321	50.11	90.31	-499.16	588.24
Total capital (million won)	483,321	373	478	-537	4,172
Support (0/1)	483,321	0.12	0.33	0.00	1.00
Support_other (0/1)	483,321	0.25	0.43	0.00	1.00
Loans/Guarantees (0/1)	483,321	0.09	0.28	0.00	1.00
Export/Outlet/Marketing (0/1)	483,321	0.01	0.11	0.00	1.00
Technology/R&D (0/1)	483,321	0.01	0.09	0.00	1.00
Education/Diagnosis/Consulting (0/1)	483,321	0.02	0.13	0.00	1.00
Founding/Commercialization (0/1)	483,321	0.01	0.09	0.00	1.00
Organization/cooperation (0/1)	483,321	0.00	0.01	0.00	1.00
Recovery / Business Transition (0/1)	483,321	0.00	0.02	0.00	1.00
Labor (0/1)	483,321	0.01	0.08	0.00	1.00
No. of firms	483,321	428,013	327,056	1,499	1,015,074
No. of small businesses	483,321	367,951	295,543	520	894,549
Years of operation (years)	477,469	8.53	6.81	1.00	116.00
Years of operation_1-4 years (0/1)	483,321	0.35	0.48	0.00	1.00
Years of operation_5-7 years (0/1)	483,321	0.19	0.39	0.00	1.00
Years of operation_8-10 years (0/1)	483,321	0.14	0.35	0.00	1.00
Years of operation_10+ years (0/1)	483,321	0.33	0.47	0.00	1.00
Year_2011 (0/1)	483,321	0.11	0.31	0.00	1.00
Year_2012 (0/1)	483,321	0.15	0.36	0.00	1.00
Year_2013 (0/1)	483,321	0.19	0.40	0.00	1.00
Year_2014 (0/1)	483,321	0.23	0.42	0.00	1.00
Year_2015 (0/1)	483,321	0.23	0.42	0.00	1.00

Source: Korea Small Business Institute (2010-2015); Korea Enterprise Data (2010-2015).

[4]A small business is a micro-firm with less than a certain number of regular workers. Therefore, establishments that fall below the upper limit of a micro-firm's average sales were selected first, after which small businesses were selected using the number of regular workers by industry.

B. *Empirical Model and Estimation Method*

The following empirical model was established to identify the effect of small business support projects on business performance outcomes.

$$y_{it} = \alpha + \sum_{k=1}^{K} \beta^k support_{it-1}^k + X_{it-1}\gamma + Z_{it-2}\delta + \varepsilon_i + \tau_t + u_{it}\,.$$

The dependent variable y_{it} denotes the business performance of firm i for year t. Depending on the model, y_{it} reflects a firm's annual sales as an indicator of the company's quantitative size; it also corresponds to operating profit and net profit to capture qualitative growth.

The independent variable $support_{it-1}^k$ is a dummy variable that has a value of 1 if firm i was supported by project k in year $t-1$ and a value of 0 otherwise.[5] In the estimations, $support_{it-1}^k$ is set as the following hierarchical dummy variables: support project overall, by field, and by detailed program.

In addition, because the support effect may not occur immediately in the beneficiary year and given that approximately 80% of the support projects are executed in the second half, the point of support is set to the $t-1$ year.

X_{it-1} is a vector of control variables which may affect a firm's business performance, including the business period of a firm and dummy variables regarding whether or not they have been supported by other central or local government projects.

In addition, when ministries select beneficiaries, it is necessary to observe the various characteristics of the applicants. Therefore, Z_{it-2} includes the variables of sales and total capital, which can influence their decisions. These variables are set to $t-2$, one period before the support time.

ε_i captures business characteristics that do not readily change and that are not observed by the researcher. Corresponding to a firm's fixed effect, ε_i can represent business know-how, industrial relationships and reputation among others.

τ_t is a dummy variable for each year and reflects fluctuations in the macro-economy or market environment, which are common to all businesses and which change over time. Finally, u_{it} is an error term that varies with the firm and over time.

The study utilized a panel regression analysis, considering the fact that support history and business performance information are identified by year. Using a fixed-effect model, the within transformations approach removes the unique characteristics (ε_i) of a business and then identifies support effects.[6]

[5]In the SSHD, there are a number of observations that do not provide a specific amount of support. It may be difficult to identify the amount of support for individual companies in the case of indirect support program such as education, consulting, and infrastructure projects. Therefore, it would be reasonable to verify effectiveness of support projects based on the variable of support rather than of specific amount supported.

[6]It is also possible to create and control for as many variables as possible from the SSHD and KED data to perform a pooled OLS estimation. However, this method may not completely control for certain industrial and

C. *Effects of Small Business Support Projects on the Quantitative Growth of Beneficiaries*

The estimation results indicate that small business support projects have contributed to the sales growth of beneficiaries on average. According to Model 1 in Table 11, small business owners who benefited from MSS projects tended to increase their sales by 42.4 million won.

TABLE 11— IMPACT OF BUSINESS SUPPORT ON THE SALES OF BENEFICIARIES

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3	Model 4
Support (t-1)	42.64*** (5.252)	22.75*** (5.265)		
Loans/Guarantees (t-1)			20.22*** (5.948)	11.47* (5.906)
Export/Outlet/Marketing (t-1)			44.32*** (15.085)	44.99*** (14.927)
Technology/R&D (t-1)			60.46*** (16.286)	43.04*** (16.153)
Education/Diagnosis/Consulting (t-1)			44.42*** (11.197)	25.18** (11.119)
Founding/Commercialization (t-1)			-13.83 (21.717)	-6.67 (21.460)
Organization/Cooperation (t-1)			-136.83 (234.636)	-127.02 (231.383)
Recovery/Business Transition (t-1)			77.62 (52.683)	48.85 (52.547)
Labor (t-1)			48.13** (20.185)	32.55 (19.980)
Support_other (t-1)		31.27*** (3.905)	38.64*** (3.924)	31.81*** (3.907)
Sales (t-2)	-0.02*** (0.003)	-0.03*** (0.003)	-0.02*** (0.003)	-0.03*** (0.003)
Total capital (t-2)	0.06*** (0.012)	-0.05*** (0.012)	0.06*** (0.012)	-0.05*** (0.012)
Years of operation (t-1)		52.12*** (3.291)		51.96*** (3.293)
Year_2012		33.34*** (8.813)		33.41*** (8.819)
Year_2013		24.85*** (5.762)		24.74*** (5.764)
Year_2014		-		-
Constant	1,438.12*** (4.726)	991.06*** (32.650)	1,431.25*** (4.793)	992.60*** (32.678)
No. of observations	226,198	223,475	226,198	223,475
R-squared	0.12	0.02	0.08	0.02
No. of groups	90,321	89,648	90,321	89,648

Note: Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

corporate characteristics that can affect business performance.

TABLE 12— FIRM DISTRIBUTION BY SUPPORT AND SUPPORT_OTHER

Support	Support_other		Total
	0	1	
0	334,333	90,828	425,161
1	27,008	31,152	58,160
Total	361,341	121,980	483,321

Source: Korea Small Business Institute (2010-2015); Korea Enterprise Data (2010-2015).

On the other hand, SSHD contains support projects conducted not only by the MSS but also by central and local governments. As shown in Table 12, more than half of small businesses (31,152 out of 58,160 firms) supported by MSS projects also benefited from other central and local government projects. Considering this, Models 2 through 4 controlled for the dummy variable 'Support_other' to separate the effects of MSS projects from those of other agencies' projects.

The result of Model 2 (in Table 11) shows again that support projects contribute to the sales growth of beneficiaries. However, the size of the sales increment (22.75 million) appears to be smaller than that in Model 1, indicating that Support is correlated with Support_other, years of operation, and economic fluctuations. Thus, Models 2-4 appear to be freer from the endogeneity problem than Model 1.

If this is the case, in which group of projects does this effect stand out? To determine this, I classified the support projects in the SSHD into eight functional groups. The classification work was carried out based on the purpose, contents, and support method of each project described in the Overview of Budget and Fund Management Plan (2007-2017, MSS).[7]

Models 3 and 4 in Table 11 demonstrate that the five project groups of Loans/Guarantees, Export/Outlet/Marketing, Technology/R&D, Education/Diagnosis/Consulting, and Labor contributed to sales growth of beneficiaries significantly. While the magnitude of the coefficients varies depending on the model, the signs and significance levels of the coefficients are consistent.

According to Model 4, the companies supported by Loans/Guarantees programs tended to show increased sales by an average of 11.47 million won. Because Loans/Guarantees projects provide funds necessary for purchasing production factors or streamlining production methods, these projects can contribute to the stability and maintenance of the business and ultimately to sales growth.

There are a total of 16 unit projects in the Loans/Guarantees group. Among them, Accounts receivable insurance support, Small business management stabilization funds, and New growth funds tend to increase beneficiaries' sales significantly.[8]

Accounts receivable insurance support secures a stable cash flow by providing insurance money when SMEs fail to recover payouts due to bankruptcies or defaults of purchasing companies. Because this project helps to eliminate cases in which

[7] As a result, support projects were classified into i) Loans/Guarantees, ii) Export/Outlet/Marketing, iii) Technology/R&D, iv) Education/Diagnosis/Consulting, v) Founding/Commercialization, vi) Organization/Cooperation, vii) Recovery/Business Transition, and viii) Labor.

[8] The regression analysis conducted involved generating dummy variables for each unit project, and the estimation results are presented in Table A1 and Table A2 in the Appendix.

small business owners cannot receive payments, it can stabilize small business owners' management and thereby increase their sales.

It is also noteworthy that the Small business management stability fund has a significant and positive effect.[9] Given the controversy over the effectiveness of policy funds, the finding that general small business loans programs have a positive impact on beneficiaries' sales are encouraging. On the other hand, given the possibility that the sales of non-beneficiary companies decreased due to the deteriorating operating environment and lack of funds, the increase in sales of beneficiaries can be an effect related to the decrease in the sales of non-beneficiaries. In this case, it would be more reasonable to interpret the findings as meaning that the project contributed to business stability rather than to sales growth.

New growth funding is aimed at general SMEs, mainly providing funds for production facilities. This project sets business performance and technology as important assessments and primarily supports firms with increasing numbers of employees or sales. Because small business owners also belong to the group of SMEs, they can benefit from this project. Especially if a rapidly growing small business continued to grow even after benefitting from the project, sales growth could be significant.

Moving on to the Export/Outlet/Marketing group, Model 4 in Table 11 shows that this project group tended to improve the sales of beneficiaries by 44.99 million won. A statistically significant effect was found in five of the 23 unit projects. These are the projects of the Trade promotion group (Export consortium), Trade promotion group (Participation in overseas exhibition and market improvement), Regional SMEs export marketing, Support for performance certification inspection expenses, and Public procurement loans.

There will be many small business owners who are willing to export, but only a few firms are successful mainly because they are limited in terms of their utilization of various bidding opportunities in overseas markets. Moreover, even if they are prepared for order competition, they may fail to secure a final order due to this low recognition.

In this situation, Export consortiums, Participation in overseas exhibitions and market improvement, and Regional SMEs export marketing can stimulate firms' export activities by reducing the cost of developing overseas markets, facilitating the formation of a network with local buyers, opening new markets, and helping these companies gain a distribution network. On the other hand, Public procurement loans secure sales channels for final products and thus can increase SMEs' plant utilization rates. Support for performance certification inspection expenses facilitates the certification and conformity assessment process, making it easier for small businesses to overcome these types of technical barriers.

While the Technology/R&D group tends to increase beneficiaries' sales by 43.04 million won, Public-private joint investment technology development projects have a significant effect. In the Education/Diagnosis/Consulting group, Business support group operation projects and SME consulting support projects have significant effects, resulting in a sales increment of 25.18 million won. Lastly, the Labor group

[9]The small business management stability fund is a typical loan support program for small business. It lends funds up to 70 million won.

generated a sales improvement effect of 48.13 million won only in Model 3; this was driven by Joint employment training support projects of venture companies.

Overall, supporting projects which help to secure production factors (Loans/Guarantees, Technology/R&D, Labor), to increase the efficiency of business management (Education/Diagnosis/Consulting), or to secure final sales channels (Export/Outlet/Marketing) tend to have positive effect on the quantitative growth of beneficiaries. On the other hand, the other three project groups (Founding/Commercialization, Organization/Cooperation, Recovery/Business transition) did not have statistically significant effects at the 10% level.[10]

To sum up, small business support projects appear to contribute to the sales growth of beneficiaries, but the quantitative growth effect varies considerably depending on the project groups and unit programs.

D. *Effects of Small Business Support Projects on the Qualitative Growth of Beneficiaries*

The findings above raise the question of how small business support projects affect the qualitative growth of beneficiaries. The qualitative growth of firms can be identified using various types of financial information. This study focuses on operating profit and net profit included in the KED data, as shown in Table 13. The results for sales in Model 1 are identical to those in Model 4 in Table 11.

First, the most important finding is that the Loans/Guarantees and Export/Outlet/Marketing group, which had positive effects on sales, tends to increase the operating profits of beneficiaries as well. Small businesses that received Loans/Guarantees and Export/Outlet/Marketing types of assistance are estimated to experience operating profit improvements on average of 1.79 million won and 4.4 million won, respectively, compared to those who were not beneficiaries. The extent of the growth of operating profit corresponds to 10~15% of sales growth. If small business owners do not experience unfair practices such as lower supply prices or passing promotional costs, an increase in sales usually leads to an increase in operating profit. In this regard, support projects with sales growth may have had a positive impact on operating profit.

However, there was no statistically significant effect on net profit. This suggests that these types of projects are unlikely to affect the ultimate profitability of beneficiaries. Of course, net profit can be affected by various factors, such as non-operating expenses, taxes, and delays in payments, making it difficult to provide an assertive interpretation.

However, the Technology/R&D and Recovery/Business Transition groups have very different results. Technology/R&D had a positive effect on sales, whereas it appears negatively to affect firms' operating profits. Even if sales improve, operating profit can decrease due to higher costs from technology investments. Moreover, it may take more than one year for technology investments to lead to higher operating profit.

In contrast, Recovery/Business Transition did not show a positive impact on sales,

[10]I estimated the effects of Support (t-2) and Support (t-3), but the overall results were very similar to the effect of Support (t-1). The estimation results are available upon request.

TABLE 13— IMPACT OF BUSINESS SUPPORT ON THE OPERATING PROFIT AND NET INCOME OF BENEFICIARIES

Dept. var. (million won)	Model 1 Sales	Model 2 Operating profit	Model 3 Net profit
Loans/Guarantees (t-1)	11.47* (5.906)	1.79** (0.760)	-0.40 (0.718)
Export/Outlet/Marketing (t-1)	44.99*** (14.927)	4.40** (1.922)	1.66 (1.816)
Technology/R&D (t-1)	43.04*** (16.153)	-7.75*** (2.080)	0.39 (1.965)
Education/Diagnosis/Consulting (t-1)	25.18** (11.119)	0.63 (1.432)	-0.73 (1.352)
Founding/Commercialization (t-1)	-6.67 (21.460)	-3.73 (2.763)	-2.37 (2.610)
Organization/cooperation (t-1)	-127.02 (231.383)	-3.92 (29.793)	-9.45 (28.145)
Recovery/Business Transition (t-1)	48.85 (52.547)	15.49** (6.766)	10.32 (6.392)
Labor (t-1)	32.55 (19.980)	1.30 (2.573)	-1.19 (2.430)
Support_other (t-1)	31.81*** (3.907)	1.95*** (0.503)	0.03 (0.475)
Sales (t-2)	-0.03*** (0.003)	-0.00*** (0.000)	-0.00*** (0.000)
Total capital (t-2)	-0.05*** (0.012)	-0.06*** (0.002)	-0.06*** (0.001)
Years of operation (t-1)	51.96*** (3.293)	8.78*** (0.424)	9.03*** (0.401)
Year_2012	33.41*** (8.819)	3.73*** (1.136)	4.70*** (1.073)
Year_2013	24.74*** (5.764)	1.65** (0.742)	2.79*** (0.701)
Year_2014	-	-	-
Constant	992.60*** (32.678)	13.71*** (4.208)	-0.43 (3.975)
No. of observations	223,475	223,475	223,475
R-squared	0.02	0.00	0.00
No. of groups	89,648	89,648	89,648

Note: Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

but this group tended to increase operating profits. During periods of closing or business restructuring, unnecessary production or operating costs are eliminated and thus operating profit can improve without sales growth.

Overall, the impact on net profit was not significant in any of the project groups, but the positive effects on operating profits from to Loans/Guarantees and Export/Outlet/Marketing group were meaningful results given the low profitability of the domestic small business industry.

VI. Trends in the Effectiveness of Support Projects

The analysis thus far has identified the effectiveness of support projects. At this point, we now focus on beneficiaries and examine the relationship between firm characteristics and the effectiveness of projects. This analysis has important policy implications in that it can provide government departments with criteria that can be used to select beneficiaries.

A. *Effectiveness of Support Projects: Years of Operation*

First, we examine how the effect of support projects depends on the operating period of the business. Table 14 reports the estimated results by adding the operating period as an independent variable. Operating periods are set as discrete variables:

TABLE 14— EFFECTIVENESS OF PROJECTS BY THE OPERATING PERIODS OF BENEFICIARIES

Dept. var.: Sales (million won)	Model 1	Model 2
Support (t-1)	25.34*** (5.279)	3.88 (9.183)
Support_other (t-1)	37.55*** (3.910)	37.53*** (3.910)
Sales (t-2)	-0.04*** (0.003)	-0.04*** (0.003)
Total capital (t-2)	-0.05*** (0.012)	-0.05*** (0.012)
Operating period_1-4 (t-1)	184.96*** (11.607)	183.93*** (11.740)
Operating period_5-7 (t-1)	202.49*** (9.877)	199.65*** (10.010)
Operating period_8-10 (t-1)	124.91*** (7.476)	119.47*** (7.659)
Support×Operating period_1-4 (t-1)		22.05* (13.070)
Support×Operating period_5-7 (t-1)		31.72** (13.580)
Support×Operating period_8-10 (t-1)		47.87*** (14.919)
Year_2012	-162.85*** (4.848)	-163.09*** (4.849)
Year_2013	-103.56*** (4.072)	-103.71*** (4.073)
Year_2014	-64.23*** (3.360)	-64.32*** (3.360)
Constant	1,446.43*** (7.977)	1,448.31*** (8.011)
No. of observations	226,198	226,198
R-squared	0.10	0.10
No. of groups	90,321	90,321

Note: Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

1-4 years, 5-7 years, 8-10 years, more than 10 years.

According to Model 1, firms with 1-4 years, 5-7 years, and 8-10 years of operation tend to have higher sales (compared to businesses with more than 10 years of operation) by 185 million won, 202 million won, and 125 million won, respectively. Overall, start-ups with shorter operating periods tend to have higher sales.

A notable variable in Model 2 is the interaction term of Support and Operating period. In this model, Support (t-1) represents the effect of support projects for companies with more than 10 years of operation, and no statistically significant coefficients were obtained. On the other hand, when the projects were targeted at firms with 1-4 years, 5-7 years, 8-10 years of operation, beneficiaries' sales tend to increase by 22.05 million won, 31.72 million won, 47.87 million won, respectively.

These results suggest that relatively young companies tend to have high sales and that growth effects are more likely to occur when supporting these younger firms.

B. *Effectiveness of Support Projects: Sales Growth*

Table 15 shows how the effect of small business support programs depends on the

TABLE 15— EFFECTIVENESS OF PROJECTS BY THE SALES GROWTH OF BENEFICIARIES

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3
Support (t-1)	23.13*** (5.246)	-1.05 (7.716)	2.44 (6.860)
Sales growth (t-1)	102.78*** (3.279)	97.98*** (3.466)	
Support×Sales growth (t-1)		39.85*** (9.324)	
Support_other (t-1)	30.25*** (3.891)	30.32*** (3.890)	27.81*** (3.902)
Sales (t-2)	-0.00 (0.003)	-0.00 (0.003)	-0.06*** (0.003)
Total capital (t-2)	-0.04*** (0.012)	-0.04*** (0.012)	-0.04*** (0.012)
Sales growth (t-2)			66.32*** (3.753)
Support×Sales growth (t-2)			39.73*** (8.928)
Years of operation (t-1)	53.03*** (3.279)	53.10*** (3.279)	41.69*** (3.327)
Year_2012	32.19*** (8.781)	32.43*** (8.780)	46.08*** (8.823)
Year_2013	27.13*** (5.741)	27.24*** (5.741)	12.56** (5.786)
Year_2014	-	-	-
Constant	876.23*** (32.737)	878.25*** (32.738)	1,092.81*** (32.980)
No. of observations	223,475	223,475	223,475
R-squared	0.00	0.00	0.06
No. of groups	89,648	89,648	89,648

Note: Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

sales growth of the companies. For example, Sales growth (t-1) is a dummy variable with a value of 1 when sales (t-1) exceed the sales (t-2) of the previous year. Estimates of Model 1 show that businesses with increased sales at the time of support (t-1) tend to increase their sales in year t.

Model 2 includes a cross-term between sales growth and support. The effect of support increased by 39.85 million won when supporting firms with increased sales (rather than supporting those with reduced sales).

However, Sales growth (t-1) is a variable that can be measured only when sales (t-1) are realized, and it is generally difficult to observe during the period (t-1) when beneficiaries are selected. To handle this issue, Model 3 includes Sales growth (t-2) to examine the effects of the project when an actual sales increase was observed and then supported. These results were very similar to those of Model 2.

The results indicate that the growth effect can be accelerated when the projects support quantitatively growing firms. Therefore, it is crucial to identify businesses which are growing (or that are likely to grow) and then to run support projects to resolve their managerial difficulties.

C. *Effectiveness of Support Projects: Business Overcrowding*

Chapter 3 showed that four major service sectors are crowded with small business owners, and further entries by small businesses are also concentrated in these industries.

This leads to the question of how this overcrowding affects the sales of small business owners. Model 1 in Table 16 additionally controls for the total number of small businesses by industry in the preceding empirical model. As a result, as one more small business enters the market, they tend to experience an annual sales decline of 4,000 won. In Model 2, which separately controls for each support project group, the estimated coefficients appear to be very similar to those in Model 1.

Subsequently, Model 3 controls for not only the number of small businesses but also for the number of non-small businesses. These results indicate that the sales reduction due to the increasing number of small businesses is lowered to approximately 3,000 won, while the sales reduction due to the increasing number of non-small businesses is estimated to be 4,000 won.

In general, when market competition increases, it leads to higher productivity and efficiency, lower prices, and ultimately better consumer welfare. In this case, increasing the number of businesses can increase the market size as well as the sales of individual firms.

However, when additional entries tend to involve the reproduction of existing goods and services and do not have any clear differentiation, the sector can become overcrowded with market growth limited, resulting in a decline of sales of individual businesses. The findings of this study are more likely to support the latter possibility more than the former.

The estimates above represent the average effect of one additional entry of a small business; thus, the magnitude of the overall sales reduction due to industry overcrowding can be calculated by multiplying the estimates and the changes in the number of small businesses.[11] According to Table 17, the effects of overcrowding

[11]The marginal effect of one more entry may decrease or increase when the size of the business exceeds a

TABLE 16— EFFECTIVENESS OF PROJECTS BY BUSINESS OVERCROWDING

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3
Support (t-1)	22.44*** (5.264)		
Loans/Guarantees (t-1)		11.40* (5.904)	11.53* (5.903)
Export/Outlet/Marketing (t-1)		45.16*** (14.920)	45.90*** (14.920)
Technology/R&D (t-1)		39.99** (16.156)	38.69** (16.156)
Education/Diagnosis/Consulting (t-1)		24.58** (11.117)	23.76** (11.118)
Founding/Commercialization (t-1)		-5.49 (21.450)	-4.54 (21.448)
Organization/cooperation (t-1)		-128.35 (231.268)	-129.04 (231.246)
Recovery/Business Transition (t-1)		47.85 (52.521)	46.92 (52.516)
Labor (t-1)		32.97* (19.970)	31.20 (19.971)
No. of firms_small business	-0.004*** (0.000)	-0.004*** (0.000)	-0.003*** (0.000)
No. of firms_non small business			-0.004*** (0.001)
Industry sales*	0.00*** (0.000)	0.00*** (0.000)	0.00*** (0.000)
Support_other (t-1)	30.51*** (3.903)	31.06*** (3.905)	31.17*** (3.905)
Sales (t-2)	-0.03*** (0.003)	-0.03*** (0.003)	-0.03*** (0.003)
Total capital (t-2)	-0.06*** (0.012)	-0.06*** (0.012)	-0.06*** (0.012)
Total capital (t-1)	74.58*** (3.916)	74.42*** (3.918)	76.22*** (3.933)
Year_2012	65.54*** (10.564)	65.07*** (10.570)	51.55*** (10.888)
Year_2013	14.60** (6.179)	14.35** (6.180)	14.82** (6.180)
Year_2014	-	-	-
Constant	1,988.54*** (91.434)	1,986.66*** (91.451)	1,813.07*** (97.407)
No. of observations	223,475	223,475	223,475
R-squared	0.03	0.03	0.03
No. of groups	89,648	89,648	89,648

Note: 1) Industry sales are figures excluding the firm's own sales, 2) Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1% level, respectively.

certain point, in which case it may not be appropriate simply to multiply the marginal effect by the amount of change in the businesses.

TABLE 17— AVERAGE ANNUAL CHANGE IN THE NUMBER OF BUSINESSES BY INDUSTRY

Industry	Changes in No. of firms*			Coefficient* × Changes in No. of small business
	Total	Non-small business	Small business	
Wholesale and retail trade	24,669.2	6,726.4	20,957.6	-82.6
Manufacturing	17,407.2	1,288.4	16,118.8	-63.5
Accommodation and food service activities	15,239.8	7,923.0	7,316.8	-28.8
Construction	7,392.8	254.2	7,138.6	-28.1
Transportation and storage	6,450.4	385.8	6,064.6	-23.9
Professional, scientific and technical activities	6,420.2	2,090.6	4,329.6	-17.1
Membership organizations, repair and other personal services	4,649.8	1,593.6	3,056.2	-12.0
Real estate activities	4,070.2	1,043.0	3,027.2	-11.9
Information and communication	3,210.0	886.6	2,323.4	-9.2
Business facilities management and business support services; rental and leasing activities	3,132.8	1,342.8	1,790.0	-7.1
Education	1,877.0	843.8	1,033.2	-4.1
Water supply; sewage, waste management, materials recovery	506.0	183.0	323.0	-1.3
Human health and social work activities	5,108.2	4,845.2	263.0	-1.0
Financial and insurance activities	555.6	345.6	210.0	-0.8
Agriculture, forestry and fishing	186.8	105.6	81.2	-0.3
Electricity, gas, steam and air conditioning supply	91.4	38.8	52.6	-0.2
Mining and quarrying	47.2	-4.0	51.2	-0.2
Public administration and defense; compulsory social security	87.0	114.0	-27.0	0.1
Services related to arts, sports and recreation	-377.0	999.8	-1,376.8	5.4

Note: 1) The change in the number of firms represents the average annual change during the period of 2010-2015, 2) The coefficient is the estimate (-0.003941) of the number of small businesses estimated in Model 2 in Table 16.

on small businesses' sales reduction were approximately 82.6 million won in wholesale and retail trade, 63.5 million won in manufacturing, 28.8 million won in accommodation and food service activities, 28.1 million won in construction and 23.9 million won in transportation and storage.

It is important to note that if we compare the effect of the sales decline due to such overcrowding with the sales increase due to support projects, a worrying trend appears (see Figure 6). To be specific, the size of the sales reduction due to overcrowding in the wholesale and retail (82.6 million won) sector is greater in absolute terms than the sales increase by support projects, with significant effects in Model 2 in Table 16: Loans/guarantees (11.4 million won), Education/diagnosis/

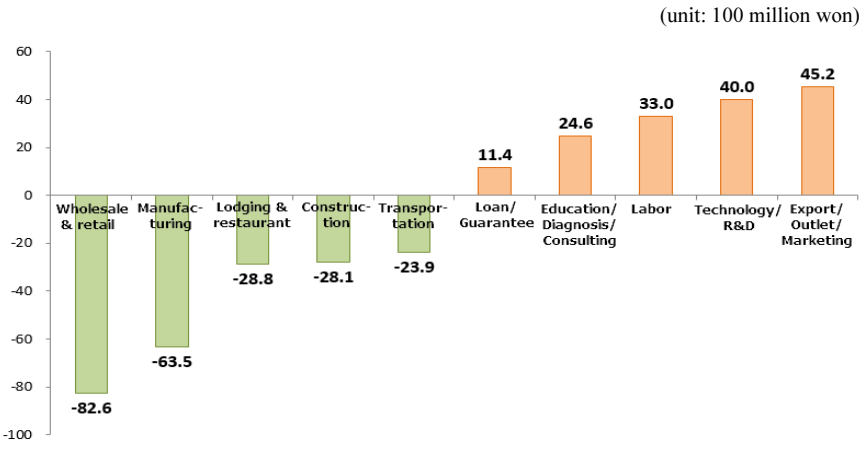

FIGURE 6. COMPARISON OF THE SALES REDUCTION EFFECT OF OVERCROWDING AND THE SALES INCREASING EFFECT OF SUPPORTING PROJECTS

Source: Based on Statistics Korea, "Census on Establishments," 2010-2014; "Economic Census," 2015; and estimated coefficients in the regression model in Table 16.

consulting (24.6 million won), Labor (33 million won), Technology/R&D (40 million won), and Export/outlet/marketing (45.2 million won). Other industries such as manufacturing, accommodation and food, and transportation, where small businesses are densely located, experience similar situations with varying degrees.

The positive effect of supporting projects, which was an encouraging result, appears to be largely offset by the negative effect of the overcrowding of small businesses. These findings suggest that the effects of government support projects will be largely limited if the overcrowding of small businesses in a few industries cannot be overcome. In addition, these results may explain cases in which the government's budget for small business support has expanded rapidly, but the beneficiaries do not realize the effects of this support.

In the future, two goals of small business support policies should be to reduce the overcrowding of certain industries and to improve their overall effectiveness.

VII. Conclusion and Policy Implications

To better understand the domestic small business industry, this paper looked into industrial aspects, large and small policies, and related budget trends. The paper also empirically examined the effectiveness of small business support projects from various perspectives.

The findings suggest that for the small business industry to grow steadily, two policy directions must be pursued at the same time: to alleviate overcrowding in some sectors and to increase the effectiveness of the support projects.

First, in order to alleviate overcrowding in a few industries, prospective founders must have more information about market conditions, the characteristics of commercial districts, and the degree of industry overcrowding, after which they should be able to enter more diverse industries. Specifically, overcrowding can be

mitigated by providing richer information about commercial districts. The MSS is currently operating a Commercial Information System (CIS) as part of its small business start-up support program. To increase the utilization of this system, the use of the CIS can be designated as an essential curriculum for a start-up education support project. Moreover, founders can be encouraged to submit self-assessment documents about their use of the CIS when applying for small business funding projects.

In addition, because market entries without sufficient preparation can cause the overcrowding of the small business industry as well, it is necessary to reinforce consulting support during the preparation stage for start-ups and to strengthen the sharing channels of technology, products, sales, and the procurement of know-how by successful entrepreneurs.

On the other hand, to enhance the effectiveness of small business support projects, governments must select and focus on firms that are young and have high growth potential and should operate support projects to resolve their management difficulties. Supporting a large number of companies, including declining and old firms is unlikely to stimulate the growth incentives of small businesses.

APPENDIX

TABLE A1— LOANS/GUARANTEES, EXPORT/OUTLET/MARKETING, TECHNOLOGY/R&D, EDUCATION/DIAGNOSIS/CONSULTING

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3	Model 4
Loans/Guarantees(t-1)		11.67**	11.42*	11.84**
		(5.908)	(5.907)	(5.941)
└ Accounts receivable insurance support (t-1)	36.61***			
	(12.627)			
└ New growth fund (t-1)	80.41***			
	(30.241)			
└ Small business management stabilization fund (t-1)	36.22**			
	(15.005)			
└ Youth Exclusive Founding Fund (t-1)	-150.16**			
	(74.049)			
Export/Outlet/Marketing (t-1)	45.10***		45.98***	45.28***
	(14.930)		(14.936)	(14.929)
└ Public procurement loans (t-1)		92.93*		
		(51.879)		
└ Support for performance certification inspection expenses (t-1)		127.65*		
		(76.469)		
└ Trade promotion group (Participation in overseas exhibitions and market improvement) (t-1)		82.23**		
		(39.504)		
└ Regional small and medium business export marketing (t-1)		64.40*		
		(33.574)		
└ Trade promotion group (Export consortium) (t-1)		199.73*		
		(107.793)		

TABLE A1— LOANS/GUARANTEES, EXPORT/OUTLET/MARKETING, TECHNOLOGY/R&D, EDUCATION/DIAGNOSIS/CONSULTING *(CON'D)*

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3	Model 4
Technology/R&D (t-1)	43.10*** (16.160)	43.47*** (16.177)		45.21*** (16.268)
└ Public-private joint investment technology Development (t-1)			216.58* (131.404)	
└ Skill transfer system (t-1)			-371.97* (210.075)	
Education/Diagnosis/Consulting (t-1)	22.47** (11.290)	25.24** (11.126)	26.21** (11.230)	
└ Business support group operation project (t-1)				72.97*** (24.629)
└ SME consulting support (t-1)				96.83** (39.217)
Founding/Commercialization (t-1)	-2.62 (21.656)	-6.56 (21.470)	-7.37 (21.474)	-7.01 (21.461)
Organization/cooperation (t-1)	-119.59 (231.404)	-131.89 (231.394)	-126.80 (231.391)	-126.06 (231.399)
Recovery/Business Transition (t-1)	44.50 (59.902)	47.92 (52.572)	48.56 (52.566)	46.24 (52.570)
Labor (t-1)	31.57 (19.985)	33.31* (19.989)	31.88 (19.996)	33.14* (19.983)
Support_other (t-1)	31.56*** (3.921)	31.83*** (3.907)	31.72*** (3.907)	32.02*** (3.910)
Sales (t-2)	-0.03*** (0.003)	-0.03*** (0.003)	-0.03*** (0.003)	-0.03*** (0.003)
Total capital (t-2)	-0.05*** (0.012)	-0.05*** (0.012)	-0.05*** (0.012)	-0.05*** (0.012)
Years of operation (t-1)	52.13*** (3.297)	52.15*** (3.298)	51.94*** (3.297)	52.07*** (3.294)
Year_2012	34.65*** (8.838)	33.86*** (8.828)	33.31*** (8.826)	33.51*** (8.819)
Year_2013	25.74*** (5.775)	25.01*** (5.768)	24.63*** (5.767)	24.79*** (5.764)
Year_2014	-	-	-	-
Constant	991.13*** (32.720)	990.71*** (32.722)	992.90*** (32.713)	991.34*** (32.682)
No. of observations	223,475	223,475	223,475	223,475
R-squared	0.02	0.02	0.02	0.02
No. of groups	89,648	89,648	89,648	89,648

Note: Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table A2— FOUNDING/COMMERCIALIZATION, ORGANIZATION/COOPERATION, RECOVERY/BUSINESS, TRANSITION LABOR

Dept. var.: Sales (million won)	Model 1	Model 2	Model 3	Model 4
Loans/Guarantees (t-1)	11.30* (5.909)	11.47* (5.906)	11.42* (5.908)	11.44* (5.906)
Export/Outlet/Marketing (t-1)	45.16*** (14.928)	45.00*** (14.928)	45.19*** (14.928)	45.21*** (14.928)
Technology/R&D (t-1)	42.50*** (16.164)	43.04*** (16.153)	43.19*** (16.153)	43.01*** (16.155)
Education/Diagnosis/Consulting (t-1)	25.04** (11.121)	25.18** (11.119)	25.31** (11.119)	25.36** (11.120)
Founding/Commercialization (t-1)	O	-6.70 (21.460)	-6.59 (21.460)	-7.09 (21.462)
Organization/cooperation (t-1)	-130.46 (231.402)	O	-126.99 (231.382)	-126.92 (231.383)
Recovery/Business Transition (t-1)	48.87 (52.550)	48.85 (52.547)	O	48.63 (52.548)
Labor (t-1)	31.78 (20.074)	32.55 (19.980)	31.93 (19.983)	O
Support_other (t-1)	31.78*** (3.907)	31.81*** (3.907)	31.79*** (3.907)	31.79*** (3.907)
Sales (t-2)	-0.03*** (0.003)	-0.03*** (0.003)	-0.03*** (0.003)	-0.03*** (0.003)
Total capital (t-2)	-0.05*** (0.012)	-0.05*** (0.012)	-0.05*** (0.012)	-0.05*** (0.012)
Years of operation (t-1)	51.92*** (3.295)	51.96*** (3.294)	51.98*** (3.294)	51.86*** (3.294)
Year_2012	33.41*** (8.824)	33.40*** (8.819)	33.42*** (8.820)	33.13*** (8.820)
Year_2013	24.74*** (5.766)	24.74*** (5.764)	24.76*** (5.764)	24.53*** (5.765)
Year_2014	-	-	-	-
Constant	993.09*** (32.690)	992.62*** (32.678)	992.52*** (32.680)	993.58*** (32.682)
No. of observations	223,475	223,475	223,475	223,475
R-squared	0.02	0.02	0.02	0.02
No. of groups	89,648	89,648	89,648	89,648

Note: 1) Standard errors are in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1% level, respectively, 2) O means that unit projects of each business group were controlled. No projects had a statistically significant effect..

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Financial Development and Economic Growth in Korea†

By SUNJOO HWANG*

Does financial development contribute to economic growth? The literature finds that an expansion in financial resources is useful for economic growth if the degree of financial development is under a certain threshold; otherwise, the expansion is detrimental to growth. Almost every published study, however, considers country-panel data. Accordingly, the results are not directly applicable to the Korean economy. By examining Korean time-series data, this paper finds that there is an inverse U-shaped relationship between the per capita real GDP growth rate and private credit (as a percentage of nominal GDP)—a well-known measure of quantitative financial development, where the threshold is 171.5%. This paper also finds that private credit is positively associated with economic growth if the share of household credit out of private credit is less than 46.9%; otherwise, private credit is negatively associated with economic growth. As of 2016, the ratio of private credit to GDP and the ratio of household credit to private credit are both higher than the corresponding thresholds, which implies that policymakers should place more emphasis on qualitative financial development than on a quantitative expansion of financial resources.

Key Word: Financial Development, Economic Growth, Private Credit, Household Credit
JEL Code: E51, E60, G00

I. Introduction

Does an expansion in financial resources always facilitate economic growth? At first glance, it seems that there is a positive relationship between financial development and economic growth, as additional financial resources can serve as

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a factor affecting production. However, recent financial crises have witnessed that too much finance can harm sustainable economic growth.

If the true relationship between finance and growth is revealed, one can draw on several important policy implications. If there is a positive relationship, more investment in the financial sector is always beneficial. If there is a negative relationship between finance and growth, existing public policies that aim to expand the financial sector must change.

There is a large body of work on the relationship between finance and growth but, interestingly, the literature draws on a general conclusion that there is an inverse U-shaped relationship between financial development and economic growth.[1] That is, an expansion in financial resources is useful for accelerating economic growth if the degree of financial development is under a certain threshold; otherwise, this expansion is detrimental to growth.

There are a number of economic theories that explain why the nonlinear relationship between finance and growth arises. According to a first group of theories, as financial resources are being accumulated, these resources are distributed less likely to sectors with high growth potential, such as the corporate sector or the investment sector, instead being distributed more to sectors with low growth potential, such as the household sector or the consumption sector (Hung, 2009; Beck *et al.*, 2012; Hoshi and Kashyap, 2004). According to a second group of theories, if the amount of debt in an economy is sufficiently large, the economy becomes vulnerable to outside shocks; therefore, it is highly likely to face a financial crisis that typically reduces growth rates for at least several years, if not a decade (Drechsler *et al.*, 2016; Stiglitz, 2000; Levchenko *et al*., 2009). According to a third group of theories, as the financial sector expands, talented workers are more likely to work in the financial sector than in the real economy; accordingly, poor labor productivity in the real economy leads to a slowdown in growth (Tobin, 1984; Kneer, 2013).

However, there are several caveats to consider when interpreting the nonlinear relationship found in the literature. First, financing methods can be divided roughly into direct financing and indirect financing. Secondly, there are two different aspects of financial development: quantitative and qualitative. The extant literature finds that there is an inverse U-shaped relationship between growth and quantitative financial development with regard to indirect financing. Although this finding is general, more research should be conducted to examine the growth-finance relationship in the area of direct financing or to examine possible relationships between growth and qualitative financial development.

Nevertheless, the findings in the literature have several important policy implications, as follows. First, a majority of households and firms in most economies, including some advanced economies, rely on different types of indirect financing, such as loans, whereas they rarely use direct financing means such as bond or stock issuances when raising funds. Secondly, if there is an inverse U-shaped relationship between growth and finance, there is a certain threshold level of financial development. If the current status of financial development is below the threshold, financial policies that aim to expand available financial resources are

[1]See Heil (2017) for a survey of this literature.

justifiable. However, if the current status of financial development exceeds the threshold, policymakers should refrain from simply expanding the financial sector and instead should improve on its qualitative aspects.

However, the findings of recent studies cannot be applied directly to the Korean economy because almost every existing study uses country-panel data. Some papers consider the OECD or G20 countries together while others study groups of emerging markets. These papers find that there are inverse U-shaped relationships between economic growth and the ratio of private credit to GDP while also indicating that 100% is a plausible threshold. Nonetheless, because none of these papers focus on the Korean economy, despite the fact that there are a number of similarities between Korea and several other countries, one cannot be sure whether such a nonlinear relationship holds or whether the threshold level is 100% in the Korean economy as well.

This paper focuses on the Korean economy and, in this regard, examines Korean time-series data. Because non-stationary time-series variables typically lead to misleading regression results if they are not cointegrated, this paper examines whether there are cointegrating relationships between the variables of interest and, if they exist, estimates these cointegrating relationships.

The main result of this paper is as follows. First, there is an inverse U-shaped cointegrating relationship between the five-year average economic growth rate and the ratio of private credit to GDP. It is also demonstrated here that the threshold level of private credit to GDP is 171.5%. The ratio of private credit to GDP in Korea has increased steadily over time, becoming as high as 193% by the end of 2016.

II. Related Literature

A. *Empirical Studies*

The literature in the early stage finds a positive relationship between financial development and economic growth. King and Levin (1993) examine country-panel data from 77 advanced and developing countries, finding that the private credit and the GDP growth rate are positively associated for the period from 1960 to 1989. However, King and Levin (1993) do not consider the possibility of reverse causality; as the economy grows, more resources are accumulated and hence the financial sector of the economy can expand. To deal with this endogeneity problem, Rajan and Zingales (1998) use instrumental variables and focus on small and medium-sized industries, for which it seems that no strong relationship between industrial growth and nationwide financial development exists. Their findings reaffirm the main result of King and Levin (1993).

However, the literature in the second stage during the period from the mid-2000s to the early 2010s finds that a financial expansion does not necessarily cause economic growth. Manning (2003) adopts the same methodology used by Rajan and Zingales (1998) but distinguishes OECD countries from non-OECD countries. He finds that the usual positive relationship holds for non-OECD countries, but there is no statistically significant relationship for OECD countries. Pagano and Pica (2012) show a similar result. These findings suggest that financial development clearly

contributes to economic growth in underdeveloped countries, whereas the link is vague in advanced countries.

Interestingly, the literature in the third stage during the period from the early 2010s to date finds even more radical results (Table 1). Cecchetti and Kharroubi (2012) find an inverse U-shaped relationship between economic growth and the ratio of private credit to GDP by studying panel data from fifty countries for the sample period of 1980-2009. Arcand *et al.* (2012) enlarge the number of countries to 100 and broaden the period to 1960-2010. Even with this large sample, the result is qualitatively equivalent, and the threshold is found to be 100%. Cournède and Denk (2015) focus on advanced countries, in their case OECD countries and G20 countries, but the result is similar and the threshold in terms of private credit is again 100% of GDP.

Law and Singh (2014) conduct a non-parametric estimation to analyze asymmetries in the nonlinear relationship. The hypothesis is that the absolute impact of finance on growth when the size of the financial sector is under a threshold may differ from the absolute impact of finance on growth when the size exceeds the threshold. Their findings show that 88% is the threshold in terms of the ratio of bank credit to GDP, and the absolute impact if the size of the financial sector is under the threshold is greater than that when the size exceeds the threshold.

Nam (2015) conducts a quantile regression analysis and finds a relatively high threshold. Using OECD country panel data, he finds that the threshold level is 150% in terms of the ratio of bank credit to GDP. Given that there is less bank credit than private credit, his result suggests that the threshold level in terms of the ratio of private credit to GDP must be higher than the typical level of 100%.

Figure 1 shows the movement of the ratio of private credit to GDP in Korea. It has increased steadily, reached 100%, which is suggested as the threshold by many existing studies, and it finally reached 193.2% at the end of 2016. The ratio of bank credit to GDP (not presented in Figure 1) also increased continuously during the same period, whereas its level as of 2016 is 131.9%, which is still lower than the 150%, the threshold suggested by Nam (2015).

Although the ratio of private credit to GDP is a very well-known measure of financial development in the literature, there are a number of other complementary measures, including household credit, total credit, liquid liabilities in the financial sector, market capitalization, financial sector employment, and the financial sector value-added factor. The literature examines the relationships between economic

TABLE 1—THRESHOLD LEVELS OF INVERSE U-SHAPED RELATIONSHIPS BETWEEN GROWTH AND FINANCE[1)]

Paper	Measure of Financial Development	Threshold (% of GDP)
Cecchetti and Kharroubi (2012)	Private credit	100%
Arcand *et al.* (2012)	Private credit	100%
Law and Singh (2014)	Bank credit[2)]	88%
Cournède and Denk (2015)	Private credit	100%
Nam (2015)	Bank credit[2)]	150%

Note: 1) The threshold level is linked to the peak of the inverse U-shape, 2) Private credit is the sum of credits that banks and non-bank institutions provide to the private sector, whereas bank credit is private credit generated only by banks.

Source: Hwang (2017), Table 3-6.

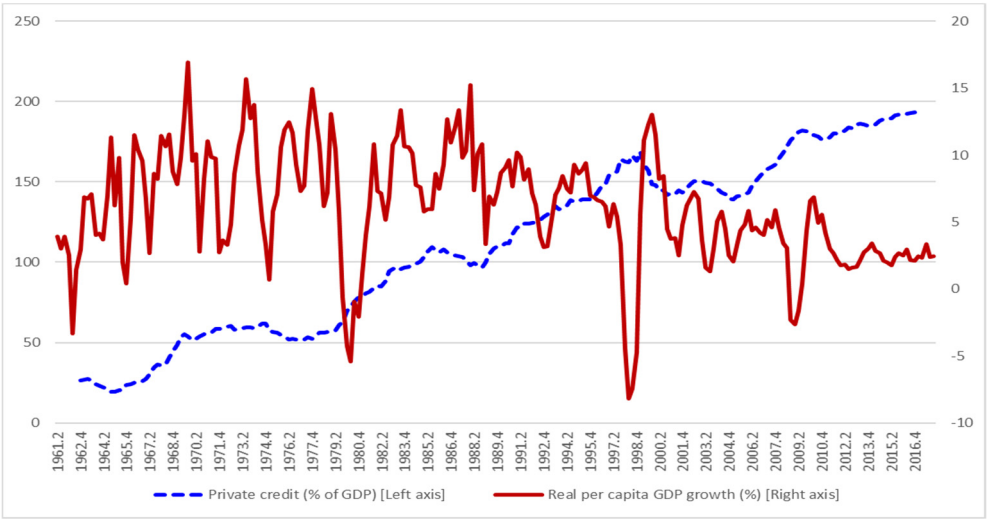

FIGURE 1. PRIVATE CREDIT (UNIT: % OF GDP) AND PER CAPITA REAL GDP GROWTH (UNIT: %)

Note: The growth rate of the per capita real GDP is calculated annually.

Source: Table A1.

growth and these complementary measures and finds corresponding threshold levels. Table 2 lists these thresholds and also shows whether the Korean ecuonomy reaches these threshold levels. As of 2016, household credit as a percentage of GDP was 93%, whereas Lombardi *et al*. (2017) find that the related threshold level is 80%. Total credit as a percentage of GDP is also substantially higher than the threshold level of 99%, as suggested by Law and Singh (2014). Similarly, the liquid liabilities and value-added factors in the financial sector are both higher than the suggested thresholds. Although the market capitalization and financial sector employment are lower than the corresponding thresholds, the differences are marginal.

TABLE 2—COMPLEMENTARY MEASURES OF FINANCIAL DEVELOPMENT AND CORRESPONDING THRESHOLDS

Measure	Unit	Year	Levels in Korea	Threshold
Household credit	% of GDP	2016	93	80[1)]
Total credit	% of GDP	2016	233	99[2)]
Liquid liabilities in the financial sector	% of GDP	2014	135	91[3)]
Market capitalization	% of GDP	2014	89	100
Financial sector employment	% of total employment	2013	3.5	3.93[4)]
Financial sector value-added	% of GDP	2010	5.7	5.54[5)]

Note: 1) Household credit is private credit provided to households and related nonprofit organizations. By examining the relationships between household credit and GDP growth, Lombardi *et al.* (2017) find that 80% is the threshold of household credit as a percentage of GDP, 2) Total credit is private credit provided to the private sector and governmental bodies. Law and Singh (2014) find that 99% is the threshold, though the inverse U-shaped relationship between total credit and GDP growth is not statistically significant, 3) Liquid liabilities in the financial sector are M3. Law and Singh (2014) find that 91% is the threshold, though the related inverse U-shared relationship is not statistically significant, 4) Financial sector employment is the ratio of the employment in the financial and insurance sector to the total employment. Cecchetti and Kharroubi (2012) find that the threshold is 3.9, 5) Financial sector valued-added refers to value-added in the financial and insurance sector, for which Cournède and Denk (2015) find that 5.54 is the threshold.

Source: Table 3-7 of Hwang (2017).

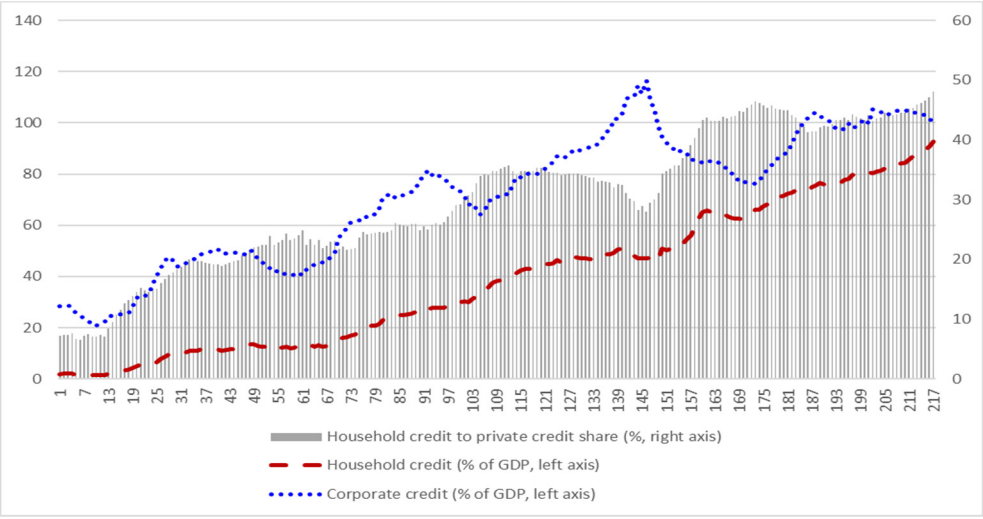

FIGURE 2. HOUSEHOLD CREDIT VS. CORPORATE CREDIT

Source: BIS Credit to the Non-financial Sector Database 2018.

Does the composition of private credit matter for economic growth? To answer this question, Lombardi *et al.* (2017) examine whether there is any inverse U-shaped relationship between the ratio of household credit to GDP and the economic growth rate. Their results show that there is indeed such a nonlinear relationship, and the corresponding threshold level is 80%. Figure 2 shows the path of household credit in Korea. It is apparent that the ratio of household credit to GDP has increased steadily since 1962, reaching 90% after 2015.

B. *Theoretic Background*

According to classical economics theories such as the money-neutrality theory or the Modigliani-Miller's theorem, money or the capital structure do not affect real economic output. This is particularly true when there is no economic friction. However, many studies show that information asymmetry between investors and entrepreneurs results in financial constraints, which constrains production possibilities. If investors cannot observe whether entrepreneurs use their money in appropriate ways, they are reluctant to invest on these entrepreneurs. Therefore, even the entrepreneurs with highly profitable projects are unable to finance their projects if their own money (i.e. net worth) is not enough (Bernanke and Gertler, 1989; Tirole, 2003). However, if financial resources are abundant, financial constraints are weak and hence entrepreneurs with highly promising projects can finance and launch their projects. As a result, real economic output increases (Diamond and Rajan, 2006; Zheng, 2013).

However, recent studies propose three theories based on which financial development beyond certain threshold levels can constrain economic growth. According to the first theory, there is a tendency for financial resources distributed to sectors with low growth potential rather than high growth potential to increase as the financial sector expands. Hung (2009) shows theoretically that financial

resources are invested mostly in the investment sector rather than in the consumption sector in the early stage of financial development; thus, these resources enhance economic growth. However, as financial resources become abundant, the most likely recipient is not the investment sector but the consumption sector, with low growth potential. In a theoretic analysis, Beck *et al*. (2012) find that the corporate sector is in a better position with regard to financing than the household sector in the early stage of financial development, but as financial resources expand, financiers invest mostly in the household sector instead, which presumably has low growth potential. Related to this, Hoshi and Kashyap (2004) find that Japanese expansionary monetary and financial policies since 1990 ultimately reduced investments in young and promising firms but increased investments in what were known as zombie firms, thereby exacerbating the longstanding recession in the Japanese economy.

The second theory explains that the nonlinear relationship between growth and finance arises because too much finance ultimately increases the likelihood of a financial crisis, which in turn slows down the speed of economic growth for several years, if not a decade. In this regard, Drechsler *et al*. (2016) find that quantitative easing in the Euro area after the 2008 global financial crisis and the subsequent European sovereign debt crisis did not significantly promote investments but only transferred risk from prudential banks to highly risky banks. Stiglitz (2000) finds that the risk and volatility of domestic financial markets and real economies increase as financial sectors are expanded such that entry barriers faced by foreign investors are reduced (see also Kose *et al*., 2006 and Levchenko *et al*., 2009). As these papers find, too much finance weakens the resilience of the financial system, thus increasing the probability of a new crisis. However, this leads one to question the nature of the relationship between crises and growth. Laeven and Valencia (2012) carefully study countries that underwent a financial crisis and find that a crisis deters economic growth not just for the first two or three years after the crisis but for many years thereafter. Each of the countries in their study deviated from the original growth path at the time of the financial crisis.

They then embarked on slow growth for many years and, only after several years or a decade, reached parity with their original growth path. For instance, in the United States, Germany, Ireland, Thailand, and Japan, it took more than eight years to resume the original growth path.

The third economic theory, holds that too much finance ends up decreasing growth rates, focuses on the allocation problem of talented workers on industries. This theory holds that talented workers tend to find jobs in the financial sector, which by itself contributes little to economic growth compared to workers in the manufacturing or other real economic sectors when the degree of financial development exceeds a certain threshold. Tobin (1984) critically analyzes the phenomenon by which talented workers move from real economic sectors to the financial sector. Kneer (2013) finds through an empirical analysis that labor productivity in the manufacturing sector for which high-skilled labor is important decreases as interstate branching regulations are relaxed, allowing banks to establish branches in not only in the states where their headquarters are located but also in other states.

C. *Korea-related Studies*

Almost every study in the literature considers country-level panel data when analyzing the potential relationships between finance and growth. Moreover, to the best of the author's knowledge, researchers have not focused on the Korean economy. Therefore, although Korea and other countries, especially those in the OECD group, are similar in several aspects, the existence of the aforementioned nonlinear relationship and the suggested threshold level cannot be directly applied per se to the Korean economy.

However, there are a few related studies, though they are not very closely related to the issue tackled in this paper. Kim and Park (2018) empirically analyze the effects of financial development on the growth of the corporate sector, though not the overall economy. For the period of 2000-2015, they find that the growth rate of bank loans has a positive effect on the value-added growth rate if the companies are small or medium-sized organizations, but these effects disappear for large companies. Their findings imply that the positive effect of finance on corporate growth is limited to companies that face strong financial constraints. Cournède and Denk (2015) conduct a simple linear regression analysis using Korean annual time-series data. Without controlling for changes in industrial structures or financial crises that occurred in Korea, such as the oil shocks in the 1970s or the 1997 Asian financial crisis, they find that growth rates are not statistically significantly associated with the ratio of private credit to GDP.

III. Finance and Growth in Korea

A. *Data*

I examine a Korean time-series dataset pertaining to the size of the financial sector and the speed of economic growth. The sample period is from 1960 Q1 to 2018 Q1 for most of the time-series variables. Two of the key variables are the per capita real GDP growth rate and the private credit as a percentage of the nominal GDP. These two variables are quarterly time-series variables. However, among many control variables, there are no quarterly data on population growth and average years in education. Therefore, I transform annual data to quarterly data by means of linear interpolation for these variables. See Table A1 in the appendix for more details about the variables. Also see Table 3 for descriptive statistics pertaining to these variables.

TABLE 3—DESCRIPTIVE STATISTICS

Variables	Unit[1)]	Sample size	Mean	S.D.	Min	Max	Time span
per capita real GDP growth	%	210	6.31	2.33	2.29	9.95	1961.1Q~ 2018.1Q
Private credit	% of GDP	217	109.98	52.46	19.6	193.2	1962.4Q~ 2016.4Q
Household credit	% of GDP	217	38.51	26.94	1.4	92.8	1962.4Q~ 2016.4Q
The ratio of household credit	% of private credit	217	30.02	11.33	6.52	48.03	1962.4Q~ 2016.4Q
Corporate credit	% of GDP	217	71.42	25.50	20.9	116.3	1962.4Q~ 2016.4Q
Total credit	% of GDP	105	175.83	32.40	125.1	234.9	1990.4Q~ 2016.4Q
Market capitalization	% of GDP	141	41.57	28.90	4.74	94.06	1979.4Q~ 2014.4Q
per capita real GDP	10,000 Korean won	233	293.16	239.54	27.05	768.26	1960.1Q~ 2018.1Q
Average year in education	Year	204	7.84	2.63	3.12	11.89	1960.1Q~ 2010.4Q
Investment rate[2)]	% of GDP	233	27.62	10.10	4.59	46.00	1960.1Q~ 2018.1Q
Population growth	%	226	1.79	.96	-.04	3.43	1960.1Q~ 2018.1Q
BIS gap between the level and a trend of the private credit	% of GDP	183	-1.31	9.75	-23.0	14.8	1972.4Q~ 2018.4Q

Note: 1) '% of GDP' means % of nominal GDP, 2) The investment rate is the growth rate of gross fixed capital formation.

B. *Inverse U-shaped Cointegrating Relationship*

In the literature, the private credit as a percentage of the nominal GDP is used as one of the leading indicators of quantitative financial development (see Heil, 2017 for a survey of the literature). Private credit is credit created by bank and nonbank institutions and provided to private economic agents, such as households and firms. Private agents can use two major options to raise funds—loans and bonds. However, bond issuance is an option applicable only for a few large-sized companies, as only highly creditworthy issuers can issue bonds, whereas bank or non-bank loans can be used by households or small- or medium-sized companies. Therefore, private credit, which is essentially the total amount of loans provided to private agents, is a good measure of the overall size of the financial sector.

Figure 1 compares the movements of private credit and economic growth over time in Korea. Since the 1960s, the ratio of private credit to GDP has increased continuously, while the per capita real GDP growth rate increased until the mid-1980s but has since decreased steadily. From this comparison, per capita real GDP growth appears to be nonlinearly related to the ratio of private credit to GDP. However, a careful econometric analysis should be conducted to draw a reliable conclusion about this relationship, as both the ratio of private credit to GDP and the per capita real GDP growth rate are time-series variables. Therefore, simple comparisons of those two variables may provide misleading results. For this reason, it is necessary to test whether they are really meaningfully related. In this study, a cointegration analysis is conducted.

The dependent variable is the five-year (i.e., 20-quarter) moving average of the per capita real GDP growth rate.[2] To increase the available sample size, I use quarterly data, and to control for seasonal effects, I use season-adjusted quarterly data. In addition, to consider the mid-term or long-term growth effects of financial development, I consider the five-year average growth rate. Most published empirical papers also use similarly defined five-year average growth rates (Heil, 2017).

I control a number of relevant variables when estimating the cointegrating relationship between the ratio of private credit to GDP and the five-year average GDP growth rate. According to classical economic growth theory, major factors that affect economic growth include the degree of economic development, human capital, physical capital, and the population. To control for each of these relevant factors, I use the logarithm of the per capita real GDP, the average number of years in education of those who are at least 25 years old, the growth rate of gross fixed capital formation, and the growth rate of the population of those 16-64 years old, respectively. These variables are commonly used as control variables in the literature (see Table 10 of Cournède and Denk, 2015, for instance).

Notably, a majority of these variables considered in this analysis are time-series variables; hence, they may be non-stationary variables with unit roots. As is well known in the econometrics literature, a simple linear regression analysis using such non-stationary variables can produce misleading results.

In this reason, I conduct a unit root test of the aforementioned time-series variables (see Table 4). The test results suggest that the five-year average growth rate, the level of the ratio of private credit to GDP, the square of the ratio of private credit to GDP, the log of the per capita real GDP, and the investment rate are I(1) variables (i.e., non-stationary), as in this case the null hypothesis that the level of each of these variables has a unit root cannot be rejected, whereas the null hypothesis that the first

TABLE 4—UNIT ROOT TEST RESULTS

Variable	P-value for the level of the variable[1)]	P-value for the first difference of the variable[1)]	Judgment
Per capita real GDP growth (five-year average)	0.3666	0.0025***[2)]	I(1)
The level of the ratio of private credit to GDP	0.1169	0.0000***	I(1)
The square of the ratio of private credit to GDP	0.1324	0.0000***	I(1)
Log (per capita real GDP)	0.9995	0.0001***	I(1)
Investment rate	0.6942	0.0000***	I(1)
Population growth	0.0597*	.	I(0)
Average years in education	0.0000***	.	I(0)

Note: 1) The null hypothesis is that the time-series variable of interest follows a random walk (i.e., contains a unit root) with a constant and a deterministic trend. The length of lagged differences in the fitting model is selected according to the Akaike information criterion. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value, 2) *, ** and *** indicates 10%, 5% and 1% significance levels, respectively.

[2]If two variables are cointegrated, it is difficult to determine which variable is the dependent variable and which is the independent variable simply based on an econometric result. That is, some economic reasoning is required to define the dependent variable. In this paper, I briefly discuss how reverse causality is less likely and how therefore it is more reasonable to regard the growth rate as opposed to private credit as the dependent variable.

difference of each of these variables has a unit root can be rejected. Similarly, the test results also suggest that the population growth and the average years in education are I(0) variables (i.e., stationary).

In this test, I consider a fitting model with a constant and a deterministic trend. The length of lagged differences in this fitting model is selected with the Akaike information criterion assuming that the maximum possible length is 19.[3] (The selected lag length for each variable is reported in Table A2 in the appendix.) As a robustness check, given that this paper considers quarterly variables and that the dependent variable is a 19-quarter moving-average variable, I also consider lag lengths of 3, 7, 11, and 15. (Because these lag lengths are based on the difference rather than on the level of a given time-series variable, I consider 3, 7, 11, and 15 rather than 4, 8, 12, and 16.) However, the test results do not critically depend on these lag selections.[4] See Table A3-A6 in the appendix for the test results with these different lags. In addition, I consider an alternative fitting model with a constant but without a deterministic trend. The related test results still suggest that the key variables, in this case the five-year average growth rate and the level and the square of the ratio of private credit to GDP, are I(1) variables.

In an estimation of a cointegrating relationship between growth and finance, I do not need to add the I(0) variables, because if there exists a cointegrating relationship among the variables of interest, the estimation result is then invariant to the addition or omission of I(0) stationary variables (see Engle and Granger, 1987). That is, I shall consider only the five I(1) variables in the following cointegration analysis.

As the unit root test results suggest that the dependent variable, the independent variables, and the two control variables are I(1) variables, I test whether there is a cointegrating relationship among those five variables. If a linear combination of two or more I(1) variables turns out to be an I(0) variable, this linear combination is referred to as a cointegrating relationship, which represents a long-term stable relationship among those I(1) variables. Because I consider five I(1) variables, there are at most four cointegrating relationships in principle. If more than two I(1) variables are of interest, the Johansen test is useful to determine how many cointegrating relationships exist. In general, the test result could depend on the length of the lagged differences in the related fitting model, which is a vector error correction model (i.e., VECM). I select a lag length of 1 using the Akaike information criterion. Moreover, the test result could depend on whether the VECM contains trends in its long-term and/or short-term relationships. For the subsequent tests, I consider a VECM with trends in both long-term and short-term relationships because the dependent variable is a moving-average variable and hence presumably contains a deterministic trend in its data-generation process.

Table 5 shows the Johansen test result. First, the test result allows the rejection of the null hypothesis that there are at most zero cointegrating relationships (i.e., maximum rank = 0), as the corresponding trace statistic exceeds the 5% significance

[3]In the following analysis, I use the Akaike information criterion to select the length of the lagged difference in the unit root tests, the Johansen cointegration tests, and the cointegration estimation based on vector error correction models. In all of these analyses, I assume that the maximum possible length is 19. Therefore, if the Akaike information criterion results in a choice of 2, it means that 2 is the optimal lag length from the group of 0, 1, 2, ..., 19.

[4]The judgment of whether the population growth is an I(1) or I(0) variable depends on the lag selection. However, I shall briefly show that the estimation result of the cointegrating relationship is robust to the inclusion or exclusion of this variable. See Table A9 in the appendix.

TABLE 5—JOHANSEN COINTEGRATION TEST RESULTS

Maximum rank	Log likelihood	Eigenvalue	Trace statistic	5% significance level
0	-1462.8559	.	85.7611	77.74
1	-1444.2471	0.16903	48.5435	54.64
2	-1430.9690	0.12377	21.9872	34.55
3	-1422.9657	0.07655	5.9808	18.17
4	-1420.0484	0.02861	0.1461	3.74
5	-1419.9754	0.00073		

Note: The underlying fitting model (i.e., a vector error correction model) contains one lagged difference and trends in the long-term and short-term relationships. The maximum rank indicates the maximum number of cointegrating relationships. For the column where the maximum rank is 1, the corresponding null hypothesis is that there is at most one cointegrating relationship. If the trace statistic exceeds the significance level, the corresponding null hypothesis is rejected.

level. Secondly, the test result does allow us to reject the null hypothesis that there is at most one cointegrating relationship because the trace statistic does not reach the 5% significance level. In sum, the test result suggests that there exists one cointegrating relationship among the five I(1) variables. For robustness checks, I consider a number of alternative fitting models with different lag lengths (from 0 to 19) with or without trends. However, the Johansen test result always suggests that there exists at least one cointegrating relationship.

In addition, I test whether there is a structural break in the cointegrating relationship between finance and growth. In relation to this, it has been argued that the Korean economy experienced several structural changes during the sample period of 1960-2018. For instance, agriculture was the major industry in the Korean economy early during this range, but as time passed, manufacturing or services became more important. In order to test whether there are any structural breaks in the cointegrating relationship, I use the Gregory-Hansen method (see Table 6). This method is useful to test whether there are breaks in levels, breaks in trends, breaks in slopes, or breaks in both trends and slopes. The null hypothesis is that there is no cointegrating relationship with a single break at an unknown date. The test result is such that the absolute level of the test statistic is smaller than the absolute level of the corresponding significance level. Accordingly, the null hypothesis is not rejected. This result is robust to the type of break considered in the null hypothesis, including a break in the level, a break in the trend, a break in the slope, or a break in both the trend and slope. This test result can be interpreted in one of the following ways. First, there exists a cointegrating relationship but without a break. Second, neither a

TABLE 6—GREGORY-HANSEN TEST RESULTS FOR A STRUCTURAL BREAK

Type of break	Level of test statistic	Significance level		
		1%	5%	10%
Break in level	-38.89	-70.18	-59.40	-54.38
Break in trend	-39.31	-76.95	-65.44	-60.12
Break in slope	-48.20	-90.35	-78.52	-75.56
Break in trend and slope	-49.70	-100.69	-88.47	-82.30

Note: The null hypothesis is that there is no cointegrating relationship with a single break (in level, in trend, in slope, or in neither the trend nor the slope) at an unknown date. If the absolute level of the test statistic exceeds the absolute level of the significance level, the null hypothesis is rejected. The test statistic is Z(a).

cointegrating relationship nor a break exists. Third, there is a break but no cointegrating relationship. Recall that the Johansen test suggests that there is a cointegrating relationship. Therefore, one can conclude that the first interpretation is acceptable. Hence, in the following analysis, I estimate the cointegrating relationship assuming the absence of a structural break.

In order to estimate the cointegrating relationship, I analyze the following vector error correction model (hereafter, VECM), which is useful to analyze both long-term relationships and short-term adjustments among non-stationary time-series variables.

$$\Delta y_t = \theta + \gamma[y_{t-1} - \alpha - \beta' x_{t-1}] + (\pi_0 \Delta y_{t-1} + \pi' \Delta x_{t-1}) + \varepsilon_t . \quad (1)$$

where g_t is the per capita real GDP growth rate at a quarter t,

$y_t = \frac{1}{20}\sum_{s=t}^{t+19} g_s$,

c_t is the private credit to GDP ratio at a quarter t,

x_{1t} is log of the per capita real GDP,

x_{2t} is the investment rate,

$x_t = (c_t, c_t^2, x_{1t}, x_{2t})'$

Explanations of the notation and the model are as follows. Let g_t denote the per capita real GDP (year-on-year) growth rate evaluated at a quarter t. $y_t = \frac{1}{20}\sum_{s=t}^{t+19} g_s$ is the five-year (i.e., 20-quarter) average of the growth rate. Let c_t denote private credit as a percentage of the GDP at a quarter t. $x_t = (c_t, c_t^2, x_{1t}, x_{2t})'$ is the vector of explanatory variables, including the level and the square of the ratio of private credit to GDP and two other I(1) variables. Δ represents the first difference of an underlying time-series variable. The linear combination of $[y_{t-1} - \alpha - \beta' x_{t-1}]$ represents a cointegrating relationship. α is a constant and $\beta = (\beta_1, \beta_2, \delta_1, \delta_2)'$ are the vector of the coefficients of the level and the square of the ratio of private credit to GDP, the log of the per capita real GDP, and the investment rate, respectively. The coefficients of interest are β_1 and β_2, which jointly represent a long-term stable relationship between growth and finance. π_0 and $\pi = (\pi_1, \pi_2, \rho_1, \rho_2)$ are the coefficients of the dependent variable and the four explanatory variables that represent short-term relationships among those variables. γ is the coefficient of adjustment. Suppose that some of these five variables deviate temporarily from the long-term stable relationship. If γ is negative, the five variables adjust to each other in the short-run in order to recover the long-term relationship. For instance, if there is a positive shock of the average growth rate (i.e.,

$y_{t-1} > \alpha + \beta' x_{t-1}$), the growth rate decreases in the short run in order to recover the long-term relationship (i.e., $y_{t-1} = \alpha + \beta' x_{t-1}$) if the coefficient of adjustment γ is negative. Finally, θ and ε_t are the constant and error term, respectively.

In the following analysis, I select a lag length of 1 based on the Akaike information criterion. In addition, I consider a VECM with trends in the long-term and short-term relationships because the dependent variable is a moving-average variable and is hence believed to contain a deterministic trend in its data-generation process. However, I shall momentarily show that the following estimation result is robust to both the lag selection and the inclusion or exclusion of trends.

Table 7 summarizes the estimation result of the cointegrating relationship between growth and finance. The result suggests that there is a long-term stable quadratic relationship between the five-year average growth rate and the private credit to GDP ratio. Note that the estimated coefficients of the level and the square of the ratio of private credit to GDP are positive and negative, respectively, which means that the quadratic relationship actually has the form of an inverse U-shape. That being said, there is a threshold level of private credit as a percentage of GDP such that an expansion of private credit is positively associated with economic growth if the current level of the ratio of private credit to GDP is under the threshold. Otherwise, the expansion of private credit is negatively associated with economic growth. The analysis shows that the estimate of the threshold level is 171.5%. (According to the formula of the quadratic equation, 171.5% is equal to $-\hat{\beta}_1 / \left(2\hat{\beta}_2\right)$, where $\hat{\beta}_1$ and $\hat{\beta}_2$ are 0.17937 and –0.00052, respectively.) This estimated threshold level exceeds 100%, the level suggested in the literature based on country-panel data. As noted above, the ratio of private credit to GDP was recorded at 193% at the end of 2016; hence, it is substantially higher than the threshold level found in this paper.

Additionally, the estimate of the coefficient of adjustment is negative. Accordingly, the VECM model is consistent with the hypothesis that there is a stable long-term relationship with a short-term adjustment process.

The estimation result in Table 7 is robust to a number of assumptions with regard to model specifications. First, in the baseline model, I utilized only one lagged difference, as one was what the Akaike information criterion recommended. However, an inverse U-shaped relationship between growth and finance can still be found even when 3, 5, 11, or 15 lagged differences were inserted into the model (see Table A7 in the appendix). Also, in these cases, the threshold level estimates are approximately 165%, is similar to the rate of 171.5% obtained from the baseline estimation. Secondly, I include trends in both long-term and short-term relationships in the baseline model. However, even if I impose restrictions that those trends do not exist in the two relationships, the estimation result is still close to that in Table 7 (see Table A8 in the appendix). Last but not least, note that the judgment of whether the population growth is an I(1) or I(0) variable depends on the number of lagged differences in the fitting model. In the baseline estimations, I consider this as an I(0) variable. However, the estimation result does not change much even if I regard it as an I(1) variable, instead, and put this one in the VECM (see Table A9 in the appendix). It is also important to note that the Johanse test shows that there is a

TABLE 7—ESTIMATION OF A COINTEGRATING RELATIONSHIP: FOCUSED ON THE SIZE OF PRIVATE CREDIT

	Estimated coefficients	Standard error	P-value
The level of the ratio of private credit to GDP	$\hat{\beta}_1$ = 0.17937***	0.03388	0.000
The square of the ratio of private credit to GDP	$\hat{\beta}_2$ = - 0.00052***	0.00012	0.000
Log of the per capita real GDP	8.51632**	3.83951	0.027
Investment rate	- 0.31572***	0.06826	0.000
Coefficient of adjustment	- 0.02661***	0.01003	0.008
Sample size		201	
The threshold of growth-finance relationship		171.5%	

Note: 1) I consider a VECM with one lagged difference (according to the Akaike information criterion) and trends in both the long-term and short-term relationships, 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively.

cointegrating relationship among the I(1) variables in most specifications regardless of the lag selection, the inclusion or exclusion of trends, and/or the inclusion or exclusion of the population growth.

Readers may be concerned about the reverse causality problem. That is, it can be argued that financial development does not affect economic growth but, instead, economic growth facilitates the accumulation of financial resources.

If this criticism were valid, a technical problem and a conceptual problem could arise. The technical problem is related to the consistency of the estimator. In a cross-sectional analysis, if the dependent variable causes the independent variable, the independent variable and the error term are correlated and, therefore, the OLS estimator becomes inconsistent regardless of how large the sample size is. However, this inconsistency problem is not an issue in a time-series analysis if there is a cointegrating relationship between the variables of interest. If a cointegration exists, the error term ε_t (i.e., the level and the square of the private credit to GDP ratio) are non-stationary I(1) variables. Thus, even if the independent variables and the error terms are correlated, this correlation disappears quickly as the sample size increases.[5] This econometric property is related to the "super-consistency," as the rate at which the estimators converge to 'true' parameters is much faster compared to that with conventional asymptotics (see Engle and Granger, 1987).

Although the first problem is not an issue in this paper, one may still be concerned about the conceptual problem by which the estimation result could be interpreted such that the cause is economic growth but not financial development. However, such an interpretation does not make sense for the following reasons. First, if the estimation result suggested a positive relationship between growth and finance, this interpretation could make sense to some extent. However, the result suggests an

[5]If one variable continuously increases (i.e., an I(1) variable), while another variable does not move much but remains mostly at its initial level (i.e., an I(0) variable), the difference between the two variables then becomes infinity as times passes. Even if the two variables are correlated at some initial stage, this correlation will disappear quickly.

inverse U-shaped relationship and, hence, if one puts growth on the horizontal axis and finance on the vertical axis, the relationship is not even a function but a correspondence, which means there is no single theory that explains both the upper side (where growth and finance are negatively associated) and the lower side (where the growth and finance are positively associated) of the correspondence. Furthermore, it is important to note that the ratio of private credit to GDP is a stock at a quarter t, whiile the growth rate is a time-average value between the quarter t and the quarter $t+19$ and hence, the growth rate contains future information. Therefore, if the growth rate is a cause, then a future variable affects a past variable.

Readers may also be concerned with the reliability of the methodology used in this paper to examine possible nonlinear relationships between growth and finance. In this paper, I simply examine a cointegrating relationship among the level and the square of a measure of financial development and the average growth rate. However, a recent development in time-series analysis proposes other methodologies that handle nonlinearities in cointegrating regressions more broadly. See Balke and Fomby (1997), Lütkepohl *et al*. (1999), and Choi and Saikkonen (2004) for these more advanced methodologies.

C. *Why Does the Nonlinear Relationship between Finance and Growth Arise?*

The literature suggests a number of theories that explains the nonlinearity between growth and finance. According to the first theory, as financial resources are being accumulated, these resources are less likely to be distributed to sectors with high growth potential, such as the corporate sector, but are more likely to be distributed to sectors with low growth potential, such as the household sector (Hung, 2009; Beck *et al*., 2012; Hoshi and Kashyap, 2004). According to the second theory, if the financial debt in an economy is sufficiently high, the economy becomes vulnerable to outside shocks. Therefore, it is highly likely to face financial crises, which typically reduce growth rates at least for several years or even a decade (Drechsler *et al*., 2016; Stiglitz, 2000; Levchenko *et al*., 2009).

Here, an empirical study focused on the first theory is conducted. Note that cointegration is a long-term "stable" relationship among non-stationary time-series variables. This analytic framework is not suitable for testing the second theory, as the impacts of financial crises on economic growth cannot be stable. Financial crises may have long-term negative effects on growth, as Laeven and Valencia (2012) find. However, crises are rare events and, hence, the relationship between financial development and economic growth, via the likelihood of a financial crisis, can never be stable.

In the following analysis, I study how the ratio of household credit to private credit affects the cointegrating relationship between the five-year average growth rate and the ratio of private credit to GDP. That is, this study examines whether the *composition* of the ratio of private credit to GDP matters with regard to the nonlinear relationship between growth and finance.

First, the unit root test suggests that both the ratio of household credit (to private credit) and the interaction term of this household credit ratio and the ratio of private credit to GDP are I(1) non-stationary variables (see Table A10 in the appendix for

the details of the test results). In this test, I assume that there is no deterministic trend as, by definition, the household credit ratio cannot exceed 100%.

Secondly, the Johansen test suggests that there exists at least one cointegrating relationship among the average growth rate, the ratio of private credit to GDP, the household credit ratio, the interaction term, the log of the per capita real GDP, and the investment rate. This test result holds in all cases where the selected length of the lagged differences is 1, 3, 7, or 11.

Given these test results, I estimate the VECM model (1), which replaces the square of the ratio of private credit to GDP with the interaction term and adds the household credit ratio as an explanatory variable. The selected lag length is one according to the Akaike information criterion. Other items remain unchanged.

Table 8 shows the estimation result. The coefficients of the ratio of private credit to GDP and the interaction term of the household credit ratio and the ratio of private credit to GDP are positive and negative, respectively. Note also that both coefficients are statistically significant. That is, the amount of the private credit is positively associated with the growth rate, but this effect diminishes as the concentration of private credit in household credit increases. The estimate of the threshold is 46.9%, which indicates that an increase in private credit facilitates economic growth if the share of household credit out of private credit is less than 46.9%; otherwise, an increase in the private credit deters economic growth.[6] This result is consistent with the aforementioned first theory and implies that the provision of financial resources is useful for accelerating economic growth only when the resources are provided mostly to the corporate sector rather than to the household sector, all other aspects being equal.

TABLE 8—ESTIMATION OF A COINTEGRATING RELATIONSHIP: FOCUSED ON THE COMPOSITION OF PRIVATE CREDIT

	Coefficient	Standard error	P-value
The ratio of private credit to GDP	0.08787**	0.03726	0.018
The interaction term (private credit to GDP ratio * household credit to private credit ratio)	- 0.18745**	0.09105	0.040
The ratio of household credit to private credit	0.29858**	0.13632	0.029
Log of the per capita real GDP	- 3.14892	2.72055	0.247
The investment rate	0.00483	0.08429	0.954
Coefficient of adjustment	- 0.00016	0.00558	0.976
Sample size		201	
Threshold of the ratio of household credit to private credit		46.9%	

Note: 1) I consider a VECM with one lagged difference (according to the Akaike information criterion) without trends in either long-term or short-term relationships., 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively.

[6]According to the formula of quadratic equation, 46.9% is equal to the coefficient of the private credit to GDP ratio, divided by the negative of the coefficient of the interaction term, and multiplied by 100.

D. *Alternative Models*

Hitherto I use the ratio of private credit to GDP to measure the degree of financial development. However, there are several criticisms of this approach. The first is that private credit does not take into account the credit provided to governmental bodies and hence is not a good measure of financial development in countries with large governments. Second, private credit is essentially the total size of loans, which is an example of indirect financing, while economic agents in some advanced economies rely heavily on direct financing tools such as initial public offerings of stocks, bond issuances, crowd-funding, venture capital funding, and so on. Third, it can be argued that a single country's time-series variables can provide only limited information about the long-run aspects of the finance-growth nexus because the absence of cross-country variation makes it difficult to control for the short-run business cycle. Fourth, one may wonder whether a simple linear relationship between growth and finance exists in the Korean economy.[7]

Below, I address the concerns raised above. With regard to the first concern, I may consider the total amount of credit, which is the sum of credit given to private agents and governmental bodies. However, the Johansen test does not provide robust evidence of the existence of a cointegrating relationship. This presumably arises because the relevant sample size is only 78. Accordingly, it is not easy to capture statistically any stable relationship between the two variables, particularly with numerous lags and explanatory variables.

Regarding the second concern, I consider the ratio of market capitalization to GDP in order to measure the degree of direct financing. The unit root test results suggest that the level of the ratio of market capitalization to GDP is an I(1) variable, whereas the square of the ratio of market capitalization to GDP is an I(2) variable (see Table A10 in the appendix). Therefore, I consider only this level in the following analysis on cointegration. The Johansen test result suggests that there exists one cointegrating relationship among the growth rate, the ratio of market capitalization to GDP, and other I(1) explanatory variables of interest. See Table 9 for the estimation result. The result suggests that the average growth rate is positively associated with the market capitalization level. Thus, this result implies that an expansion in direct financing could contribute to economic growth. Recall that the inverse U-shaped relationship between growth and the ratio of private credit to GDP implies that an expansion in indirect financing can deter economic growth if the amount of indirect financing exceeds a certain threshold. This divergence in the growth effects of direct financing and indirect financing presumably occurs because the loan market is already well developed quantitatively, while the capital market is comparably less developed. Related to this, Cournède and Denk (2015) also find that many G20 countries, including Korea, are similar in that their capital markets are not greatly developed quantitatively in comparison to their loan markets.

In response to the third concern, I consider the BIS gap (a percentage of GDP) between the actual level and a trend of private credit, which is a de-trended private-

[7]Additional criticisms are as follows. First, the private credit measures only the quantitative aspect but not the qualitative aspect of financial development. Second, the private credit is not directly linked to the degree of financial constraints, financial accessibility, or financial inclusion.

TABLE 9—ESTIMATION OF A COINTEGRATING RELATIONSHIPS BASED ON ALTERNATIVE MODELS

	Model 1 (Market capitalization is considered)	Model 2 (Private credit gap is considered)	Model 3 (Linear relationship is considered)
The level of market capitalization to GDP ratio	0.04572*** (0.01485)		
The level of the BIS credit to GDP gap		- 0.98991*** (0.27268)	
The square of the BIS credit to GDP gap		0.02059*** (0.00520)	
The private credit to GDP ratio			0.06568 (0.04093)
Log of the per capita real GDP	8.4001** (3.7526)	- 2.76845*** (0.78431)	35.47317*** (8.62278)
The investment rate	- 0.23884*** (0.0783)	0.15198* (0.09199)	- 0.78175*** (0.16422)
Coefficient of adjustment	0.03815*** (0.01169)	- 0.01138** (0.00493)	0.00277 (0.00463)
Sample size	133	161	201

Note: 1) I assume that Models 1 to 3 equally contain one lagged difference because the Akaike information criterion proposes that one is an optimal lag length in all these models. I also assume that Models 1 and 3 contain trends in the long-term and short-term relationships, whereas Model 2 does not have a trend because the BIS gap is a de-trended variable, 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively. The levels in parentheses are standard errors.

credit-to-GDP ratio calculated by the Bank of International Settlement in order to examine the possible relationship between growth and finance along the short-run business cycle (or the financial cycle). If there is an inverse U-shaped relationship between growth and this BIS gap, the empirical result implies that the ratio of private credit to GDP when exceeding the estimated threshold level is an early warning signal for an upcoming downturn or a financial crisis. However, the unit root test results suggest that both the level and the square of this BIS credit to GDP gap is an I(0) variable (see Table A10 in the appendix).[8] Therefore, it is difficult to believe that there is any cointegrating relationships between the average growth rate, the level and the square of this gap, and other explanatory variables. The Johansen test result also suggests that there is no cointegration among these variables. Perhaps there may be some important relationships between growth and this BIS credit to GDP gap. However, these relationships are not easily studied in a cointegration framework. Nevertheless, I estimate a cointegrating relationship in Table 9. The estimation result suggests that there is a (not inverse) U-shaped relationship between this gap and the average economic growth, as the coefficients of the level and the square of this gap are negative and positive, respectively. This result implies that economic growth accelerates if the de-trended ratio of private credit to GDP exceeds

[8]The BIS gap between the private credit level and a trend has negative levels at some points during the sample period. Therefore, if I take the square of this gap, then the square may provide misleading information about the relationship between this gap and economic growth. Thus, I generate a new time-series variable, referred to as gap30, by adding a constant of 30 uniformly to each level of the gap. Therefore, this new variable has a positive level for the entire sample period. Then, I take the square of gap30. The unit root test, the Johansen test, and the estimation of the cointegrating relationships are all based on the square of gap30.

a certain threshold. As the BIS credit to GDP gap does not pass the unit root test or the Johansen cointegration test, this estimation result is not meaningful.

With respect to the fourth concern, I examine whether there is a simple linear relationship between the average growth rate and the ratio of private credit to GDP. The Johansen test result suggests that there exists one cointegrating relationship in this case if I assume that there are trends in the long-term and the short-term relationships in the underlying VECM. However, the estimation result suggests that the estimated linear relationship is not statistically significant.

IV. Conclusion

Does an expansion in financial resources contribute to economic growth? There is a large body of related literature which finds a robust result that quantitative financial development, as measured by the ratio of private credit to GDP, contributes to economic growth when the ratio of private credit to GDP is less than 100%; otherwise, it deters economic growth.

However, this finding in the literature cannot be directly applied to the Korean economy because most published research uses country-panel data, though these countries and Korea have some similarities. As complementary research, this paper exclusively examines Korean time-series data to study whether there is such a nonlinear relationship between growth and finance.

The main results are two-fold. First, there exists an inverse U-shaped relationship between the ratio of private credit to GDP and the five-year average per capita real GDP growth rate, with a threshold level of 171.5%. Secondly, the impact on an increase in private credit on growth is positive if the share of household credit out of the private credit is less than 46.9%; otherwise, the impact reverses and becomes negative. As of 2016, the ratio of private credit to GDP and the share of the household credit out of private credit are 193% and 50%, respectively, and both exceed their corresponding threshold levels.

These findings suggest that policymakers should refrain from simply expanding the financial sector and should rather focus on improving the qualitative aspects of financial development. Moreover, excessive reliance on household credit is risky.

An advantage of this research is that it exclusively uses Korean time-series data. It finds that the results in the literature obtained by analyzing country-panel data are valid in the Korean economy as well. Although this paper does not provide any novel qualitative implications, it provides certain quantitative implications fitted to the Korean economy.

However, this merit could also be an important limitation. First, it is not easy to obtain strong evidence of the finance-growth nexus from a time-series analysis, as a single country's time-series variables provide only limited information about the nexus, and controlling for short-run business cycle fluctuations is not easy. Therefore, I do not assert that the findings in this paper are strong evidence of a nonlinear relationship between finance and growth. In addition, readers should be cautious when interpreting the findings in this paper as evidence of a causal relationship between finance and growth. Secondly, the empirical findings may not be very robust, as the sample size is relatively small. Lastly, this paper considers only

aggregate variables; hence, detailed microeconomic foundations of the nonlinearity of the growth-finance relationship are not revealed.

APPENDIX

TABLE A1—VARIABLES AND SOURCES

Variables	Unit	Source	Remark	Time span
per capita real GDP growth rate	%	Bank of Korea	Real, quarterly, season-adjusted	1961.1Q~ 2018.1Q
Private credit	% of GDP	BIS, "Credit to the Non-financial Sector"	Quarterly	1962.4Q~ 2016.4Q
Household credit	% of GDP	BIS, "Credit to the Non-financial Sector"	Quarterly	1962.4Q~ 2016.4Q
The household credit to private credit ratio	%	BIS, "Credit to the Non-financial Sector"	Quarterly	1962.4Q~ 2016.4Q
Corporate credit	% of GDP	BIS, "Credit to the Non-financial Sector"	Quarterly	1962.4Q~ 2016.4Q
Total credit	% of GDP	BIS, "Credit to the Non-financial Sector"	Quarterly	1990.4Q~ 2016.4Q
Market capitalization	% of GDP	World Bank, "Global Financial Development Database"	Quarterly, after linear interpolation of annual data	1979.4Q~ 2014.4Q
Per capita real GDP	10,000KRW	Bank of Korea	Real, quarterly, season-adjusted	1960.1Q~ 2018.1Q
Average year in education	Year	Barro and Lee, "Educational Attainment for Total Population, 1950-2010"	For those older than 25 years, quarterly, after linear interpolation of five-year-level data	1960.1Q~ 2010.4Q
Investment rate	% of GDP	Bank of Korea	Real, quarterly, season-adjusted	1960.1Q~ 2018.1Q
Population growth	%	Statistics Korea	For those 15-64 years old, quarterly, after linear interpolation of annual data	1960.1Q~ 2018.1Q
BIS gap between the level and a trend of the private credit	% of GDP	BIS, "Credit to GDP gap data"	Quarterly	1972.4Q~ 2018.4Q

TABLE A2—LAG LENGTHS SELECTED BY THE AKAIKE INFORMATION CRITERION

Variable	Lag length for the level	Lag length for the first difference
Per capita real GDP growth (five-year average)	18	17
The level of the ratio of private credit to GDP	2	1
The square of the ratio of private credit to GDP	2	1
Log (per capita real GDP)	9	8
Investment rate	7	11
Population growth	17	8
Average year in education	1	0

Note: The Akaike information criterion selects a length, assuming that the maximum possible length is 19. Table 4 is based on the selected lag lengths above.

TABLE A3—UNIT ROOT TEST RESULTS WITH A LAG LENGTH OF 3

Variable	P-value for the level of the variable	P-value for the first difference of the variable	Judgment
Per capita real GDP growth (five-year average)	0.1056	0.0000	I(1)
The level of the ratio of private credit to GDP	0.1345	0.0001	I(1)
The square of the ratio of private credit to GDP	0.1363	0.0002	I(1)
Log (per capita real GDP)	0.9999	0.0000	I(1)
Investment rate	0.8081	0.0000	I(1)
Population growth	0.3304	0.0000	I(1)
Average year in education	0.0826	.	I(0)

Note: The null hypothesis is that the time-series variable of interest follows a random walk (i.e. contains a unit root) with a constant and a deterministic trend. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value.

TABLE A4—UNIT ROOT TEST RESULTS WITH A LAG LENGTH OF 7

Variable	P-value for the level of the variable	P-value for the first difference of the variable	Judgment
Per capita real GDP growth (five-year average)	0.1601	0.0009	I(1)
The level of the ratio of private credit to GDP	0.1286	0.0026	I(1)
The square of the ratio of private credit to GDP	0.3457	0.0003	I(1)
Log (per capita real GDP)	0.9993	0.0000	I(1)
Investment rate	0.6942	0.0003	I(1)
Population growth	0.4007	0.0001	I(1)
Average year in education	0.0251	.	I(0)

Note: The null hypothesis is that the time-series variable of interest follows a random walk (i.e. contains a unit root) with a constant and a deterministic trend. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value.

TABLE A5—UNIT ROOT TEST RESULTS WITH A LAG LENGTH OF 11

Variable	P-value for the level of the variable	P-value for the first difference of the variable	Judgment
Per capita real GDP growth (five-year average)	0.1506	0.0193	I(1)
The level of the ratio of private credit to GDP	0.1807	0.0031	I(1)
The square of the ratio of private credit to GDP	0.4313	0.0010	I(1)
Log (per capita real GDP)	0.9997	0.0017	I(1)
Investment rate	0.8508	0.0000	I(1)
Population growth	0.2082	0.0336	I(1)
Average year in education	0.0095	.	I(0)

Note: The null hypothesis is that the time-series variable of interest follows a random walk (i.e. contains a unit root) with a constant and a deterministic trend. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value.

TABLE A6—UNIT ROOT TEST RESULTS WITH A LAG LENGTH OF 15

Variable	P-value for the level of the variable	P-value for the first difference of the variable	Judgment
Per capita real GDP growth (five-year average)	0.2281	0.0417	I(1)
The level of the ratio of private credit to GDP	0.1429	0.0169	I(1)
The square of the ratio of private credit to GDP	0.2872	0.0254	I(1)
Log (per capita real GDP)	0.9996	0.0090	I(1)
Investment rate	0.7252	0.0239	I(1)
Population growth	0.0595	.	I(0)
Average year in education	0.0018	.	I(0)

Note: The null hypothesis is that the time-series variable of interest follows a random walk (i.e. contains a unit root) with a constant and a deterministic trend. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value.

TABLE A7—ESTIMATION OF A COINTEGRATING RELATIONSHIP: ROBUSTNESS TO THE LAG SELECTION

Length of lagged differences	The level of the private credit to GDP ratio	The square of the ratio of private credit to GDP	Log of the per capita real GDP	Investment rate	Coefficient of adjustment	Threshold	Sample size
3	0.42285***	-0.00122***	-12.889**	-0.061	-0.015*	172.4%	199
7	0.61567***	-0.00180***	-11.015	-0.231*	-0.007	170.7%	195
11	0.49606***	-0.00151***	-12.559***	-0.126	-0.017	163.7%	191
15	0.07286*	-0.00023*	4.246	-0.113**	0.023	155.7%	187

Note: 1) I consider a VECM with trends in both the long-term and short-term relationships, 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively.

TABLE A8—ESTIMATION OF A COINTEGRATING RELATIONSHIP: ROBUSTNESS TO THE EXCLUSION OF TRENDS

Length of lagged differences	The level of the private credit to GDP ratio	The square of the ratio of private credit to GDP	Log of the per capita real GDP	Investment rate	Coefficient of adjustment	Threshold	Sample size
1	0.21267***	-0.00068***	-4.783***	-0.078**	-0.035***	155.9%	201
3	0.43602***	-0.00124***	-10.816***	-0.104	-0.018***	174.6%	199
7	0.70436***	-0.00205***	-15.992***	-0.196***	-0.009*	171.0%	195
11	0.35570***	-0.00108***	-7.425***	-0.110***	0.004	163.5%	191
15	0.14476***	-0.00047***	-2.782***	-0.043*	0.034*	153.7%	187

Note: 1) I consider a VECM without trends in both the long-term and short-term relationships, 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively.

TABLE A9—ESTIMATION OF A COINTEGRATING RELATIONSHIP: ROBUSTNESS TO THE INCLUSION OF POPULATION GROWTH

Length of lagged differences	The level of the private credit to GDP ratio	The square of the ratio of private credit to GDP	Log of the per capita real GDP	Investment rate	Population growth	Coefficient of adjustment	Threshold
1	0.23321***	-0.00075***	-5.575***	-0.097***	-0.522	-0.040***	154.9%
3	0.37054***	-0.00111***	-9.408***	-0.154***	-0.982**	-0.033***	166.0%
7	0.72834***	-0.00210***	-16.494***	-0.199**	0.200	-0.007	173.1%
11	0.42360***	-0.00129***	-8.658***	-0.118***	0.094	0.001	163.4%
15	0.02213	-0.00006	-0.976	0.107**	-0.022	0.020*	169.7%

Note: 1) I consider a VECM without trends in both the long-term and short-term relationships. In addition, the population growth is added as an explanatory I(1) variable, 2) *, **, *** represent the 10%, 5%, 1% level of significance, respectively, 3) The sample size for each specification is equivalent to that in Table A8.

TABLE A10—UNIT ROOT TEST RESULTS ON ADDITIONAL TIME-SERIES VARIABLES

Variable	For the level		For the first difference		Judgment[1)]
	Number of lags selected by the AIC	P-value	Number of lags selected by the AIC	P-value	
The household credit (to private credit) ratio	9	0.5081	8	0.0014	I(1)
The interaction between the household credit ratio and the ratio of private credit to GDP	4	0.9980	3	0.0001	I(1)
The level of the ratio of market capitalization to GDP	17	0.5280	1	0.0063	I(1)
The square of the ratio of market capitalization to GDP	17	0.9572	16	0.1476	I(2)[2)]
The level of the BIS gap between the level and a trend of the ratio of private credit to GDP[3)]	2	0.0486	.	.	I(0)
The square of the BIS gap between the level and a trend of the ratio of private credit to GDP[3)]	2	0.0622	.	.	I(0)

Note: 1) For the household credit ratio, the interaction term, and the BIS gap, the null hypothesis is that there is a unit root where the fitting model has a constant but not a deterministic trend. For the level and the square of the ratio of market capitalization to GDP, the null hypothesis is that there is a unit root where the fitting model has a constant and a deterministic trend. The test statistic is Z(t) and the p-value is a MacKinnon approximate p-value, 2) The test result suggests that the square of the ratio of market capitalization to GDP is an I(2) variable, as the p-values for the level, the first difference, and the second difference are 0.9572, 0.1476, and 0.0144, respectively, 3) The level of the BIS gap is simply a de-trended ratio of private credit to GDP as calculated by the Bank of International Settlement. To calculate the square of the gap, I generate a new time-series variable, referred to here as gap30, by adding a constant of 30 uniformly to each level of this gap. Because the original gap is at least as much as –24 for the entire sample period, the new gap (i.e., gap30) has a positive level for the entire sample period. The square of this gap is in fact the square of gap30.

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Measuring the Effects of the Uniform Settlement Rate Requirement in the International Telephone Industry

By SUIL LEE*

As a case study of an ex-post evaluation of regulations, in this paper I evaluate the 'uniform settlement rate requirement', a regulation that was introduced in 1986 and that was applied to the international telephone market in the U.S. for more than 20 years. In a bilateral market between the U.S. and a foreign country, each U.S. firm and its foreign partner jointly provide international telephone service in both directions, compensating each other for terminating incoming calls to their respective countries. The per-minute compensation amount for providing the termination service, referred to as the settlement rate, is determined by a bargaining process involving the two firms. In principle, each U.S. firm could have a different settlement rate for the same foreign country. In 1986, however, the Federal Communications Commission introduced the Uniform Settlement Rate Requirement (USRR), which required all U.S. firms to pay the same settlement rate to a given foreign country. The USRR significantly affected the relative bargaining positions of the U.S. and foreign firms, thereby changing negotiated settlement rates. This paper identifies two main routes through which the settlement rates are changed by the implementation of the USRR: the Competition-Induced-Incentive Effect and the Most-Favored-Nation Effect. I then empirically evaluate the USRR by estimating a bargaining model and conducting counterfactual experiments aimed at measuring the size of the two effects of the USRR. The experiments show remarkably large impacts due to the USRR. Requiring a uniform settlement rate, for instance, results in an average 32.2 percent increase in the negotiated settlement rates and an overall 13.7 percent ($3.43 billion) decrease in the total surplus in the U.S. These results provide very strong evidence against the implementation of the USRR in the 1990s and early 2000s.

Key Word: Ex-post Evaluation, Uniform Settlement Rate Requirement, Bargaining, Competition-Induced-Incentive Effect, Most-Favored-Nations Effect
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I. Introduction

Regulations are everywhere. Our everyday lives are largely structured by regulations. Running a business is also greatly influenced by various types of regulation. Therefore, it is very important to maintain effective and efficient regulations in order to make our everyday lives better and to improve the competitiveness of our companies and even the level of national competitiveness.

However, finding unreasonable regulations around us is not at all difficult. For instance, regulations on opening hours for large marts, such as E-Mart, bring discomfort to consumers every weekend, with no positive impact on the revitalization of traditional markets, which was the initial purpose of the regulation. The differentiated broadcast advertising regulation is another example. From the standpoint of the viewer, although a terrestrial broadcasting channel and a pay broadcasting channel provide nearly identical services, differentiated advertising regulations continue between terrestrial broadcasting channels and pay broadcasting channels. For example, unlike pay broadcast channels, terrestrial broadcast channels are not allowed to include mid-program advertising.[1] Not long ago as well there was a ridiculous case when a newly founded online car auction company called 'Hey Dealer' was banned and was shut down, as online car auction companies were subjected to the same regulations as offline companies with regard to parking lots and auction facilities.

While it does not turn out to be obviously unreasonable, it is easy to find a controversial case regarding the legitimacy of a regulation. For example, currently in Korea, SK Telecom, the No. 1 mobile operator, is obliged to provide wholesale services for MVNOs[2] with regulated wholesale prices. This regulation was introduced in 2010 to stimulate competition in the mobile telecommunications market and reduce the burden of the telecommunications costs for the public. The scope of the mandatory wholesale services and support for the MVNO continues to expand in the name of increasing the competitiveness of MVNOs. Recently, however, criticism has been raised, holding that the policy goal of activating competition in the mobile telecommunications market through MVNOs has already been largely achieved, and maintaining and expanding the regulation and support for MVNOs has undermined the incentives for MVNOs to secure their own competitiveness and eventually can hinder competition in the market.[3]

All of these examples illustrate the importance of ex-post evaluations of regulations. Initially, most regulations are introduced to achieve socially desirable outcomes, but over time, if the environment surrounding regulation changes, the legitimacy of the regulation can be undermined. Changes in the environment can

[1] Some analysts justify regulatory discrimination between terrestrial and paid channels based on the high viewership of terrestrial broadcast channels. However, in 2017, the viewership of J-TBC, a paid broadcast channel, surpassed that of MBC, a terrestrial broadcasting channel.

[2] A MVNO (Mobile Virtual Network Operator) does not have a communications network and provides mobile communications services by borrowing the communications networks of MNOs (Mobile Network Operators).

[3] Most countries that enforced regulations on MVNOs abolished regulations five to six years after the introduction of regulations intended to activate competition in the mobile market. Except for the UK and the Netherlands, these countries have MVNO market shares of around 10% as of October of 2016, lower than Korea's MVNO market share as of May of 2017 (European Commission, 2017a). Spain abolished its wholesale obligations for MVNOs in 2016, at which time their total market share was 10.7% (European Commission, 2017b).

lead to discrepancies between regulatory objectives and regulatory measures, and even when regulatory objectives have already been achieved, regulations may continue to have negative side-effects. Therefore, it is highly socially desirable regularly to check the rationality and legitimacy of regulations and to maintain the quality of regulations through ex-post evaluations.

As a case study of the ex-post evaluation of regulations, in this paper I evaluate the 'uniform settlement rate requirement', a regulation that was introduced in 1986 and that had been applied to the international telephone market in the United States for more than 20 years.

The international message telephone service (IMTS) is somewhat unique in that it is provided jointly by two firms or carriers. It is this was simply because a single firm cannot operate the service on an end-to-end basis. As an example of an international call from the U.S. to a foreign country, a call that originates from a U.S. IMTS firm is carried to an international midpoint and is then transferred to a foreign IMTS firm which carries the call to the destination and terminates it. Because users only pay the U.S. firm, a compensation mechanism must exist between the two firms.

There is such a compensation mechanism, called the 'international accounting rate system.' Under this mechanism, two IMTS firms bargain over 1) the per-minute total expense for carrying a call from the origin to the destination, and 2) each firm's portion of the per-minute total expense. The negotiated per-minute total expense is called the 'accounting rate', and each firm's portion of the accounting rate is called the 'settlement rate.'[4] Then, for an international call from the U.S., the U.S. IMTS firm pays the foreign firm a 'settlement payment' amounting to the foreign firm's settlement rate times the number of minutes of the call. Because the U.S. has far more outgoing than incoming traffic for almost all foreign countries,[5] U.S. carriers have paid foreign carriers large amounts in settlement payments. In 1996, for example, U.S. carriers paid $5.7 billion in net settlement payments for the termination of U.S. international calls, which amounts to 40% of all IMTS revenues.

Every U.S. IMTS firm has such an arrangement with regard to the accounting rate and settlement rate for each foreign country or international point. In principle, each U.S. carrier may have a different arrangement for the same foreign country. In 1986, however, the Federal Communications Commission (FCC) introduced the 'International Settlement Policy (ISP)' into the IMTS market. Among other things, it required U.S. IMTS firms to pay the same settlement rate to a foreign country for the termination of international traffic, referred to as the 'uniform settlement rate requirement.' Practically, the uniform settlement rate requirement has been implemented such that only one U.S. IMTS firm (mainly AT&T) entered into negotiations with foreign firms, and the resulting settlement rates were automatically applied to other U.S. firms. This requirement was applied to all foreign countries for nearly ten years, but since 1994 it has been lifted for many foreign countries, introducing significant competition into their IMTS markets. Nonetheless, in the mid-2000s, more than 100 countries operated under the requirement.

In fact, the uniform settlement rate requirement was implemented to remove entry

[4]Because negotiated accounting rates have been equally divided between two firms involved in almost all cases, we may define the settlement rate as one half of the negotiated accounting rate.

[5]From the U.S. viewpoint, an international call from the U.S. to a foreign country is 'outgoing' traffic and a call to the U.S. is 'incoming' traffic.

barriers and to introduce competition into the IMTS market. After the imposition of this requirement, U.S. IMTS markets became increasingly competitive, and by 1992, three or more U.S. IMTS providers competed in the market for all main foreign countries. However, it also significantly changed the bargaining framework within which U.S. carriers negotiate with foreign carriers. Changes in the bargaining framework affect the relative bargaining positions of the IMTS carriers involved. There are two main routes through which the relative bargaining positions of the IMTS carriers are affected by the implementation of the requirement. First, the uniform settlement rate requirement may weaken U.S. carriers' incentives to bargain aggressively over settlement rates, as they cannot gain any advantage during product market competition by lowering their own rates. This is referred to here as the 'Competition-Induced-Incentive (CII) Effect.' Second, it may also strengthen foreign carriers' bargaining positions through what is termed the 'Most-Favored-Nation (MFN) Effect,' according to which whatever concession a foreign carrier gives to a specific U.S. carrier doubles. Because these two effects both have a negative impact on U.S. carriers' bargaining positions, the uniform settlement rate requirement may have been detrimental to U.S. carriers during the negotiation of settlement rates. These 'side-effects' of the uniform settlement rate requirement will weaken or even eliminate the justification of the requirement, depending on their size. Hence, in terms of policy evaluations, it is very important to identify and measure these possible side-effects of the requirements of settlement rates, net settlement payments, and the total surplus in the U.S.

Given the potential for a negative impact from the uniform settlement rate requirement, this paper evaluates the uniform settlement rate requirement both theoretically and empirically, thereby providing a clear example which highlights the importance of conducting ex-post evaluations of regulations.[6] First, in a theoretical model, I compare an actual regime in which the uniform settlement rate requirement is enforced with counterfactual regimes where various firm-specific settlement rates are allowed. I identify the presence of the Competition-Induced-Incentive Effect and the Most-Favored-Nation Effect in the actual regime and show that these two effects increase the settlement rate, thereby resulting in a higher settlement rate in the actual regime. It should be noted that U.S. carriers have an incentive to reduce settlement rates, as they have paid foreign carriers large net settlement payments. Second, I empirically measure the impact of the uniform settlement rate requirement, as found in the theoretical model, on the negotiated settlement rates, net settlement payments, and welfare in the U.S. My general strategy is to estimate a structural bargaining model of settlement rate negotiation and then conduct a counterfactual experiment using the estimated structural bargaining model.

The remainder of the paper is organized as follows. In Section 2, I discuss the ISP, and in particular, the uniform settlement rate requirement more extensively. In Section 3, I provide a theoretical model in which the competition-induced-incentive

[6]Although the main contribution of the paper is that it provides a good case study of ex-post evaluations of regulations, a couple of contributions can also be found in the methodology of estimating a bargain model. For example, my bargaining model is unique in the sense that product market competition is explicitly embedded in the bargaining model. Additionally, when estimating the bargaining model, I take a two-step approach, initially estimating the profit functions and then, by plugging the profit function estimates into the bargaining model, estimating the remaining bargaining power function, which allows for great flexibility in the functional form when specifying the bargaining power function. These points will be apparent in the main part of the paper.

effect and the most-favored-nation effect are identified. In the next section, I suggest an empirical strategy and develop an econometric framework to measure the impact of the requirement on the settlement rates, settlement payments, and welfare. The data are described in Section 5. In Section 6, I present the estimation result for the bargaining model and conduct the counterfactual experiment. Finally, Section 7 concludes the analysis by summarizing the results of the experiment and suggesting several policy measures for strengthening the ex-post evaluations of regulations in Korea.

II. The Uniform Settlement Rate Requirement: Can it be Justified?

The greatest concern of the FCC regarding the IMTS market has been excessively high calling prices. The Commission determined that inflated consumer calling prices were attributable to both above-cost international settlement rates and the lack of competition in the IMTS markets. As a response to those problems, in 1986 the FCC implemented the International Settlement Policy (ISP), which provides a regulatory framework within which U.S. IMTS carriers negotiate with foreign carriers to provide bilateral international services. Under the ISP, (1) all U.S. carriers entering into agreements with foreign carriers must be offered the same effective accounting rate and same effective date for the rate ('nondiscrimination'); (2) U.S. carriers are entitled to a proportionate share of return traffic based upon their proportion of U.S. outgoing traffic ('proportionate return'); and (3) the accounting rate is divided evenly between the U.S. and foreign carriers for U.S. incoming and outgoing traffic ('symmetrical settlement rates'). The first and third requirements imply that all U.S. carriers must be offered the same settlement rate ('uniform settlement rate').

The second and third requirements can be thought of as a means of reducing above-cost settlement rates.[7] In contrast, the uniform settlement rate requirement is a response to the lack of competition in the IMTS markets rather than to the above-cost settlement rates. In the IMTS industry, the greatest entry barrier for potential competitors was that they needed an arrangement with each foreign carrier about the accounting and settlement rates for the provision of service. Furthermore, monopolistic foreign carriers tended to be more favorable to the incumbent U.S. carrier, AT&T, rather than to new entrants.[8] Thus, the FCC forced all U.S. carriers to have the same arrangement (the uniform settlement rate requirement) as an effective way to remove this type of entry barrier. As mentioned in the introduction, in reality the uniform settlement rate requirement has been implemented such that only one U.S. carrier (mainly AT&T) enters negotiations with foreign carriers and the negotiated settlement rate is automatically applied to other U.S. carriers.

Since 1986, the IMTS markets have become increasingly competitive. In 1986,

[7]Because U.S. outgoing traffic outnumbers U.S. incoming traffic for almost all foreign countries, historically foreign carriers with monopoly power have engaged in 'whipsawing' behavior; that is, they have 'manipulated traffic flows' and 'retained a greater percentage of the accounting rate' in order to obtain a higher settlement rate (FCC, 2001). Thus, the second and third requirements of the ISP are natural responses to the above-cost settlement rates.

[8]The U.S. carriers' partners in international facilities are largely monopolistic, and these monopolists are most comfortable with traditional practices which tend to favor incumbent carriers, including AT&T (FCC, 1996).

AT&T was the only service provider for 63 of the 100 countries for which U.S. outgoing traffic was largest. Since then, that number has decreased rapidly, falling to 36 in 1988 and eleven in 1990, and finally, by 1992, the IMTS markets for all main foreign countries became competitive, with three or more U.S. IMTS providers.

The trend towards more competitive markets suggests that the uniform settlement rate requirement did in fact play a role in developing competition by removing a major entry barrier. Even if this were true, however, it is problematic as to whether the uniform settlement rate requirement continues to be beneficial to the U.S. The unification of the bargaining position may actually weaken U.S. carriers' bargaining positions in their negotiations with foreign carriers. The following effects, which are unique in the uniform settlement rate requirement, are important.

(1) *Competition-Induced-Incentive Effect* (from the viewpoint of U.S. carriers): Because the settlement rate is a major component of the marginal cost for U.S. carriers, if there is no requirement, each U.S. carrier will attempt to gain a competitive advantage in the product market competition by lowering its own settlement rate. However, under the uniform settlement rate requirement, any reduction in the settlement rate obtained by a specific U.S. carrier will be automatically applied to other U.S. carriers, thereby leaving no competitive advantage from a reduction in the settlement rate. Therefore, the uniform settlement rate requirement weakens U.S. IMTS carriers' incentives aggressively to bargain over settlement rates.

(2) *Most-Favored-Nation Effect* (from the viewpoint of foreign carriers): Whatever concessions a foreign carrier gives to a specific U.S. carrier are at least doubled because the same concessions should be automatically given to other U.S. carriers. This fact will harden the bargaining positions of foreign carriers.

These two effects weaken the U.S. carriers' bargaining positions, leading to higher settlement rates than those that would be seen if the uniform settlement rate requirement were not enforced. These higher settlement rates are likely to give rise to higher prices and greater net settlement payments to foreign carriers. Higher prices will also result in a welfare loss in the U.S.

Therefore, regarding whether the uniform settlement rate requirement can be justified from the viewpoint of the U.S. involves a comparison between the benefit (introducing competition into the markets) and the cost (raising settlement rates). Conducting this comprehensive comparison is beyond the scope of this paper. Instead, this paper focuses solely on the cost side and measures the impact of the uniform settlement rate requirement on the negotiated settlement rates, net settlement payments, and finally welfare in the U.S. However, with the cost-side analysis alone, we can still gain a clear answer concerning the implementation of the uniform settlement rate requirement after 1992, as the benefit of the requirement was fully exhausted after its first stage of implementation. By 1992, MCI and Sprint had already entered all major markets and, in particular, MCI had gained a significant market share.[9] Nonetheless, the uniform settlement rate requirement was maintained for almost all foreign countries until 1998 and was enforced for more than 100

[9]In 1992, MCI's and Sprint's market shares based on net revenue were 19.8% and 7.5%, respectively (FCC, 1998).

countries even into the mid-2000s. Therefore, an empirical finding of a major negative impact of the requirement in terms of the settlement rates, net settlement payments, and welfare, will provide strong evidence against continuing with the requirement after 1992.

III. Theoretical Evaluation of the Uniform Settlement Rate Requirement

In this section, using a simple model, I compare individual settlement rates with a uniform settlement rate and identify the Competition-Induced-Incentive (CII) Effect and Most-Favored-Nation (MFN) Effect.

From the U.S. viewpoint, for each foreign country, the IMTS industry consists of two domestic firms, carrier 1 (AT&T) and carrier 2 (MCI), and one foreign firm. The events in this industry take place in two stages. In the first stage, if the uniform settlement rate requirement is not enforced, each domestic carrier bargains with its foreign correspondent over the settlement rate. If the uniform settlement rate requirement is enforced, carrier 1, as the representative firm, bargains over the uniform settlement rate. In the second stage, the settlement rate agreements are known, and the domestic firms compete in the product market. During product market interaction, domestic firms decide on the prices they will charge.[10] For computational simplicity, the quantity produced by the foreign firm is assumed to be given at a fixed ratio m of the total quantity produced by the domestic firms. That is, $q^f = m(q_1 + q_2)$.[11] I assume that $0 < m < 1$.[12]

Furthermore, the price charged by the foreign firm is assumed to be fixed at p^f.[13]

A. *Product Market Competition*

The demand for product i is

$$q_i(p_i, p_{3-i}) = \alpha - p_i + \gamma p_{3-i} \qquad i = 1, 2 \tag{1}$$

where $1 > \gamma > 0$.

[10]Pricing competition appears to be more appropriate than quantity competition when characterizing the IMTS market. Qualitative results of the model do not change when we characterize product market competition as a quantity game.

[11]Although the main reason for assuming this is computational ease, this assumption may not be unrealistic. The existence of "reciprocity" in international telephone traffic, that is, $\frac{\partial q^f}{\partial q^a} > 0$ has been commonly surmised among researchers. Appelbe *et al.* (1988) show the existence of reciprocal calls using traffic data between the U.S. and Canada.

[12]The U.S. has more outgoing traffic than incoming traffic at almost all international points. Factors such as the large U.S. population, the high per capita income of U.S. consumers, low U.S. calling prices, and numerous immigrant populations contribute to greater U.S. outgoing traffic flows (FCC, 2002).

[13]p^f is likely to be affected by the settlement rate. The main reason for assuming a fixed p^f is to make the model analytically tractable. Considering that nearly all foreign firms have been state-owned firms, however, this assumption may not be very restrictive as state-owned firms may have objectives other than profit maximization. For example, they may try to boost the consumption of IMTS by maintaining a low price. In such a case, the price may not reflect any change in the settlement rate.

Given the settlement rates s_i, the profit function of the domestic firm i is

$$\begin{aligned}\pi_i(p_i, p_{3-i}) &= p_i q_i - (c+s_i)q_i - (c-s_i)q^f \frac{q_i}{q_1+q_2} \\ &= p_i q_i - (c+s_i)q_i - (c-s_i)mq_i \\ &= (p_i - (1+m)c - (1-m)s_i)q_i\end{aligned} \tag{2}$$

where c is the per-minute handling cost. I assume that this cost is identical for both outgoing and incoming calls. The third term in the first line in equation (2) represents the costs incurred from terminating incoming calls. The foreign carrier must return traffic to the US carriers in proportion to the number of minutes sent to that carrier's country by each US carrier (the proportionate return requirement).

The profit function of the foreign firm is

$$\begin{aligned}\pi^f(p_1, p_2) &= p^f q^f - \sum_{i=1}^{2}\left[(c^f + s_i)q^f \frac{q_i}{q_1+q_2} + (c^f - s_i)q_i\right] \\ &= p^f m(q_1+q_2) - \sum[(c^f+s_i)mq_i + (c^f - s_i)q_i] \\ &= \sum(p^f m - (1+m)c^f + (1-m)s_i)q_i \\ &= \sum(F + (1-m)s_i)q_i\end{aligned} \tag{3}$$

where $F = p^f m - (1+m)c^f$.

As seen in equations (2) and (3), the domestic firms have an incentive to reduce settlement rates while the foreign firm has the opposite incentive. This stems from the fact that $m < 1$.

In the second stage, two domestic firms compete over prices in the product market. The equilibrium concept for this interaction is the Nash equilibrium. Given the profit functions, it is straightforward to calculate the equilibrium price and output:

$$p_i(s_i, s_{3-i}) = \frac{(2+\gamma)[\alpha + (1-m)c] + (1-m)(2s_i + \gamma s_{3-i})}{4-\gamma^2} \tag{4}$$

$$\begin{aligned}q_i(s_i, s_{3-i}) &= \frac{(2+\gamma)[\alpha - (1+m)(1-\gamma)c] - (1-m)[(2-\gamma^2)s_i - \gamma s_{3-i}]}{4-\gamma^2} \\ &= \frac{(2+\gamma)D - (1-m)[(2-\gamma^2)s_i - \gamma s_{3-i}]}{4-\gamma^2}\end{aligned} \tag{5}$$

where $D = \alpha - (1+m)(1-\gamma)c$, $i = 1, 2$. The equilibrium profit of the domestic carrier i is

$$(6)\qquad \pi_i(s_i, s_{3-i}) = \left[\frac{(2+\gamma)D - (1-m)[(2-\gamma^2)s_i - \gamma s_{3-i}]}{4-\gamma^2}\right]^2 = (q_i(s_i, s_{3-i}))^2$$

The profit of the foreign carrier can also be expressed by the given settlement rates such that

$$(7)\qquad \pi^f(s_1, s_2) = (F + (1-m)s_1)q_1(s_1, s_2) + (F + (1-m)s_2)q_2(s_1, s_2)$$

In the following analysis I assume that D and F have proper values so that positive bargaining solutions result.

B. *Bargaining over Settlement Rates*

I model the outcomes of settlement rate bargaining using the formula of a Nash bargaining solution. In fact, real-world bargaining between a U.S. firm and a foreign firm can be described better by a noncooperative dynamic bargaining game of the type presented by Rubinstein (1982) rather than the static Nash bargaining model.[14] Binmore *et al.* (1986), however, show that the Nash solution approximates the perfect equilibrium outcome of the noncooperative dynamic bargaining game when the length of a single bargaining period is sufficiently short. Therefore, although I build up logic on the static Nash bargaining model in this paper, it will be useful to think of the Nash bargaining model as a reduced form of an appropriate dynamic bargaining model and to interpret the Nash solution in the context of the noncooperative dynamic bargaining game observed in the real world.

1. Individual Settlement Rates Regime

When the uniform settlement rate policy is not enforced, applying a Nash solution is not straightforward. In such a case, each of the domestic carriers takes part in the bargaining with the foreign correspondent and determines its own settlement rate. Therefore, it is necessary to account for interdependence between the two different bargaining problems. Here, I analyze these symmetric and simultaneous outcomes, in which the foreign carrier negotiates with two domestic firms symmetrically and simultaneously.

The solution is a pair of settlement rate agreements s_1^n and s_2^n such that s_i^n is the Nash solution to the bargaining problem between the foreign carrier and the domestic carrier i, given that both anticipate correctly that the other rate will be s_{3-i}^n. Therefore, given s_{3-i}^n, I describe the bargaining problem between the foreign carrier and the domestic carrier i using the following set of payoff pairs,

[14]In the model considered by Rubinstein, the bargaining takes place over time according to a predetermined procedure of alternating offers and responses of both parties.

$$B_i^n = \{[\pi_i(s_i, s_{3-i}^n), \pi^f(s_i, s_{3-i}^n)] \mid s_i \geq 0\},$$

and a choice over the disagreement point.[15]

Although a proper specification of the disagreement point is not straightforward, we can consider two plausible scenarios by which disagreement points can be characterized.

Case 1. If firm i and the foreign firm cannot reach an agreement, firm i earns zero and firm $(3-i)$ operates at the anticipated equilibrium level $q_{3-i}(s_1^n, s_2^n)$. The disagreement point will then be

$$\{0, [F + (1-m)s_{3-i}^n]q_{3-i}(s_i^n, s_{3-i}^n)\}.$$

If we interpret the Nash bargaining solution while examining the underlying dynamic game of the Rubinstein type (1982), the disagreement point should correspond to the streams of income that accrue to the two parties during the course of the dispute. Furthermore, the two negotiations take place simultaneously rather than sequentially. In this case, it may be reasonable to assume that firm $(3-i)$ operates at the anticipated equilibrium level and that the foreign firm earns positive profit amounting to $[F + (1-m)s_{3-i}^n]q_{3-i}(s_i^n, s_{3-i}^n)$ from the business with firm $(3-i)$ during the dispute with firm i. The Nash bargaining solution with respect to the above disagreement point is

$$(8) \quad s_i^n = \underset{s_i}{\operatorname{argmax}}\, \pi_i(s_i, s_{3-i}^n)^{\phi_i} \cdot \{\pi^f(s_i, s_{3-i}^n) - [F + (1-m)s_{3-i}^n]q_{3-i}(s_i^n, s_{3-i}^n)\}^{(1-\phi_i)}$$
$$i = 1, 2$$

where ϕ_i is firm i's bargaining power and may capture other possible asymmetries between firm i and the foreign firm which are not reflected in the profit functions and disagreement point. In the following empirical sections, I recover the actual value of ϕ_i from the data. Here, however, I simply assume that $\phi_1 = \phi_2 = 0.5$; i.e., all asymmetries are reflected in the profit functions and disagreement point. The first order conditions for (8) are then expressed as shown below.

$$(9) \quad \left\{[F + (1-m)s_i]\frac{\partial q_i}{\partial s_i} + [F + (1-m)s_{3-i}^n]\frac{\partial q_{3-i}}{\partial s_i} + (1-m)q_i\right\}\pi_i + \frac{\partial \pi_i}{\partial s_i}[F + (1-m)s_i]q_i = 0, \qquad i = 1, 2$$

[15]The disagreement point is also referred to as the status quo or the threat point depending on the context considered.

Substituting equations (5), (6), and (7) into equation (9) and solving yields

$$(10) \qquad s_1^n = s_2^n = s^{c1} = \frac{(2+\gamma)D - (6-\gamma-3\gamma^2)F}{2(1-m)(4-\gamma-2\gamma^2)},$$

where s^{c1} refers to a counterfactual settlement rate in Case 1.

Case 2. In contrast to Case 1, we can assume that a regulation exists requiring both domestic carriers to break off relations with a specific foreign carrier if any of the domestic carriers cannot reach an agreement with that foreign carrier.[16] In this case, the disagreement point will be zero for all bargaining participants and the Nash solution is

$$(8') \qquad s_i^n = \underset{s_i}{\operatorname{argmax}}\, \pi_i(s_i, s_{3-i}^n)^{\phi_i} \cdot \pi^f(s_i, s_{3-i}^n)^{(1-\phi_i)} \qquad i = 1,\ 2$$

with the assumption of $\phi_1 = \phi_2 = 0.5$, the first-order conditions for (8') are

$$(9') \quad \left\{[F + (1-m)s_i]\frac{\partial q_i}{\partial s_i} + [F + (1-m)s_{3-i}^n]\frac{\partial q_{3-i}}{\partial s_i} + (1-m)q_i\right\}\pi_i + \frac{\partial \pi_i}{\partial s_i}\pi^f = 0, \quad i = 1,\ 2$$

substituting equations (5), (6), and (7) into equation (9') and solving yields

$$(10') \qquad s_1^n = s_2^n = s^{c2} = \frac{(2+\gamma)D - (10-\gamma-5\gamma^2)F}{2(1-m)(6-\gamma-3\gamma^2)},$$

where s^{c2} refers to a counterfactual settlement rate in Case 2.

2. Uniform Settlement Rate Regime

If the uniform settlement rate requirement is enforced, there should be only one settlement rate applied to both domestic firms. As an example, carrier 1 bargains with the foreign carrier over the settlement rate. This negotiated settlement rate is then applied to carrier 2. The solution here is the settlement rate agreement $s_1 = s_2 = s^u$. The bargaining problem between the foreign carrier and domestic carrier 1 can be described by the following set of payoff pairs,

[16]The FCC may impose this regulation to improve U.S. carriers' bargaining positions. In the context of an underlying dynamic game, this regulation is interpreted as requiring both domestic firms to suspend their business with a specific foreign firm until both domestic firms reach an agreement with that foreign firm.

$$B_1^u = \{[\pi_1(s), \pi^f(s)] \mid s \geq 0\},$$

and the choice over the disagreement point.

I make the following assumption pertaining to the disagreement point: if firm 1 and the foreign firm cannot agree, the interdependent relationships between the domestic firms and the foreign firm break down completely. As such, all firms in the industry earn zero profit.[17] With respect to this disagreement point, the Nash bargaining solution is

$$s^u = \underset{s}{\operatorname{argmax}}\, \pi_1(s)^{\phi_1} \cdot \pi^f(s)^{(1-\phi_1)}. \tag{11}$$

Once again, I assume that $\phi_1 = 0.5$. The first-order condition for (11) is

$$\left\{[F + (1-m)s]\left(\frac{\partial q_1}{\partial s} + \frac{\partial q_2}{\partial s}\right) + (1-m)(q_1 + q_2)\right\}\pi_1 + \frac{\partial \pi_1}{\partial s}\pi^f = 0. \tag{12}$$

Substituting equations (5), (6), and (7) into equation (12) and solving yields

$$s^u = \frac{D - 3(1-\gamma)F}{4(1-m)(1-\gamma)}. \tag{13}$$

3. Comparison: Individual Settlement Rates vs. Uniform Settlement Rate

When comparing the first case of the individual settlement rates regime with the uniform settlement rate regime, three differences are apparent from the two first-order conditions (9) and (12). First, we observe the Competition-Induced-Incentive (CII) Effect. That is, the uniform settlement rate requirement reduces incentives for the domestic carrier to negotiate low settlement rates, as it removes any possible differential in rates paid by competing carriers for the termination of outgoing traffic (FCC, 1999). This effect is captured by $\frac{\partial \pi_1}{\partial s}$ in equation (12).

$$\begin{aligned}\left|\frac{\partial \pi_1(s)}{\partial s}\right| &= 2q_1(s)(1-m)\left[\frac{2-\gamma^2}{4-\gamma_2} - \frac{\gamma}{4-\gamma^2}\right] \\ &< 2q_1(s,s)(1-m)\left(\frac{2-\gamma^2}{4-\gamma^2}\right) = \left|\frac{\partial \pi_1(s_1, s_2)}{\partial s_1}\right|_{s_1 = s_2 = s}.\end{aligned}$$

[17] In the context of underlying dynamic game, this assumption is interpreted as the interdependent relationships between the domestic firms and the foreign firm being suspended until firm 1 and the foreign firm reach an agreement.

The second difference comes from the Most-Favored-Nation (MFN) Effect. Because any settlement rates negotiated by firm 1 and the foreign firm are automatically applied to firm 2, whatever concession (reduction in the rate) the foreign firm gives to firm 1 doubles under the uniform settlement rate requirement, thereby hardening the foreign firm's bargaining position. The differentiation $\frac{\partial \pi^f(s)}{\partial s}$ expressed by the large [·] in equation (12) describes this effect:

$$\frac{\partial \pi^f(s)}{\partial s} = 2 \cdot \frac{\partial \pi_1(s_1, s_2)}{\partial s_1}\Big|_{s_1 = s_2 = s}.$$

The third difference arises from asymmetry in the foreign carrier's disagreement point. When choosing disagreement points, I punish the foreign carrier more severely in the uniform settlement rate regime if it fails to reach an agreement. With more severe punishment, the foreign carrier's bargaining position becomes weaker.

While the Competition-Induced-Incentive and the MFN effects increase the settlement rate, the difference in the disagreement points suggests a lower settlement rate in the uniform settlement rate regime. A direct comparison of s^{c1} and s^u, however, gives the following result:

$$s^u - s^{c1} = \frac{\gamma(D + (1-\gamma)F)}{4(1-m)(1-\gamma)(4-\gamma-2\gamma^2)} > 0. \tag{14}$$

In Case 2, the comparison of the individual settlement rates regime and the uniform settlement rate regime results in a clearer answer. By forcing both domestic carriers to break off their relationships with a specific foreign carrier if either of the domestic carriers cannot reach an agreement with that foreign carrier, we have the same disagreement point of the foreign carrier in both regimes. Then, with the remaining two differences, the CII and MFN effects, we unambiguously expect a higher settlement rate in the uniform settlement rate regime. The comparison of s^{c2} and s^u confirms this expectation:

$$s^u - s^{c2} = \frac{(2+\gamma-\gamma^2)(D + (1-\gamma)F)}{4(1-m)(1-\gamma)(6-\gamma-3\gamma^2)} > 0. \tag{15}$$

IV. Estimation Strategy and Empirical Model

At this stage, I introduce an estimation strategy and develop an econometric framework to measure the negative impacts of the uniform settlement rate requirement on the U.S. side, as found in the previous section. If there were two datasets between which the only structural change was whether the uniform rate

requirement was enforced or not, it would be straightforward to measure the effects of the requirement. Unfortunately, this is not possible. Therefore, I measure the impacts of the requirement in the following two stages. First, I estimate a bargaining model of settlement rate negotiation, after which, using the estimated bargaining model, I conduct a counterfactual experiment in which the negative impacts of the uniform settlement rate requirement are measured from a direct comparison between the actual regime and a counterfactual regime. Essentially, the same bargaining model used in the previous section will be estimated. Moreover, when conducting the counterfactual experiment, I consider the two counterfactual scenarios specified in the previous section (Case 1 and Case 2).[18]

A. *Estimation of the Bargaining Model*

In the actual regime, AT&T (as a representative U.S. carrier) and a foreign carrier bargain over a common settlement rate sr. Given the assumptions on the bargaining model described in the previous section (in particular subsection 3.B.2), their objective function is

$$\max_{sr} \pi_1(sr)^{\phi_1} \cdot \pi_f(sr)^{1-\phi_1}, \tag{16}$$

where π_1 and π_f are the profit functions of AT&T and foreign carrier, respectively, and ϕ_1 is AT&T's bargaining power function.

As stated in the introduction, I estimate the bargaining model (16) in two steps. First, I estimate the profit functions for the U.S. carriers and foreign carriers and express each one as a function of the settlement rate. In the second step, I plug the estimates of the profit functions into the bargaining model (16) and estimate the remaining bargaining power function ϕ_1 using the observed uniform settlement rates.

1. Estimation of Profit Functions

Profit functions can be estimated directly or indirectly. The indirect estimation method involves two steps. First, demand and markup equations are estimated, with profit functions then constructed using the estimates. Because the counterfactual experiment requires estimates of the demand and markup equations as well as the profit functions, I utilize the indirect means of estimating the profit functions.

For each observation, there are two U.S. carriers, AT&T and MCI, which I index by $i = 1, 2,$ respectively, and there is one foreign carrier (f).[19] When referring to

[18]Counterfactual scenarios considered in the paper assume that the numbers of carriers are identical to those in the actual regime. I do not incorporate the benefit from the uniform settlement rate requirement of removing entry barriers into the counterfactual experiment.

[19]For tractability, Sprint is excluded from the analysis. Although Sprint is the third largest carrier in the U.S. IMTS industry, its market share was far less than 10% in the 1990s. In contrast, MCI's market share was around 30% in the late 1990s.

all carriers, I use the subscript h. Firm-specific variables have three subscripts, for example, q_{ijt} or p_{fjt}. The first subscript (i or f) refers to a specific U.S. carrier or foreign carrier. The second subscript (j) designates the foreign country considered and the third one (t) is for the year. Superscripts O and I correspondingly stand for "outgoing" and "incoming" traffic from the U.S. perspective.

Demand. The demand for U.S. carrier i's IMTS to foreign country j at time t is

$$q_{ijt} = \alpha_{i1} + \alpha_{i2} p_{1jt} + \alpha_{i3} p_{2jt} + \alpha_{i4} trade_{jt} + \alpha_{i5} Y_t + \alpha_{i6} QS_t + u_{ijt}, \tag{17}$$

where q_{ijt} is U.S. carrier i's outgoing traffic to country j, p_{ijt} is U.S. carrier i's per-minute collection rate for outgoing calls to country j, $trade_{jt}$ denotes the real exports and imports between the U.S. and country j, Y_t is the U.S. real GDP per capita, and QS_t measures the U.S. network quality of service as a percentage of mainlines connected to digital switches. Finally, u_{ijt} is a mean-zero stochastic term representing either the measurement error or a demand shock and is assumed to be serially uncorrelated.

The demand for the foreign carrier's IMTS by the U.S. at time t is

$$q_{fjt} = \beta_1 + \beta_2 p_{fjt} + \beta_3 trade_{jt} + \beta_4 Y_{jt} + \beta_5 QS_{jt} + u_{fjt},^{20} \tag{18}$$

where q_{fjt} denotes the total minutes of incoming traffic from country j to the U.S., Y_{jt} is country j's real GDP per capita, QS_{jt} measures the foreign network quality of service as a percentage of mainlines connected to digital switches, and u_{fj} is a mean-zero stochastic term that is serially uncorrelated.

When estimating these demand equations, a possible endogeneity problem arises: the correlation between prices and country-specific demand shocks. I deal with this challenge using an identification strategy similar to Nevo (2001). The identifying assumption for the U.S. demand equations (17) is that country-specific demand shocks u_{ijt} are independent across destination countries. Given this assumption, a demand shock for a specific country will be independent of the prices for other countries. Due to the similar marginal costs, prices for different countries within a region will be correlated and can therefore be used as valid instrumental variables.[21]

[20]One reviewer noted that the trade variable in Equation (17) and (18) alone cannot sufficiently capture the relationships properly between the two countries involved and/or demographic factors which may affect the level of demand for international calls. Although this comment is constructive, I do not include other variables in the model mainly due to data accessibility issues and, instead, make the assumption that the trade variable captures a large part of such relationships. In fact, this assumption may be justified given that business-related calls accounted for the majority of the international call demand in the relatively expensive international telephone markets during the period of the empirical analysis, which here ranges from 1988 to 1995.

[21]Countries in the sample are divided into six regional groups: Asia-Pacific, Africa, Western Europe, Eastern

For the foreign demand equation (18), I also make a similar identifying assumption: country-specific demand shocks u_{fjt} are independent across origination countries. With this assumption, for the price in a specific country, prices in different countries within the same region can be used as a valid instrumental variable.

Markup. U.S. carrier i's profit from a bilateral market between the U.S. and foreign country j is

$$\pi_{ijt} = (p_{ijt} - mc_{ijt})q_{ijt}(p_{1jt}, p_{2jt}), \tag{19}$$

where mc_{ijt} is the marginal cost of a call. Reflecting the proportionate return traffic requirement, the marginal cost is specified as follows:[22]

$$mc_{ijt} = (co_{ijt} + sr_{ijt}) + (ct_{ijt} - sr_{fjt})m_{jt-1}, \tag{20}$$

where sr_{hjt} is the firm-specific per-minute settlement rate between the U.S. and country j, co_{ijt} is the per-minute cost of originating a U.S. call, ct_{ijt} is the per-minute cost of terminating a foreign call, and $m_{jt-1} = \frac{q_{fjt-1}}{q_{djt-1}}$ is the ratio of incoming traffic to the total outgoing traffic between the U.S. and foreign country j in the previous year. In theory, $sr_{1j} = sr_{2j} = sr_{fj} = sr_j$. That is, settlement rates are identical for all U.S. competing carriers and foreign carriers under the ISP. In reality, however, negotiated settlement rates usually vary according to the time of the day, i.e., peak and off-peak rates, and U.S. consumers have different usage patterns over peak and off-peak times from foreign consumers. Furthermore, significant differences may exist in the usage patterns among U.S. carriers' subscribers. Therefore, when I compute the average settlement rate of each carrier by dividing its settlement payments by its quantity, it is natural to observe some variation in these average settlement rates even under the uniform settlement rate requirement, as shown in the data.

To specify the markup equations of U.S. carriers, I assume that they compete in the product market *a la* a Bertrand-Nash game. Assuming the existence of a pure-strategy equilibrium and assuming as well that the equilibrium prices are strictly positive, the price p_{ijt} must satisfy the first-order condition of

$$(p_{ijt} - mc_{ijt})\frac{\partial q_{ijt}}{\partial p_{ijt}} + q_{ijt}(p_{1jt,}p_{2jt}) = 0. \tag{21}$$

Europe, Middle East, and Western Hemisphere.

[22]For the derivation of the marginal cost functions, see the appendix.

This implies the following markup equation of U.S. carrier i:

$$p_{ijt} = mc_{ijt} - \left[1 / \left(\frac{\partial q_{ijt}}{\partial p_{ijt}} \right) \right] q_{ijt}. \tag{22}$$

By virtue of assuming a Bertrand-Nash game, we can estimate the markup equations of U.S. carriers using estimates of the demand parameters without observing the actual handling costs, co and ct.

When specifying a markup equation for foreign carriers, there should be concern over the assumption of a specific type of conduct: most foreign carriers had been state-owned or at least strictly regulated in terms of their respective pricing until the mid-1990s. Reflecting this, rather than assuming the conduct, I specify a markup equation for foreign carriers using a general functional form similar to that in Madden and Savage (2000):

$$p_{fjt} = \delta_1 + \delta_2 (co_{fjt} + sr_{fjt}) + \delta_3 HHI^I_{jt-1} + \delta_4 PO_{jt} + \delta_5 HHI^O_{jt-1} + \upsilon_{fjt}, \tag{23}$$

where co_{fjt} is the per-minute cost of originating a call to the U.S., HHI^I_{jt-1} is the extent of the market concentration for incoming traffic from foreign country j to the U.S. in the previous year, PO_{jt} is the extent of the privatization of the dominant foreign carrier, HHI^O_{jt-1} is the extent of the market concentration for outgoing traffic from the U.S. to foreign country j in the previous year, and υ_{fjt} are mean zero-error terms, which represent the randomness of the carriers. In contrast to the markup equations of U.S. carriers, the estimation of equation (23) requires additional information about the foreign carriers' handling costs, co_f. I impute co_f for each foreign carrier using cost information from the FCC (1997a). Finally, the inclusion of the lagged endogenous variables HHI^I_{jt-1} and HHI^O_{jt-1} in equation (23) may bring about another endogeneity problem: a correlation between these lagged endogenous variables and the error term, υ_{fjt}. However, I already assumed that the demand shocks, u_{ijt} and u_{fjt}, are serially uncorrelated. Given this assumption, the presence of lagged endogenous variables in the markup equation does not lead to any endogeneity problem.[23]

Profit Functions. Thus far, I have specified the demand and markup equations for the two U.S. carriers and one foreign carrier. Estimating these equations will give us the following equilibrium quantity and price estimates for the U.S. carrier i:

[23]Even if u_{ij} and u_{fj} are serially correlated, if the demand shock u_{fj} and supply shock υ_{fj} are independent of each other, we avoid the endogeneity problem due to the presence of the lagged endogenous variables.

$$\hat{q}_{ijt}(sr_{1jt}, sr_{2jt}, sr_{3jt}, X_{jt} \mid \hat{\theta}),\ \hat{p}_{ijt}(sr_{1jt}, sr_{2jt}, sr_{3jt}, X_{jt} \mid \hat{\theta}), \tag{24}$$

and for the foreign carrier j

$$\hat{q}_{fjt}(sr_{fjt}, X_{jt} \mid \hat{\theta}),\ \hat{p}_{fjt}(sr_{fjt}, X_{jt} \mid \hat{\theta}), \tag{25}$$

where X_j terms are exogenous variables, except sr_{hj} in the bilateral relationship between the two countries, and $\hat{\theta}$ refers to the estimated parameters.

Using equations (24) and (25), I construct estimates of the profit functions. The estimate of the U.S. carrier i's profit function is

$$\hat{\pi}_{ijt}\left(\cdot \mid \hat{\theta}\right) = \hat{p}_{ijt}\left(\cdot \mid \hat{\theta}\right) \cdot \hat{q}_{ijt}\left(\cdot \mid \hat{\theta}\right) - \widehat{mc}_{ijt}\left(\cdot \mid \hat{\theta}\right) \cdot \hat{q}_{ijt}\left(\cdot \mid \hat{\theta}\right), \tag{26}$$

where $\widehat{mc}_{ijt} = \widehat{ac}_{ijt} = (co_{ijt} + sr_{ijt}) + (ct_{ijt} - sr_{fjt})\widehat{mc}_{jt-1}$.

Similarly, the estimate of foreign carrier j's profit function is

$$\hat{\pi}_{fjt}\left(\cdot \mid \hat{\theta}\right) = \hat{p}_{fjt}\left(\cdot \mid \hat{\theta}\right) \cdot \hat{q}_{fjt}\left(\cdot \mid \hat{\theta}\right) - \widehat{C}_{fjt}\left(\cdot \mid \hat{\theta}\right), \tag{27}$$

where $\widehat{C}_{fjt} = (co_{fjt} + sr_{fjt})\hat{q}_{fjt} + (ct_{fjt} - sr_{1jt})\hat{q}_{1jt} + (ct_{fjt} - sr_{2jt})\hat{q}_{2jt}$.

2. Estimation of the Bargaining Power Function

To estimate AT&T's bargaining power function, first I plug the estimated profit functions (26) and (27) into the bargaining model (16). If we consider a bargaining problem between AT&T and foreign carrier j at time t, their objective function is then expressed as follows:[24]

$$\begin{aligned} \max_{sr_{jt}} \phi_{1jt} \ln \hat{\pi}_{1jt}\left(\kappa_{1jt} sr_{jt}, \kappa_{2jt} sr_{jt}, \kappa_{fjt} sr_{jt}, X_{jt} \mid \hat{\theta}\right) \\ +(1-\phi_{1jt}) \ln \hat{\pi}_{fjt}\left(\kappa_{1jt} sr_{jt}, \kappa_{2jt} sr_{jt}, \kappa_{fjt} sr_{jt}, X_{jt} \mid \hat{\theta}\right), \end{aligned} \tag{28}$$

where $\kappa_{hj} = sr_{hj} / sr_j$ reflects firm-specific usage patterns over various times of the day.

Specification of Bargaining Power Function $\phi_1(\cdot)$. I specify the bargaining power

[24]When estimating a bargaining model, I use the common settlement rate sr_j, which is the average value of sr_{1j}, sr_{2j}, and sr_{fj} instead of using firm-specific settlement rates directly in order to avoid an unnecessary computational burden. Each firm-specific settlement rate (sr_{hj}) is expressed as the product of a known firm-specific proportional factor κ_{hj} and sr_j, where h = 1, 2, and f.

function as follows:[25]

$$\phi_1(\cdot) = 1/[1+\exp\{-(\lambda_0 + \lambda_1 q_{1fj,t-1} + \sum_{k=2}^{8} \lambda_k D_{1987+k})\}], \quad (29)$$

[26]

where $q_{1fj,t-1}\left(=\frac{q_{1j,t-1}}{q_{fj,t-1}}\right)$ is the ratio of the outgoing traffic of AT&T to the incoming traffic from country j in the previous year, and the D_{1987+k} terms are year dummies.

Historically AT&T's bargaining power has varied depending on the foreign country. The variable $q_{1fj,t-1}$ captures this historical cross-sectional variation. If AT&T had a relatively large stake involved during the bargaining with a foreign carrier in the past, its historical bargaining power would be lower because it would lose more in the event of a disagreement. The inclusion of year dummies reflects the fact that since the late 1980s, the FCC has appealed settlement rates that were far in excess of the true termination costs, eliciting a worldwide response. With this international trend, we can expect that the bargaining power of AT&T, whose aim is to decrease settlement rates, has been increasing over time. The year dummies will capture this time trend and are expected to have positive signs.

Estimation of Bargaining Power Function $\phi_1(\cdot)$. Given an observation, for each possible value of ϕ_{1jt}, we can find an optimal settlement rate sr_{jt}^* which maximizes the objective function (28).

$$\underset{sr_{jt}}{\operatorname{argmax}}\, \phi_{1jt} \ln \hat{\pi}_{1jt} + (1-\phi_{1jt}) \ln \hat{\pi}_{fjt} = sr_{jt}^*(\phi_{1jt}) \quad (30)$$

If the estimated profit functions capture precisely what the carriers have in mind when bargaining,[27] and if any agreement is reached following the Nash bargaining model, then the observed settlement rate sr_{jt}^o should be located between $sr_{jt}^*(1)$ and $sr_{jt}^*(0)$. Here, $sr_{jt}^*(1)$ is the solution to the maximization problem (30) for the case in which AT&T has full bargaining power, and $sr_{jt}^*(0)$ is the solution when

[25]With the logistic function $1/[1+e^{-f(\cdot)}]$, the value of the bargaining power φ is restricted to [0,1].

[26]One reviewer suggested using $\frac{q_{1j,t-1}}{q_{1j,t-1}+q_{2j,t-1}}$ instead of $q_{1fj,t-1}(=\frac{q_{1j,t-1}}{q_{fj,t-1}})$ in Equation (29). However, the direction and size of the net settlement payment, the greatest concern of the two firms involved in an international telephone market, is determined by the settlement rate and the traffic imbalance between the outgoing traffic and the incoming traffic. Therefore, when bargaining over the settlement rate, an important factor affecting the relative bargaining positions of the two firms is the traffic imbalance, which can be properly measured by $q_{1fj,t-1}(=\frac{q_{1j,t-1}}{q_{fj,t-1}})$. The variable $\frac{q_{1j,t-1}}{q_{1j,t-1}+q_{2j,t-1}}$ does not have any direct implications with regard to the direction or size of the net settlement payment.

[27]This comes from the specification of the error terms in the demand and supply equations. In both equations, the error term represents a random shock to the carriers

the foreign carrier has full bargaining power. The function $sr^{*}_{jt}(\phi_{1jt})$ is also continuous and monotonically decreasing in the domain of $[0,1]$. The Intermediate Value Theorem then says that there exists a unique value of ϕ_{1jt} which satisfies the following equation:

$$sr^{*}_{jt}(\phi^{*}_{1jt}) = sr^{o}_{jt} \tag{31}$$

For each foreign country j and each year t, we can find ϕ^{*}_{1jt}.

Once I find ϕ^{*}_{1jt}, I estimate the bargaining power function (29) by nonlinear least squares and complete the estimation of bargaining model (16):

$$\phi^{*}_{1jt} = 1/[1+\exp\{-(\lambda_0 + \lambda_1 q_{1fj,t-1} + \sum_{k=2}^{8}\lambda_k D_{1987+k})\}] + \varepsilon_{jt} \tag{32}$$

B. *Counterfactual Experiment*

Given the estimated structural bargaining model, we can conduct a counterfactual experiment. In the experiment, I consider two counterfactual regimes in which each U.S. carrier bargains over its own settlement rate with a foreign carrier. Therefore, each counterfactual regime involves two interdependent bargaining problems. As in Section 3, I assume that the foreign carrier negotiates with the two U.S. carriers symmetrically and simultaneously. I also assume Nash equilibrium for the equilibrium concept for those interdependent bargaining problems.

In the first counterfactual regime (Case 1) where, if a U.S. carrier and the foreign carrier cannot reach an agreement and that U.S. carrier earns zero profit and the other U.S. carrier operates at the anticipated equilibrium level of the settlement rates, the disagreement point for U.S. carrier i and foreign carrier j is

$$\left[0, \hat{\pi}^{3-i}_{fjt}\left(sr^{n}_{ijt}, sr^{n}_{3-i,jt}, X_{jt} \mid \hat{\theta}\right)\right], \tag{33}$$

where $\hat{\pi}^{3-i}_{fjt}\left(\cdot \mid \hat{\theta}\right) = \left[\hat{p}_{fjt} - (co_{fjt} + \kappa_{fjt} sr_{jt})\right]\hat{q}_{fjt}\dfrac{\hat{q}_{3-i,jt}}{\hat{q}_{djt}} + (ct_{fjt} - \kappa_{3-i,jt} sr_{jt})\hat{q}_{3-i,jt}$ represents foreign carrier j's profit when it has business only with U.S. carrier $(3-i)$. In contrast, in the second regime (Case 2) assuming that if any U.S. carrier does not agree with the foreign carrier, the interdependent relationships between the U.S. carriers and foreign carrier totally break down and the disagreement point is simply $[0,0]$ for both bargaining problems.

1. Counterfactual Settlement Rates

In Case 1, counterfactual individual settlement rates $(sr^{c1}_{1jt}, sr^{c1}_{2jt})$ are the Nash

equilibrium of the following two Nash bargaining problems:

$$(34)\quad \begin{aligned} sr_{ijt}^{c1} = sr_{ijt}^{n} = \underset{sr_{jt}}{\operatorname{argmax}}\, & \hat{\phi}_{ijt} \ln \hat{\pi}_{ijt}\left(sr_{ijt}, sr_{3-i,jt}^{n}, X_{jt} \mid \hat{\theta}\right) \\ & + \left(1-\hat{\phi}_{ijt}\right)\left[\ln \hat{\pi}_{fjt}\left(sr_{ijt}, sr_{3-i,jt}^{n}, X_{jt} \mid \hat{\theta}\right) - \ln \hat{\pi}_{fjt}^{3-i}\left(sr_{ijt}^{n}, sr_{3-i,jt}^{n}, X_{jt} \mid \hat{\theta}\right)\right], \end{aligned}$$

where $\hat{\phi}_{ijt}$ represents the estimated bargaining power of U.S. carrier i.[28]

AT&T's bargaining power $\hat{\phi}_{1jt}$ is simply ϕ_{1jt}^{*}, which satisfies equation (31), and MCI's bargaining power $\hat{\phi}_{2jt}$ is imputed by replacing $\hat{q}_{1fj,t-1}$ with $\hat{q}_{2fj,t-1}$ in the estimated bargaining power function, as follows:

$$(35)\quad \hat{\phi}_{2jt} = 1/[1+\exp\{-(\hat{\lambda}_0 + \hat{\lambda}_1 \hat{q}_{2fj,t-1} + \textstyle\sum_{k=2}^{8} \hat{\lambda}_k D_{1987+k})\}]$$

Here, $\hat{q}_{2fj,t-1} = \dfrac{\hat{q}_{2j,t-1}}{\hat{q}_{fj,t-1}}$, and $\hat{\lambda}_0$, $\hat{\lambda}_1$ and $\hat{\lambda}_k$ are estimated parameters.

Counterfactual settlement rates $(sr_{1jt}^{c2}, sr_{2jt}^{c2})$ in Case 2 are the Nash equilibrium of the following two Nash bargaining problems:

$$(36)\quad \begin{aligned} sr_{ijt}^{c2} = sr_{ijt}^{n} = \underset{sr_{jt}}{\operatorname{argmax}}\, & \hat{\phi}_{ijt} \ln \hat{\pi}_{ijt}\left(sr_{ijt}, sr_{3-i,jt}^{n}, X_{jt} \mid \hat{\theta}\right) \\ & + \left(1-\hat{\phi}_{ijt}\right) \ln \hat{\pi}_{fjt}\left(sr_{ijt}, sr_{3-i,jt}^{n}, X_{jt} \mid \hat{\theta}\right) \end{aligned}$$

2. Counterfactual Net Settlement Payments, Consumers' and Producers' Surpluses

Once we find the counterfactual settlement rates (sr_{ijt}^{c}), it is straightforward to compute the counterfactual net settlement payment $(nsrpay_{jt}^{c})$, consumer surplus (cs_{jt}^{c}), and producer surplus (ps_{jt}^{c}) for each counterfactual regime. The computation of the counterfactual net settlement payments is as follows,

[28]It should be noted that I use the same profit functions $\hat{\pi}_{ij}$ and $\hat{\pi}_{fj}$ both in the actual and counterfactual regimes. A change in the bargaining framework only affects the negotiated settlement rates. It does not change the structure of the product market competition because the specification of the demand and supply functions does not reflect any element of the bargaining framework. This allows for the use of the same profit functions both in the actual and counterfactual regimes. However, it is possible to imagine a situation in which a change in the bargaining framework not only affects the negotiated settlement rates but also changes the structure of the product market competition. In fact, the settlement rate constitutes the bulk of the marginal cost. Thus, roughly speaking, competing U.S. carriers have identical marginal costs under the uniform settlement rate requirement. In the counterfactual regime, on the other hand, they have different, and sometimes very different, marginal costs. In a repeated game setting, the equilibrium structure of product market competition may depend on marginal cost differentials among competing firms, as determined by a specific bargaining framework. Thus, by taking into consideration this possible connection between product market competition and the bargaining framework, the model will become more realistic and reliable. I will leave this extension for future research.

$$(37) \qquad nsrpay_{jt}^{c} = \sum_{i} \left(\kappa_{ijt} sr_{ijt}^{c} \cdot q_{ijt}^{c} - \kappa_{fjt} sr_{ijt}^{c} \cdot q_{fjt}^{c} \cdot \frac{q_{1jt}^{c}}{q_{djt}^{c}} \right),$$

where $q_{hjt}^{c} = \hat{q}_{hjt}\left(sr_{1jt}^{c}, sr_{2jt}^{c}, X_{jt} \mid \hat{\theta}\right)$, as computed using equations (24) and (25), denotes the counterfactual outgoing and incoming traffic levels. The counterfactual consumer surplus obtained by consuming q_{1jt}^{c} and q_{2jt}^{c} is computed using the estimates of the demand and markup equations. The counterfactual producer surplus is the sum of the profits of the two U.S. carriers at the counterfactual settlement rates,

$$(38) \qquad ps_{jt}^{c} = \sum_{i} \hat{\pi}_{ijt}\left(sr_{1jt}^{c}, sr_{2jt}^{c}, X_{jt} \mid \hat{\theta}\right),$$

where $\hat{\pi}_{ijt}\left(\cdot \mid \hat{\theta}\right) = \hat{p}_{ijt}\left(\cdot \mid \hat{\theta}\right) \cdot \hat{q}_{ijt}\left(\cdot \mid \hat{\theta}\right) - \widehat{mc}_{ijt}\left(\cdot \mid \hat{\theta}\right) \cdot \hat{q}_{ijt}\left(\cdot \mid \hat{\theta}\right)$, as given in equation (26).

Actual settlement rates and net settlement payments in the actual regime are observed. The actual consumer surplus and producer surplus values can be computed identically to how the counterfactual values were determined. Finally, a direct comparison of the counterfactual settlement rates, net settlement payments, consumer surplus, and producer surplus values with the actual values provides the magnitude of the effects of the uniform settlement rate requirement on the negotiated settlement rates, net settlement payments, and welfare in the U.S.

V. Data Description

To measure the effects of the uniform settlement rate requirement, I obtained annual data for forty bilateral markets from 1988 to 1995 (281 observations).[29] From these data, I dropped fifty two observations in which a foreign carrier's collection rate is not available or MCI does not provide the IMTS. As a result, there are 229 total observations.[30] The bilateral markets represent approximately 72% of the total outgoing traffic and 82% of incoming traffic in 1995. Definitions, sample means and standard deviations for all variables are provided in Table A1 in the appendix. Some variables need to be explained in more detail.

A. *Price*

I construct the U.S. carrier i's average per-minute price for calls to country j

[29] FCC, *International Telecommunications Data,* various issue, 1988-1995.

[30] 1988-1995: Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Japan, Australia, New Zealand; 1991-1995: Austria, Canada, Israel, Venezuela, India, Indonesia, Malaysia, Singapore, Thailand, Hungary; 1992-1995: Luxembourg, Kuwait, Argentina, Chile, Colombia, Hong Kong, Philippines; 1993-1995: Mexico, Korea, Czech republic; 1993-1994: South Africa; 1994-1995: Turkey, Brazil.

by dividing the revenue by the quantity, $p_{ij} = rev_{ij} / q_{ij}$. I cannot follow the same procedure to find the average foreign price for international calls to the U.S. simply because foreign carriers' revenue information is not available. Instead, for each foreign country, I have the basic peak rate and discount off-peak rate of international calls to the U.S. I create the following steps to calculate country j's average price. First, I derive the usage pattern of U.S. consumers based on p_{1j}, AT&T's basic peak rate, and the discount off-peak rate. Second, I calculate foreign carrier j's average rate by applying the U.S. usage pattern to foreign carrier j's basic peak rate and discount off-peak rate. In doing so, I also consider the difference in the digitalization of the main lines between the U.S. and country j. This captures possible differences in the effectiveness of discount off-peak rates between the U.S. and country j.

B. *Cost*

International telephone carriers' marginal costs consist of two components. One is the handling cost of carrying a call from the origin to the international midpoint (originating a call, co) or from the international midpoint to the destination (terminating a call, ct). The other is the settlement payment to the foreign carrier (originating a call) or settlement receipt from the foreign carrier (terminating a call). Once again, the handling cost consists of three components: international transmission, international switching, and national extension. I assume that each foreign carrier has an identical handling cost when both originating and terminating a call ($co_f = ct_f$). In contrast, in the U.S., the handling cost of originating a call differs from that of terminating a call because U.S. local telephone companies impose different access charges for originating and terminating a call ($co_i \neq ct_i$).

This handling cost information is not publicly available. In 1995, however, the FCC estimated each component of the handling cost of making a call to the U.S. for major foreign countries (FCC, 1997b). By extrapolating these estimates into the past, I construct the handling cost for each foreign country for the period of 1988-1994. When I construct the first component of the handling cost (international transmission), I consider the distance between the U.S. and the foreign country, the percentage of digitalization of the main lines in the U.S. and the foreign country, and AT&T's and the foreign carrier's discount off-peak rates. I also consider technology development reflecting the fact that the construction costs of trans-Atlantic and trans-Pacific cable have dropped significantly.

In order to estimate the second component (international switching), the FCC employed the method developed in ITU (1995), and here I follow the same method to recover the international switching costs for 1988-1994. When I construct the last component (national extension) for each foreign country, I consider the size, investment per main line, location of the foreign country, and the foreign carrier's basic peak rate to the U.S. For the U.S., I construct the national extension cost by adding \$0.01 (an approximation of the domestic transmission cost) to the access charge.

C. *Settlement Rates*

There are usually two different settlement rates for each international point. One is for the peak time and the other is for the off-peak time. I could not calculate an average settlement rate with these official settlement rates here because reliable information about usage patterns over peak and off-peak times is not available. Instead, following the same approach used to construct the average prices, I obtained U.S. carrier i's average settlement rate for foreign country j by dividing its settlement payments by its quantity, $sr_{ij} = srpay_{ij} / q_{ij}$. These variables should reflect existing peak and off-peak settlement rates and the usage pattern of consumers. In the same manner, foreign carrier j's average settlement rate sr_{fj} is $srpay_{fj} / q_{fj}$.

VI. Estimation Results and Counterfactual Experiment

A. *Nash Bargaining Model*

1. Profit Functions

When estimating demand equations (17) and (18), the greatest concern is that prices may be correlated with country-specific demand shocks. As stated in the previous section, I address this problem using an instrumental variable with the assumption that country-specific demand shocks u_{ijt} and u_{fjt} are independent across countries.

Another challenge in the estimation of demand functions is that there are large differences among foreign countries in terms of the market size. For instance, with similar prices, the amounts of outgoing traffic to Finland and the U.K. in 1995 were 22.3 billion and 905.6 billion minutes, respectively. The numbers for incoming traffic also show similar patterns. If demand equations are estimated without controlling for these differences, price variables would explain in excess the variation of the quantities for small-market countries while explaining very little in the case of large-market countries. The inclusion of other country-specific aggregate variables, such as GDP and the amount of trade, may mitigate this problem but would not remove it. One means by which to avoid this difficulty is to divide each aggregate variable by market size.[31] I use the amounts of outgoing and incoming traffic in 1985 (q_{dj1985}, q_{fj1985}) as a proxy for market size. Therefore, when estimating the domestic demand equations, I use the normalized variables $\overline{q}_{ijt}\left(=\frac{q_{ijt}}{q_{dj1985}}\right)$,

[31]The use of a log-log model is another legitimate solution that avoids this type of difficulty. I tested a log-log model and several modified models, but none resulted in reasonable coefficients, implying that taking logs is not feasible for controlling differences in the IMTS market size.

$\overline{trade}_{jt} = \left(\frac{trade_{jt}}{q_{dj1985}} \right)$ and $\bar{Y}_t \left(= \frac{Y_t}{q_{dj1985}} \right)$ instead of q_{ijt}, $trade_{jt}$, and Y_t. For the foreign demand equation, $\tilde{q}_{fjt} \left(= \frac{q_{fjt}}{q_{fj1985}} \right)$, $\widetilde{trade}_{jt} = \left(\frac{trade_{jt}}{q_{fj1985}} \right)$ and $\tilde{Y}_t \left(= \frac{Y_{jt}}{q_{fj1985}} \right)$ are used. I also include country dummies in each demand equation.

When estimating markup equation (23), I add regional dummies to each equation to capture unobserved cost differentials over various locations.

All demand and markup equations are estimated by GLS. These results are reported in Tables A2 and A3 in the appendix. Table A2 summarizes the estimation results of the domestic and foreign demand functions.[32] Because I had controlled for cross-sectional variation over foreign countries with the inclusion of country dummies and the normalization of the aggregate variables, the price coefficients are nailed generically by time-dimensional variations. As expected, own-price effects are all negative and statistically significant in the domestic demand functions. I also obtain positive signs of rival prices despite the fact that one of them is not statistically significant. With regard to $\overline{trade}$, however, I fail to obtain expected positive signs. In particular, the negative sign is even significant for the AT&T demand function. This result may be explained by the fact that the U.S. has very different relative sizes of trade to call traffic $\left(= \overline{trade} / \bar{q}_d \right)$ relative to those of foreign countries.[33] In this case, estimating a common relationship between trade and outgoing traffic in an equation is doomed to be restrictive.[34] I also find that improving the call quality (QS_{us}), as measured by the percentage of digitalization of the main lines, has a negative impact on the demand for MCI.[35]

In the foreign demand equation, all variables have the expected signs. It should be noted, however, that the estimate of the price coefficient is much smaller than those in the domestic demand equations. Outgoing traffic from the U.S. and incoming traffic from foreign countries increase at similar rates. Therefore, if foreign prices decreased much more than U.S. prices during the period of analysis, that point would be explained. In fact, that is the case. Nominal prices dropped dramatically from 1988-1995 in the foreign countries. Furthermore, compared with the U.S., inflation rates were higher in foreign countries. When converting from nominal to real prices, this factor will induce even greater changes in foreign prices.

The markup equations of U.S. carriers are estimated by plugging the demand

[32]For reference, Table A2 also summarizes the estimation results of demand functions when the original price variables instead of the instruments are used in the estimation.

[33]Concerning the estimation of the AT&T demand function, the values of $\overline{trade}/\bar{q}_1$ are less than sixty (USD/min) for some foreign countries, such as Greece, Colombia, and Hungary. On the other hand, for Japan, Singapore, and Malaysia, this ratio exceeds 600. This diversity is not controlled for by the normalization steps taken for market size, as $trade$ and q_1 are divided by the same numbers.

[34]In fact, country-specific correlations between trade and outgoing traffic exceed 0.75 for most countries.

[35]This unexpected result comes from the high correlations between QS_{us} and the prices. If I estimate the MCI demand function with neither of these prices, the coefficient of QS_{us} is positive and statistically very significant.

estimates into equation (22) and solving with respect to the prices:

$$p_{ijt} = \widehat{mc}_{ijt} - [1/\hat{\alpha}_{i,i+1}]\hat{q}_{ijt}, \quad i = 1, 2$$

The estimation result for the markup equation of foreign carriers is summarized in Table A3. It shows that a change in the marginal cost has a strong effect on pricing. For the variables representing market competitiveness (HHI^{I}_{jt-1}, PO_{jt} and HHI^{O}_{jt-1}), I obtain the expected signs.

Using the estimation results for the demand and markup equations, I construct estimates for the profit function $\hat{\pi}_{hjt}$ with $h = 1, 2,$ and f. When I do this, I use $\hat{q}_{ijt} = \hat{\bar{q}}_{ijt} \cdot q_{dj1985}$ and $\hat{q}_{fjt} = \hat{\bar{q}}_{fjt} \cdot q_{fj1985}$ to recover the differences in the market size.

2. Bargaining Power Function

Table A4 in the appendix reports the estimates of $sr^{*}_{jt}(1)$ and $sr^{*}_{jt}(0)$ for each observation. As expected, $sr^{*}_{j}(1) < sr^{o}_{j} < sr^{*}_{j}(0)$ in 223 out of the total of 229 observations. This preliminary test may convince us that the demand and markup equations are correctly specified in the first stage of the estimation. When I estimated $sr^{*}_{jt}(1)$ and $sr^{*}_{jt}(0)$, I assumed that AT&T cannot ask for a settlement rate below its termination cost, ct_{1jt}. That is, ct_{1jt} is the lower bound for the settlement rate when bargaining.

The last column (bp_1) in Table A4 reports the unique value of ϕ_{1jt} for each observation which equates the solution of the maximization problem (31), sr^{*}_{jt}, with the observed settlement rate sr^{o}_{jt}.[36] The average bargaining power of AT&T over all observations is 0.635.

Finally, Table A5 summarizes the estimation results of the bargaining power function (32). As discussed earlier, AT&T's bargaining power is expected to be low with high values of $q_{1fj,t-1}$, the relative business size of AT&T in the previous year. The estimation result confirms the expectation by showing that the coefficient of $q_{1fj,t-1}$ is negative and statistically significant. All year dummies except 1991 have statistically significant, positive coefficients. Furthermore, they increase over time, meaning that AT&T's bargaining power has likely increased continuously since 1988.

[36]A setup of lower bounds does not make any difference when determining the value of ϕ^{*}_{1jt} and therefore in the estimation of the bargaining power function.

B. *Counterfactual Experiment: Uniform Settlement Rate Regime vs. Individual Settlement Rates Regimes*

Given the estimates of the structural bargaining model, I conducted two counterfactual experiments. Table A6 in the appendix summarizes all of the results of the counterfactual experiments. In this table, regimes A, C1, and C2 refer to the actual regime and two counterfactual regimes (Case 1 and Case 2), respectively. For the first six variables, comparisons are made for each observation and the results are averaged out over all observations. For the remaining variables, in contrast, comparisons are made with the sum of each variable over all observations.

1. Uniform Settlement Rate Regime vs. Case 1

As mentioned in Section 3, there are three differences between the actual regime and Case 1 of the counterfactual regimes: the Competition-Induced-Incentive Effect, Most-Favored-Nation Effect, and difference in the disagreement points. In the theoretical example presented in Section 3, the overall effect of the first two differences dominates that of the third difference, resulting in a higher settlement rate in the actual regime.

The experiment shows that counterfactual settlement rates are lower than the observed actual settlement rate in most observations.[37] On average, allowing individual settlement rates reduces negotiated settlement rates by 13.2% ($0.10). These settlement rate changes flow through to IMTS prices. Compared to the actual regime, the production-weighted average prices of U.S. carriers decrease by 2.6% and foreign carriers' prices drop by 9.5% in the counterfactual regime. With these price changes, outgoing traffic from the U.S. and incoming traffic to the U.S. increase by 9% and 8%, respectively, resulting in a 15.6% increase in the amount of the traffic imbalance. While the reduction in the settlement rate and the increase in the outgoing traffic have countervailing effects on settlement payments to each other, the experiment shows that the settlement rate changes dominate the outgoing traffic changes. The settlement payments of the U.S. carriers decrease by 7.7% overall in the counterfactual regime. However, settlement receipts from foreign carriers also drop by 12%, causing little change in the net settlement payments. The net settlement payments decrease by only 1% ($74 mil.) compared to the observed net settlement payments in the actual regime. Regarding the welfare analysis, we can easily expect that consumer surplus in the U.S. would increase with the reductions of IMTS prices in the counterfactual regime. In fact, the experiment reports a 9.5% increase in consumer surplus in the U.S. Producer surplus in the U.S. also increases by 9.5% with the help of a major increase in demand.[38] These changes in the consumer and

[37]In thirty-two observations, counterfactual settlement rates are higher than the actual settlement rate. For these observations, the effect of the difference in the disagreement points may dominate the CII and MFN effects. Alternatively, these exceptions can be explained by the fact that there was a sudden drop in the settlement rate in most of the observations. The counterfactual experiment does not count these exceptional events.

[38]The result of the same percentage increase in consumer surplus and producer surplus stems from the fact that I assumed a linear demand function and a Bertrand-Nash game in the product market competition. Given a linear demand function and a rival price, a U.S. carrier's profit-maximizing price in the Bertrand-Nash game is simply the average value of the vertical intercept of the demand curve and a constant marginal cost. Therefore, given the settlement rates, the producer's surplus is always twice as large as the consumer's surplus.

producer surplus outcomes result in a 9.5% ($2.05 bil.) increase in the total surplus in the U.S.

In foreign countries, consumer surplus increases by 4% in the counterfactual regime. Producer surplus, however, drops by 14% overall. These two reciprocal changes in consumer and producer surpluses offset each other, resulting in little change in the total surplus (0.25% decrease). Interestingly, allowing individual settlement rates only has a minor effect on the foreign countries' total surplus while providing the U.S. a very large increase in the total surplus.

2. Uniform Settlement Rate Regime vs. Case 2

In addition to allowing individual negotiation over the settlement rate, the Case 2 counterfactual regime also imposes a regulation such that all U.S. carriers are required to break off their relationships with a specific foreign carrier if any U.S. carrier cannot reach an agreement with that foreign carrier. With this regulation, the difference in the disagreement points which existed between the actual regime and the Case 1 counterfactual regime is removed; therefore, only the first two differences, the CII and MFN effects, remain as differences between the two regimes. In this sense, the second counterfactual experiment corresponds exactly to the purpose of the paper of measuring the effects of the uniform settlement rate requirement.

We can easily predict that the counterfactual individual settlement rates are lower than the actual uniform settlement rates given that the two remaining differences, the CII and MFN effects, commonly increase actual settlement rates. Furthermore, compared to the first experiment, the changes in the settlement rates would be even greater because the regulation discussed above already removed the countervailing effect from the difference in the disagreement points.[39]

As expected, the experimental result shows that negotiated settlement rates in the Case 2 counterfactual regime are much lower than the actual settlement rates in most observations; they are also lower than those in the Case 1 counterfactual regime in all observations. On average, allowing individual settlement rates under the above regulation reduces the negotiated settlement rates by 22% ($0.16) compared to the actual regime, which is significantly larger than the amount of the reduction in the first experiment (13.2%). As in the first experiment, these settlement rate changes decrease the IMTS prices and increase the outgoing and incoming traffic amounts, but on a much larger scale. The second experiment also reports a reduction of 6.45% ($0.45 bil.) in the net settlement payments in the counterfactual regime. The patterns of changes in consumer surplus and producer surplus in the U.S. and in the foreign countries are very similar to those in the first experiment. However, the magnitudes of the changes in the second experiment are much larger than those in the first. The total surplus in the U.S. increases by 16% ($3.43 bil.) overall in the counterfactual regime. The total surplus in the foreign countries decreases by 0.84%.

Thus far, I have estimated the Nash bargaining model, and, using estimates of the structural bargaining model, I conducted two counterfactual experiments. The second experiment shows that the costs of the uniform settlement rate requirement

[39]In this sense, differences between the two counterfactual regimes would be interpreted as the effects of that regulation.

or the impacts of the CII and MFN effects amount to a 32.2% ($0.16) increase in the negotiated settlement rates and a 13.7% ($3.43 bil.) decrease in the total surplus in the U.S. It also imposes on U.S. carriers a 6.9% ($0.45 bil.) increase in the net settlement payments.

VII. Conclusion

In 1986, the FCC introduced the International Settlement Policy (ISP) into the IMTS market. Among other things, it required U.S. IMTS firms to pay the same settlement rate to a foreign country for the termination of international traffic [uniform settlement rate requirement]. Major motivations behind this regulation were to remove entry barriers and introduce competition into the market. However, it also significantly changed the bargaining framework for the settlement rate. Changes in the bargaining framework affect the relative bargaining positions of all IMTS carriers involved and accordingly change the negotiated settlement rate. This "side-effect" of the uniform settlement rate requirement may strengthen, weaken or even obliterate the rightfulness of the regulation, depending on its direction and size.

The counterfactual experiment reports remarkably large impacts of the uniform settlement rate requirement. Enforcing the uniform settlement rate results in an average 32.2% increase in the negotiated settlement rates and an overall 13.7% ($3.43 billion) decrease in the total surplus in the U.S. It also presents U.S. carriers with a 6.9% ($0.45 billion) increase in their net settlement payments. These results do not provide evidence against the initial implementation of the uniform settlement rate requirement. As explained in Section 2, the uniform settlement rate requirement was implemented to remove entry barriers and introduce competition into the IMTS markets. In fact, the U.S. IMTS markets became increasingly competitive after the imposition of the requirement. In order to evaluate the requirement fairly, the analysis should include not only its costs but also the benefits it generates. However, the benefit side of the requirement was not analyzed in the paper, as the paper focused solely on the cost side.[40] Therefore, the large negative impacts of the requirements shown in the counterfactual experiments can lead us to biased and unbalanced implications against the implementation of the requirements in the late 1980s and early 1990s, when the intended competition effect arose largely through the requirements. However, the findings in the counterfactual experiments serve as strong evidence against the continuation of the requirement during the 1990s and early 2000s, as by 1992, entry barriers were removed from the market for all main foreign countries and three or more U.S. companies competed in the market, which can be interpreted as evidence that the benefit of the requirement was fully exhausted after that time.

The analysis in this paper exemplifies how important ex-post evaluations of regulations are. In Korea, however, ex-post evaluations of regulations are generally poor. In the context of Korea, some policy measures would be important to strengthen ex-post evaluations of regulations. First, when preparing a Regulatory

[40]Including the benefit side of the requirement in the analysis requires a completely different approach from the analysis performed in the paper, which is beyond the scope of the paper as mentioned in Section 2.

Impact Statement for a newly created or reinforced regulation, it should be required that the ex-post evaluation plan for the regulation be as specific as possible. A plan for who and when to conduct an ex-post evaluation and under which criteria should be specified, and it is of the utmost importance to specify the data necessary for the evaluation and how to compile the data.[41] Requiring a detailed ex-post evaluation plan not only allows ex-post evaluations to be carried out effectively but also increases the likelihood that a regulatory impact statement will be properly drawn up in advance. The second way to strengthen ex-post evaluations of regulations is to substantiate the operation of the sunset system currently in effect.[42] In Korea, every year thousands of regulations reach the sunset stage, but human and material resources for the government are clearly inadequate to conduct in-depth ex-post evaluations of all of these regulations. Therefore, it will be much more efficient and effective to select 3-5% of the regulations which reach the sunset stage as 'major regulations' through consultations between the Office for Government Policy Coordination in charge of regulation management and each ministry, and to carry out in-depth ex-post evaluations on only those major regulations while carrying out simple ex-post evaluations of the remaining regulations.

[41] It is known that the greatest reason why ex-post evaluations of regulations or policies are poorly performed in Korea is the lack of data for the evaluations.

[42] In Korea, article 8 of the Framework Act on Administrative Regulation requires, in principle, the establishment of an effective period or review period within five years when creating new regulations or reinforcing existing regulations.

APPENDIX

A. *Tables*

TABLE A1—VARIABLE DESCRIPTIONS AND SAMPLE STATISTICS 1988-1995

Variable	Definition	Mean	StD Dev	Min	Max
General Information					
q_1	AT&T originating traffic minutes (millions)	119.76	247.25	3.87	1639.95
rev_1	AT&T revenue from originating traffic in the US (million USD)	112.85	166.48	4.50	1141.10
$srpay_1$	AT&T payout to foreign PTT (million USD)	59.08	90.58	1.87	723.92
q_2	MCI originating traffic minutes (millions)	45.52	98.93	0.87	774.25
rev_2	MCI revenue from originating traffic in the US (million USD)	38.36	57.17	1.12	381.20
$srpay_2$	MCI payout to foreign PTT (million USD)	20.95	30.28	0.00	249.22
q_f	Minutes of traffic billed in foreign country (millions)	109.24	261.61	3.06	2067.29
$srpay_f$	Receipts from foreign PTT, traffic billed in foreign country (million USD)	50.96	61.17	2.53	271.09
Price Information					
p_1	AT&T per-minute collection rate (USD)	1.2291	0.2402	0.3886	2.2692
p_2	MCI per-minute collection rate (USD)	1.1148	0.2633	0.3637	2.0981
p_f	Foreign carrier's per-minute collection rate (USD)	1.9562	1.2368	0.1996	7.3890
Cost Information					
sr_1	AT&T per-minute settlement rate (USD)	0.6837	0.2468	0.1150	1.6961
sr_2	MCI per-minute settlement rate (USD)	0.6873	0.2590	0.1143	1.7380
sr_f	Foreign carrier's per-minute settlement rate (USD)	0.8294	0.4306	0.1079	3.0278
sr_{ave}	Weighted average settlement rate over sr_1, sr_2, sr_3, and sr_f (USD)	0.7329	0.2891	0.1121	1.8515
$co_1 = co_2$	US carriers' per-minute cost of originating a US call (USD)	0.1379	0.0482	0.0757	0.2587
$ct_1 = ct_2$	US carriers' per-minute cost of terminating a foreign call (USD)	0.1413	0.0546	0.0760	0.2993
$co_f = ct_f$	Foreign carrier's per-minute cost of originating or terminating a call (USD)	0.3278	0.2004	0.0700	1.4100
Supply Information					
MS_1	AT&T market share (share of minutes), based on the entire industry (%)	67.66	10.34	89.10	55.80
EA	Main lines converted to equal access (%)	93.57	5.58	78.90	98.60
HHI_{us}	HHI based on revenue, route-specific	0.53	0.09	0.34	0.87
PO	One plus private ownership share of dominant foreign carrier (%)	1.14	0.29	1.00	2.00
HHI_f	HHI of foreign country, based on world outgoing traffic minutes	0.95	0.14	0.28	1.00
Demand Information					
Y_{us}	US GDP (billion USD)	6977.89	299.36	6533.01	7439.62
QS_{us}	Digital main lines in the US (%)	58.45	14.29	30.60	76.20
Y_f	Foreign country's GDP (billion USD)	439.34	598.68	5.62	2889.67
QS_f	Digital main lines in foreign country (%)	56.96	25.82	0.00	100.00
size	Market size, the product of US and foreign country mainlines (trillion)	1242.55	1790.09	20.20	9733.62
trade	Trade between the US and foreign country (million USD)	21617.14	41887.82	133.19	274328.00

Note: USD is real. Base year is 1995.

Source: FCC (1985-1995; 1997a; 1997b; 1998; 2001); IMF (1996-1997); ITU (1995); OECD (1990-1997); TeleGeography (1995); World Bank (2003).

TABLE A2—ESTIMATIONS OF DOMESTIC AND FOREIGN DEMAND FUNCTIONS

TABLE (A)

	q_1		q_2			q_f	
	Coef.	P>|z|	Coef.	P>|z|		Coef.	P>|z|
p_1	-4.6492	0.000	0.8983	0.212	p_f	-0.4844	0.000
p_2	1.1595	0.060	-5.5118	0.000			
trade	-0.0005	0.017	-0.0004	0.201	*trade*	0.0008	0.000
Y_{us}	0.0002	0.743	0.0015	0.099	Y_f	0.0026	0.718
QS_{us}	0.0171	0.000	-0.0229	0.011	QS_f	0.0062	0.264
constant	8.5687	0.001	6.6533	0.071	*constant*	13.1125	0.000
# of obs.	229		229		# of obs.	229	

TABLE (B)

	q_1		q_2			q_f	
	Coef.	P>|z|	Coef.	P>|z|		Coef.	P>|z|
p_1	-4.4230	0.000	1.0496	0.189	p_f	-0.4615	0.000
p_2	1.1308	0.097	-5.2498	0.001			
trade	-0.0004	0.009	-0.0007	0.224	*trade*	0.0008	0.000
Y_{us}	0.0002	0.872	0.0017	0.101	Y_f	0.0021	0.826
QS_{us}	0.0169	0.001	-0.0241	0.009	QS_f	0.0043	0.212
constant	6.1273	0.003	11.5708	0.057	*constant*	20.2324	0.000
# of obs.	229		229		# of obs.	229	

Note: 1) Table (A) and Table (B) summarize the estimation results of demand functions with and without instrumental variables, respectively, 2) When estimating domestic demand functions, q_1, q_2, *trade*, and Y_{us} are normalized by q_{d1985}, 3) When estimating domestic demand functions, q_f, *trade*, and Y_f are normalized by q_{f1985}, 4) Coefficient estimates for country dummies are omitted from the report.

TABLE A3—ESTIMATIONS OF FOREIGN SUPPLY FUNCTIONS

	p_f	
	Coef.	P>|z|
$sr_f + co_f$	1.794	0.000
$HHI_{us,t-1}$	-0.060	0.916
PO	-0.284	0.021
$HHI_{f,t-1}$	-0.070	0.803
constant	0.640	0.094
# of obs.	229	

TABLE A4—ATT'S BARGAINING POWER

Country	Year	$sr^*(1) = co_1$	sr^o	$sr^*(0)$	bp_1
Austria	1991	0.256	0.770	1.840	0.771
	1992	0.302	0.646	1.920	0.844
	1993	0.283	0.512	1.860	0.848
	1994	0.233	0.440	1.560	0.830
	1995	0.284	0.376	1.570	0.868
Belgium	1988	0.311	0.918	1.720	0.546
	1989	0.329	0.956	1.650	0.613
	1990	0.398	0.874	1.550	0.635
	1991	0.265	0.792	1.500	0.570
	1992	0.281	0.731	1.440	0.606
	1993	0.342	0.652	1.350	0.576
	1994	0.261	0.565	1.370	0.604
	1995	0.285	0.382	1.440	0.782
Denmark	1988	0.354	0.787	1.620	0.611
	1989	0.352	0.736	1.760	0.825
	1990	0.349	0.706	1.670	0.783
	1991	0.350	0.716	1.630	0.681
	1992	0.327	0.724	1.680	0.707
	1993	0.351	0.729	1.590	0.613
	1994	0.309	0.732	1.640	0.597
	1995	0.270	0.414	1.550	0.839
Finland	1988	0.399	0.831	2.750	0.801
	1989	0.365	0.751	2.330	0.886
	1990	0.375	0.685	1.850	0.817
	1991	0.390	0.709	2.290	0.792
	1992	0.376	0.549	2.680	0.902
	1993	0.353	0.474	2.760	0.889
	1994	0.260	0.415	2.750	0.894
	1995	0.160	0.309	2.520	0.938
France	1988	0.366	0.922	1.710	0.505
	1989	0.391	0.811	1.700	0.711
	1990	0.381	0.777	1.730	0.718
	1991	0.368	0.648	1.590	0.672
	1992	0.387	0.511	1.700	0.785
	1993	0.382	0.396	1.560	0.811
	1994	0.299	0.358	1.510	0.856
	1995	0.219	0.288	1.590	0.912
Greece	1988	0.174	1.651	1.710	0.094
	1989	0.156	1.652	1.740	0.149
	1990	0.246	1.452	1.590	0.229
	1991	0.198	1.366	1.440	0.066
	1992	0.284	1.094	1.310	0.201
	1993	0.267	0.876	1.230	0.336
	1994	0.212	0.808	1.190	0.367
	1995	0.325	0.699	1.200	0.486
Ireland	1988	0.275	0.776	1.390	0.609
	1989	0.220	0.748	1.380	0.638
	1990	0.166	0.722	1.450	0.678
	1991	0.184	0.644	1.400	0.650
	1992	0.210	0.549	1.270	0.699
	1993	0.108	0.497	1.240	0.724
	1994	0.046	0.430	1.290	0.776
	1995	0.068	0.356	1.320	0.843
Italy	1988	0.231	1.135	1.540	0.405
	1989	0.210	1.185	1.510	0.419
	1990	0.206	1.083	1.530	0.531
	1991	0.223	1.014	1.390	0.414
	1992	0.271	0.835	1.350	0.544
	1993	0.295	0.785	1.600	0.608
	1994	0.311	0.559	1.260	0.666
	1995	0.339	0.437	1.230	0.749

TABLE A4—ATT'S BARGAINING POWER *(CONT'D)*

Country	Year	$sr^*(1) = co_1$	sr^o	$sr^*(0)$	bp_1
Luxembourg	1992	0.452	0.734	2.420	0.822
	1993	0.475	0.530	2.080	0.775
	1994	0.353	0.521	2.060	0.800
	1995	0.252	0.453	2.040	0.852
Netherlands	1988	0.381	0.788	2.000	0.677
	1989	0.363	0.788	1.870	0.796
	1990	0.347	0.788	1.990	0.771
	1991	0.325	0.663	1.960	0.741
	1992	0.315	0.540	2.090	0.847
	1993	0.303	0.370	1.800	0.854
	1994	0.234	0.309	2.270	0.929
	1995	0.163	0.293	1.810	0.930
Norway	1988	0.393	0.817	2.290	0.746
	1989	0.364	0.754	1.800	0.793
	1990	0.381	0.697	1.860	0.868
	1991	0.358	0.716	1.860	0.706
	1992	0.370	0.582	2.120	0.855
	1993	0.349	0.513	2.020	0.818
	1994	0.263	0.379	2.340	0.899
	1995	0.225	0.254	2.110	0.938
Portugal	1989	0.127	1.385	1.530	0.330
	1990	0.116	1.124	1.550	0.492
	1991	0.180	1.005	1.370	0.398
	1992	0.980	1.066	1.240	0.008
	1993	0.095	0.784	1.280	0.559
	1994	0.091	0.717	1.220	0.547
	1995	0.048	0.620	1.240	0.646
Spain	1988	0.149	1.172	1.980	0.505
	1989	0.119	1.162	1.920	0.575
	1990	0.160	1.146	2.070	0.614
	1991	0.127	1.086	1.820	0.463
	1992	0.199	0.979	1.830	0.566
	1993	0.134	0.892	1.530	0.546
	1994	0.147	0.831	1.430	0.501
	1995	0.280	0.743	1.510	0.616
Sweden	1988	0.254	0.885	3.080	0.975
	1991	0.153	0.365	2.840	0.962
	1993	0.097	0.369	3.110	0.960
	1994	0.093	0.280	2.550	0.935
	1995	0.091	0.191	2.330	0.966
Switzerland	1988	0.399	0.905	1.780	0.582
	1989	0.410	0.867	1.680	0.746
	1990	0.471	0.814	1.720	0.822
	1991	0.403	0.745	1.810	0.693
	1992	0.408	0.630	1.880	0.794
	1993	0.409	0.503	1.620	0.761
	1994	0.358	0.462	1.650	0.797
	1995	0.288	0.359	1.610	0.895
Turkey	1994	0.214	1.329	2.240	0.483
	1995	0.120	0.825	1.700	0.579
UK	1988	0.401	0.582	1.220	0.761
	1989	0.362	0.549	1.540	0.874
	1990	0.338	0.524	1.720	0.872
	1991	0.300	0.473	1.330	0.835
	1992	0.309	0.375	1.450	0.886
	1993	0.296	0.305	1.400	0.905
	1994	0.264	0.272	1.580	0.945
	1995	0.202	0.214	1.560	0.990
South Africa	1993	0.244	0.955	1.840	0.587
	1994	0.310	0.673	1.860	0.659

TABLE A4—ATT'S BARGAINING POWER *(CONT'D)*

Country	Year	$sr^*(1) = co_1$	sr^o	$sr^*(0)$	bp_1
Israel	1991	0.252	1.404	1.730	0.208
	1992	0.279	1.225	1.550	0.227
	1993	0.147	1.071	1.510	0.307
	1994	0.034	1.002	1.470	0.344
	1995	0.148	0.832	1.360	0.389
Kuwait	1992	0.430	0.834	1.440	0.525
	1993	0.363	0.840	1.100	0.275
	1994	0.323	0.869	1.210	0.270
	1995	0.269	0.866	1.200	0.269
Canada	1991	0.123	0.150	0.956	0.890
	1992	0.119	0.148	1.060	0.922
	1993	0.081	0.153	1.080	0.893
	1994	0.078	0.138	1.030	0.916
	1995	0.076	0.112	0.988	0.928
Mexico	1993	0.087	0.620	1.090	0.465
	1994	0.083	0.580	1.110	0.514
	1995	0.081	0.467	1.140	0.640
Argentina	1992	0.202	0.905	1.500	0.525
	1993	0.212	0.850	1.470	0.492
	1994	0.099	0.804	1.560	0.537
	1995	0.097	0.722	1.410	0.595
Brazil	1994	0.090	0.888	1.910	0.645
	1995	0.088	0.597	1.590	0.687
Chile	1992	0.265	0.856	1.860	0.557
	1993	0.151	0.791	1.730	0.553
	1994	0.146	0.668	1.580	0.569
	1995	0.150	0.558	1.790	0.703
Colombia	1992	0.221	1.122	1.450	0.323
	1993	0.095	0.958	1.320	0.363
	1994	0.069	0.801	1.240	0.414
	1995	0.101	0.679	1.160	0.445
Venezuela	1991	0.312	1.853	1.880	0.118
	1992	0.273	1.489	1.900	0.514
	1993	0.217	1.171	2.110	0.646
	1994	0.156	0.866	2.000	0.661
	1995	0.118	0.623	1.700	0.650
Hong Kong	1992	0.532	0.953	3.000	0.735
	1993	0.484	0.718	2.690	0.764
	1994	0.369	0.533	2.440	0.799
	1995	0.168	0.501	2.080	0.786
India	1991	0.582	1.392	4.270	0.758
	1992	0.638	1.190	4.420	0.793
	1993	0.217	1.091	4.280	0.818
	1994	0.108	0.956	3.530	0.795
	1995	0.106	0.899	3.280	0.780
Indonesia	1991	0.397	1.200	2.040	0.536
	1992	0.524	1.031	1.750	0.538
	1993	0.313	1.003	1.740	0.514
	1994	0.161	0.958	1.970	0.605
	1995	0.129	0.800	1.840	0.660
Japan	1988	0.527	1.040	1.740	0.501
	1989	0.496	0.894	1.660	0.631
	1990	0.411	0.932	2.020	0.690
	1991	0.432	0.858	2.210	0.694
	1992	0.459	0.705	2.700	0.824
	1993	0.415	0.572	2.800	0.871
	1994	0.288	0.533	2.710	0.875
	1995	0.213	0.478	2.460	0.881
Korea	1993	0.394	0.839	1.570	0.510
	1994	0.220	0.747	1.800	0.583
	1995	0.117	0.713	1.960	0.666

TABLE A4—ATT'S BARGAINING POWER *(CONT'D)*

Country	Year	$sr^*(1) = co_1$	sr^o	$sr^*(0)$	bp_1
Malaysia	1991	0.581	0.978	1.470	0.347
	1992	0.645	0.955	1.400	0.308
	1993	0.566	0.751	1.330	0.494
	1994	0.450	0.556	1.530	0.673
	1995	0.305	0.509	1.570	0.729
Philippines	1992	0.390	0.981	1.270	0.299
	1993	0.174	0.870	1.270	0.427
	1994	0.136	0.720	1.290	0.566
	1995	0.127	0.629	1.270	0.634
Singapore	1991	0.195	0.490	3.040	0.909
	1992	0.192	0.484	2.950	0.918
	1993	0.118	0.450	2.660	0.885
	1994	0.115	0.458	2.650	0.869
	1995	0.112	0.468	2.520	0.865
Thailand	1991	0.469	1.148	1.640	0.283
	1992	0.597	0.951	1.520	0.342
	1993	0.399	0.888	1.500	0.427
	1994	0.179	0.835	1.830	0.535
	1995	0.074	0.778	1.790	0.581
Australia	1988	0.651	0.707	2.670	0.844
	1989	0.609	0.702	2.610	0.959
	1991	0.489	0.519	3.560	0.944
	1992	0.452	0.456	3.500	0.980
	1993	0.424	0.426	3.570	0.974
	1995	0.261	0.303	3.850	0.981
New Zealand	1988	0.525	1.278	2.560	0.608
	1989	0.530	1.251	2.420	0.675
	1990	0.575	1.186	2.650	0.750
	1991	0.579	1.079	2.600	0.677
	1992	0.609	0.915	2.700	0.792
	1993	0.387	0.447	2.660	0.951
	1994	0.351	0.464	2.730	0.953
	1995	0.283	0.329	4.670	0.997
Czech Republic	1993	0.076	0.859	3.580	0.771
	1994	0.094	0.677	3.330	0.772
	1995	0.092	0.590	2.340	0.721
Hungary	1991	0.045	1.329	3.250	0.675
	1992	0.114	1.026	3.130	0.722
	1993	0.189	0.862	3.480	0.763
	1994	0.095	0.761	3.340	0.754
	1995	0.093	0.681	2.130	0.629

Note: 1) $sr^*(1)$ is the optimal settlement rate when AT&T has full bargaining power, 2) $sr^*(0)$ is the optimal settlement rate when the foreign carrier has full bargaining power, 3) sr^o is the observed settlement rate, 4) bp_1 is AT&T's bargaining power, satisfying the equation, $sr^*(\cdot) = sr^o$. Portugal (1988), Sweden (1989; 1990; 1992), and Australia (1990; 1994) are dropped from this table as they do not satisfy the constraint of $sr^*(1) < sr^o < sr^*(0)$.

TABLE A5— ESTIMATIONS OF BARGAINING POWER FUNCTIONS

bp_1	Coef.	P>|z|
$q_{1f,t-1}$	-0.280	0.001
t89	0.440	0.001
t90	0.651	0.000
t91	0.227	0.054
t92	0.589	0.000
t93	0.770	0.000
t94	0.936	0.000
t95	1.218	0.000
constant	0.597	0.013
# of obs.	229	
Adj R-squared	0.9895	

Note: Coefficient estimates for country dummies are omitted from the report.

TABLE A6— ESTIMATIONS OF BARGAINING POWER FUNCTIONS

Regime	A	C1	C2	A → C1		A → C2	
				(C1-A)	(C1-A)/A (%)	(C2-A)	(C2-A)/A (%)
Average of sr_i ($)	0.670	0.569	0.506	-0.101	-13.23	-0.163	-22.01
Average of p_i ($)	1.185	1.155	1.136	-0.031	-2.58	-0.049	-4.14
$q_1 + q_2$ (mil.)	172.267	183.863	191.166	11.596	8.92	18.899	14.70
p_f ($)	1.928	1.717	1.582	-0.211	-9.45	-0.347	-16.50
q_f (mil.)	112.123	114.589	115.970	2.466	8.09	3.846	10.95
$(q_1 + q_2) - q_f$	60.144	69.273	75.197	9.129	15.60	15.053	27.77
srpay (bil. $)	17.568	16.210	15.064	-1.358	-7.73	-2.504	-14.25
srrec (bil. $)	10.657	9.373	8.599	-1.284	-12.05	-2.058	-19.31
nsrpay (bil. $)	6.911	6.837	6.465	-0.074	-1.07	-0.445	-6.45
CS_{us} (bil. $)	7.181	7.864	8.323	0.683	9.51	1.142	15.91
PS_{us} (bil. $)	14.362	15.728	16.646	1.366	9.51	2.284	15.90
$TS_{us} = CS_{us} + PS_{us}$	21.543	23.591	24.969	2.049	9.51	3.426	15.90
CS_f (bil. $)	72.529	75.393	77.159	2.864	3.95	4.630	6.38
PS_f (bil. $)	22.136	19.034	16.709	-3.102	-14.02	-5.427	-24.52
$TS_f = CS_f + PS_f$	94.665	94.427	93.867	-0.238	-0.25	-0.798	-0.84

Note: 1) The average of sr_i and the average of p_i are the production-weighted averages of U.S. carriers 1 and 2, respectively, 2) *srrec* denotes the settlement receipts from foreign carriers, 3) Fifteen observations which generate negative demand for MCI are excluded from the counterfactual experiment.

B. *Derivation of Marginal Cost Functions*

For U.S. carrier i, the total cost of sending q_{ij} minutes to country j and terminating $q_{fj}\frac{q_{ij}}{q_{dj}}$ minutes from country j is

$$c_{ij} = (co_{ij} + sr_{ij})q_{ij} + (ct_{ij} - sr_{fj})q_{fj}\frac{q_{ij}}{q_{dj}}. \tag{A1}$$

Then, the marginal cost is

$$\begin{aligned} MC_{ij} &= (co_{ij} + sr_{ij}) + (ct_{ij} - sr_{fj})\frac{q_{fj}}{q_{dj}} + (ct_{ij} - sr_{fj})q_{ij}\frac{d}{dq_{dj}}\left(\frac{q_{fj}}{q_{dj}}\right) \\ &= (co_{ij} + sr_{ij}) + (ct_{ij} - sr_{fj})\frac{q_{fj}}{q_{dj}} + (ct_{ij} - sr_{fj})q_{ij}\frac{q_{fj}}{q_{dj}}\left(\frac{dq_{fj}/dq_{ij}}{q_{fj}} - \frac{dq_{dj}/dq_{ij}}{q_{dj}}\right). \end{aligned} \tag{A2}$$

By adding some assumptions with regard to $\frac{dq_{fj}}{dq_{ij}}$ and $\frac{dq_{dj}}{dq_{ij}}$ such that $\frac{d}{dq_{dj}}\left(\frac{q_{fj}}{q_{dj}}\right) = 0$, that is, $\left(\frac{q_{fj}}{q_{dj}}\right)$ is constant, the marginal cost is

$$MC_{ij} = (co_{ij} + sr_{ij}) + (ct_{ij} - sr_{fj})\frac{q_{fj}}{q_{dj}} = AC_{ij} \tag{A3}$$

For foreign carrier j, the total cost of sending q_{fj} minutes to the U.S. and terminating q_{dj} minutes from the U.S. is

$$C_{fj} = (co_{fj} + sr_{fj})q_{fj} + (ct_{fj} - sr_{1j})q_{1j} + (ct_{fj} - sr_{2j})q_{2j} \tag{A4}$$

For simplicity, I assume that the elasticity of q_{ij} w.r.t. q_{fj} is equal to 1; that is, $\frac{dq_{ij}}{dq_{fj}} = \frac{q_{ij}}{q_{fj}}$. The foreign carrier j's marginal cost is then

$$MC_{fj} = (co_{fj} + sr_{fj}) + \frac{1}{q_{fj}}[ct_{fj}\cdot q_{dj} - (sr_{1j}\cdot q_{1j} + sr_{2j}\cdot q_{2j})] = AC_{fj}. \tag{A5}$$

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