

Bank Capital Regulation and Procyclicality of Bank Lending: Implications for Basel II Implementation*

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

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I. Introduction

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

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

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

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

The outline of this paper is as follows. Section 2 reviews some discussions on the relationship between pro-cyclicality of bank lending and financial regulation, and provides background motivations of this paper in the context of Basel II. Section 3 presents the regression model and the data, and reports the empirical results. Section 4 reviews some relevant supervisory response suggested in previous studies. Section 5 concludes.

II. Procyclicality of Bank Lending and Basel II

1. Procyclicality of Bank Lending and Financial Regulation

Bank lending is expected to exhibit pro-cyclical behavior through following two channels: procyclicality of the demand for bank lending and the cost of bank lending that also fluctuate over the business cycle. First, the demand for bank lending is based on the production and investment activities of firms or household consumption and thus inherently procyclical. On the other hand, the costs that banks need to pay when they raise funds for lending is fluctuating counter-cyclically and, hence, make supply of bank lending procyclical. For example, when economic conditions are depressed, collateral values decrease and the cost of bank lending increases so that even borrowers with profitable project find it difficult to obtain funding. When economic conditions are improved, the reverse tends to be the case.

Prudential regulation on financial institutions also can be pointed out as another factor of the procyclicality of bank lending. In particular, regulations of minimum capital requirements for banks has been a long-standing concern for supervisory authorities in that pressures on bank capital in a recession could lead to cutbacks in bank lending further and exacerbate the recession into credit crunch. A number of academic papers have focused on the relationship between capital regulation and bank lending, and suggests following two channels through which capital regulation could increase the procyclicality of bank lending: (i) appropriateness of the risk assessment by banks to the changes in risk over business cycle and (ii) sensitivity of regulatory measures (e.g. minimum capital requirements) to the estimated risk.

When the risk is inappropriately assessed over the business cycle, this could amplify the procyclicality of bank lending. The absolute level of risk measured at a particular point in time inherently varies over time. However, it is very difficult to precisely observe the risk and, consequently, the actual estimated risks are likely to be different from each other since their models take different assumptions depending on the priors held by banks. For example, if a one-year horizon is used for measuring risk, as in most internal rating models of banks, the measured risk tends to be negatively correlated with the economic cycle – that is, it falls in booms and increases in recessions. Conversely, with models using longer-term horizon and assuming modest recession scenario in estimation of borrower's risk, measured risk is less likely to move over the business cycle (Borio *et al.*, 2001).¹

¹ It is known that there are at least two industry standard rating methods used by banks which may lead to

In addition, if bank lending is highly dependent upon collateral values as in most of developing countries including Korea, and if the risks associated with collateral are mis-assessed, the procyclicality of bank lending will increase. In other words, rating methodologies that deliver collateral values moving closely with the business cycle are likely to generate greater procyclicality. The same is true when the average loan-to-value (LTV) ratio is higher, since the higher the LTV ratio means higher marginal amount of new lending that can be granted for a given change in the value of the collateral.

Procyclicality of bank lending could also increase when financial regulations are more sensitive to the estimated risk. In general, banks are required to make provisions to cover the expected loss (EL) of their loan portfolio, and their provisioning decisions tend to show cyclical pattern since accounting and tax constraints, together with the methodologies used to measure risk, lead to provisions increasing in downturns, rather than being built up during periods of strong economic growth. Thus, the marginal cost of bank lending will increase when economic conditions are depressed and, when accounting standard is more sensitive to the risk, the procyclicality will be extended. To cover the unexpected loss (UL) in a certain time horizon, a sufficient amount of bank capital needs to be kept and the level of required capital is often determined by prudential regulations of supervisory authorities. In a recession, for example, the cost of capital increases, and banks are likely to meet the capital adequacy ratio by cutting back their lending rather than increasing their own capital. Thus, more risk-sensitive capital

a different amount of variability in ratings in a recession. One is the point-in-time (PIT) method and the other is the through-the-cycle (TTC) method (Borio *et al.*, 2001, Catarinew-Rabell *et al.*, 2003, Kashyap and Stein, 2004). First, under a rating scheme with the PIT method, the current equity price of the borrower and current information on the borrower's liabilities are used to calculate the probability of its default, therefore credit ratings may well show more variability as economic conditions change and the average rating of a bank's loan portfolio is likely to change over the course of business cycle. For example, when economic conditions are favorable, loans are likely to move up the rating scale to higher-ratings given that the probability of default in the next year (one year horizon) is relatively low. Thus the nature of PIT credit rating system means that it does not take possible changes in economic climate into account. As a result, measured risk would be negatively correlated with business cycle. Second, a rating scheme with the TTC method measures borrowers' probability of default in a constant hypothetical downside scenario and classifies borrowers with similar (stressed) probability of default to the same rating grade. Thus credit ratings are likely to remain through the business cycle, which means that credit rating scheme designed to give less variability in ratings in response to changes in economic conditions. However, even with the TTC method, an economic downturn that is worse than expected (as in stress scenario) is likely to lead to overall ratings being downgraded simultaneously, and thus we cannot exclude the possibility that the procyclicality of bank lending significantly increases. Although some banks have chosen to adopt rating systems which are modeled on the approach taken by the rating agencies, most internal rating systems of banks tend to use the PIT method, and most credit rating agencies use the TTC (through-the-cycle) method.

regulations have the potential to lead to larger changes in capital requirements over time and, hence, increase the procyclicality of bank lending.²

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

The New Basel Accord (Basel II) reinforces the capital regulations by applying diversified risk weights according to the creditworthiness of the borrowers, thus one of the main objectives underlying the Basel II is to substantially increase the risk sensitivity of the regulatory capital (that is, minimum capital requirements) for banks. Considering that credit risk of bank portfolio tends to increase during a downturn, the minimum required capital depends on the business cycle, especially when banks are under the risk-sensitive capital regulations such as Basel II (Catarinew-Rabell *et al.*, 2003). In a recession, as bank profitability decreases and the cost of raising new capital becomes high, increasing capital requirements would force banks to reduce their lending or curtail the supply of new loans, thereby further deepening economic downturns or prolonging the recession. Thus, the procyclicality of bank loans is likely to be increased if the New Basel Accord leads capital requirements to fluctuate even more compared to the past.

Basel II will offer two approaches (standardized and internal-ratings based) for the setting of credit risk-based capital requirements. Under the Standardized Approach (SA), banks will be permitted to make use of external credit ratings given by the acknowledged rating agencies, so called ECAI (external credit assessment institution) to apply different risk weights that ranges from 20% to 150%. Rating agencies estimate borrowers' risk considering their profitability and growth potential, which are inherently procyclical, to assess their credit ratings, thus these ratings generally tend to move upward (downward) in booms (recessions).

Under the Internal-Ratings Based (IRB) Approach, banks are allowed to use internal ratings of credit risk to calculate minimum required capital that implies even more sensitive risk weights that ranges from as little as 3% to as much as 600% and more. As the risk factors, such as the probability of default (PD) of the borrower set by the bank, loss given default (LGD) which would be experienced were the borrower to fail, and exposure at default (EAD), tend to increase in booms and decrease in recessions, it is

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

quite natural to expect higher cyclicity of the minimum capital requirements. Further, since credit ratings measured by banks' internal model using PIT method are known to be more volatile through the business cycle than those by rating agencies using the TTC method, the more banks choose the IRB Approach, we would expect the higher procyclicality of bank lending.

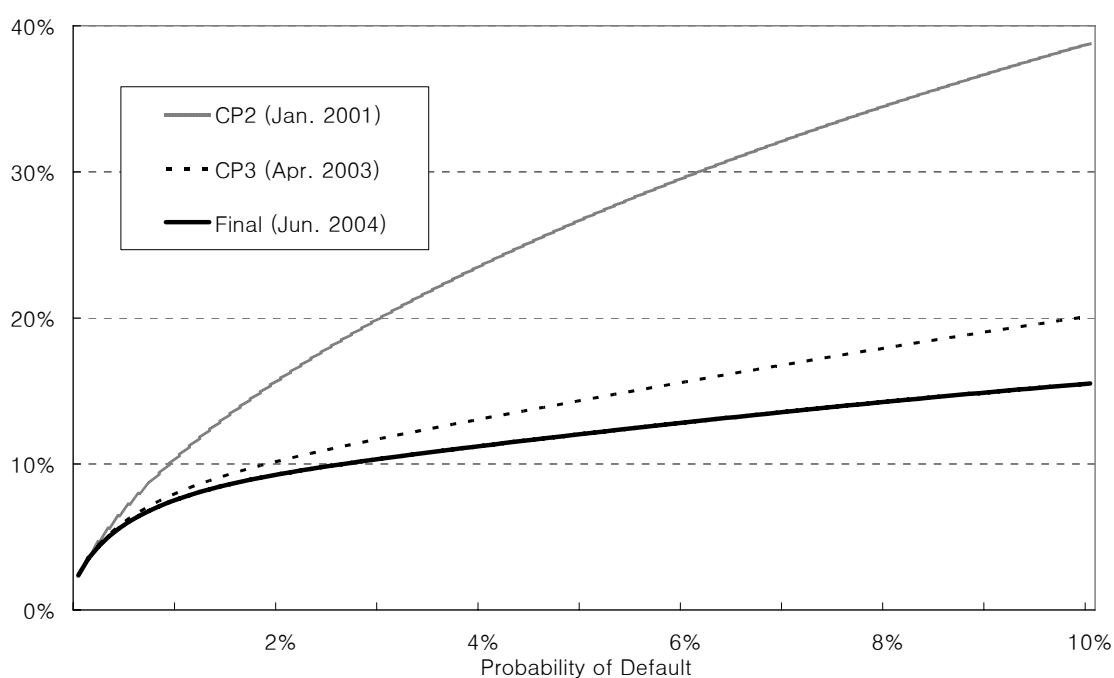
At an earlier stage when the first draft of the Basel II was released, extensive debates have been prompted in policy circles concerning the potential procyclicality effect of bank loans due to the more risk sensitive capital requirements (*e.g.* Segoviano and Lowe, 2002; Borio *et al.*, 2001; Turner, 2000). They argued that implementation of Basel II significantly extends the procyclicality of bank lending and economies are highly likely to have larger swings in their business cycle, which will negatively affect the stability of financial system. Some economic literature also backed up those arguments by providing the simulation results that the minimum capital requirement will fluctuate more counter-cyclically under Basel II and interpreting these results as indirect evidence to predict that bank lending would become more procyclical. For example, Segoviano and Lowe (2002), using a transition matrix constructed with internal credit ratings of banks in Mexico, examines how capital requirements might have changed over time if Basel II's Foundation IRB (F-IRB) Approach had been in place. They conclude that minimum capital requirement could have increased significantly in the aftermath of the Peso Crisis of December 1994 and that if actual capital shows the same cyclical variation under the New Accord, business cycle fluctuations may be amplified.³ Catarinew-Rabell, *et al.* (2003) also examines the potential procyclicality of bank loans under Basel II and the implications of the choice of loan rating scheme for the implementation of the new accord. They find that the likelihood of sharp increase in capital requirements in recessions could be bigger under Basel II when rating schemes of banks are conditioned on the current point in the cycle (*i.e.* PIT type), but rating schemes designed to be more stable over the cycle (*i.e.* TTC type), akin to those of the external rating agencies, would increase procyclicality in a smaller scale.

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

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

which need lower capital requirements and are less risk sensitive.⁴ For the banks to adopt the IRB Approach, it is recommended that they consider the business cycle effects when making decisions on the borrowers' credit ratings, which implicitly encourage banks to estimate TTC ratings instead of PPT ratings. In addition, the Committee has emphasized that adequate stress testing under the Pillar 2 would dampen the cyclical impact of Basel II since banks need to show that their capital is sufficient to cope with a recession without a reduction in their lending.

[Chart 1] Capital Requirements for Corporate Exposures under Basel II



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

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

However, it is still questionable whether these modifications are relevant to most banks in developing countries since the revisions of Basel II mentioned above have been based on the sophisticated financial technique of banks in G-10 countries or other Basel Committee member countries and the risk profiles of their asset portfolio. That is, though it could be reasonable for advanced countries to expect that the capital requirements of their banks and the procyclicality problem under revised Basel II might not significantly increase from those under the current regime,⁵ it is uncertain that similar outcome could be expected in developing countries, given that their economies have experienced relatively greater uncertainties and volatilities than major advanced countries. Hence, the impact of Basel II and its inherent procyclicality is still an important concern for developing countries.⁶

Extending the scope of Segoviano and Lowe (2002), Hong (2004) arrives at the conclusion that similar findings about procyclicality of bank lending under Basel II would hold in Korea. Utilizing corporate exposure data for a major Korean bank, which include borrowers' internal ratings, credit scores, historical default rates, outstanding exposures, and overdue status, he finds that, though the SA of Basel II is not likely to raise minimum capital requirements to any great extent in Korea, the capital requirements under the F-IRB Approach would have increased significantly in the recession after the 1997 Crisis, if Basel II had been in place in Korea, and argues that Advanced IRB (A-IRB) Approach with PIT type credit risk models are likely to lead to much more volatile capital requirements than the F-IRB Approach. He also argues that the potential impact of Basel II on the movement of capital requirements would be significant for developing countries during recessions and that the advanced approaches of Basel II may not provide incentives for significant banks in developing countries to reduce regulatory capital requirements since the calibration and revisions of Basel II have not been based on a broader area of samples that include those banks.

Meanwhile, we observe that most banks maintain excess capital (buffer capital) over the required minimum. Using a large data set of over 7,000 bank-year observations from twenty-nine OECD countries, Bikker and Metzermakers (2004) presented that between 1994 and 2001, the median BIS ratio fluctuated for around 12.2%, an ample 50% above

⁵ Note, however, that this may not be true. Goodhart *et al.* (2004), using Moody's data for the USA from 1982 to 2003, for Norway from 1988 to 2001, and for Mexico from 1995 to 2000, shows that procyclicality may well still be a serious problem with Basel II, even after the smoothing of the risk curves.

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

the minimum.⁷ These observations underline that banks have incentives to set a target level of capital independently from regulations. Banks may assess the risk of their asset portfolio as being higher than the outcome of the Basel I scheme. Or they may be more risk averse and wish to hold capital buffers for funding at lower costs. Banks also have incentives to keep buffers above the required minimum capital adequacy ratios, both for their protection against sanctions taken by supervisory authorities and to satisfy rating agencies, and these buffers are likely to be raised during booms when the required minimum may fall to extremely low levels (Goodhart *et al.*, 2004).

Given their buffer capital, the capital requirement under Basel II may not be a binding constraint on banks' lending operations. If banks' capital targets are generally well above the minimum requirements and the buffer capital fluctuates in a way that reduces the volatility of capital, the procyclicality of bank loans would be mitigated. If the existence of buffer capital reflects that banks already adjust their capital to cover the risk assessed more than that is implied by Basel I, the procyclicality will increase only to a limited degree even under Basel II.

Therefore, findings of previous studies based on the regulatory capital without any considerations on the buffer capital will not be sufficient evidences for addressing the potential problem of the procyclicality. That is, even if the minimum capital required by regulations fluctuate to a greater extent under Basel II, it is necessary to investigate the movement of total capital of banks, since banks tend to hold substantial capital buffers on top of minimum requirements and fluctuations of bank lending will depend not only on the regulatory capital but also on the buffer capital.

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

III. Empirical Analysis

1. Motivation

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

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

Indeed, it is often argued that the adverse impacts of the new risk-sensitive bank capital regulation on business cycle fluctuations appear to be larger in developing countries. Since capital market is less developed and thus firms are more bank-dependent in developing countries, it is more difficult for firms to find an alternative source of funds when the supply of bank credit decreases. Recently, Huizinga and Zhu (2006) examine how financial structure matters for macroeconomic volatility and find that aggregate output is more variable in case of heavy reliance on debt financing. Their study indicates that countries with less developed capital market would experience more volatile business cycle.

Moreover, we can imagine that asymmetric information problems between lenders and borrowers are severe in developing countries. Reliable information on firms' credit risk, in particular on small firms' risk, is not largely available in developing countries.

Banks' lending decisions in these countries, therefore, depend heavily on collateral values that borrowers can provide. Theories on credit cycles predict that collateral-based lending practice can generate a finance-based propagation mechanism through which business cycle fluctuations are amplified. In recessions, a fall in asset prices lowers the collateral values and thereby reduces the amount of bank loans. The decrease in bank loans, in turn, aggravates business cycle downturns. Pro-cyclical collateral values along with banks' lending practice intensify the concerns about the adverse impacts on business cycle.

2. Empirical Specification and the Data

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

$$\begin{aligned}
 BUF_{ijt} = & \alpha + \beta_1 BUF_{ijt-1} + \beta_2 ROE_{ijt} + \beta_3 NPL_{ijt} + \beta_4 RW_{ijt} + \beta_5 SIZE_{ijt} \\
 & + \beta_6 LOAN_{ijt} + \beta_7 ROA_{ijt} + \gamma GDP_{jt} + e_{ijt},
 \end{aligned}$$

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

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

The empirical model in this paper is consistent with a simple partial adjustment model, in which a bank's current buffer capital ratio adjusts to its optimal level. Motivated by real investment models, Ayuso, Perez, and Saurina (2004) provide a theoretical background derived from a cost minimizing problem of a representative bank. Estrella (2004) also presents a dynamic model of optimal capital in which banks minimize costs associated with failure, holding capital, and flows of external capital.

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

We assume that the cost of capital is proportional to the level of capital and approximated by the returns on equity (ROE). To the extent that ROE reflects the cost of raising and holding capital, ROE is expected to be negatively correlated with buffer capital ratio. We expect that NPL and RW proxy for the risks that banks may face. Banks with more impaired loans may have higher probability of default and thus need to increase the buffer capital ratio. Similarly, higher RW implies that asset portfolio is riskier, leading higher probability that the bank fails to meet the required capital adequacy ratio. Thus, the expected signs of the coefficients on NPL and RW are positive.

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

In addition, we include loan growth rate and ROA in the regression. Suppose that total capital is constant or adjusting capital is very costly. Then, an increase in loans implies an increase in required capital and a decrease in buffer capital, which lowers buffer capital ratio. Therefore, as far as loan growth is pro-cyclical, buffer capital ratio is likely to be negatively correlated with business cycle. Including loan growth rate allows us to examine additional cyclical pattern of buffer capital, controlling for this

possibility of mechanical negative correlation. We include ROA for similar reason as ROA indicates the ability to retain earnings which is an important part of capital.

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

Our main purpose of the regression analysis is to investigate the relationship between buffer capital ratio and the business cycle, controlling for other potential determinants of buffer capital ratio. The coefficient estimate on GDP growth provides evidence on how the banks have changed buffer capital over the business cycle. We further investigate whether the cyclical pattern of buffer capital ratio is different between advanced countries and emerging market Asian countries. To do this, we construct regional dummy variables to test for the differential effect of business cycle on the buffer capital. Asian countries include Hong Kong, Singapore, Taiwan, Thailand, Malaysia, Indonesia, Philippines, and Korea.⁸ Among the OECD countries, we select and construct a dummy variable for Basel committee member countries which are believed to have more advanced banking industry.⁹

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

3. Estimation Results

Table 1 presents the sample mean of the bank characteristics for each country group. The average buffer capital ratio in our sample is 50.6% which is equivalent to 12.1% of BIS capital ratio. Banks in Asian countries maintain much higher buffer capital and BIS capital ratio than OECD countries during the sample period. The outbreak of East Asian financial crisis in 1997 and the subsequent restructuring of financial institutions in East Asia could cause higher buffer capital ratio in the region, yet the number is still above

⁸ Although Korea is an OECD member, we classify Korea as an Asian country.

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

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

70% over the period 2002-2004. Financial crisis also explains high non-performing loan ratio (NPL) in Asian countries.

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

Table 1: Sample mean of bank characteristics

	Total	OECD	Basel	US	Other OECD	Asia
BUF	50.56	47.79	47.62	58.41	50.08	80.87
BIS	12.05	11.82	11.81	12.67	12.01	14.47
ROE	10.97	11.30	11.11	15.59	13.81	7.35
NPL	3.31	2.89	2.90	0.68	2.79	7.95
RW	94.36	78.54	72.91	73.83	151.44	267.52
SIZE	8.66	8.66	8.57	8.54	9.87	8.70
LOAN	9.65	9.81	9.37	12.13	15.51	7.90
ROA	0.90	0.92	0.91	1.32	0.95	0.69

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

The coefficient on the lagged buffer capital ratio is estimated significantly, suggesting a substantial adjustment cost. The coefficient estimate on ROE, a proxy for the cost of capital, is negative and statistically significant, implying that higher cost of capital has a negative impact on bank's capital accumulation. The buffer capital ratio, however, is not correlated with our risk proxies. The coefficient estimate on NPL is negative though not statistically significant. This result is counter-intuitive because

theory predicts that high-risk banks are better capitalized relative to their overall level of risk. Ayuso, Perez, and Saurina (2004) also find that buffer capital ratio is negatively correlated with NPL. They argue that the estimated sign is negative since NPL is an ex-post measure of risk. We find a positive correlation between buffer capital ratio and RW, yet the coefficient estimate is never significant.

Meanwhile, we find that the coefficient on SIZE is negative, though significant only at 10% level. It predicts that large banks are more likely to hold less buffer capital. The negative size effect, as discussed earlier, is consistent with economies of scale, the ability to diversify risks, or ‘too big to fail’ hypothesis. Previous studies also report negative size effect. As expected, we find buffer capital ratio is negatively correlated with loan growth rate and positively correlated with ROA.

Now we turn to the estimated relationship between buffer capital and business cycle. Model I in Table 1 shows that coefficient estimate on GDP is 0.17, but not statistically significant, implying that, on average, buffer capital ratio is not correlated with business cycle. Since the estimation results in Model II and Model III are qualitatively the same, we conclude that year dummy variables or loan growth rate do not affect the estimated cyclical aspect of buffer capital ratio.¹¹

Table 2: Estimation results I

	Model I	Model II	Model III
Constant	44.875 (2.22)**	44.214 (2.34)**	21.264 (1.19)
Lagged Dep. Var.	0.641 (9.64)***	0.641 (9.66)***	0.645 (9.66)***
ROE	-0.542 (-3.33)***	-0.533 (-3.33)***	-0.558 (-3.36)***
NPL	-0.283 (-1.63)	-0.279 (-1.61)	-0.034 (-0.19)
RW	0.001 (0.45)	0.001 (0.40)	0.001 (0.36)
SIZE	-0.518 (-1.73)*	-0.538 (-1.75)*	-0.255 (-0.85)
LOAN	-0.298 (-9.72)***	-0.297 (-9.87)***	
ROA	10.015 (4.17)***	9.915 (4.16)***	9.847 (3.98)***
GDP	0.166 (0.75)	0.010 (0.06)	0.231 (1.00)
Country dummy	Yes	Yes	Yes
Year dummy	Yes	No	Yes
No. observation	3907	3907	3907
R2	0.70	0.70	0.69

¹¹ Other balance sheet variables are also correlated with business cycle. For example, ROE tends to increase in expansionary periods while NPL rises in recessions.

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

The findings in Table 1 suggest that, in general, buffer capital ratio does not fluctuate systematically over the business cycle. Nevertheless, it is possible that buffer capital ratio shows pro-cyclical or counter-cyclical patterns in some countries or regions. We attempt to find a heterogeneous behavior among country groups.

Table 3 presents the estimation results from the regression allowing for a possibility of different correlation between buffer capital ratio and business cycle across country groups. The second column in Table 3 reports the coefficient estimates on GDP along with other coefficient estimates for two country groups: Asian countries and OECD countries.¹² In contrast to Table 2, the estimation result in Table 3 tells a different story: buffer capital is positively correlated with GDP in OECD countries while negatively correlated with GDP in Asian countries. The coefficient estimate is 1.06 for OECD countries and it is statistically significant, but it is -0.55 for Asian countries with marginal significance.

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

The estimation results in Table 3 show different cyclical patterns of buffer capital across country groups. The buffer capital ratio rises in Basel committee member countries while it declines in Asian countries in the periods of high economic growth. These findings suggest that, once Basel II is implemented, Asian countries are more likely to observe an increase in output volatility. The empirical findings reinforce the concern that developing countries are more likely to be influenced by the new bank capital regulation. Indeed, since bank credit is the more important source of funds in

¹² Korea is a member of OECD, but is included in Asian country group.

developing countries, a decrease in bank loans might exacerbate economic recession more severely. In advanced countries such as Basel committee member countries, in contrast, the pro-cyclicality issue might not be a great concern. Nevertheless, it should be noted that the empirical results are from the regression using the sample observations under Basel I and the predictions are based on the assumption that banks continue to maintain their behavior under Basel II. If banks change their behavior under Basel II, our predictions may be changed.

Table 3: Estimation Results II

	I	II	III
Constant	48.310 (2.38) **	44.143 (2.19) **	44.474 (2.21) **
Lagged Dep. Var.	0.640 (9.64) ***	0.640 (9.65) ***	0.640 (9.65) ***
ROE	-0.551 (-3.39) ***	-0.557 (-3.44) ***	-0.547 (-3.36) ***
NPL	-0.291 (-1.68) *	-0.295 (-1.70) *	-0.307 (-1.77) *
RW	0.002 (0.69)	0.001 (0.28)	0.001 (0.27)
SIZE	-0.528 (-1.76) *	-0.551 (-1.84) *	-0.583 (-1.93) *
LOAN	-0.296 (-9.67) ***	-0.293 (-9.61) ***	-0.292 (-9.57) ***
ROA	10.035 (4.19) ***	10.052 (4.20) ***	9.965 (4.15) ***
GDP OECD	1.055 (2.46) **		
Basel		2.032 (5.26) ***	
USA			2.753 (4.39) ***
others			1.527 (3.39) ***
Non-Basel		-0.208 (-0.56)	-0.178 (-0.48)
Asia	-0.545 (-1.98) **	-0.490 (-1.78) *	-0.511 (-1.86) *
Country dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
No. observation	3907	3907	3907
R2	0.70	0.70	0.69

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

IV. Policy Implications

Empirical findings in this paper suggest that developing countries need appropriate policy responses to the potential pro-cyclicality problems under Basel II. In what follows, we review some policy recommendations which have been discussed among academics and policy circles.¹³

First, the financial supervisory authorities need to encourage banks to have longer time horizon over which risk is measured and managed.¹⁴ It is important to recognize that risk is actually building up in booms, and that bad loans are materialized in recessions, which does not necessarily imply an increase in risk. If banks do not underestimate risks in booms and do not over-estimate risks in recessions, the potential problem of excessive business cycle fluctuation could be alleviated. For this purpose, the supervisory authorities can establish rules contingent to business cycle to promote long-horizon risk measurement. In fact, the Basel Committee recommends banks to adopt the IRB Approach in the revised draft of the new accord, in which banks are encouraged to use forward looking TTC method instead of PPT ratings for their credit rating system.¹⁵

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

¹³ Borio, Furfine, and Lowe (2001) provide a good reference on the policy options to the pro-cyclicality problems.

¹⁴ If banks have excessively long horizon to the extent that the measured risk converges to the historical average, capital requirement would become less sensitive to risk. Thus, it should be addressed that excessively long horizon is not consistent with the main goal of Basel II to achieve the stability in banking system.

¹⁵ Catarineu-Rabell *et al.* (2003) also concludes that, under the IRB Approach with PIT method where current information on borrowers' equity price and book liabilities is used to obtain estimates of borrowers' probability of default, and the risk weights determined based on this model are highly sensitive to current economic conditions since cyclical effects in asset valuation would be reflected in the default probabilities.

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

V. Concluding Remarks

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

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

These findings suggest that some appropriate policy responses will be requested, especially in Asian developing countries. Regulatory authorities of these countries should keep in mind that the possibility of expanding procyclicality can be emerged as the most critical constraint on the economic policy planning, especially in a downturn. Therefore, successful implementation of the new capital standard will depend on how one might design a credible, transparent formula that links capital requirements to some measure of aggregate economic conditions. This is a difficult question and one that we are not prepared to answer fully.

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

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

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