Estimating Effect of Countercyclical Capital Buffer on Banking System Resilience:
Cases of the United States and South Korea during 2008 Crisis

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Abstract. Would a countercyclical capital buffer (CCyB) be accumulated enough before the 2008 global financial crisis and thus be able to alleviate a social cost of the crisis? Would it be enough countercyclical against the banking sector's procyclicality to weaken the build-up of the systemic risk? This study builds a hypothetical CCyB phase on 14 "systemically important banks" of the United States and South Korea since 2000, to estimate the economic efficacy of this banking supervisory tool on the resilience of the sector during financial crises. The study estimates the potential capital requirement by the CCyB for each bank and compares it to the amount of recapitalization through public funds. It also tests the effect of some regulatory variables on the CCyB accumulation using a panel regression analysis. The results are twofold. First, the tool would be able to cover about 58% of the capital injected into seven largest U.S. banks via a Capital Purchase Program and 100% of recapitalization of seven largest Korean Banks, which was operated right after the crisis. Second, according to the panel analysis, in both countries, the CCyB regulatory variables such as credit-to-GDP gap have a positive effect on the CCyB accumulation simultaneously but not in a lagged fashion. This finding implies that the buffer rule might function as a partial suppressor of procyclical banking behavior.

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Keywords: countercyclical capital buffer, macroprudential policy, bank supervision, financial cycle, business cycle

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1 Introduction

The requirement of a countercyclical capital buffer (CCyB) was introduced and discussed by the Basel Committee on Banking Supervision (BCBS) post 2008, after it was acknowledged that alleviating the impacts of systemic risk is important for policy makers and banking supervisors to accomplish financial stabilization goals. As a result, each member country is legalizing and activating the new buffer rule since 2015. The CCyB is designed to be an additional capital buffer rate ranging from 0% to 2.5% of the CET 1 ratio to curb excessive credit expansion relative to the real side of the economy, which has been widely considered as the main driver of the recent systemic risk. This level of buffer is expected to be promptly released when credit is halted significantly so that the banking sector can sufficiently absorb the negative impact of the risk. The secondary goal of the buffer is to weaken banking sector procyclicality, which has been considered as a causality of the excessive credit expansion during boom, and thus resolve the volatility mismatch between financial and business cycles, an issue found to be complicated by monetary and macroprudential policy makers.

The CCyB is a unique macroprudential supervision tool that equally accounts for financial and business cycles, and it regulates only one variable, bank capital ratio, to affect the overall credit supply in economies where these properties somewhat resemble the Taylor rule type monetary policy. The BCBS suggests one common indicator, credit-to-GDP gap, which is used in the decision-making process pertaining to the buffer rate. The indicator explicitly considers both financial (credit) and business (GDP) cycles to identify whether excessive credit expansion would happen in up to 8 quarters, which possibly triggers procyclicality of banking behavior and systemic risk. The macroprudential supervisory authority decides the amount of additional buffer rate to the required bank capital ratio, based on the indicator and other quantitative and qualitative measurements to protect the banking sector from possible systemic turmoil.

The bank capital regulatory tool might seem similar to the inflation targeting monetary policy in terms of its broad effect on overall credit size. However, the two differ in purpose and regulatory target. While the CCyB aims to protect the banking sector and prevent systemic risk in the financial industry, the monetary policy tries to stabilize inflation and considers financial stabilization as part of the larger policy objective. The former regulates the bank capital ratio that possibly affects the overall credit supply, whereas the latter usually

manipulates the nominal interest rate and part of central bank's balance sheet to alter money supply. Thus, considering the idiosyncratic but broad, blunt effect of the CCyB on the economy, it is necessary to estimate the magnitude of its effect to understand policy implications. However, technical difficulties exist in empirically testing this effect. No significant economic crisis has occurred after the CCyB was introduced, and most BCBS member countries have set the rate at zero since activation. Thus, it is impossible to empirically gauge its "real" impact on the economy.

With this background knowledge, this study tries to measure the effectiveness of the CCyB on two parameters: How would it reduce the social cost of the financial crisis and how would it be countercyclical against the banking sector's procyclicality to reduce the probability of the build-ups of systemic risk? Accordingly, the study creates a strong assumption that the CCyB could have been started in 2000 and worked well for the financial crisis in 2008. Based on this assumption, the study builds a hypothetical CCyB for the period 2000 to 2015 for seven global systemically important banks (G-SIB) in the United States and seven domestic systemically important banks (D-SIB) in South Korea. It also compares the buffer size to the social cost measured by injection of public capital into those banks during the recent crisis. This simulation work uses contracts papers of the Capital Purchase Program (CPP) as a proxy to the social cost of the crisis, which captures the exact amount of capital that was publicly injected into the seven largest U.S. banks. From the Korean context, since there was no such nation-wide public capital injection program during the crisis, the study uses Financial Supervisory Service's data on recapitalization made by the banks themselves after being hit by the crisis shock. To calculate the virtual CCyB, the study uses the credit-to-GDP gap as a common indicator based on Tier 1 capital ratio. To identify how it would work well on blocking systemic risk, or the so-called "leaning against the wind," the study empirically tests the countercyclicality of the CCyB on the procyclical banking behavior using a panel analysis. The effect of the CCyB-related regulatory variables, which capture the procyclicality of the banking sector, on the hypothetical accumulation of CCyB is tested as well.

The results are twofold. First, a comparison of the virtual CCyB to the real capital injections in the United States reveals that the CCyB could cover about 58% of the capital injections before the crisis. Likewise, in Korea, it could cover over 100% of the recapitalization. Moreover, if the buffer was used along with the G-SIB or D-SIB framework, the capital buffering ability in both countries would have been boosted. Second, in both

countries, CCyB is shown to be simultaneously countercyclical on the banking procycyclical behaviors. However, this result is not shown to be robust if lagged variables are tested. Thus, assuming the purpose of the tool that it should indicate the crisis at least 4 to 8 quarters in advance, the countercyclical characteristic of the CCyB that only works simultaneously may not be enough to perfectly prevent the build-up of procyclicality and systemic risk in the banking sector.

The immediate contribution of the study is that it is the first to estimate the impact of the CCyB on bank capital accumulation during periods of crisis. Considering the hypothetical CCyB would be able to cover a large portion of the economic cost of the recent crisis, banking sector supervisory authorities should be expected to get more room to discuss the usability of the tool. The study also reveals that the countercyclical tool may have a real countercyclical effect on the banking behavior, and thus it has the potential to curb the excessive build-up of credit and reduce the probability of systemic risk. This study contributes to the burgeoning literature on the time-series dimension of macroprudential policy by pointing out the countercyclical merit of the CCyB based on panel analysis.

This study relies on several related studies, usually pertaining to policy making. It basically follows the conceptual and methodological guidelines presented in the BCBS (2010) and BCBS (2012). However, it moves away from some parts of the official guidelines, such as moderating HP filters to correctly adjust country-specific financial cycles, by accepting the argument of Lee and Park (2015) that South Korea has much shorter financial cycles, about 1.5 to 1.8 times the business cycles. This study strongly relies on the assumption that the CCyB has a potential crisis-suppressing ability because its common indicator has an early warning characteristic, as argued by Drehmann et al. (2010) and Shin (2013).

2 Methodology

Estimating the economic effectiveness of the CCyB during the financial crisis is technically difficult for two reasons. First, is the unavailability of sufficient data sets for each country, since the capital regulation tool was adopted after the crisis and has existed for a very short period. Moreover, the majority of BCBS member countries that legalized the rule since 2015 have left the buffer at 0%, which rarely implies very little things about the structural changes in the banking sector by the rule. To overcome these statistical challenges, this study simulates the projected hypothetical level of the CCyB, by assuming that the rule

would be adopted since 2000 and has been accumulated by the credit-to-GDP gap of each country used as the main and the only indicator. Following the guidelines of calculating the CCyB by the BCBS (2012) and assuming there would be no discretional (qualitative) decision by the authorities, the CCyB at each quarter is automatically decided and accumulated in a linear fashion when the credit-to-GDP gap is higher than 2, the lower bound, and is fixed at 2.5% when it hits 10%, the higher bound. Figure 1 explains how the CCyB is accumulated by the level of the indicator in a linear fashion. b_t, the CCyB level at each quarter, is set to be zero if z_t, the quarter's credit-to-GDP gap, is less than L, the lower threshold. b_t is set to be increased linearly if z_t is between L and H, the upper bound, and is fixed at 2.5% if it is above H. The graph on the right illustrates the linear accumulation of the CCyB. After calculating the national level of the CCyB at each quarter from 2000 to 2015, a bank-specific additionally required capital ratio (ARCR) is estimated from the real bank capital and risk-weighted asset (RWA) data. These projected capital requirements for each bank are then compared to the actual quantity of recapitalization for each bank, directly sorted from government-published contract papers or press releases. The sum of differences between the actual recapitalization and the projected CCyB should be the amount of capital that CCyB "would" cover before the crisis, and is defined as a proxy to the CCyB's economic effectiveness during the crisis.

[Figure 1]

To answer how the CCyB would be countercyclical against the procyclical activity of large banks, which has been widely criticized for being a likely cause behind the 2008 financial crisis, this study conducts a panel regression analysis using the data of seven U.S. G-SIBs and seven Korean D-SIBs. In this panel study, the study regresses several banking procyclicality variables on the regulatory variables, such as the capital ratio required by the CCyB, to figure out if one of the regressors statistically increases the magnitude of the dependent variables, which means that the dependent variables react countercyclically. The study considers the amount of bank-specific risk-weighted assets, overall debts, and credit-to-GDP gap as proxies to the procyclical behavior of banks. Furthermore, it tests additionally required capital ratio and additionally required capital by the CCyB as the representatives of regulatory variables. Additionally, to test the original design of the CCyB completely, which includes its ability to

issue an early warning and predicting sudden changes in credit in advance, it considers 1 to 4 periods of lagged independent variables.

3 Data

To calculate the national level CCyB for both countries from 2000 to 2015 (56 quarters), the study uses the credit-to-GDP gap as the sole indicator. As mentioned in the BCBS (2010), the total credit of a jurisdiction is defined by all sources of debt funds for the private sector, which includes households, non-financial institutions, and non-profit organizations. The term "all sources" implies all types of bonds and loans including government loans. GDP is nominal and seasonally adjusted. The total credit and GDP data of the United States are collected from the dataset provided by the BIS, and the Korean data is collected from the Bank of Korea website. All data are set to be quarterly. To calculate the gap variable, the study uses the Hodrick-Prescott filter on the credit-to-GDP ratios of both countries, but with a different sensitivity multiplier, or simply characterized by the Greek letter λ. In the U.S. case, adopting the recommendation of the BCBS (2010), λ is set to be 400,000. In Korean case, however, since many argue that the credit cycle and business cycle have relatively smaller differences, λ is set to be a normal value for a quarterly data: 1,600.[1]

Based on the calculated quarterly national level CCyB data for each country, the bank-specific required capital ratio (RCR) and ARCR are calculated. These two indicators for individual bank i are defined by

$$RCR_i = Minimum\ capital\ ratio\ (8.5\%) + CCyB_i\ (0\sim 2.5\%) \quad (1)$$

$$ARCR_i = RCR_i - CR_i \quad (2)$$

where CR_i means Tier 1 capital ratio of bank i, . The additionally required capital (ARC) is defined by

$$ARC_i = ARCR_i \cdot RWA_i \quad (3)$$

In the U.S. case, the historical data of Tier 1 capital ratio (CR_i) and RWA of large banks out of 9 first CPP recipients are collected from the Federal Deposit Insurance Corporation

[1] Lee and Park (2015) argue that the better smoothing parameter value for the Korean economy is more likely to be 1,600 and not λ =400,000 as predicted by the BIS as this value cannot correctly predict the three economic crises in Korea. A smaller λ, such as 1,600, which assumes the credit and business cycles are exactly overlapped, functions well as an early warning indicator for all three crises.

(FDIC) website[2]. In the Korean case, the same formats of data of seven largest banks selected as D-SIB in 2015 are collected through the Financial Supervisory Service webpage. Both data sources are publicly available. The 14 banks considered in this study are listed in Table 1.

[Table 1]

The amounts of injected capital into the seven U.S. banks are directly imported from the "Purchase Price" term in the "Securities Purchase Agreement" contract paper of the CPP, and the public capital injections into the seven Korean banks are estimated by FSS's news release[3] and the Korean government's white paper on the 2008 financial crisis[4]. For each quarter, an individual CCyB of a bank is assumed to have started to linearly accumulate if the RCR is higher than the actual CR. The overall CCyB of a jurisdiction is the sum of individual CCyB of seven representative banks, and it is compared to the amount of capital injected to estimate the economic ability of the CCyB to absorb a shock during a crisis.

The second part of the study consists of a panel analysis to judge how CCyB is really countercyclical. This prevents the procyclical behavior of banks before the crisis. In this simple analysis, RWA, overall debt, and the credit-to-GDP gap are used as procyclicality indicators, and RCR, ARCR, and ARC are used as regulatory variables of the CCyB. All data sources are the same as the data used in the previous part.

4 CCyB of Two Countries

Figure 2 shows the calculated credit-to-GDP gaps and CCyBs of the United States and South Korea since 2000 to 2015.

[Figure 2]

In both countries, it is shown that there would have been a certain level of systemic risk indicator increasing, as well as CCyB accumulation, before the 2008 financial crisis. In the

[2] Goldman Sachs is excluded from the analysis because its time series data is available only after 2008. Merrill Lynch, another bank that does not explicitly appear on the list, was merged with Bank of America during the financial turmoil, and so its independent data since 2008 does not exist.

[3] FSS General Banks Service Department, "BIS Capital Ratio and Recapitalization of Korean Domestic Banks," 2008.12.

[4] The Compilation Committee of Overcoming Global Financial Crisis, "Global Financial Crisis and Korean Government's Responses," 2012, pp.78.

simulation result for the United States, the maximum CCyB level reached was 1.48% in the first quarter of 2008, in the wake of the crisis, which might be somewhat lower than the normally expected level, considering the severity of the crisis in the country. Its accumulation period continued too long, starting from the third quarter in 2002. This violates one of the principles of the CCyB, which requires 4 to 8 quarters preceding the indicator's starting point of accumulation. This prolonged period of accumulation may confuse the policy maker when it comes to deciding an appropriate point of activating the policy tool. On the other hand, the release (or reduction) of the accumulated CCyB since 2008 was conducted much faster than the accumulation itself, and this result reflects well on the prompt release approach. In the case of Korea, the maximum CCyB level reached was 1.88% in the fourth quarter of 2006, which is higher than that of the United States and about eight quarters before the wake of the crisis. Furthermore, it did not reach the maximum level of 2.5%. Moreover, South Korea suffered a domestic financial crisis from 2002 to 2003, and the CCyB reacts to this crisis as well. However, its accumulation and release speed seems symmetric, which implies a potential difficulty of releasing CCyB when a financial sector needs a prompt credit rescue from the government.

5 Simulation Results: Capital Accumulation

This section consists of two steps. First, to guarantee that the potential CCyB could intervene before the crisis, the study estimates the required capital ratio of each bank and compares it to the real capital ratio during the 15-year span. If the average RCR of a bank in a specific time span is higher than the actual capital ratio, then there should be a positive CCyB accumulation at least in a quarter. Second, to capture an economic effect of the imaginably accumulated CCyB, the study compares the sum of additionally required capital ratio of each bank to the proxy of social cost that is assumed to be provided to sustain the life of the bank, estimated by the recapitalization or socially injected capital. If the ratio of the CCyB to the social cost of a bank is high, it can be interpreted that the bigger portion of the social cost could be covered by the newly adopted capital buffer rule, and thus the social cost occurring during the crisis could be reduced.

5.1 Case of the United States

Table 2 shows the average RCR and the actual capital ratio of the seven U.S. banks, and Figure 2 shows their time series changes (the dotted line is the RCR and the continuous line is the actual capital ratio). All seven banks show a stronger capital ratio after the crisis, and thus the difference from the RCR has increased. If (a) - (B) is higher than zero, it means that there should be a positive level of capital buffer to be accumulated to satisfy the minimum capital ratio requirement. Specifically, while State Street and Morgan Stanley showed relatively better capital ratio before the crisis, other banks such as JPMorgan, Bank of New York Mellon, and Wells Fargo suffered from a fragile capital prudential situation. However, the two better placed banks also saw their capital ratio going below their own RCR, which means they needed a positive level of CCyB before the crisis as well.

[Table 2]

[Figure 3]

Table 3 shows the projected CCyB accumulation for each U.S. bank, calculated by ARCR and ARC, and the actual CPP recapitalization injected into those banks. The difference between these two, shown in the third column, indicates how much public spending would be needed in the wake of the crisis, around the second or third quarter of 2008, to revive those banks, assuming the CCyB was activated before the crisis. For instance, JPMorgan received $25b from the Department of Treasury and its projected CCyB until the time of the receipt would be about $21b, which is the amount of money that could be reduced by the capital buffer; thus, only about $4b might be needed from the public side, which is relatively smaller than the original amount of public rescue, i.e., $25b. Reasonably, the lower the bank capital ratio, the more is the CCyB needed. Banks with a higher capital ratio since 2001, such as Morgan Stanley and State Street, had less CCyB preservation ratio, as shown in the fifth column of Table 3. The overall CCyB accumulation of all seven banks would be $60.376b, about 57.5% of the actual CPP capital injection by the Department of Treasury. If the CPP injection can be interpreted as a proxy to the social or economic cost of the 2008 financial crisis compensated by the public side, the CCyB could reduce more than a half of it if it was set since 2001. The trend that the bank with a lower capital ratio highly depends on the CCyB

is more clearly shown in Figure 4, which represents changes in the ARCR and ARC of each U.S. bank from 2001 to 2015. The blue continuous line indicates the ARCR for each bank and the area colored by red defines the amount of the ARC. As this area gets larger, the bank requires more CCyB. The required capital would have increased until 2008 and totally disappeared since then because the banks' capital adequacy was fulfilled. Unlike Morgan Stanley and State Streets, most banks in capital jeopardy after the crisis would have continuously been asked to stack more capital than they actually did, to sustain the negative effect of the crisis.

[Table 3]

[Figure 4]

The seven banks were selected as G-SIB in 2015, with different levels ranging from 1.0% to 3.5%. Therefore, to see a combined effect of the CCyB and G-SIB on the reducing CPP recapitalization cost would be meaningful. Table 4 shows the result and the comparison. If the CCyB was mixed with G-SIB, and G-SIB selection was not changed for 15 years (this is very strong assumption), the overall additionally required capital accumulation would increase from about $60b to $173b, and the preservation rate would more than double, from 58.5% to 164.3%. This result indicates that although the CCyB is an imperfect policy tool option for absorbing the economic cost of the financial crisis, the economic preservation effect could be largely enhanced if it is combined with G-SIB, another capital requirement policy tool option from Basel III. While the CCyB controls the capital requirement of a bank in time-series dimension, G-SIB is a kind of cross-section policy that possibly compensates a shortcoming of CCyB.

[Table 4]

5.2 Case of Korea

Five commercial banks (or bank holding companies) and two government-controlled banks (KDB and IBK) are selected as D-SIB in 2015. These banks are reasonable candidates for an experiment to observe how the economic impact of systemically important banks can be changed by a stricter capital buffer policy. Following the same methodology as with the U.S.

case, a few technical problems, however, hamper the accuracy of the simulation result. First, there are no reasonable proxies to the capital loss or the economic cost of the 2008 crisis in South Korea as the government did not officially operate a recapitalization program such as CPP or TARP. During the aftermath of the crisis, the Korean government provided about KRW1.7 trillion in the form of public spending to KDB and IBK, and the two banks used the money for recapitalization, which can be estimated as a proxy of the social cost. The rest of the banks, which were private and commercial, did not officially receive that kind of capital rescue, but they were recommended by the financial supervisory authority to recapitalize by themselves. As a result, according to the FSS (2008), those five banks recapitalized about KRW14 trillion[5] during November and December 2008. The sum of the two direct and indirect recapitalizations is used as the proxy, but its accuracy must be developed further. Second, D-SIB selection in South Korea was not as effective as that in the United States in 2015. Two government-controlled banks were removed from the list despite their systemic importance. Furthermore, all banks were asked to have the same level of capital requirement of 1%p despite their uneven asset size and possibly different economic impacts. With this vague D-SIB selection process, it is harder to gauge an accurate level of capital loss absorbing ability of the CCyB in South Korea before and after the financial crisis. Table 5 shows the average RCR and actual capital ratios of seven largest Korean banks before and after the 2008 financial crisis. Tier 1 capital ratios of all seven banks were below the average RCR before the crisis, while the relationship was converted after the crisis by the sufficient increase in the actual ratios. Figure 5 shows this reversal trend through a graph. While the RCR has a bump before the crisis due to the sudden increase in the RWA, the capital ratios suffered a large drop in the same period. One exceptional case is KDB, which is heavily controlled by the government. It had a sufficient level of capital during the entire sample period.

[Table 5]

[Figure 5]

[5] Specifically, KRW14 trillion in recapitalization consists of KRW5.9 trillion in capital increase, KRW0.3 trillion in issuance of new securities, KRW8.9 trillion in issuance of junior consolidation claims, and KRW1.1 trillion in sale of treasury stocks.

Table 6 shows the simulation results of the CCyB and D-SIB accumulation for each bank in South Korea for the period 2001 to 2008. According to the projection, the CCyB accumulation for seven years before the crisis would be about KRW19 trillion, which could exceed the overall approximated social cost of KRW16 trillion. Moreover, if D-SIB was solely operated during the same time span, it would build up slightly less than KRW21 trillion, exceeding the approximation, and the combined effect would be more than KRW30 trillion. Similar to the U.S. case, banks with lower capital adequacy needed a higher RCR, while KDB, having no negative average ARCR period, had zero CCyB effect on its capital structure.[6] Figure 6 shows the changes in the accumulation since 2001. Except KDB, all banks suffered the maximum level of CCyB build-up just prior to the 2008 crisis, and they continued to have a relatively better prudential adequacy since then. In spite of the analytical limitations, it is clearly shown that the combined economic effect of two banking regulation tools is bigger than that of any one of them, which is in line with the objective of CCyB, indicating that the tool should be coordinated with other prudential policy tools such as SIB, LTV, or DTI.

6 Empirical Analysis: Countercyclicality

In this section, a simple empirical analysis is set to judge whether the CCyB has a countercylical effect to reduce the procyclical asset management behavior of the banking sector. A simple generalized least squares (GLS) with fixed effect panel regression model is assumed, taking into account the effect of the banking sector procyclicality variables on the regulatory variables. Quarterly RWA, loan, and the credit-to-GDP gap of a bank are considered as independent variables while RCR, ARCR, and ARC are considered as dependent variables. If the former positively affect the latter, it is interpreted that the regulatory variables react countercyclically to the procyclical behaviors. To make sure that the principles of CCyB by BCBS argue that CCyB should react 4 to 8 quarters before the sudden changes in overall credit, the panel analysis also tested the lagged effect of the independent variables on the dependent ones.

[6] The exceptional case of KDB can be interpreted as an example of regulatory arbitrage. KDB has been in charge of restructuring jeopardized companies, as directed by the government, and thus it has been heavily affected by business cycle fluctuations as well as policy regimes. This could have exaggerated the capital adequacy of KDB, given its macroeconomic policy-oriented objectives of operation.

6.1 Case of the United States

Table 7 shows the results of the analysis for the U.S. case. An individual bank's credit-to-GDP gap, as an instrumental variable of bank procyclicality, is the only independent variable that positively affects the RCR and ARCR in both cases, i.e. when the CCyB is operated independently or in combination with G-SIB. The other variables, however, do not countercyclically affect the regulatory variables in both cases. Moreover, the credit-to-GDP gap does not have the same result when a lag of 1 to 4 periods is assumed. Additionally, in contrast to the previous section, there is no significant improvement in countercyclicality when G-SIB is combined with the CCyB. In short, regulatory variables that were designed to trigger the CCyB react to a specific type of variable that captures bank procyclicality, but it fails to have the same reaction when the procyclicality is lagged.

[Table 7]

6.2 Case of Korea

The Korean case is similar to that of the United States, as shown in Table 8. The credit-to-GDP gap positively affects two types of regulatory variables for all three cases of experiment. Additionally, the bank-specific RWA exhibits a similar effect; however, the effect is relatively smaller than that of the credit-to-GDP gap. However, as in the U.S. case, as the time gap between the independent and dependent variables widens, the positive effect rapidly diminishes. This means that the CCyB cannot preemptively warn about the crisis if it is operated under the assumptions made in this study.

[Table 8]

7 Concluding Remarks

This study estimates the potential reduction in public spending directed toward the largest banks in the United States and South Korea during the aftermath of the 2008 financial crisis had the CCyB been operated since 2001. Thus, it highlights that the CCyB would have reduced a significant portion of the social cost of such bank recapitalization had it been built

up before the crisis as it would have functioned as a capital buffer to absorb negative economic effects of the crisis approximated by the recapitalization cost. To the best of my knowledge, this is the first study to gauge the potential cost-absorbing ability of the CCyB when a financial crisis hits the economy, by calculating a hypothetical amount of CCyB accumulation of the largest banks in both countries. Moreover, although very limited, a countercyclical reaction of the CCyB is founded in the simulation work.

However, this study has certain limitations. First, due to the lack of data, it cannot use the common equity tier 1 capital ratio, which is normally and widely used. Second, it does not consider the dynamic changes in bank activities, such as the dynamic and self-fulfilling movement of the RWA and capital being affected by potential CCyB accumulations. Lastly, in principle, the appropriate CCyB level in each period must be determined based on quantitative analysis and qualitative decision making by policy makers, but the latter aspect is absent in this study.

The CCyB is a supervisory tool designed to preemptively block excessive credit expansion caused by procyclical banking activity and thus effectively reduce the probability of systemic risk and further financial crisis. However, it is not the only supervisory tool to reduce crisis probability, and therefore, it should be considered along with other macroprudential policy tools. Most countries employ multiple domestic level macroprudential tools, such as CCyB, LTV, DTI, and D-SIB. This study clearly shows that if the CCyB is combined with other tools, its positive economic effect will be magnified.

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Figures and Tables

Fig. 1. Linear Accumulation of CCyB

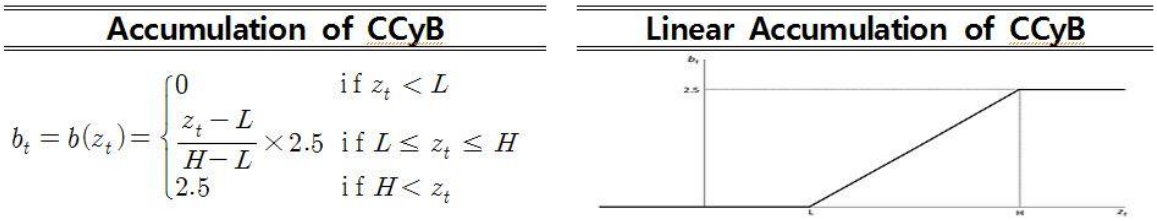


Fig. 2. Credit-to-GDP Gaps and CCyBs of the United States and South Korea

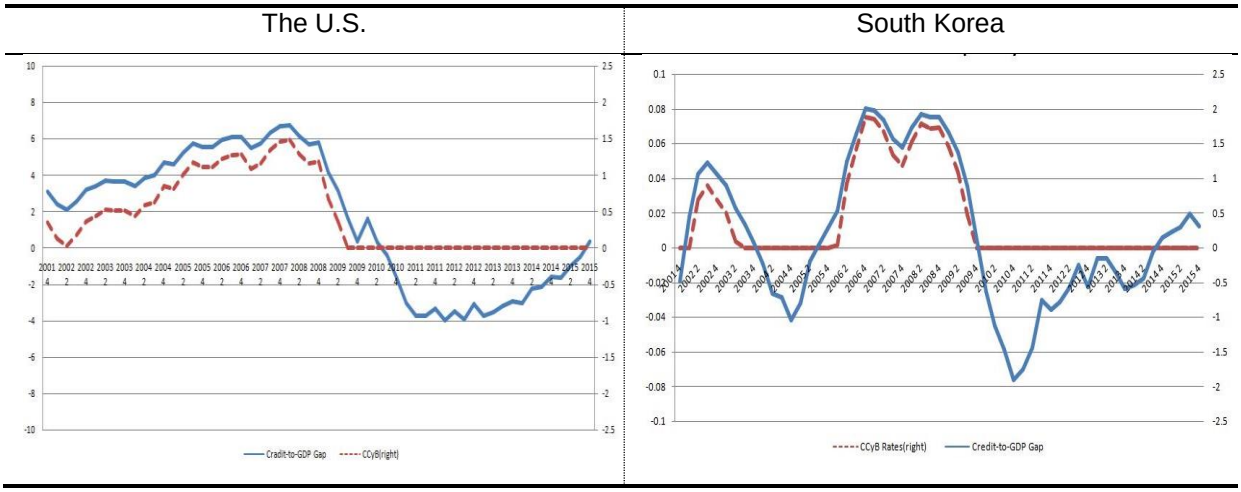


Fig. 3. Changes in RCR and Actual Capital Ratio of 7 U.S. Banks

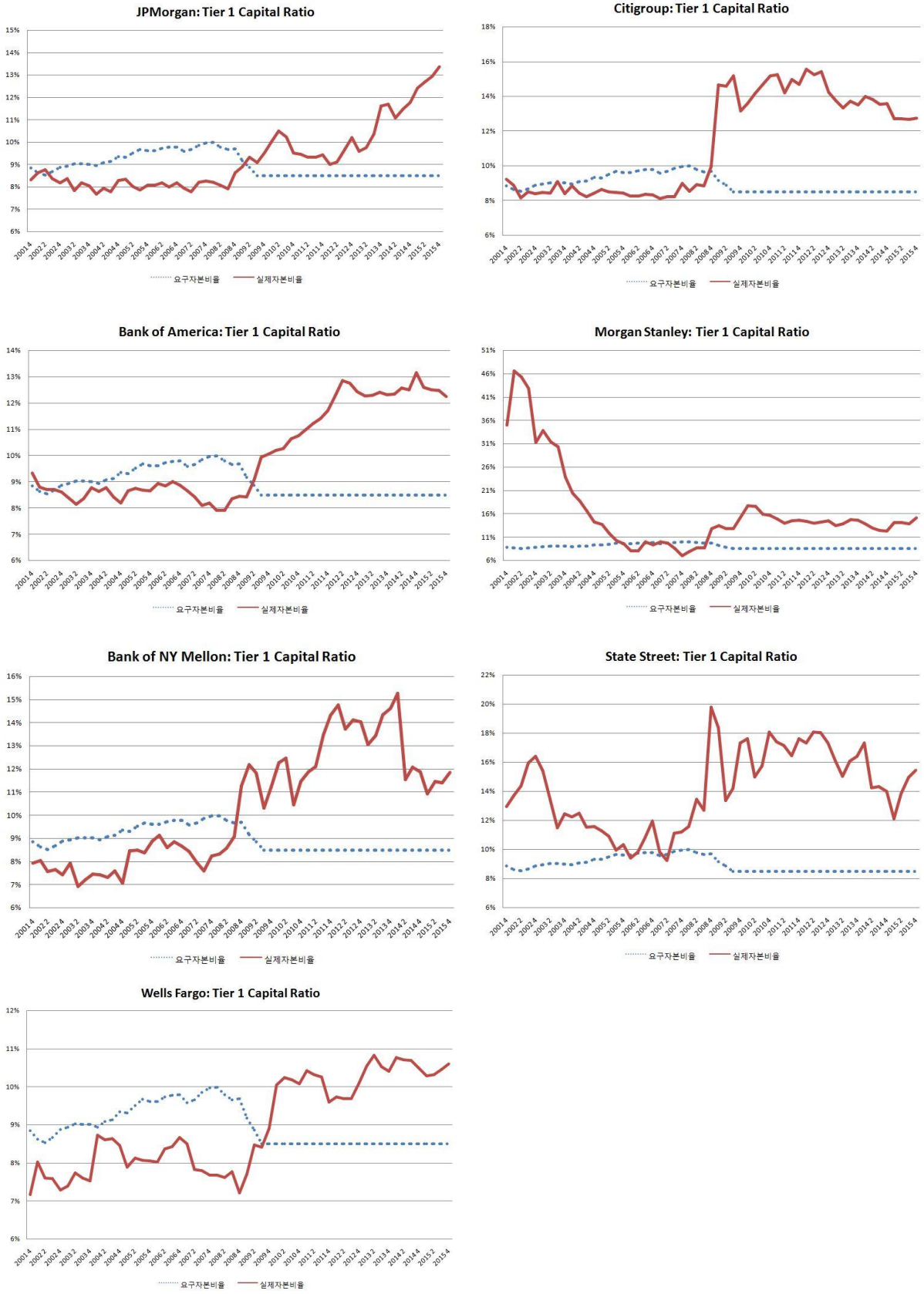
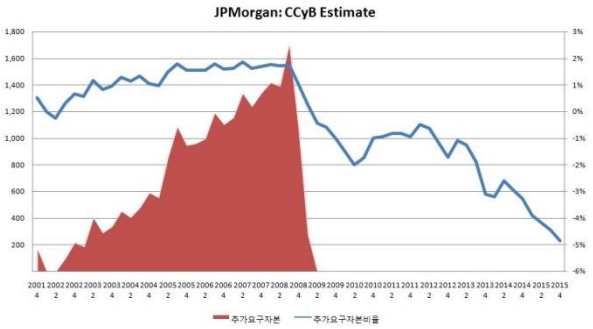
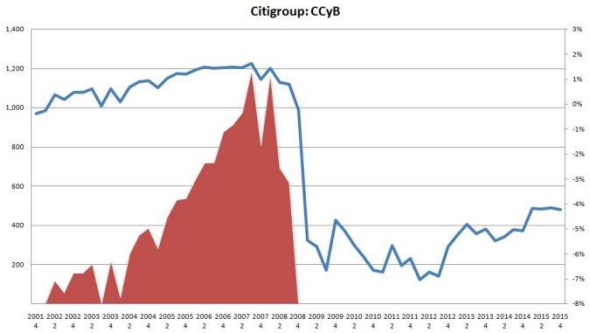
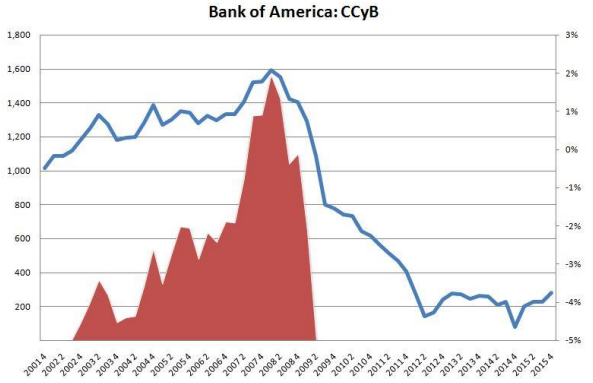
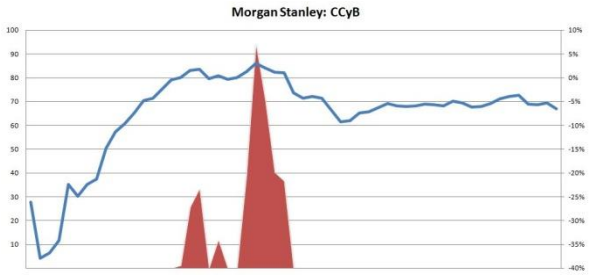


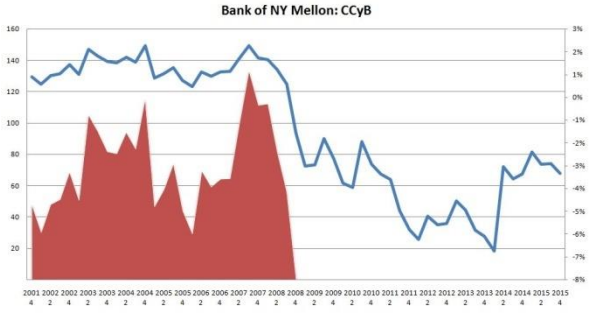
Fig. 4. Changes in ARCR and ARC of 7 U.S. Banks

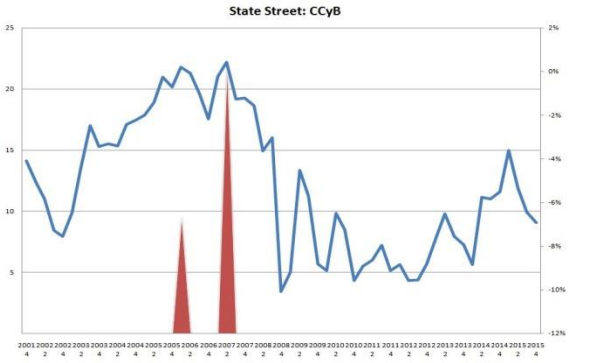












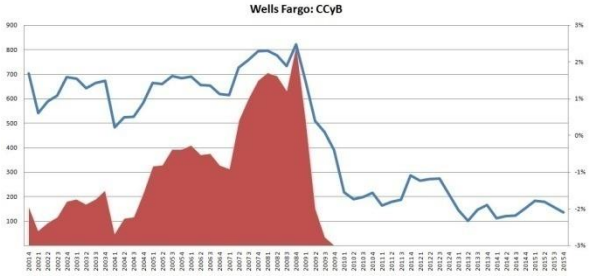


Fig. 5. Changes in RCR and Actual Capital Ratio of 7 Korean Banks

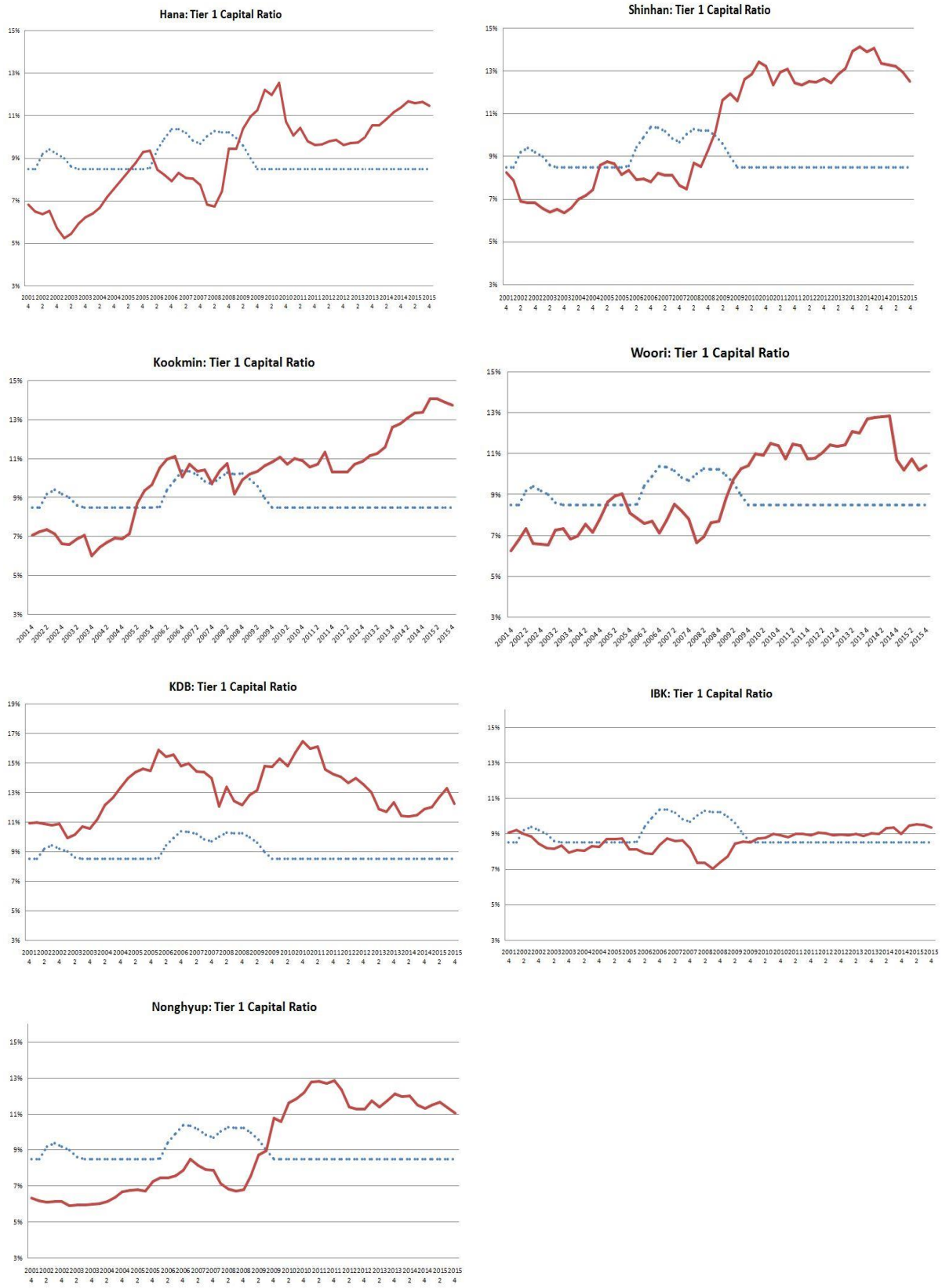


Fig. 6. Changes in ARCR and ARC of 7 Korean Banks

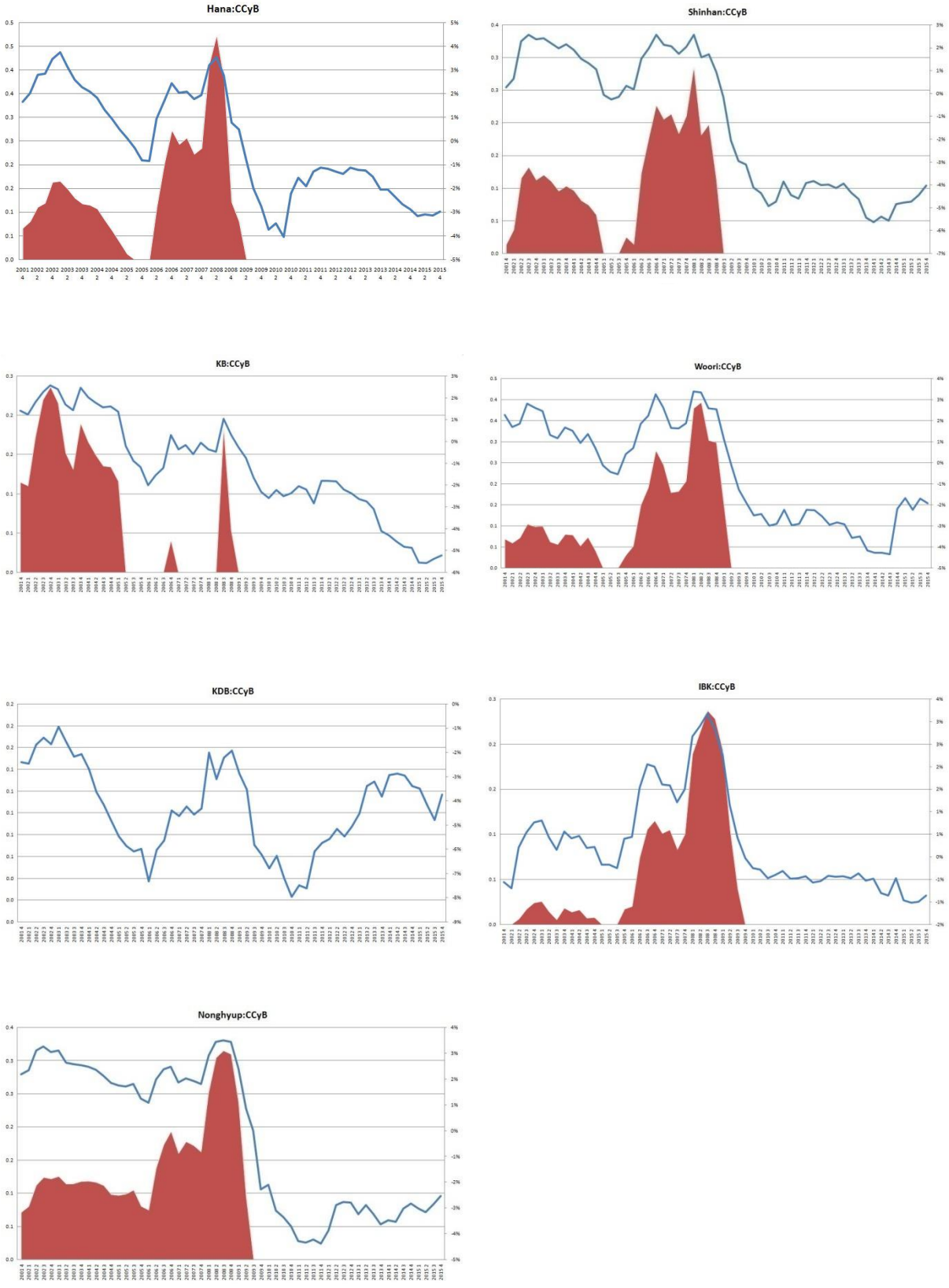


Table 1. Large Banks Analyzed

7 American Banks	7 Korean Banks
JP Morgan	Hana
Citigroup	Shinhan
Bank of America	Kookmin
Morgan Stanley	Woori
Bank of New York Mellon	Korea Development Bank(KDB)
State Street	Industrial Bank of Korea(IBK)
Wells Fargo	Nonghyup

Table 2. Average RCR, Actual Capital Ratio, and ARCR of 7 U.S. Banks

		2001.4Q~2008.3Q	2008.4Q~2015.4Q	2001.4Q~2015.4Q
Average Required Capital Ratio (a)		9.34	8.58	8.95
Actual Capital Ratio	JPMorgan	8.12	10.34	9.25
	Citigroup	8.52	13.95	11.28
	Bank of America	8.56	11.48	10.05
	Morgan Stanley	18.97	14.29	16.59
	NY Mellon	8.04	12.54	10.33
	State Street	12.06	16.16	14.15
	Wells Fargo	7.96	9.92	8.95
	Average (B)	10.31	12.67	11.49
Average Additionally Required Capital Ratio (a)-(B)		-0.97	-4.09	-2.54

Table 3. CCyB and CPP Accumulations of 7 U.S. Banks($billions)

	Accumulated CCyB (a)	Actual CPP Injection (b)	CCyB Deficit ((a)-(b))	CCyB Preservation Ratio(%) ((a)/(b))
JPMorgan	20.894	25.000	-4.106	83.57
Citigroup	13.015	15.000	-1.985	86.77
Bank of America	15.097	25.000	-9.903	60.39
Morgan Stanley	0.353	10.000	-9.647	3.53
NY Mellon	2.057	3.000	-0.943	68.57
State Street	0.032	2.000	-1.968	1.6
Wells Fargo	8.930	25.000	-16.070	35.72
Overall	60.376	105.000	-44.624	57.50

Table 4. CCyB and G-SIB Accumulations of 7 U.S. Banks($billions)

	CCyB	CCyB Preservation Rate(%)	CCyB & G-SIB	CCyB & G-SIB Preservation Rate(%)
JPMorgan	20.894	588.26	73.625	294.50
Citigroup	13.015	268.60	39.941	266.27
Bank of America	15.097	236.50	39.091	260.60
Morgan Stanley	0.353	4.15	0.857	8.57
NY Mellon	2.057	22.46	3.667	122.23
State Street	0.032	0.18	0.262	13.10
Wells Fargo	8.930	90.81	15.099	60.40
Overall	60.376	57.50	172.54	164.33

Table 5. Average RCR, Actual Capital Ratio, and ARCR of 7 Korean Banks

		2001.4Q~2008.3Q	2008.4Q~2015.4Q	2001.4Q~2015.4Q
Average Required Capital Ratio (a)		9.15	8.66	8.90
Actual Capital Ratio	Hana	7.29	10.62	8.98
	Shinhan	7.63	12.66	10.19
	Kookmin(KB)	8.51	11.58	10.07
	Woori	7.48	11.02	9.28
	KDB	12.85	13.49	13.18
	IBK	6.81	11.25	9.07
	Nonghyup	8.29	8.90	8.60
	Average (b)	8.40	11.36	9.91
Average Additionally Required Capital Ratio (a)-(B)		0.75	-2.70	0.30

Table 6. CCyB and D-SIB Accumulations of 7 Korean Banks(trillion KRW)

	Accumulated CCyB	Accumulated D-SIB	CCyB & G-SIB
Hana	4.3272	4.4429	6.4559
Shinhan	3.1979	3.5023	5.2057
Kookmin	2.4694	3.3530	4.7122
Woori	3.5391	3.7357	5.4287
KDB	0.0000	0.0000	0.0038
IBK	3.9363	4.2340	5.6416
Nonghyup	1.5179	1.6464	2.7280
Overall	18.9877	20.9143	30.1758

Table 7. Effects of Procyclicality of Banking Sector on Regulatory Variables in the UnitedStates

	CCyB Only			CCyB with G-SIB		
	RCR(%)	ARCR(%)	ARC (trillion $)	RCR(%)	ARCR(%)	ARC (trillion $)
RWA(trillion $)	0.27 (0.15)	0.69 (0.60)	0.37 (0.42)	0.40* (0.16)	0.78 (0.61)	0.42 (0.34)
Total Loan(trillion $)	0.24 (0.13)	0.04 (0.51)	0.11 (0.32)	0.37** (0.14)	0.19 (0.52)	0.19 (0.27)
Credit-to-GDP Gap (%)	0.70** (0.26)	3.34** (1.00)	n/a	0.68* (0.27)	3.03** (1.04)	n/a
RWA (4Qs lagged)	-0.20** (0.07)	-1.39** (0.48)	0.07 (0.01)	0.45*** (0.09)	-1.3** (0.49)	0.12 (0.01)
Total Loan (4Qs lagged)	-0.20*** (0.05)	-.1.1** (0.38)	0.08 (0.08)	-0.18** (0.06)	-1.1** (0.38)	0.12 (0.7)
Credit-to-GDP Gap (1Q lagged)	0.25 (0.26)	0.49 (0.98)	n/a	0.22 (0.26)	0.38 (0.99)	n/a
Credit-to-GDP Gap (4Qs lagged)	-0.15 (0.26)	-0.60 (1.00)	n/a	-0.13 (0.26)	-0.62 (1.01)	n/a

Table 8. Effects of Procyclicality of Banking Sector on Regulatory Variables in South Korea

	CCyB Only		CCyB with D-SIB		D-SIB only	
	ARCR(%)	ARC (trillion ₩)	ARCR(%)	ARC (trillion ₩)	ARCR(%)	ARC (trillion ₩)
RWA(trillion ₩)	0.02** (0.004)	0.002*** (0.0006)	0.02*** (0.0043)	0.002*** (0.00055)	0.015*** (0.0036)	0.002*** (0.00047)
Total Loan(trillion ₩)	0.006 (0.004)	0.0003 (0.0005)	0.006 (0.004)	0.0008 (0.0005)	0.001 (0.003)	0.00006 (0.0004)
Credit-to-GDP Gap (%)	0.075*** (0.015)	0.828*** (0.191)	0.075*** (0.014)	0.876*** (0.183)	0.049*** (0.012)	0.436** (0.161)
RWA (4Qs lagged)	-0.02*** (0.00003)	0.00004 (0.00016)	0.001 (0.0016)	0.00006 (0.0001)	-0.0012 (0.0034)	-0.00003 (0.00013)
Total Loan (4Qs lagged)	-0.001 (0.001)	-0.0001 (0.0001)	-0.0016 (0.0013)	-0.00008 (0.00012)	-0.0023 (0.001)	-0.00009 (0.00009)
Credit-to-GDP Gap (1Q lagged)	-0.0018 (0.015)	-0.00009 (0.0019)	-0.0018 (0.015)	0.00006 (0.0018)	-0.0084 (0.0128)	-0.0012 (0.0016)
Credit-to-GDP Gap (4Qs lagged)	-0.038* (0.015)	-0.0034 (0.0019)	-0.038* (0.015)	-0.0034 (0.0018)	-0.018 (0.012)	-0.0009 (0.0016)