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The Macroeconomic Implications of Regulatory Capital Adequacy Requirements for Korean Banks[1]

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The capital adequacy requirement, combined with the flight to quality, contributed to a drastic credit slowdown and a sharp recession in Korea in the aftermath of the financial crisis. Since most banks were placed under the strengthened capital adequacy constraints, they reduced loans to firms with high credit risks. As a result, bank-dependent small and medium-sized enterprises (SMEs) were badly hit, and eventually demand for bank loans fell. The reduction in loans was most visible among banks with poor capital adequacy, yet the overall change in bank portfolios had a disproportionately large negative influence on financial conditions for SMEs. In conclusion, the banks' response to capital adequacy requirements resulted in changes in the loan/bond ratio which, in turn, reduced loans to SMEs and caused a sharp cut in production. The resulting contraction in SME production created a polarized industrial structure and a chronic depression in the traditional sectors of the economy. The introduction of capital adequacy requirements (CARs) in the wake of financial crisis worsened conditions for SMEs and weakened the validity of the CARs that were mainly necessitated by successive failures among larger firms.

1. Introduction

Earlier episodes of financial crises frequently highlight credit crunch as a prevalent phenomenon. Korea was no exception in that the severity and magnitude of the credit crunch were unparalleled and the ensuing bankruptcies of SMEs still remain potential risks for future recovery. When Korea hit the

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unprecedented crisis situation in 1997, demand contraction itself was so severe that it alone could have started a credit crunch. Further, immediately after the IMF bail-out, prudential standards were upgraded to meet Basle Core Principles. Banks were required to present a detailed timetable to meet, or exceed, the Basle minimum capital adequacy standards, following international provisioning and loan classification guidelines. Also, supervisory authorities began to review closely the financial institutions' internal procedures for credit analysis and risk monitoring, and required corrective actions where needed. New review and capital requirements were also applied to overseas branches of Korean banks, as inadequate supervision had been a major contributing factor to the current crisis.

It turned out that the newly enforced CARs dealt a fatal blow to the already feeble bank operations, creating a rush to replenish risk-based capital. Across the board, attempts to survive the preliminary requirements of the newly formed Financial Supervisory Commission (FSC) meant that some old loans were recalled and virtually no new loans were extended.

The purpose of this paper is to evaluate the impact of introducing a regulatory framework that causes the corporate sector to face a sudden curtailment of credit in the wake of the 1997 currency crisis. Using banking data, and controlling for macro factors that influence supply and demand factors for bank loans, the role of capital requirements in determining the size of loans is investigated. Specifically, we are interested in how a credit crunch brought about by regulatory measures imposed on Korean commercial banks translated into a severe economic contraction. That is, we highlight the fact that recent reductions in bank capital and strengthened CARs have caused Korean banks to reduce loan supply to the corporate sector, especially to SMEs. Some related topics are also discussed. In addition to evaluating the significance of the BIS term in the bank loan equation, the findings show that some capital-constrained banks tended to reduce the size of their loans more drastically than others, and CAR-induced shocks largely propagated themselves through the industrial structure. The results are expected to shed light on the validity of emphasizing capital requirements in a macro context, especially in the aftermath of financial crisis.

After all, CARs are intended to sustain financial stability in case of unexpected shocks but, in Korea, the 8 per cent BIS requirements were applied in a hasty manner, forcing banks to exit that lacked financial muscle, not necessarily financial soundness. In other words, after the crisis Korean banks suddenly had to focus on profit rather than size, and capital adequacy served as a crucial yardstick for survival decisions by the FSC. Banks' desperate attempts to fulfill CARs virtually paralysed the banking system which, in turn, suffocated SMEs that used to rely on banks for their financing needs. Capital-deficient banks were particularly quick to cut back loans to SMEs, causing a very sharp and drastic economic contraction.

The rest of this paper is organized as follows. Section 2 contains a

literature review on capital induced credit crunches to seek out ways to tackle the subject. In section 3, I outline relevant concepts related to the capital crunch that was initiated with regulatory CARs. Section 4 discusses some of the important findings that appear in Korean banking data, which is followed by more elaborate empirical investigations in section 5. Implications of CARs in the Korean setting, especially for SMEs, are also briefly discussed. A brief summary of the results and implications appear in the final section.

2. Literature Review

A credit crunch is often defined as a significant reduction in the supply of credit given, the level of real interest rates and the credit standing of borrowers. That is, a credit crunch issue arises when the relationship between credit availability and interest rates changes. Unlike a typical credit crunch, however, CARs block the lending channel without significantly changing the cost of borrowing and credit rationing. This channel has the potential for better explaining the credit crunch and macro contraction that took place in Korea during 1997–8. Recently, Ding *et al.* (1998) confirm the existence of credit crunches in other crises countries in Asia. According to Ding *et al.*, capital in all crisis countries took a flight to quality, that is, banks shifted towards less risky assets, and depositors turned to those banks regarded as more secure, with negative ramifications for SMEs. Similar findings in Korea were reported by Ferri and Kang (1998) and Choi (1998).

Earlier studies by Furlong (1989) and Peek and Rosengren (1995b) also showed that credit crunches from 1988 to 1991 in the USA and Japan were due to reductions in bank lending, since the BIS ratio regulation was imposed as part of CARs starting in 1988. Brinkmann and Horvitz (1995) also explained that part of the reason for the prolonged economic recession from 1987–91 in the USA was that use of the BIS capital adequacy ratio lessens the effectiveness of a low interest rate policy. In a similar context, Shrieves and Dahl (1995) used an econometric model to show that banks' decisions regarding lending and capital are determined simultaneously. Their results suggest that the credit crunch in the USA during 1990–1 resulted from a combination of factors including macro variables and changes in the supervisory climate and bank capital regulation.

Specifically, Peek and Rosengren (1993) studied a regulation-induced credit crunch. Strengthened regulations on directed lending stifle competition among banks, lowering the effectiveness of monetary policy. Despite differences in the transmission mechanism, prudential regulation in one form or another also resulted in significant changes in the effectiveness of monetary policy. While Lindgren *et al.* (1996) emphasize that relaxing capital regulations to make an expansionary monetary policy more effective would make the

banking system more vulnerable, the opposite case can also be true in the event of financial crisis like that Korea experienced in 1997–8.

Of course, other explanations for what appeared to be a traditional credit crunch also exist. One theory argues that the implementation of the leverage requirement by regulators or the strengthened loan examination process also caused much of the reduction in commercial lending. In addition to capital adequacy, emphasizing the liquidity position of banks forces them to increase the share of government bond holdings, resulting in reduced domestic credit to the private sector. Likewise, the requirement that banks hold capital of at least a certain percentage of unweighted bank assets may have forced US banks to shrink the size of their asset portfolios in the early 1990s. Since many Korean banks lost capital due to continued bankruptcies, the so-called leverage credit crunch is hard to detect. However, as proposed by Berger and Udell (1994), more careful examination by regulators who were concerned about bank risk should have affected banks' portfolio behaviour in a significant manner. For example, regulators at the FSC tightened examination criteria and loan-loss reserve policies, and increased the imposition of enforcement actions. Such shifts in regulatory policy would place an additional regulatory tax on lending and encourage the substitution of safer assets.

Credit supply may also change, possibly materially, for other reasons. In particular, throughout the economic cycle, credit supply tends to change as lenders' perceptions of risk alter because of a change in borrowers' financial conditions. Deterioration in the cash flows and balance sheets of some borrowers and a tight credit supply are typical features of an economic slowdown. Credit supply can be tightened in other ways, such as reducing the maturity of loans, increasing collateral requirements, or imposing more demanding covenants (e.g., regarding events that can trigger a technical default).

In fact, the magnitude of credit crunch that was foretold by demand and supply considerations turned out to be big enough to bring the Korean engine of growth to an abrupt halt. Furthermore, the capital requirements that initiated the substitution of government bonds for loans could have contributed to the severe credit crunch in 1998. As documented by Berger and Udell (1994), Domaç and Ferri (1998) and Ferri and Kang (1998), it is necessary to test the risk-based capital (RBC) credit crunch hypothesis in Korea in a dynamic setting, with special emphasis on the effects of regulatory shocks on macro-economic activity.

3. Capital-induced Credit Crunch

As evident in Figure 1, Korea recently experienced the worst recession in its post-war history, as partly evident by the credit crunch. A credit crunch may arise because of deterioration in the financial position of lenders that constrains

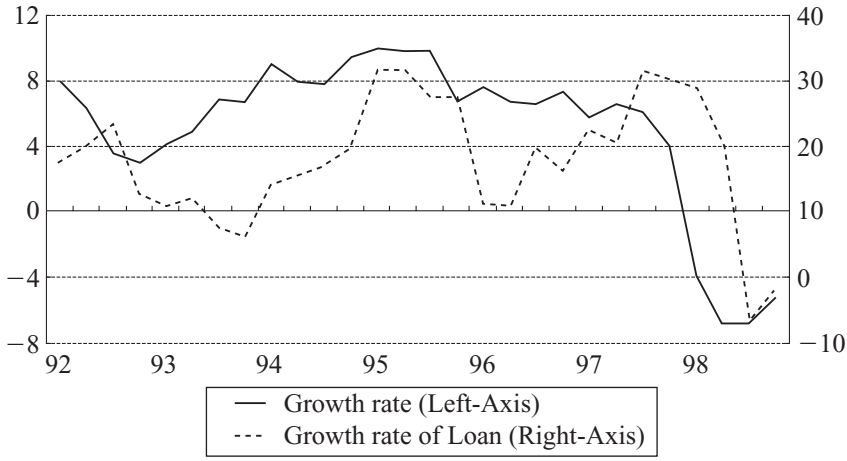


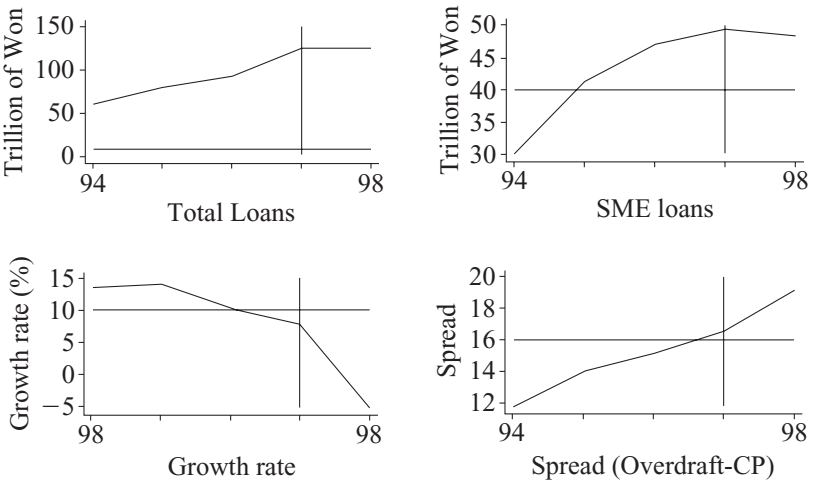
Figure 1: Economic Growth vs Loan Growth

their ability to supply credit, while the lender simultaneously finds deposits more difficult or costly to attract. In addition, banks' lending may be constrained by a fall in their surplus capital, perhaps as a result of losses. So, if losses were to cause a capital surplus to decline, banks might decide to reduce the size of their total asset base (essentially their loans), or to seek out assets carrying a lower regulatory risk-weighting. Banks facing binding capital constraints as a result of large loan losses due to continued bankruptcies have the option of either raising capital/asset ratios or lowering both assets and liabilities. The latter channel is usually tried before the former, which is usually activated by a public money injection. Therefore, if one detects a simultaneous change in both loans and government bond holdings, we can claim that the Korean credit crunch was caused by a capital crunch, whereby a decline in capital causes a bank to shrink.

In this study, such relations are investigated using available banking and macro data. Further, to gauge the macro impact of introducing CARs, we need to check the severity of the credit crunch or capital crunch that was triggered by CARs. While various interest rate spreads that measure risk premiums are helpful in identifying supply and demand factors for a credit crunch, simultaneous monitoring of government bond holdings and loan supply can also help us to identify a capital-induced credit crunch. In a related context, it was reported that losses of bank capital cause banks to shrink, initially to restore target capital/asset ratios in response to regulatory pressures, and later in response to other financial market pressures (Hancock and Wilcox, 1992; Peek and Rosengren, 1995a).

Strengthening CARs usually touches off the so-called financial accelerator effect by activating a flight to quality, and the single-minded pursuit of capital adequacy in the midst of a severe recession inflicts serious damage to the

economy. Decomposition of loan reduction by demand and supply can shed light on the role of regulatory factors independently of macro settings. Specifically, changes in the ratio of loan/bond holdings are fed into interest rate spreads and played out to exert the macro impact in a dynamic setting. See Figure 2.

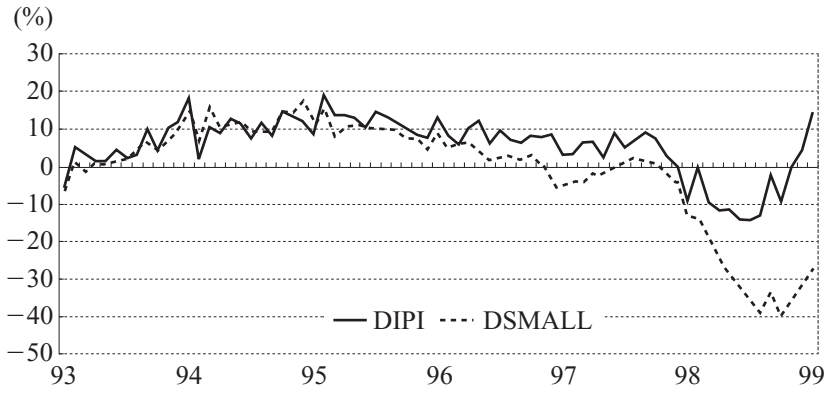


Note: Financial indicators for 15 banks from 1982–98.
The graph shows movements of indicators 3 years before and 1 year after the Korean crisis.

Figure 2: Major Banking Indicators around this Crisis

The Korean experience with credit crunch deserves attention since it allows us to look at the impact of monetary contraction as well as institutional changes on the supply and demand for credit. Bank-based financial systems and highly leveraged firms provide a significant credit channel for the transmission of monetary policy shocks which, in turn, render the economy, especially SMEs, vulnerable to monetary shocks. In particular, even with a flexible monetary stance, CARs in fact force banks to remain overly cautious in lending to SMEs, aggravating economic conditions even in the face of favourable developments in larger firms.

So a sharp reduction in the supply of credit would lead to slower growth; see Figure 3. As Bernanke and Gertler (1995) point out, a slowdown in the expansion of loans after the monetary squeeze is not enough to identify a shift in the supply of loans, since worsening business prospects lead firms to refrain from venturing into new investments or extending more credit. Therefore, empirical investigations of credit crunches have been hampered by the difficulty of separating demand contraction from the diminished supply of loans. However, in the case of Korea after the crisis, since all Korean banks were subject to identical demand shocks, supply side considerations could be



Note: DIPI: Growth rate of industrial production (1995=100),
DSMALL: Growth rate of industrial production of SMEs
Source: National Statistical Office

Figure 3: Growth Rate of Industrial Production by Firm Size

identified. To sum it up, the schematics of a CAR-induced credit crunch in Korea take the following course: *Chaebol* collapse → increased NPLs → enforced CARs → lower credit to SMEs / increased government bond holdings and spread changes → poor industrial performance of SMEs and lack of demand for bank loans → bank NPLs increase → polarization of business conditions and industrial structure. See Figure 4.

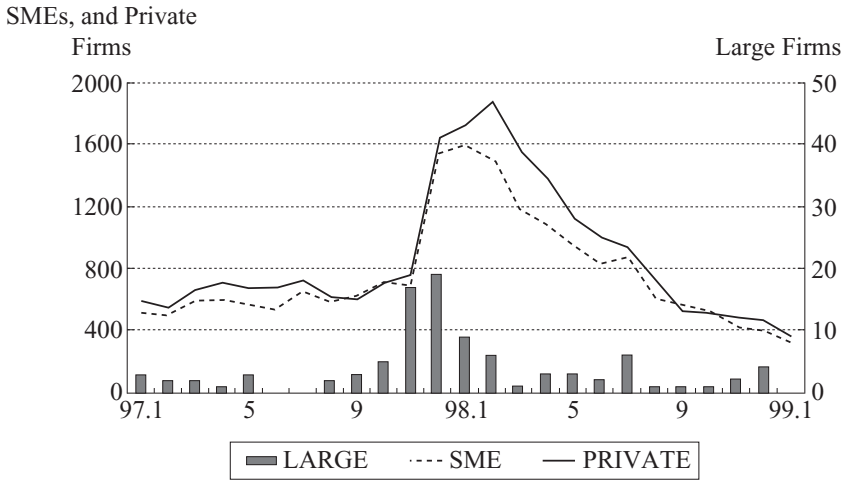


Figure 4: Bankruptcies by Firm Size

4. Evidence in Banking Data

It is quite evident that the aggregate credit reallocation or credit crunch effect will be stronger if a large number of banks held a significant portion of aggregate assets prior to the implementation of risk-based capital standards. In fact, the replacement of the old capital standards with RBC in 1997 increased the number of banks below the regulatory capital requirements from 0 to 14, a number subsequently reduced to 7 in 1998 as a result of financial restructuring. According to the report by the Banking Supervisory Committee at the Bank of Korea, the BIS ratio of commercial banks was 7.04 per cent as of the end of 1997, down from the previously reported 8.92 per cent. (See Figure 5). Also, out of 26 banks, only 12 banks satisfied the minimum requirement of 8 per cent, while 14 banks including Cheil and Seoul fell short of the 8 per cent requirement. More important than the number of banks affected was the size of those banks; RBC requirements were more often binding for the very largest banks. Banks' capital deficiency amounted to 59 per cent of total Korean assets in 1997, reduced to 26 per cent in 1998. Deficient banks were required to raise their ratios of capital to risk-weighted assets to meet the RBC standards within two years, either by raising expensive capital or by reducing risk-weighted assets through substituting out of high-risk assets, such as commercial loans. (See Figure 6).

The changes in the composition of bank portfolios and the size of bank loans show that those banks with less satisfactory CARs reduced bank lending, and banks with BIS ratios between 6–8 per cent increased government bond holdings quite significantly. In contrast, banks that met capital adequacy standards increased bank lending as well as the size of bond holdings. Since the contraction of bank loans was predominantly among those banks with poor capital adequacy, and those banks were the primary lenders to SMEs, an asymmetric burden was placed on cash-strapped SMEs.

Figures 7 and 8 and the earlier statistics clearly show the seed for drastic loan contraction, and the improvement in capital adequacy should be judged against such a drastic decline in bank loans. That is, capital adequacy was achieved at the expense of severe financial distress at most enterprises. Strengthening CARs not only creates a supply-side credit crunch, but also exacerbates a demand-driven credit crunch where weaker demand for loans propels financial imploding. In addition, the bank-dependent SMEs were virtually wiped out by being cut off from credit lines, and the demand for bank loans has remained low since the financial crisis. Accordingly, in analysing the macro impact of enforcing regulatory capital adequacy, attention needs to be devoted to the demand side as well as the contraction in loan supply.

To summarize, the capital-induced credit crunch in Korea has several implications. First, capital-constrained banks had to adjust their portfolios by reducing risky assets and increasing capital. Second, bank-dependent borrowers of SMEs were badly hit as a result of banks' adjustment to enhanced

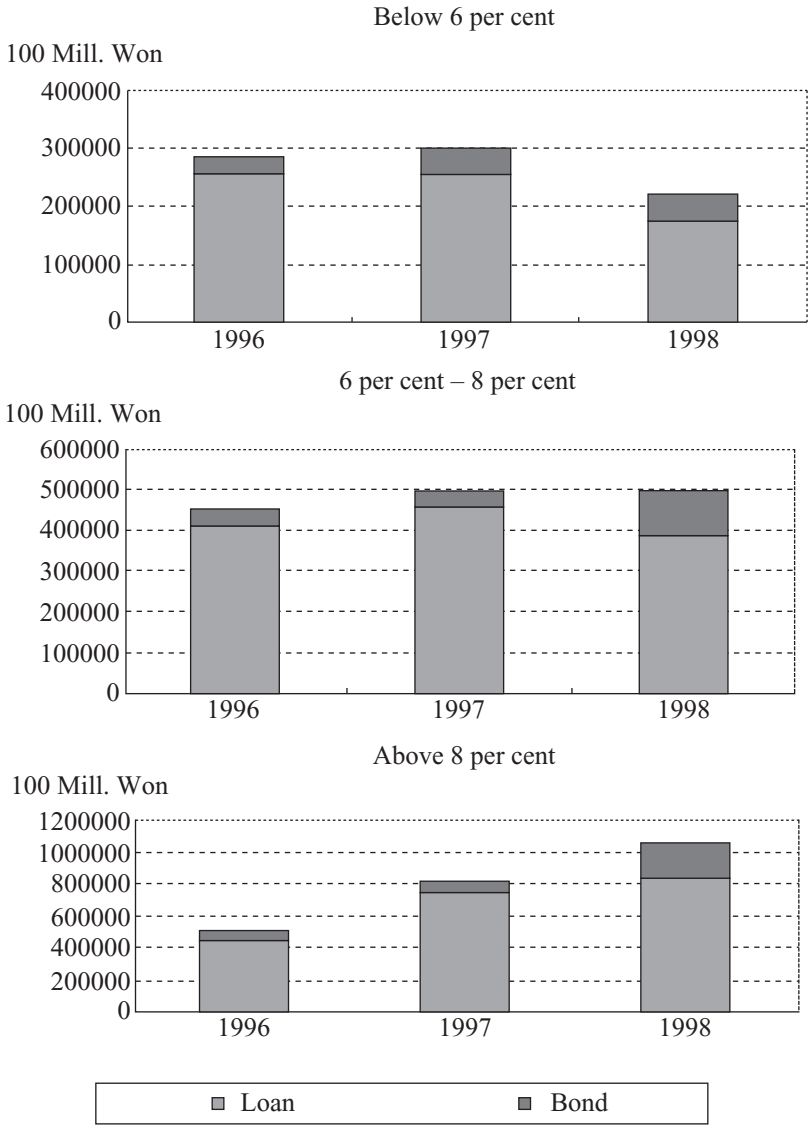


Figure 5: Comparison of Bank's Portfolio Adjustment by BIS Ratio

regulatory standards. Third, the macro consequences of a prolonged credit crunch situation affects the industrial structure such that the economy becomes heavily reliant on a few *chaebols* at the cost of a near collapse of SMEs. Also, existing *chaebol* structures may actually be reinforced by the shake-up, exaggerating the amplitude of the business cycle.

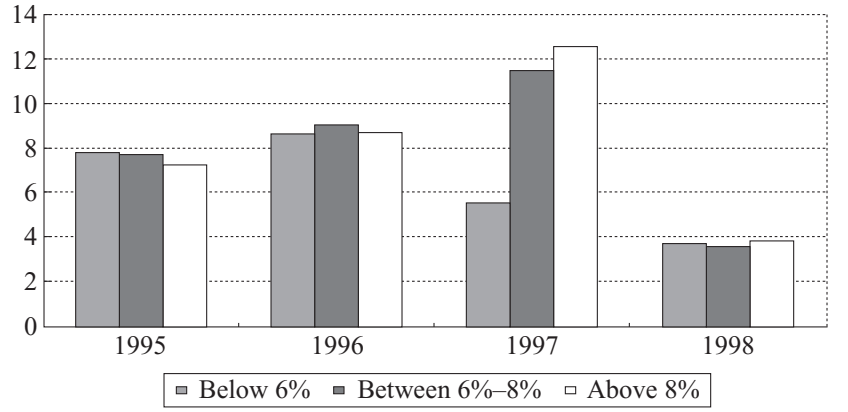


Figure 6: Changes in Loan/Bond Ratio of Commercial Banks by BIS Ratio

5. Empirical Findings

The purposes of this chapter are to measure the extent of the credit crunch due to regulatory measures concerning the capital adequacy of commercial banks in Korea, and to identify transmission channels that lead to a severe economic contraction. As mentioned earlier, the study addresses the question of whether risk-based capital played a major role in the reallocation of bank credit or whether such a supply-side induced credit crunch led to a sharp decline in SME production. Bank-specific data for 26 Korean banks from 1995 to 1998 were collected to run panel regression of bank loans for the purpose of evaluating the significance of various factors. See Tables 1–6.

5.1. Factors Affecting Bank Loan Decisions

It should also be noted that the role of bank portfolio substitution out of risky assets into safer government bonds is explicitly modelled as a function of the deviation of the BIS ratio from its target level of 8 per cent. The following equations were estimated using both the fixed effect and the random effect model. The robustness of the results was checked with various groupings based on BIS ratio, asset size, and the evaluation results by the FSC.

$$\Delta loan_{it} = \alpha_i + \alpha_i \Delta BIS_{it} + \alpha_2 Spread_{it} + \alpha_3 NPL_{it} + \upsilon_{it}$$

where

$$\Delta BIS = BIS_{it} - 8\%$$
$$\text{Spread} = \text{draft} - \text{libor (3month)} - \Delta\text{won}$$
$$\text{NPL} = \text{NPL}/\text{Total Loan}$$
$$\Delta\text{won} = (\text{won}/\text{won}(-1) - 1)100$$

$i = 1, 2, \ldots, N$
$t = 1995, 1996, 1997, 1998$

The hypothesis that CARs were a significant factor in explaining the reduction of bank loans was confirmed, as shown by the significance of the

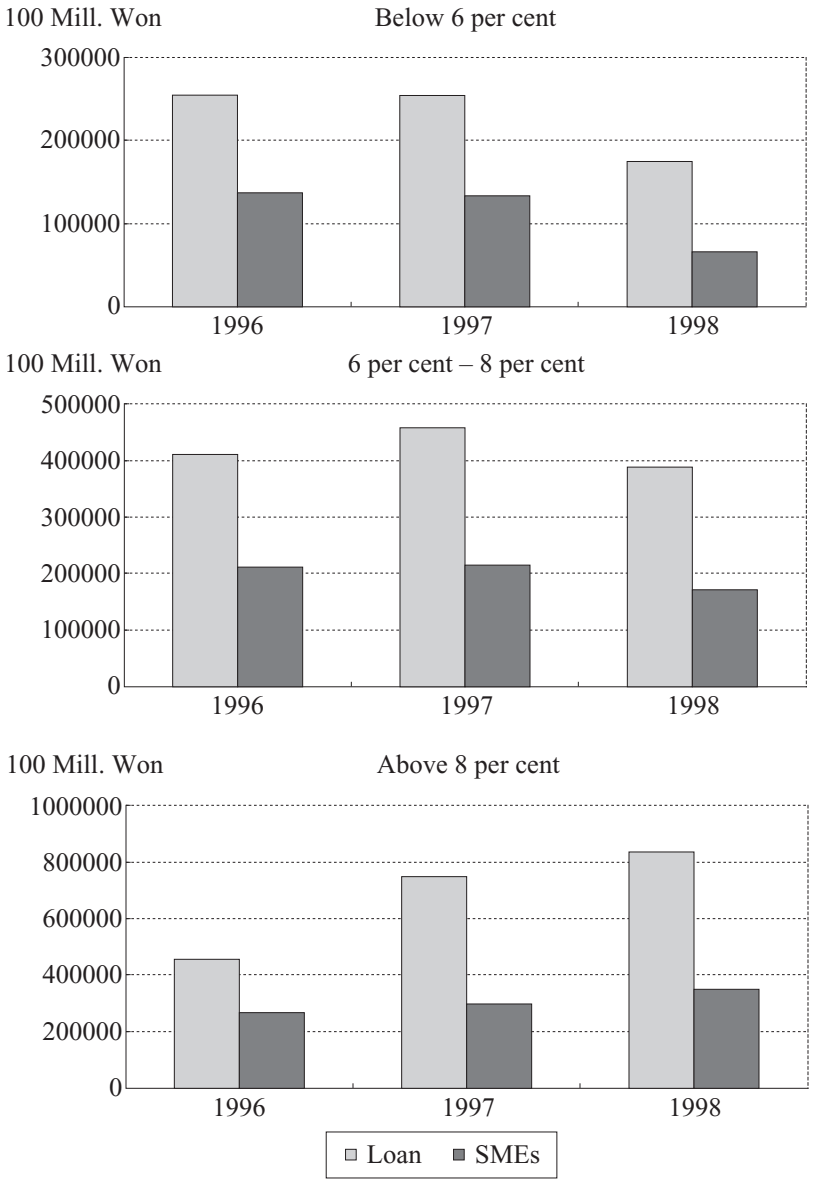


Figure 7: Total Loans vs Loans to SMEs by BIS Ratio

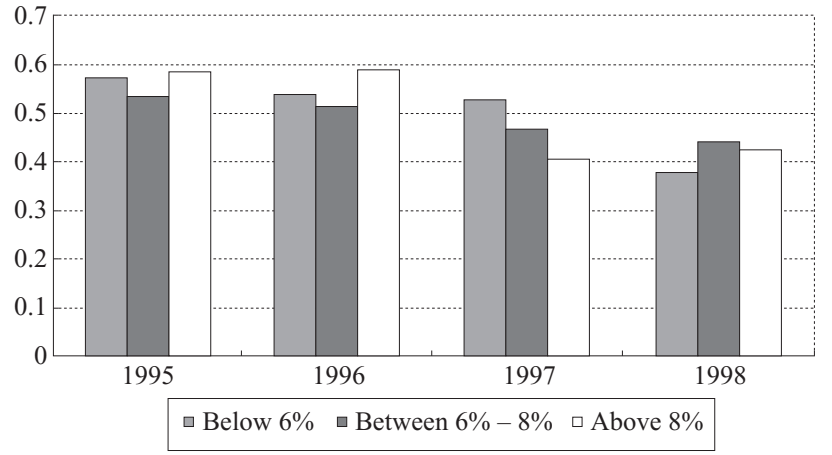


Figure 8: Changes in SME Loan/Total Loan of Commercial Banks by BIS Ratio

Table 1: Bank Classification by Size of Asset (trillion won)

	Banks
More than 4	Cheil, Shinhan, Housing, Hanvit (Commercial), Hanil, Kookmin, Cho-hung, KEB
1–4	Dong-nam, Busan, Dong-wha, Daegue, Han-mi, Boram, Hana, Seoul
Less than 1	Kyung-ki, Peace, Kyung-nam, Kwang-ju, Daedong, Chung-chung, Chung-buk, Kang-won, Chun-buk, Cheju

Table 2: FSC Decisions (1998) on Commercial Banks in Korea

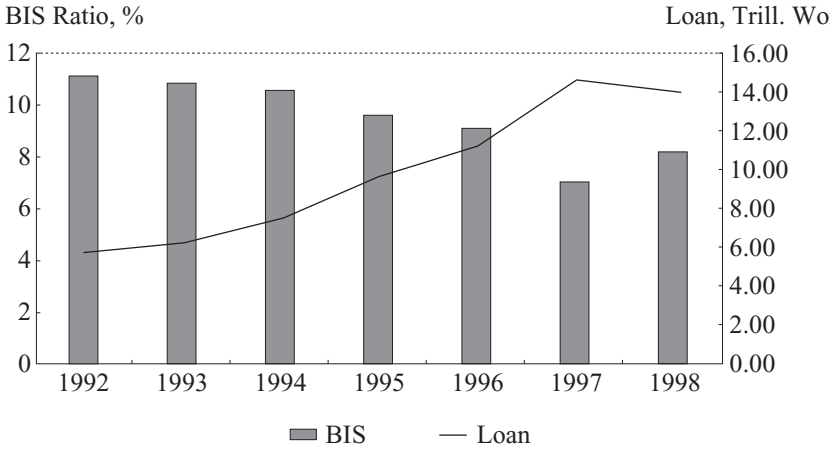
	Below 6%	6–8%	Above 8%
Approved	Cheil, Seoul, Peace, Kang-won, Chung-buk	Cho-hung, Commercial, Hanil, KEB	
Merged	Dong-wha, Dong-nam, Dae-dong	Chung-cheong, Kyung-ki	
(Merging)			Kookmin, Housing, Shinhan, Hanmi, Hana
Sound			Boram, Dae-gu, Busan, Kwang-ju, Cheju, Chun-book, Kyung-nam

Note: Classified by BIS Ratio in 1997.

BIS variable in the bank lending equation. The significance of the BIS term was observed irrespective of firm size, while the interest rate spread between the overdraft lending rate and (LIBOR + rate of won/dollar depreciation) turned out to be less significant, possibly due to an aliasing problem. In contrast, the ratio of non-performing loans/total loans led to a reduction in loans, including those to SMEs in the random effect model. Since the rise in

NPLs was largely due to bankruptcies of large corporations, SMEs were found to have borne a larger share of the burden from loan contraction. Also, regardless of the model used for estimation, loans to SMEs were particularly sensitive to capital shortages.

In terms of the BIS ratio, those banks with CARs below 6 per cent showed the most sensitive lending practices compared with other categories. While banks with BIS ratios of 6–8 per cent showed a drastic cut in bank loans in response to BIS requirement and interest rate changes, NPLs continued to be a binding constraint for that group of banks. In terms of the grouping done by the FSC, the lending behaviour of merged banks shows the greatest sensitivity to changes in the BIS ratio (Figure 9). Also, interest rate spreads turned out to be a dominant factor for loan decisions of sound banks, unlike the capital constraint that most stifled loans to SMEs by the approved or merged banks. With respect to the asset size of banks, the BIS ratio is most important to the medium-sized asset category.



Note: Bank loans represent average of general lending by commercial banks.

Figure 9: BIS Ratio and Growth Rate of Bank Loans

It turns out that risk-based capital regulations or CARs are a particular identifiable shock that changes a bank's portfolio. Under a supply-side credit crunch, banks withheld credit or raised the cost of credit as a result of regulatory or internal pressures to reduce bank risk. It is particularly noteworthy that weakly capitalized banks reduced lending more drastically than their competitors. Thus, bank-specific data reveal that the credit crunch in Korea has many characteristics of a CAR-induced capital crunch. The implications of this finding are that CARs decelerated the bank lending of capital-deficient banks most drastically, which placed a disproportionate burden on SMEs and polarized the industrial structure (Figure 10).

Table 3: Bank Lending Behaviour

A. All commercial banks

Fixed effect model	Dependent variable	Independent variables				Sigma-u	Sigma-e	Test statistics				
		dBIS	Spread	NPLs	Constant			F-test that all u-I=0	Corr (u-I, Xb)	R^2		
										within	between	overall
	Dloan (loans to business)	1.87*** (0.52)	0.15 (0.96)	0.39 (0.52)	9.48*** (3.69)	9.54	12.07	F(25, 65) = 1.55 (0.079)	−0.2	0.32	0.02	0.18
	Dsmes (loans to SMEs)	2.82*** (0.61)	0.19* (0.11)	0.28 (0.61)	8.51** (4.32)	17.13	14.13	F(25, 65) = 3.05 (0.002)	−0.21	0.47	0.02	0.22
Random effect model	Dependent variable	Independent variables				Sigma-u	Sigma-e	Test statistics				
		dBIS	Spread	NPLs	Constant			LR test of all coefficients are zero		Likehood ratio test of sigma-u=0		
	Dloan (loans to business	0.98*** (0.36)	0.08 (0.09)	−0.83** (0.39)	17.55*** (2.9)	3.61 (2.49)	12.18 (1.07)	33.6 (0)		0.64 (0.42)		
	Dsmes (loans to SMEs)	1.93*** (0.55)	0.07 (0.12)	−0.99*** (0.6)	17.14 (4.51***)	10.22 (2.91)	14.54 (1.36)	43.97 (0)		6.44 (0.01)		

Table 3: (*continued*)

B. Sample excluding seven closed banks

Fixed effect model	Dependent variable	Independent variables				Sigma-u	Sigma-e	Test statistics				
		dBIS	Spread	NPLs	Constant			F-test that all u-I = 0	Corr (u-I, Xb)	R^2		
										within	between	overall
	Dloan	1.89*** (0.56)	0.15*** (1.10)	0.45 (0.56)	8.51*** (4.20**)	10.63	12.69	F(18, 53) = 1.76 (0.057)	−0.25	0.33	0.03	0.18
	Dsmes	2.73*** (0.66)	0.22* (0.12)	0.21 (0.66)	8.21* (4.93)	16.17	14.91	F(18, 53) = 2.92 (0.0013)	−0.19	0.48	0.04	0.25
Random effect model	Dependent variable	Independent variables				Sigma-u	Sigma-e	Test statistics				
		dBIS	Spread	NPLs	Constant			LR test of all coefficients are zero		Likelihood ratio test of sigma-u = 0		
	Dloan	1.04*** (0.40)	0.07 (0.10)	−0.79* (0.45)	17.07*** (3.48)	4.08 (2.99)	12.89 (1.28)	27.85 (0)		0.56 (0.45)		
	Dsmes	1.69*** (0.57)	0.14 (0.12)	−1.13* (0.62)	17.57*** (5.16)	9.89 (3.12)	15.05 (1.51)	39.88 (0)		5.24 (0.02)		

Note: * Based on sample data of 26 banks from 1995 to 1998.
*, **, *** show significance level of 10, 5, and 1 per cent, repsectively.
Figures inside the parentheses show t-statistics and p-values, respectively.

Table 4: Bank Lending Behaviour by BIS Ratio

Fixed effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics				
			dBIS	Spread	NPLs	Constant			F-test that all u-I = 0	Corr (u-I, Xb)	R^2		
											within	between	overall
	Dloan	6	2.36** (0.75)	−0.16 (0.25)	0.26 (0.76)	11.21** (5.42)	8.93	8.22	2.78 (0.04)	0.03	0.68	0.12	0.48
		6–8	−3.07* (1.39)	0.41** (0.13)	−2.67** (0.85)	28.65** (5.83)	6.8	6.89	1.93 (0.19)	−0.47	0.66	0.03	0.39
		8	2.9** (1.12)	0.19 (0.16)	−0.38 (0.99)	5.40 (7.19)	14.89	15.08	1.6 (0.15)	−0.66	0.21	0.12	0.01
	Dsmes	6	3.36** (1.29)	−0.38 (0.45)	−0.74 (1.31)	15.87** (9.33)	11.0	14.14	1.64 (0.19)	0.07	0.69	0.35	0.6
		6–8	0.46 (1.63)	0.38** (0.15)	−0.38 (0.99)	11.65 (6.81)	3.41	8.05	0.52 (0.72)	−0.15	0.46	0.01	0.39
		8	3.14** (1.25)	0.22 (0.18)	0.56 (1.04)	7.92 (8.03)	24.3	16.83	3.4 (0)	−0.59	0.23	0.29	0.01

Table 4: (*continued*)

Random effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics	
			dBIS	Spread	NPLs	Constant			LR test of all coefficients are zero	LR test of sigma-u = 0
	Dloan	6	1.88** (0.73)	−0.27 (0.25)	−0.61 (0.76)	17.14** (5.63)	5.48* (2.8)	7.91* (1.33)	26.77 (0)	1.58 (0.21)
		6–8	−1.52 (1.14)	0.38*** (0.12)	−1.4** (0.68)	20.08** (4.62)	0.00 (9.17)	6.84 (1.17)	9.8 (0.02)	0 (1)
		8	0.93 (0.76)	0.04 (0.14)	1.17** (0.57)	20.76** (4.04)	0.00 (-)	15.52 (1.65)	5.92 (0.12)	0 (1)
	Dsmes	6	2.45** (0.19)	−0.53 (0.4)	−2.14 (1.09)	25.08*** (7.94)	4.44 (5.32)	13.57 (2.23)	30.31 (0)	0.21 (0.64)
		6–8	0.72 (1.09)	0.35*** (0.11)	−0.04 (0.65)	9.47*** (4.39)	0.00 (2.45)	6.49 (1.11)	8.6 (0.04)	0 (1)
		8	1.18 (1.2)	0.02 (0.18)	−1.15 (0.96)	22.52** (7.86)	12.48 (17.36)	5.74 (2.48)	4.48 (0.21)	2.81 (0.09)

Note: * Based on sample data on 26 banks from 1995 to 1998.
*, **, *** show a significance level of 10, 5, and 1 per cent, respectively.
Figures inside the parentheses show t-statistics and p-values, respectively.

Table 5: Bank Lending Behaviour by FSC Groupings

Fixed effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics				
			dBIS	Spread	NPLs	Constant			F-test that all u-I = 0	Corr (u-I, Xb)	R^2		
											within	between	overall
	Dloan	Appr.	0.99 (0.63)	0.24* (0.13)	−0.12 (0.57)	10.49** (4.05)	5.85	8.4	1.65 (0.16)	0.01	0.63	0.19	0.53
		Mrg.	3.37 (2.31)	−0.27 (0.41)	−0.75 (2.89)	16.98 (14.02)	11.54	14.44	1.34 (0.28)	−0.26	0.39	0.01	0.25
		Sd	0.75 (1.64)	0.48* (0.18)	0.42 (1.23)	11.32 (7.92)	10.0	10.5	1.63 (0.23	−0.26	0.5	0.48	0.22
	Dsmes	Appr.	2.24** (0.94)	0.25 (0.19)	−0.24 (0.85)	9.57 (6.02)	8.98	12.5	1.7 (0.15)	0.02	0.7	0.32	0.61
		Mrg.	5.73** (2.53)	−0.54 (0.44)	1.37 (3.17)	6.16 (15.39)	15.47	15.83	1.94 (0.1)	−0.23	0.44	0.19	0.24
		Sd	−0.19 (1.15)	0.68* (0.12)	−0.03 (0.87)	19.4** (5.56)	18.6	7.42	14.38 (0)	0.03	0.81	0.51	0.32

Table 5: (*continued*)

Random effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics	
			dBIS	Spread	NPLs	Constant			LR test of all coefficients are zero	LR test of sigma-u = 0
	Dloan	Appr.	0.6 (0.58)	0.23** (0.12)	−0.6 (0.5)	13.63** (3.73)	3.03 (2.32)	8.0 (1.13)	28.74 (0)	0.57 (0.45)
		Mrg.	1.38 (1.34)	−0.35** (0.22)	−2.29* (1.26)	25.91** (6.66)	0 (-)	14.21 (1.81)	10.74 (0.01)	0 (1)
		Sd	−0.54 (1.05)	0.4** (0.17)	−0.89 (0.99)	21.6*** (4.7)	0 (-)	10.1 (1.6)	11.42 (0.01)	0 (1)
	Dsmes	Appr.	1.57* (0.88)	0.24 (0.17)	−1.06 (0.77)	14.93** (5.72)	4.57 (3.56)	11.96 (1.71)	36.12 (0)	0.55 (0.46)
		Mrg.	3.09* (1.87)	−0.49* (0.29)	−1.4 (1.81)	20.41** (9.62)	7.58* (4.69)	15.24* (2.43)	14.58 (0)	0.97 (0.32)
		Sd	−0.69 (1.04)	0.66* (0.11)	−0.33 (0.79)	22.31** (8.46)	5.4* (1.26)	6.73 (1.26)	25.13 (0)	13.63 (0)

Notes: Based on sample data on 26 banks from 9195 to 1998.
*, **, *** show significance level of 10, 5, and 1 per cent respectively.
FSC grouping of banks include 'Approved', 'Merger and Acquisition', and 'Sound', which is not entirely consistent with the BIS ratio.
Figures inside the parentheses show t-statistics and p-values, respectively.

Table 6: Bank Lending Behaviour by the Size of Bank Assets

Fixed effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics				
			dBIS	Spread	NPLs	Constant			F-test that all u-I = 0	Corr (u-I, Xb)	R^2		
											within	between	overall
	Dloan	40 < Asset	0.56 (0.62)	0.23** (0.09)	−0.24 (0.26)	14.88** (2.43)	0.41	7.59	0.01 (1.00)	−0.07	0.44	0.13	0.44
		10 < Asset < 40	3.92** (1.59)	−0.05 (0.23)	0.51 (1.90)	6.40 (11.99)	0.16	16.54	0.00 (1.00)	−0.07	0.32	0.15	0.32
		Asset < 10	0.75** (-)	0.43*** (0.15)	0.99 (2.12)	8.26 (12.41)	0.02	8.85	0.00 (1.00)	−0.00	0.61	0.29	0.61
	Dsmes	40 < Asset	1.24* (0.72)	0.38*** (0.11)	−0.32 (0.30)	14.41*** (2.82)	0.55	8.82	0.01 (1.00)	−0.06	0.63	0.02	0.32
		10 < Asset < 40	5.01*** (1.76)	0.09 (0.25)	2.21 (2.11)	−5.07 (13.33)	0.70	18.39	0.01 (1.00)	−0.06	0.32	0.00	0.32
		Asset < 10	2.39*** (1.70)	0.33 (0.21)	1.26 (3.03)	3.83 (17.74)	0.03	12.67	0.00 (1.00)	−0.00	0.67	0.01	0.67

Table 6: (*continued*)

Random effect model	Dependent variable		Independent variables				Sigma-u	Sigma-e	Test statistics	
			dBIS	Spread	NPLs	Constant			LR test of all coefficients are zero	LR test of sigma-u = 0
	Dloan	40 < Asset	0.84*** (0.31)	0.13*** (0.05)	−0.51*** (0.21)	15.55*** (1.39)	0.00 (0.73)	2.66*** (0.47)	23.79 (0.00)	0.00 (1.00)
		10 < Asset < 40	3.92*** (1.25)	−0.05 (0.18)	0.49 (1.48)	6.51 (9.39)	0.00 (2.40)	13.16*** (1.70)	11.43 (0.01)	0.00 (1.00)
		Asset < 10	0.75* (0.39)	−0.43*** (0.12)	0.99 (1.71)	8.26 (9.99)	0.00 (1.72)	7.13 (0.83)	34.40 (0.00)	0.00 (1.00)
	Dsmes	40 < Asset	0.84 (0.74)	0.12 (0.11)	0.21 (0.49)	10.29 (3.31)	0.00 (0.15)	6.33*** (1.12)	2.86 (0.41)	0.00 (1.00)
		10 < Asset < 40	4.97*** (1.39)	0.08 (0.20)	2.13 (1.64)	−4.59 (10.44)	0.00 (2.69)	14.65*** (1.89)	11.59 (0.01)	0.00 (1.00)
		Asset < 10	2.39*** (0.56)	0.33* (0.17)	1.26 (2.44)	3.84 (14.29)	0.00 (1.68)	10.20*** (1.18)	40.69 (0.00)	0.00 (1.00)

Note: * Based on sample data on 26 banks from 1995 to 1998.
*, **, *** show a significance level of 10, 5, and 1 per cent, respectively.
Categories of asset size are based on the threshold levels of 40 trillion won, 10 to 40 trillion won, and below 10 trillion won, respectively.
Figures inside the parentheses show t-statistics and p-values, respectively.

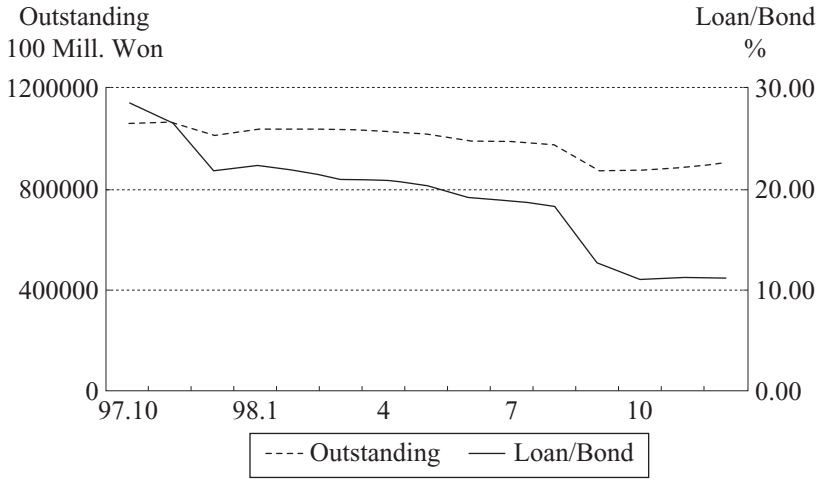


Figure 10: Changes in Bank Portfolio and Lending to SMEs

5.2. Econometric Issues

The choice between specifications of fixed- and random-effect models relies on both economic and econometric significance. The fixed-effects estimator provides estimates conditional on the sample in that unit-specific residuals are not assumed to have a distribution but are instead treated as fixed. If the unit-specific residual is correlated with explanatory variables, the estimator cannot determine how much of the change in dependent variable associated with an increase in explanatory variables to assign to the estimates versus how much to attribute to the unknown correlation. To tackle this problem, as well as to test the specification, we applied IV/GLS (instrumental variable/generalized least squares) approach according to Hausman and Taylor (1981); see Table 7. The Hausman tests on the null that time-varying and time-constant explanatory variables are exogenous resulted in the rejection of the

Table 7: IV/GLS Estimation to Tackle Endogenous Variable Case in Panel Data

	dbis	Spread	Nonperforming loan/Loan	Hausman test statistic	$\theta = \sqrt{\frac{\sigma_e^2}{\sigma_e^2 + T\sigma_\alpha^2}}$
dloan	2.068	−1.454	0.520	10.432	0.411
	(5.879)	(−1.571)	(0.792)	(0.001)	
dsmes	3.200	−0.655	0.413	6.401	0.412
	(7.485)	(−0.583)	(0.518)	(0.011)	

Notes: Figures inside the parentheses are t-values and chi^2 probability. BIS term and nonperforming loan ratio are treated as endogenous, while interest rate spread is regarded as exogenous in the instrumental variable estimation.

null of no correlation between a unit-specific residual and endogenous explanatory variables, and the within (fixed-effects) estimator turned out to be at least a consistent one.

5.3. Dynamics of a Regulation-induced Credit Crunch

Besides isolating identifying factors for bank loan decisions, the dynamic transmission channel needs to be examined. The most obvious consequence of CARs is the credit crunch situation in Korea, which persists despite the historically low interest rate. Since Korea faced tremendous shocks after the crisis, such as the reversal of capital flows and tight money conditions, even a slight increase in interest rates could have had a strong contractionary impact. The point is that, while tight money conditions dominated the short-run aspect of the credit crunch, CARs posed a significant threat to the viability of financial institutions, resulting in a credit crunch that should be distinguished from other episodes. In other words, the CAR-imposed credit crunch worsened the economic contraction, and CARs are tantamount to an effective interest rate hike in terms of generating credit crunch situations.

While previous studies concentrate on measuring the effect of various factors in determining bank lending, I examine the role of CARs in the context of macroeconomic implications, relating CARs to macroeconomic changes through the credit crunch channel. The macro impact of a CAR-induced credit crunch should be distinguished from those usual episodes reported in earlier studies, which take place through both the balance sheet and bank lending channel effect. Characteristically, implementation of risk-based capital (RBC) requirements is expected to accelerate the substitution of risk-free assets like government bonds for assets in the 100 per cent risk category, such as commercial loans.

The allocation of credit away from commercial loans could potentially have caused a significant reduction in macroeconomic activity, since usual borrowers, especially bank-dependent borrowers like SMEs could not easily resort to other funding sources. Thus, the macroeconomic impact of RBC or CARs is expected to take place through the credit channel or, more specifically, through the capital channel, while the magnitude of the effect depends on other macro considerations. The so-called flight to quality phenomenon can also take place through CARs and is expected to affect the ratio of loans to bond holdings. That is, the financial accelerator of Bernanke *et al.* (1996), became activated as a result of CARs. This change, in turn, is transmitted to macro variables as suggested by the credit crunch hypothesis to gauge macro impact. Unlike previous studies on the credit channel that isolate the supply-side effect from the demand side, however, this study seeks to reconcile empirical findings on bank loans and capital adequacy using dynamic simulations initiated by CARs. Again, the role of RBC in assessing the macro impact needs to be

emphasized, since it affects both the bank portfolio (credit reallocation) and the severity of the credit crunch.

Primarily, the macro impact of CARs should stem from the monetary transmission mechanism, since the relationship between monetary policy instruments and nominal income changes dramatically when a credit crunch prevails. However, the usual inspection of key monetary indicators cannot unveil the role of CARs in a macro context. Therefore, the role of CARs should be examined from both the supply and demand side, as well as distinguishing the short-run from long-run consequences.

The null hypothesis is that CAR-induced bank portfolio adjustment worsens the bank lending channel in the short-run while, in the intermediate run, loan demand is significantly affected. The relative importance of various channels that result in a credit crunch can be examined using variance decomposition results on various interest rate spreads, bank lending, and output change. See Table 8.

Table 8: Causality Test

Null Hypothesis	F-Statistic	Probability
Dloan does not Granger Cause DGDPSH	20.36	0.00
DGDPSH does not Granger Cause Dloan	1.65	0.21

Note: Sample period: 1992 .1Q – 1998. 4Q
Dloan: Growth rate of commercial bank loans
DGDPSH: Trend of growth rate
Lags: 3

Specifically, under the null hypothesis, the ratio of loans/government bond holdings or loan-bond mix *à la* Kashyap *et al.* (1993), should have been affected by the RBC requirements. In addition, a particular type of interest rate spreads should be sensitive to changes in the loan/bond holding ratio. Since macro impacts are gauged using quarterly data in this chapter, the BIS term of the previous bank lending equation was replaced with loan-bond mix to construct a four variable system that consists of loan-bond mix, interest rate spreads, loan, and output change.

As shown in Domaç and Ferri (1998), the shock propagation mechanism is different among channels of credit crunch. The balance sheet channel emphasizes the potentially depressing impact of the monetary squeeze on the borrower's assets and profits, including the borrower's net worth, cash flow, and increased risk premium. However, CARs are not directly related to the monetary squeeze that raises corporate risks, especially that of *chaebol* groups. Accordingly, the spread between CP and risk-free assets may not increase in response to strengthened CARs as suggested by the findings of Kashyap *et al.* (1993). On the other hand, CARs largely affect the supply side, specifically the retrenchment of loans by depository institutions and increased holdings of public bonds, which are more or less transmitted via the bank-lending channel. See Figure 11.

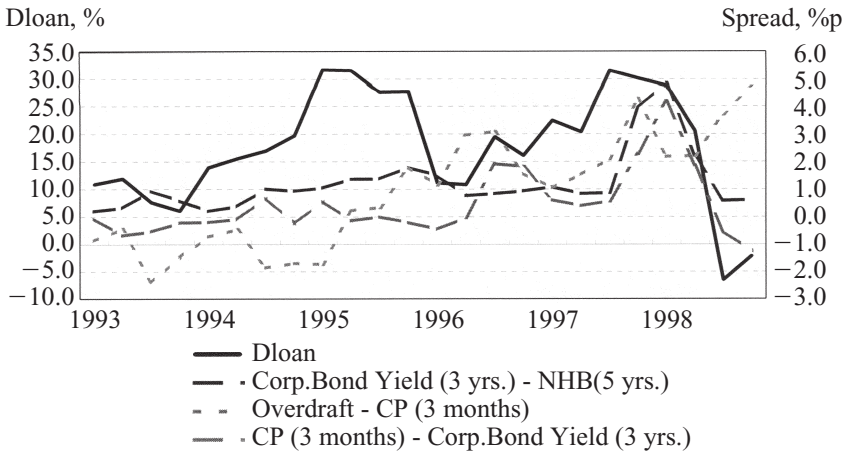


Figure 11: Growth Rate of Loans and Spreads

In highlighting the transmission channel of CAR to output change, the four variable VAR system is estimated, whose variance decomposition results can be examined to check the empirical support. It is assumed that changes in bank portfolio as reflected in loan-bond mix (loan/bond or loan/(loan + bond)) affect loan size and subsequent output changes, especially for SMEs. See Figure 12 and Tables 9 and 10.

The results largely support the hypothesis that regulation-induced bank lending channels were important in the Korean case, especially for SMEs, even if the independent role of various interest rate spreads and loan-bond mix could not be confirmed in explaining output changes. The fact that output

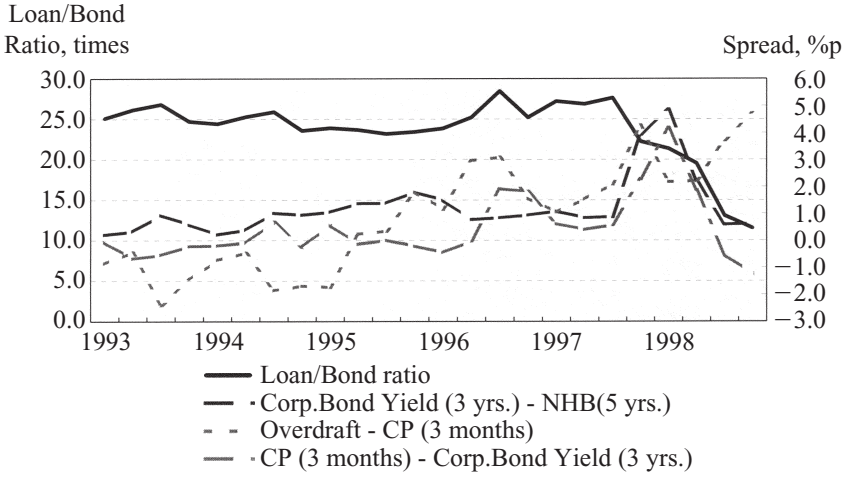


Figure 12: Loan/Bond Ratio and Spreads

Table 9: Variance Decomposition for SME Output and Interest Rate Spreads (per cent)

	SME industrial production (SPI)			Spread 1	Spread 2	Spread 3
	Spread 1	Spread 2	Spread 3			
Loan/Bond	35.54	53.14	19.08	16.38	6.33	20.65
	(10.60)	(51.82)	(7.47)	(22.85)	(12.85)	(1.06)
DLOAN	2.40	0.86	1.71	36.10	0.36	1.51
	(3.51)	(1.86)	(3.60)	(16.71)	(0.44)	(10.65)
Spread 1	45.57			47.18		
	(73.78)			(59.88)		
Spread 2		6.41				
		(3.55)				
Spread 3			76.36		87.08	77.76
			(81.54)		(81.39)	(85.70)
SPI	16.47	39.57	2.80	0.35		0.08
	(12.25)	(43.55)	(7.40)	(0.57)		(2.58)

Note: Figures inside the parentheses show the results when Loan/(Loan + Bond) is applied. Sample period covers from 1992:Q1 to 1998:Q4 with lag = 1 or 2.

Table 10: Variance Decomposition for Output and Interest Rate Spreads (per cent)

	Overall industrial production IPI			Spread 1	Spread 2	Spread 3
	Spread 1	Spread 2	Spread 3			
Loan/Bond	13.09	40.68	3.59	9.73	8.13	5.44
	(12.24)	(6.54)	(7.15)	(14.22)	(15.55)	(6.41)
DLOAN	7.57	4.92	4.70	38.09	0.44	2.73
	(6.92)	(6.15)	(3.29)	(26.76)	(0.12)	(3.18)
Spread 1	61.84			47.96		
	(71.32)			(56.99)		
Spread 2		5.51			89.92	
		(2.20)			(82.81)	
Spread 3			86.45			90.97
			(84.76)			(88.91)
IPI	17.49	48.87	5.26	4.21	1.50	0.86
	(9.52)	(85.11)	(4.77)	(2.02)	(1.52)	(1.59)

Note: Figures inside the parentheses show the results when Loan/(Loan + Bond) is applied. Sample period covers from 1992:Q1 to 1998:Q4 with lag = 1 or 2.

contraction was not fully accounted for by changes in the interest rate spreads suggests that the loan/bond ratio may have played a bigger role, especially for SMEs, resulting in a deeper contraction than can be explained by usual spreads behaviour. In fact, I found some empirical support to the above conjecture.

In short, the macro impact of CARs can be assessed in two steps. The first step is to run dynamic simulations on the vector error correction system of the loan/bond ratio, interest rate spread, loan, and output changes. The loan/bond ratio highlights the distinctive contraction that was incurred by the CAR. Second, the four-variable system was re-estimated using industrial production of SMEs in place of industrial production. Since we do not have monthly data on bank lending to SMEs, the effect of changing portfolios on SME output

cannot be measured accurately. Instead, we use interest rate spreads to proxy lending to SMEs. As seen in the error variance decomposition results, the macro impact of CARs is the actual triggering of a credit crunch on the supply side that gradually spreads through the balance sheet effect. Unlike other episodes of credit crunch, it is still not clear whether a CAR-triggered credit crunch takes longer to resolve.

The above findings on the transmission channels are further confirmed by the following set of equations and Tables 11 and 12, where the roles of various spreads, the loan-bond mix and traditional quantity variables are simultaneously examined (Friedman and Kuttner, 1993). The empirical findings suggest that no independent role of bank portfolio behaviour in explaining output change could be found, especially in light of the complementary role of interest rate spreads in the transmission channel.

$$\Delta X_t = \alpha + \sum_{i=1}^{6} \beta_i \Delta X_{t-i} + \sum_{i=1}^{6} \gamma_i \Delta P_{t-i} + \sum_{i=1}^{6} \delta_i \Delta \gamma_{p,t-i} + \sum_{i=1}^{6} \theta_i \Delta Z_{t-i} + \phi t + u_t$$

$$\Delta X_t = \alpha + \sum_{i=1}^{6} \beta_i \Delta X_{t-i} + \sum_{i=1}^{6} \gamma_i \Delta P_{t-i} + \sum_{i=1}^{6} \delta_i \Delta \gamma_{p,t-i} + \sum_{i=1}^{6} \theta_i \Delta Z_{t-i} + \sum_{i=1}^{6} \xi_i \Delta S_{t-i} + \phi t + u_t$$

X Log of industrial production or industrial production of SMEs (year on year change)
P Log of PPI
r CP (6 month) rate
Z Spread 1 = corporate bond yield – government bond (National Housing Bond)
Spread 2 = overdraft – CP
Spread 3 = CP – corporate bond yield
Spread 4 = overdraft – LIBOR – won/dollar depreciation
Loan-bond mix 1 = loan/bond
Loan-bond mix 2 = loan/(loan + bond)

This study so far has taken a closer look at the banking data to size up CAR-induced credit crunch and its macro impact in a dynamic setting. In summary, the above results suggest that the macro implications of CARs are changes in bank portfolios and reduced loans that resulted in a significant contraction of output, especially with regard to SMEs. Part of the reason for sizeable impact on SMEs is due to typical informational asymmetry, which

reflects the fact that most SMEs find banks the only economical source of debt financing (Gertler and Gilchrist, 1994). It should also be noted that less capitalized banks trying very hard to satisfy the BIS ratio to avoid the flight to quality by depositors. What is the behaviour of those banks that recorded the most dramatic improvement in the BIS ratio? Do CARs, in fact, lead to a less risky financial system where more risky banks curtail loans in a more dramatic fashion?

Since Korean banking data clearly show asymmetric treatment of bank lending to SMEs, productive activities of SMEs are better explained by changes in bank lending and bond holdings. As a result of capital loss mainly due to business failures of large corporations, strengthened CAR brought about bank's portfolio change, which reduced lending to SMEs disproportionately. In fact, the build-up of corporate financial vulnerabilities largely depends on whether a particular firm belongs to a *chaebol* rather than the size of their debt (Bongini *et al.*, 1998). The so-called liquidity variables, inter-firm debt, and the interest coverage ratio do not help to predict bankruptcies for *chaebols*. Given that this condition cannot be corrected in the short run given the poor provision for database and credit history, firm size becomes an important piece of information for credit evaluation purposes. On a related note, the asymmetric impact of a contractionary monetary policy on bank–firm relations was also reported (Conigliani *et al.*, 1998).

In fact, liquidity constraints are more stringent for non-*chaebols* than for *chaebols*, which can resort to other means of financing. Using the Korean data, Bongini *et al.* (1998) find that pre-crisis leverage was systematically higher for firms with lower returns, for larger firms, and for firms belonging to *chaebols*. They also find that belonging to a *chaebol* systematically reduces the chance

Table 11: F-Statistics for Alternative Financial Indicators in Real Output

Financial Variable	92.1–97.11		92.1–99.3	
	IPI	SPI	IPI	SPI
Spread 1	4.13***	1.79	2.97**	1.29
Spread 2	1.29	0.46	1.65	0.72
Spread 3	0.50	1.17	1.13	1.83
Spread 4	1.93	0.80	2.51**	1.00
Loan/Bond	5.23***	3.59***	2.06*	2.38***
Loan/(Loan+Bond)	7.06***	3.44***	2.80**	2.50**
M1E	4.04***	1.81	4.09***	1.83
M2E	3.29***	1.51	2.29*	1.13
M3E	1.61	1.19	1.77	1.21

Note: Loan/Bond and Loan/(Loan + Bond) are the loan-bond mix, which resemble the loan-paper mix of Kashyap *et al.* (1993).
F-statistics are for the null hypothesis that the coefficient of either the spread, loan-bond mix or quantity variable is zero.
The regressions use monthly data for the 1992:1 to 1993:3 sample period, and include six lags of each independent variable.
*, **, and ***, denote 10%, 5%, and 1% significance levels, respectively.

Table 12: F-Statistics for Quantity Variables in Combination with Various Spreads

	Spread 1		Spread 2		Spread 3		Spread 4	
	IPI	SPI	IPI	SPI	IPI	SPI	IPI	SPI
Loan/Bond	1.43	1.06	1.42	1.35	1.71	1.11	1.47	1.08
	(1.68)	(2.97)**	(1.14)	(0.39)	(2.86)**	(2.00)*	(1.25)	(2.51)**
Loan/	1.60	1.31	2.35**	2.14**	2.10*	1.43	1.83	1.78
(Loan + Bond)	(1.40)	(2.83)**	(1.58)	(1.79)	(2.77)**	(1.94)*	(1.15)	(2.89)**
M1E	2.71**	2.56**	3.73***	3.94	2.09*	2.62**	2.35**	2.19*
	(1.34)	(1.86)**	(1.66)	(1.25)	(1.59)	(1.00)	(0.58)	(1.11)*
M2E	1.77	1.22	2.11*	1.86	1.50	1.70	2.37**	2.50**
	(1.63)	(2.02)*	(1.43)	(0.88)	(2.21)*	(1.55)	(1.73)	(2.91)**
M3E	1.32	2.13*	2.05*	2.72**	1.68	2.49**	1.72	0.61
	(0.96)	(2.58)*	(1.13)	(1.29)	(2.13)*	(1.90)*	(0.88)	(0.73)

Notes: IPI, SPI represents total industrial production and that of SMEs, respectively.
Figures inside the parentheses are F-statistics of various spreads.
*, **, and ***, denote 10, 5, and 1 per cent significance levels, respectively.

of bankruptcy, implying that SMEs were disproportionately subject to a credit crunch situation induced by CARs. It may well be true that banking soundness was actually impaired through strengthened capital requirements. (Loan categories could not be finely classified due to lack of data availability.)

6. Summary and Conclusion

An empirical investigation of micro and macro data reveals noticeable differences in lending behaviour among banks with varying capital adequacy, especially with respect to the sensitivity of loans to changes in CAR. Macro impacts, however, were largely transmitted through bank-dependent SMEs. Enforcement of CARs in the aftermath of financial crisis usually induces a supply-side credit crunch, which further worsens the contraction in loan demand initially incurred by the contractionary monetary policy. The prolonged weak demand for bank loans was partly due to the bank's increase of bond holdings and reduction in loan supply to meet the CAR.

RBC requirements could also activate the so-called capital crunch, which may have triggered the serious credit crunch that was observed in Korea in the wake of the currency crisis in late 1997. Since Korea experienced a very strong monetary squeeze to achieve exchange rate stability and a turnaround in the current account balance, demand contraction should have affected loan demand in the very short run. However, strengthened prudential regulation on capital adequacy continued to depress loan demand and weaken supply factors for bank loans. In short, demand as well as supply factors were significantly affected by CARs, which explains the credit crunch and severe depression in Korea, especially with regard to wide disparity between *chaebols* and SMEs.

As evident in many related studies, tight monetary policy in the aftermath of the Korean financial crisis helped to restore market confidence in the short run by stabilizing the exchange rate, but stability was achieved at the expense of increased bankruptcies of the SMEs that are largely bank-dependent. Even with a continued downward trend in interest rates after the crisis in 1997, the CAR for Korean banks stifled the lending channel and reduced the supply of credit to cash-strapped firms and eventually resulted in reduced demand for bank loans. The CARs initially worsened economic contraction, and gradually eroded the demand basis for bank loans, thus accelerating the decline in interest rates and profitability for most commercial banks. Furthermore, corporate sector restructuring limited the range of potential customers for bank loans, since the biggest consumers of bank loans, *chaebols*, are restricted by debt ratio requirements and cannot borrow from banks. It is feared that export-driven demand cannot take place at a desirable speed because the credit crunch retards the transfer of resources from the non-tradeable to tradeable sector.

Implications of this paper's findings are as follows. While highly leveraged bank operations were conducive to high growth in a non-crisis period, lowering

the leverage ratio in the aftermath of the financial crisis resulted in a sharp reduction in bank assets and increased the vulnerability of the financial system. Mergers and acquisitions among conditionally approved Korean banks resulted in an increased need for ever-scarcer large loans. Furthermore, the sharp reduction in bank lending, especially among those merged banks shows that management reshuffling with CARs also played a significant role in the reduction of bank lending after the crisis. The implication of this result is that prudential regulation and supervision are meaningful only when macro considerations are carefully observed and the effect of firm size are explicitly taken care of. As pointed out by Lindgren *et al.* (1996), the coordinated implementation of prudential regulation and monetary policy is necessary so as to take into account macroeconomic and financial conditions of individual banks. Also, the results of this study suggest that CARs should be emphasized in normal times because CARs can themselves contribute to worsen a credit crunch and cause collateral damage to SMEs via asymmetric loan demand contraction.

It should also be noted that one of the side-effects of CARs in the Korean context is that almost all banks satisfied the BIS ratio by the end of 1998. In other words, while CARs were intended to restore public confidence in the financial system, Korean banks may have concealed the risks of certain businesses to satisfy BIS requirements. The final outcome of applying CARs was banks with cleaner balance sheets and better cushions against risks. However, placing sole emphasis on CARs resulted in a weaker industrial base and reduced lending that resulted in weaker loan demand. Unless world demand improves, or the Korean economy revives strongly, reduced loan demand will be a overriding factor in reducing the credit supply of those well-capitalized banks, and the vicious cycle of a weak financial sector causing and resulting from a depressed economy can restart. Also, the Korean case is distinctive in that increased emphasis on CARs was motivated by concerns about *chaebols*, while the accompanying side-effects are mostly borne by SMEs.

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