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# THE CYCLICAL PATTERNS OF CAPITAL BUFFERS: EVIDENCE FROM JAPANESE BANKS

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## *Abstract*

This study explores the relationship between banks' choice of capital buffers and prevailing macroeconomic conditions. Considering the unique features of Japan's economy and diverse capital adequacy standards, I analyze the data of Japanese commercial banks from 2002 to 2012. I find a negative relationship between capital buffers and the phases of the business cycle, but a positive relationship for internationally active banks. The negative signs were larger in magnitude and of higher significance level when including crisis dummies. The findings suggest that the capital buffers of internationally active banks behave in a counter-cyclical manner; however, during crises, the capital buffer patterns became procyclical.

*Keywords:* Bank regulation; Business cycle; Capital buffers; Counter-cyclical; Pro-cyclicality
*JEL Classification:* G21; G28

## I. *Introduction*

There has been much debate over the "pro-cyclical" nature of bank capital requirements since the 2004 release of the Basel II guidelines by the Basel Committee on Banking Supervision. During economic upturns, bank capital requirements would decrease, which would encourage banks to take on risk. Consequently, banks would extend credit without building up sufficient capital for potential future losses. This holds true even during economic upturns, when profits increase relatively easily, and it is cheaper to raise external capital. During economic downturns, borrowers are more likely to be downgraded, so banks must increase their capital. Since it is difficult for banks to raise external capital during recessions, they would reduce loans and dispose of assets to meet the regulatory minimum capital requirements (Repullo and Suarez, 2013; Borio and Zhu, 2012). The adoption to Basel II was expected to take place gradually, but with the breakout of the global financial crisis, Basel III was implemented. It called for improvements to macro-prudential regulations, particularly related to the pro-cyclicality issue. There was concern that the drastic regulatory changes and timing of the implementation might lead to non-convergence.

These interactions between the financial and real sectors, referred to as pro-cyclicality, can

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amplify business fluctuations and exacerbate financial instability. Therefore, addressing pro-cyclicality in the financial system may be essential to strengthening regulatory frameworks.

Previous research, such as that by Francis and Osborne (2010), suggests that capital requirements will undoubtedly influence banks' capital management practices. Banks can respond to the change in capital requirements and adjust their capital ratios in several ways. They can alter their capital ratio by raising new capital, retaining a higher proportion of their earnings, or in terms of their risk-weighted assets, adjusting the on-and-off-balance sheet composition.

In dealing with the pro-cyclicality problem, capital management practice is undoubtedly crucial. In academia, however, the evidence on capital management practices is rather mixed. Some previous studies (Ayuso *et al*., 2004; Jokipii and Milne, 2008; Stolz and Wedow, 2011; Shim, 2012; Chen and Hsu, 2014; Huang and Xiong, 2015) provide evidence that capital buffers behave in a pro-cyclical manner,[1] while others show contrary results; that is, capital buffers behave counter-cyclically (Jokipii and Milne, 2008;[2] Gursoy and Atici, 2012; Kontbay-Busun and Kasman, 2015). These studies use data from different countries or regions in the U.S. and Europe, and there is little research using data from Asian countries.

Japan has dual standards for setting capital requirements. The capital adequacy minimum for domestic banks is four percent, while it is just eight percent for internationally active banks. The different capital adequacy minimums create varying levels of regulatory pressure, which will further influence banks' capital decisions. This unique feature of the Japanese banking industry sheds light on their capital adjustment behavior. Policymakers are concerned about this type of behavior because capital buffer behavior will affect macro-economic output overall in the long run. This will also assist in their ongoing effort to design more efficient regulations to deal with pro-cyclicality. These results may establish a benchmark for understanding how banks set their capital management practices in light of this divergence and the subsequent policy implications, particularly Basel III.

Japan is infamous for its long economic stagnation following the collapse of the asset price bubble in late 1991 and early 1992. Japan experienced not only the "lost decade," but lost decades, or *ushinawareta nijyuunen* (Fukada, 2018), and the effects of the stagnation lingered until 2010. Even though more than 25 years have passed since the market crash, a full accounting of its effects has yet to be realized.

Considering the recent macroeconomic trends, economic stagnation is not a phenomenon limited to Japan. After the Great Recession of 2007-2009, many commentators, economists, and governments of Western countries drew conclusions about the conditions of economic stagnation that are evident in developed countries. Many warned that developed countries are in danger of experiencing a "lost decade" or are becoming "enmeshed in a Japanese-style deflationary outcome" (Chan, 2012). In fact, conditions in the G7 reflect the trend of stagnation, with low interest rates and limited inflation rates informing their economic conditions. The research on capital management practices is inconclusive due to heterogeneous results. The

[1] For clarification, I refer to pro-cyclical co-movement or fluctuations as the correlation of a variable of the cycle. Thus, a negative (positive) coefficient of the business cycle in the buffer regressions is an indicator of a counter- (pro-) cyclical fluctuation of capital buffers over the business cycle. This suggests pro- (counter-) cyclical behavior of capital buffers. The term pro-cyclical does not carry the sense that the variable amplifies business cycle fluctuations.

[2] Pro-cyclical behavior of capital buffers was found in 15 EU countries in 2004 using an international bank database; however, others find counter-cyclical behavior using a sample limited to the RAM10 in 2004.

long-term economic stagnation in Japan creates an optimal setting in which to evaluate banks' capital decisions.

To the best of my knowledge, there is no conclusive evidence on banks' capital decisions under such economic conditions. This research makes a first attempt to address this gap by investigating the extent of pro-cyclicality problems in Japan during the long period of economic stagnation. I use data from Japanese commercial banks from 2002 to 2012. This study aims to provide a better understanding of banks' diverse capital management practices. In addition to the sample period, I employ two crisis dummies with different attributes to explore the cyclical pattern of capital buffers further. I explore the relationship between banks' choice of capital buffers and macroeconomic conditions while controlling for other factors that affect banks' capital management practices. I extend the previous research on banks' responses to changes in regulatory capital requirements to evaluate the extent to which these responses depend on bank-level characteristics and macroeconomic conditions. These issues are vital to arriving at a clearer picture of banks' behavior, which is important for policy considerations and revisions to create a more comprehensive regulatory regime. Moreover, the results of this study establish a benchmark for banks' capital decisions for developed countries, which is currently informed by the trend of economic stagnation. This paper contributes to the existing literature by examining the behavior of capital buffers under an expanded range of diversion in capital adequacy minimums during long-term economic stagnation.

I find negative and significant relationships between capital buffers and the phases of the business cycle. In other words, the capital buffers of Japanese commercial banks behave pro-cyclically, informing the adoption of myopic capital management practices. On the other hand, positive and significant relationships between capital buffers and the phases of the business cycle appear for internationally active banks. In the overall sample period, I find positive signs for internationally active banks, indicating that the counter-cyclical behavior of capital buffers. However, these positive signs lose resiliency during a crisis period and the capital buffer of internationally active banks behave pro-cyclically during crisis periods. This result supports the notion that internationally active banks are under higher regulatory pressure and therefore have a stronger incentive to maintain ample capital buffers. However, the counter cyclical pattern of capital buffers for internationally active banks is not sustainable during crisis periods.

The remainder of this paper is organized as follows. Section 2 reviews related studies and the institutional background. Section 3 develops the hypotheses. In Sections 4 and 5, I describe the econometric approach and the data and sample, respectively. In Section 6, I present the empirical results. Finally, Section 7 summarizes the findings and conclusions.

## II. *Related Literature and Institutional Background*

In this review of the literature, I first explain the cyclical behavior of capital buffers. Second, I address the relationship between the cyclical behavior of capital buffers and the Basel Accords. Finally, last subsection provides some institutional background on the dual capital adequacy standards and economic conditions.

## 1. Capital Management Practices

Recent studies investigate the cyclical behavior of capital buffers. However, they find conflicting results, making the evidence on the cyclical pattern of capital buffers inconclusive. The cyclical behavior of capital buffers is mainly either pro-cyclical or counter-cyclical.

If capital buffers are negatively associated with a business cycle proxy, then the capital buffers exhibit pro-cyclical behaviors, meaning that banks do not sufficiently build up their capital buffers for the additional risk arising from portfolio expansion during economic upturns. During economic downturns, banks face challenges, as capital costs rise dramatically and their capital buffers erode due to the write off of bad debts. These behaviors are considered short-sighted or myopic. Some of the literature finds general evidence of pro-cyclical behavior in buffers (e.g., Bikker and Metzemakers, 2004; Ayuso *et al*., 2004; Linquist, 2004; Jokipii and Milne, 2008; Stolz and Wedow, 2011; García-Suaza *et al*., 2012, Shim., 2012; Saadaoui, 2014; Chen and Hsu, 2014; Huang and Xiong.; 2015) after controlling for other bank-level buffer determinants such as size, risk profile, and the cost of capital.

However, some studies find that capital buffers behave counter-cyclically (e.g., Jokipii and Milne, 2008; Gursoy and Atici, 2012; Kontbay-Busun and Kasman, 2015). If capital buffers are positively associated with a business cycle proxy, then the implication is that capital buffers will behave counter-cyclically. This means that banks will increase their capital levels during economic upturns or relatively favorable economic conditions. The timing of these increases to cover potential future losses makes them relatively easy and cheap. This counter-cyclical behavior is considered forward looking, and if banks adopt this forward-looking capital management practice over the long term, then banks should fulfill the "counter-cyclical buffer" requirement in Basel III relatively easily. Some of the studies that analyzed samples across countries find variations in the cyclical patterns of capital buffers, while others find that cyclical patterns diverge depending on bank size or other characteristics (e.g., Jokipii and Milne, 2008; Vu and Turnell, 2015[3]; Carvallo *et al*., 2015[4]).

While some studies find significant relationships between capital buffers and a business cycle proxy, the banks' characteristics led to the conclusion that capital buffers may be only moderately counter-cyclical or moderately pro-cyclical. Banks with low capitalization facing the pressure of low capital do not reduce loan supply during downturns (Stolz and Wedow, 2011). This behavior is contrary to myopic behavior.

## 2. The Basel Accord and Capital Management Practices

The Basel Accords set capital requirements to maintain banks' soundness. Basel I was set in 1988. In 2004, the Basel Committee on Banking Supervision proposed revisions to capital regulations. This resulted in Basel II, which came into force in 2007. In Japan, Basel I was implemented in 1992 and Basel II was implemented at the end of 2006.

In contrast to Basel I, the capital charges of Basel II are based on the quality of the asset

[3] In Australia, they find evidence of pro-cyclical behavior for large banks and counter-cyclical behavior for smaller banks.

[4] Using a sample of 13 Latin American and Caribbean countries from 2001 to 2012, the authors find that only capital buffers in Bolivia, Brazil, Mexico, Panama, and Venezuela behave pro-cyclically.

rather than the type of asset. Banks can choose from several approaches. The standard approach is based on the borrower's public ratings by attributing specific risk weights to each rating class. Alternatively, banks can choose the internal ratings-based approach (IRB), which allows them to employ their own internal rating systems to weigh the creditworthiness of their debtors. In Basel I, the total capital charges were 8% of risk-weighted assets, and all credit assets received the same weight, regardless of the financial soundness of their debtors. This revision increased the sensitivity of the risk weighting system and led to a more sophisticated risk asset evaluation.

The revision yielded an obvious microeconomic benefit by reducing potential regulatory arbitrage. However, increasing the sensitivity of the risk weighting system (credit risk) will cause the capital requirement to become more cyclical. Consequently, banks might face capital management problems, especially during an economic downturn. This is despite the fact that it is difficult to raise capital during a downturn, and banks will simultaneously face a challenging situation in which capital costs are likely to increase, but their equity capital will decrease due to write offs in loan portfolios. The situation worsens if banks are forced to reduce their lending due to capital constraints. This pro-cyclicality could trigger a severe impact on the macro economy, in which the cycle will amplify and delay the recovery of financial stability. Several studies document the pro-cyclical effect of Basel II on the business cycle (Gordy and Howells, 2006; Heid, 2007; Hakenes and Schnabel, 2011).

### 3. Institutional Background

Japan has a dual set of capital requirements, one for domestic banks and another for uniform international standards. For the former, the capital requirement is four percent, while for the latter, the capital requirement is eight percent.

Japan has experienced difficult long-term economic conditions, including the "lost decade" (1991 to 2001) and effects that have lingered well into the 21st century. Thus, the term coined by Fukada (2018), *ushinawareta nijyuunen* (lost decades), refers to the long period of economic stagnation in Japan.

To summarize, considering the long-term economic conditions as the background and the existence of dual capital minimums, I employ the partial adjustment framework to explore the cyclical patterns of capital buffers in Japanese commercial banks and the influence of the dual capital requirements on the determination of the level of capital buffers.

## III. *Hypotheses*

In this analysis, I examine the cyclical patterns of capital buffers of Japanese commercial banks. The focus is on determining whether the capital buffers in Japanese commercial banks behave counter-cyclically, which triggers financial pro-cyclicality. There are two cyclical patterns in capital buffers.

First, if I find a positive coefficient of the business cycle in the buffer regression, then we can surmise that the capital buffer is counter-cyclical, which is considered prudent and forward looking. This positive relationship implies that during an economic upturn, when banks tend to expand their asset portfolios while simultaneously facing an increase in the potential risks,

banks increase their capital buffers in response to the incremental rise in risks because the cost of capital is lower. Banks increase their capital buffers more than average or beyond the optimal level to account for the risks arising from their expansion in lending, and this will also help to attenuate the potential loss effect during a downturn. Thus, during an economic downturn, when risk (credit risk) materializes, banks can utilize these higher capital buffers to maintain stability.

By contrast, if I find a negative coefficient of the business cycle in the buffer regression, then we can surmise that the capital buffer is pro-cyclical, which is considered myopic and short-sighted. This negative relationship implies that during an economic downturn, when resources are scarce and the cost of capital is high, banks need to build up their capital buffers to meet the capital requirement standard or decrease their assets by cutting credits dramatically. Banks engaging in this myopic behavior will greatly expand their asset portfolios but reduce their capital buffers to levels at or below the average level during an economic expansion, which is not sufficient to address the incremental increase in their risks. If banks reduce credit dramatically, then they might provoke a financial pro-cyclicality problem.

To delve deeper into the question of whether the cyclical pattern of capital buffers varies under different capital requirements, I differentiate between the banks that employ domestic and uniform international standards. Moreover, considering that economic conditions are a main indicator, I divide the analysis into several time frames.

For internationally active banks, I expect a greater level of counter-cyclical behavior in capital buffers since these banks have higher regulatory pressures, which gives them a higher incentive to maintain this cyclical pattern.

H1 $>$ 0 : The capital buffer is positively correlated with the cyclical indicator.

H2 $>$ 0 : The capital buffer for internationally active banks has a stronger positive correlation with the cyclical indicator compared to that for domestic standard banks.

## IV. *Methodology*

### 1. Partial Adjustment Model

I test the determinants of capital buffers through a dynamic model. Many researchers, including Ayuso *et al.* (2004), Estrella (2004), Jokipii and Milne (2008), and Francis and Osborne (2010) adopt this simple partial adjustment model I employ in this study (Equation (1)).

$$BUF_{i,t} - BUF_{i,t-1} = \theta(BUF^{*}_{i,t} - BUF_{i,t-1}), \quad (1)$$

where $\theta$ is a positive adjustment parameter, $i$ indexes banks and $t$ indexes time. Under this partial adjustment model, it is assumed that banks take time to adjust their capital buffer levels, which means that this adjustment is not instantaneous. Hence, bank $i$ only partially reaches its optimal capital buffer $BUF^{*}_{i,t}$, during the period between $t$-1 to $t$. $\theta$ reflects the speed of adjustment; if $\theta$ equals zero, then no adjustment is being made, and if $\theta$ is equal to 1, then the bank makes a full adjustment within one period. Because I use half-yearly data, one period is half a year. A faster speed of adjustment (a value greater than $\theta$) will lower the cost of

adjustment.

The optimal capital buffer level $BUF^{*}_{i,t}$ is not observable. Thus, I approximate the optimal capital buffer level $BUF^{*}_{i,t}$ as a function of the *N* explanatory factors I discuss in the last section.

$$BUF^{*}_{i,t} = \sum_{n=1}^{N} \delta' X_{n,i,t}, \tag{2}$$

where X is a vector of *N* explanatory factors that determine its target capital ratio and $\delta'$ is a vector of parameters, where $\delta' = (\delta_1 ..... \delta_n)$. Combining (1) and (2) gives the following model of a bank's choice of capital buffer:

$$BUF_{i,t} = (1-\theta) BUF_{i,t-1} + \sum_{n=1}^{N} \delta' X_{n,i,t}, \tag{3}$$

where $X_{i,t}$ is a vector of variables that influence bank *i*'s optimal buffer at time *t*, and $(1-\theta)$ reflects the costs of adjustments. The idea behind this specification is to evaluate the effect of such variables on the accumulation of capital buffers (Jokipii and Milne, 2008; Stolz and Wedow, 2011; Carvallo *et al*., 2015).

The introduction of a lagged dependent variable in the right-hand side variables in Eq. (3) creates an endogeneity problem, since the lagged dependent variable might correlate with the disturbance term. To solve this problem, I employ the difference GMM estimator developed by Arellano and Bond (1991) for the coefficients in the equation above, in which the lagged levels of regressors are the instruments for the equation in the first differences. However, as Blundell and Bond (1998) show, these instrumented variables lead to weak instruments, and might result in downward-biased estimates of parameters and the loss of asymptotic efficiency. Blundell and Bond (1998) developed a system GMM estimator that includes levels of lagged differences as instruments for the equation. On this issue, Arellano and Bover (1991) and Blundell and Bond (1998) suggest differencing the instruments instead of the regressors to make them exogenous to the fixed effects. This leads to a shift from the difference GMM to the system GMM estimator, which is a joint estimation of the equation in levels and first differences. I therefore use two-step system GMM estimators with the Windmeijer (2005) corrected standard error.

## V. *Data*

### 1. Sample

The main data source is the Nikkei Financial Quest database. The sample period is fiscal year 2002 to fiscal year 2012 on a half-yearly basis. The period of analysis covers 22 half yearly data sets. This study covers the implementation period of Basel I and Basel II, and is restricted to unconsolidated reports, as banks' observed behavior on a solo basis is one of the main objectives of this study. I limit the sample period to 2012 due to the introduction of "Abenomics," which consists of monetary easing, fiscal stimulus, and structural reforms. Moreover, the estimation period did not cover the full economic cycle; it covers a relatively favorable economic period and thus it is difficult to draw conclusions on whether and how banks behave during more prolonged economic downturns. The estimation period also includes the period in which the non-performing loans in the Japanese banking sector peaked and

Lehman shocks of 2008. I recognize that using data spanning a full economic cycle is a better choice for estimation; however, data limitations prevent me from proceeding further. The data consist of city banks, regional banks, and Tier 2 regional banks. I removed institutions subject to government intervention and those with less than five observations within the period from the sample. For banks involved in M&A activities, I handled the data based on the new Nikkei code. This yielded a sample size of 1795 observations. I collected the data on GDP growth from the Department of National Accounts Japan's quarterly estimation reports, and banks' financial data from NEEDS Financial QUEST.

## 2. Variables

According to Estrella (2004) and Ayuso *et al.*(2004), the adjustment cost is one of the major costs that affect buffer holdings. Banks face adjustment costs in the process of adjusting towards their optimum capital buffer levels. Estrella (2004) and Ayuso *et al.*(2004) test this cost using a lag of capital buffers (BUF (-1)) as a proxy for this cost. If the bank faces adjustment costs when adjusting toward the optimum capital buffer level, then I should find a significant and positive relationship between capital buffers and the lag of capital buffers.

I use the ratio of after-tax earnings to book equity (ROE) as a proxy of the direct opportunity costs of holding equity capital (Ayuso *et al*. 2004; Bikker and Metzemakers, 2004; Stolz and Wedow, 2005; Jokipii and Milne, 2008). I thus expect a negative relationship between capital buffers and ROE. In contrast, according to Jokipii and Milne (2008), ROE may exceed the remuneration demanded by shareholders and is therefore a measure of revenue rather than cost. A higher level of profits can substitute for capital as a cushion against unexpected losses. Moreover, raising capital through the market might be costly; thus, banks often use retained earnings to increase capital buffers. Hence, the expected sign of ROE is positive.

Capital reduces the likelihood of bankruptcy and financial distress costs, including both in the legal bankruptcy process and the loss of charter value (Keeley, 1990; Estrella, 2004). Stolz and Wedow (2011) and Francis and Osborne (2010) use the ratio of total risk-weighted assets over total assets (RISK). To avoid any potential endogeneity, in which the dependent variable is scaled by risk-weighted assets, I define RISK in lagged form in the specification (RISK (-1)), which represents the previous regulatory measure of asset risk. Haq *et. al.* (2014), using a sample of banks across 15 Asia-Pacific countries, find positive relationships between bank capital and bank risk. A positive relationship between (RISK (-1)) and capital buffers reveals that banks are attempting to mitigate the expected cost of failure. A negative relationship may indicate moral hazard behavior.

In addition, I consider loan loss provision (PROVISION) as an indicator of banks' own internal estimation of risk that reflects their managerial assessment of the losses embedded in their portfolio. A positive relation might be consistent with the interpretation that banks attempt to attenuate the expected costs of failures, while a negative relation would be consistent with moral hazard behavior.

According to the too big to fail (TBTF) hypothesis, big banks will keep a relatively low level of capital buffers compared to small banks, as they expect to benefit from government rescue measures when they face difficulties. In general, larger banks have greater investments and better diversification opportunities in their portfolios. Thus, with the power of diversificati-

TABLE 1. VARIABLE DESCRIPOTIONS

| Variables | Description | Expected sign |
|---|---|---|
| Capital Buffer (BUF) | Capital ratio as a parcentage after deducting the capital requirement<br>Variations in the computations of capital buffer<br>Intemationally Active Banks: 8 percentage points deducted from the capital ratio Domestic Banks: 4 percentage points deducted from the capital ratio | + |
| Lagged Buffer (BUF(-1)) | Lagged of capital buffer | + |
| Growth of the Gross Domestic Product (Semi-Annual) (GDP) | Growth rate in real Japanese gross domestic product (Semi Annual) | +/− |
| Growth of the Domestic Product (Annual) (GDP_A) | Growth rate in real Japanese gross domestic product (Annual) | +/− |
| Growth of the Gross Domestic Product (Prefecture) (GDP_P) | Growth rate in real Japanese gross domestic product (according to Prefecture) | +/− |
| Crisis Dummy 1 | Dummy equal to one for high level of non perfom-ing loans, (2002_2004) | − |
| Crisis Dummy 2 | Dummy equal to one for global financial crisis, (2008_2009) | − |
| Internationally Active Bank (INTER) | Dummy equal to one for international active bank | +/− |
| INTER*GDP | Intercept between INTER and GDP | +/− |
| INTER*CRISIS DUMMY 1 | Intercept between INTER and CRSIS DUMMY 1 | +/− |
| INTER*CRISIS DUMMY 2 | Intercept between INTER and CRSIS DUMMY 2 | +/− |
| Return on Equity (ROE) | Return on Equity | +/− |
| Size | Log of total assets | − |
| Loan Loss Provisions (PROVISION) | Ratio of loss provisions to total assets | +/− |
| Lagged Risk (RISK(-1)) | Lagged ratio of risk-weighted assets to the sum of total assets | +/− |
| Negotiable Certificate of Deposits (NCD) | Ratio of negotiable certificate of deposits to total deposits | + |
| Tier 1 (TIER 1) | Ratio of Tier 1 capital to total capital | +/− |
| Market Concentration (CONC) | Square of the ratio of total loans of each bank to the total loans of all banks | +/− |
| Market Concentration (CONC_P) | Square of the ratio of total loans of each bank to the total loans of all banks in a particular areas or prefecture | +/− |
| Internal Based Rating Dummy (IBR) | Dummy equal to one for banks that employ internal-based rating | +/− |

on, such banks require less capital compared to small banks, which may therefore reduce the cost of financing capital. Additionally, big banks can take advantage of the perception of a safety net for depositors, which allows them to maintain lower capital ratios or capital buffers. Numerous studies use the log of total assets (SIZE) to represent the size of banks when testing the TBTF hypothesis (Ayuso *et al*., 2004; Jokipii and Milne, 2008; Francis and Osborne, 2010). While the sign of SIZE can be either positive or negative, several prior studies find a negative relationship between SIZE and capital buffers.

The capital composition will influence the banks' ability to absorb losses. Thus, Francis and Osborne (2010) include the ratio of Tier 1 capital to total capital (TIER1) as a proxy for banks' capital quality. Banks with a larger ratio of high quality capital are considered financially sound and will tend to hold lower capital buffers.

Information about the changes in capital levels are observable in the market, which creates other sources of pressure for the banks in adjusting their capital level. It is harder to measure banks' capital management in light of the influential role of rating agencies (which have the

Table 2. Sample Descriptive Statistics

| Variables | N | Mean | Sttd. Dev. | p25 | p50 | p75 |
|---|---|---|---|---|---|---|
| Capital Buffer (BUF) | 2103 | 6.722 | 0.411 | 4.830 | 6.190 | 8.460 |
| Capital Buffer (Domestic Banks) | 1779 | 6.868 | 0.365 | 5.090 | 6.400 | 8.500 |
| Capital Buffer (Internationally Active Banks) | 324 | 5.919 | 0.642 | 3.120 | 4.460 | 7.870 |
| Growth of Gross Domestic Product (Semi-Annual) (GDP) | 2103 | 0.438 | 4.527 | -0.200 | 0.902 | 1.898 |
| Growth of Gross Domestic Product (Annual) (GDP_A) | 1278 | 0.746 | 2.425 | 0.500 | 1.200 | 2.000 |
| Growth of the Gross Domestic Product (Prefecture) (GDP_P) | 1278 | 0.768 | 3.731 | -0.452 | 1.053 | 2.346 |
| Internationally Active Bank Dummy (INTER) | 2103 | 0.154 | 2.344 | 0.000 | 0.000 | 0.000 |
| CRSIS DUMMY 1 (2002-2004) | 2103 | 0.261 | 1.685 | 0.000 | 0.000 | 1.000 |
| CRSIS DUMMY 2 (2008-2009) | 2103 | 0.181 | 2.126 | 0.000 | 0.000 | 0.000 |
| Return on Equity (ROE) | 2103 | 2.259 | 1.676 | 1.456 | 2.536 | 4.097 |
| Size (SIZE) | 2103 | 14.586 | 0.075 | 13.819 | 14.599 | 15.193 |
| Loan Loss Provisions (PROVISION) | 2103 | -1.135 | -0.453 | -1.415 | -1.020 | -0.732 |
| Tier 1 (TIER 1) | 2103 | 90.749 | 0.133 | 84.415 | 90.428 | 96.623 |
| Negotiable Certificate Deposits (NCD) | 2103 | 2.110 | 1.726 | 0.000 | 0.874 | 3.052 |
| Market Concentration (CONC) | 2103 | 0.481 | 2.762 | 0.095 | 0.203 | 0.365 |
| Market Concentration (Prefecture Based) (CONC_P) | 1260 | 10.854 | 2.014 | 1.606 | 8.291 | 13.032 |
| IBR | 672 | 0.180 | 0.380 | 0.000 | 0.000 | 1.000 |

Table 3. Correlations

| | BUF | GDP | ROE | SIZE | PROVISION | RISK | NCD | TIER1 | CONC |
|---|---|---|---|---|---|---|---|---|---|
| Capital Buffer (BUF) | 1 | | | | | | | | |
| Gross Domestic Product (GDPG) | 0.0097 | 1 | | | | | | | |
| Return on Equity (ROE) | 0.1876 | 0.1805 | 1 | | | | | | |
| Size | 0.1738 | -0.013 | 0.1489 | 1 | | | | | |
| Loan Loss Provisions (PROVISION) | 0.2631 | -0.0908 | 0.1664 | 0.2326 | 1 | | | | |
| Lagged Risk (RISK(-1)) | -0.168 | -0.0288 | -0.0484 | -0.1272 | -0.2865 | 1 | | | |
| Negotiable Certificate of Deposits (NCD) | 0.2429 | -0.0216 | 0.0669 | 0.4858 | 0.1616 | -0.0702 | 1 | | |
| Tier 1 (TIER 1) | -0.0785 | -0.2352 | -0.1884 | 0.0426 | 0.0266 | 0.0113 | 0.0283 | 1 | |
| Market Concentration (CONC) | 0.0578 | -0.021 | 0.0277 | 0.5195 | 0.1005 | -0.0447 | 0.2622 | 0.2148 | 1 |

same information as the regulator doe), which influences banks' funding costs. Therefore, banks with a low capital buffer will be under pressure from sources besides the regulator in responding to their capital adjustment. In other words, the other sources of pressure (i.e., market forces and rating agencies) may outweigh the capital requirement in influencing banks' choice of capital adjustment. Haq *et. al*. (2014), using a sample of banks in 15 Asia-Pacific countries, provide evidence that market discipline complements bank capital. Following Nier and Baumann (2006) and Haq *et. al*. (2014), I address this possibility by controlling for the

impact of market discipline by including a measure of market discipline (Ratio of Negotiable Certificate of Deposits to Total Deposits). The deposit insurance scheme does not cover negotiable certificates of deposit (NCD). Schaeck and Cihák (2012) show that competition creates incentives for greater capital retention; that is, market competition increases the level of capital holdings. Valencia and Bolanos (2018) include market concentration as a variable in their study on the effect of competition and business cycles on bank capital buffers internationally. I examine the market concentrations of total loans, computed as the square of the ratio of the total loans of each bank to the total loans of all banks in given years (CONC) as a proxy for market competition.

After determining the factors that influence capital buffers, I focus on gross domestic product (GDP) growth as a variable. This is a popular cyclical indicator in previous research. Prior studies tried to answer whether capital buffers pro-cyclically or counter-cyclically over the cyclical indicator. However, we cannot draw strong conclusions from it.

## VI. *Empirical Results*

In Table 4, I show the results of my baseline specification for the overall sample, which includes both domestic standard and internationally active banks. The coefficient on the lagged buffer (BUF (-1)) is highly statistically significant in all specifications, revealing the presence of significant adjustment costs for banks to change their capital buffers to their target amounts. The coefficients range from 0.65 to 0.75, which suggests that Japanese commercial banks adjust their capital buffers by about 25% half yearly. Thus, their optimal capital buffer levels are about 50% annually.

At first glance, Table 4, column 1, indicates no significant relationships between the capital buffer and GDP growth. I then introduced a dummy equal to one for internationally active banks (INTER) and the cross term of INTER and GDP. Table 4, row 2 shows that capital buffer is statistically significant and positively correlated with the cross term of INTER and GDP. In other words, it behaves counter-cyclically. Despite the GDP coefficient showing a negative sign, (-0.03), the overall marginal effect of GDP on the capital buffers of internationally active banks remains positive (-0.03+0.07=0.04). A one percent increase in GDP will lead to an approximate 0.04% increase in the capital buffer. In Table 4, column 3, the results are robust under different estimation specifications, suggesting that the counter-cyclical behavior of the capital buffers of internationally active banks is persistent. However, I find no significant relationships for domestic banks. One of the possible interpretations of this counter-cyclical behavior of capital buffers for internationally active banks might be related to the dual capital requirements in Japan. The average capital buffer of internationally active banks is around 5.92%, slightly lower than the average capital buffer of the whole sample (6.87%). This reveals that different standards in capital requirements do create different levels of pressure to build up capital buffers. Under stricter standards, internationally active banks are maintaining lower capital buffers compared to domestic banks. Internationally active banks may face higher regulatory pressure to fulfill the international standard capital requirements subject to Basel regulations. Thus, those banks have higher incentives to build up capital buffers during relatively favorable economic conditions in anticipation of unexpected losses or shocks in order to avoid the breach of regulatory minimums. Another possible interpretation of this positive and

TABLE 4. ESTIMATION RESULTS: DETERMINANTS OF CAPITAL BUFFERS, 2002 H2-2012H2

| | Expected Signs | (1) | (2) | (3) |
|---|---|---|---|---|
| (1) BUF(-1) | + | 0.339 *** | 0.301 *** | 0.295 *** |
| | | (0.046) | (0.045) | (0.045) |
| (2) GDP | +/- | -0.016 | -0.033 ** | |
| | | (0.012) | (0.014) | |
| (3) INTER | +/- | | -1.345 *** | -1.342 *** |
| | | | (0.268) | (0.269) |
| (4) INTER*GDP | +/- | | 0.070 ** | 0.052 * |
| | | | (0.032) | (0.031) |
| (5) ROE | +/- | 0.028 *** | 0.025 *** | 0.023 *** |
| | | (0.010) | (0.009) | (0.008) |
| (6) SIZE | - | 0.198 * | 0.363 *** | 0.392 *** |
| | | (0.102) | (0.118) | (0.122) |
| (7) PROVISIONS | +/- | 0.195 | 0.162 | 0.196 |
| | | (0.149) | (0.148) | (0.147) |
| (8) RISK(-1) | +/- | -0.019 | -0.026 | -0.025 |
| | | (0.029) | (0.029) | (0.029) |
| (9) NCD | + | 0.083 ** | 0.092 ** | 0.091 ** |
| | | (0.040) | (0.041) | (0.041) |
| (10) TIER1 | +/- | 0.010 * | 0.002 | 0.004 |
| | | (0.006) | (0.007) | (0.006) |
| (11) CONC | +/- | -0.063 | -0.006 | -0.026 |
| | | (0.078) | (0.078) | (0.072) |
| N | | 1795 | 1795 | 1795 |
| AR(1) | | 0.000 | 0.000 | 0.000 |
| AR(2) | | 0.107 | 0.098 | 0.199 |
| Hansen Test | | 0.575 | 0.505 | 0.545 |
| Year | | Yes | Yes | Yes |

*Notes:* Standard errors in parentheses *p<0.10,**p<0.05,***p<0.01. The Hansen is a test of the over-identifying restrictions for the GMM estimator. AR1 and AR2 are tests for the first-order and second-order serial correlation. N denotes the number of observations. Year denotes whether the regression contains the year dummy variables. BUF(-1) is the lag of bank's capital buffer; GDP is the growth in gross domestic products; INTER is a dummy variable that takes 1 for internationally active bank; ROE is the return on equity; SIZE is the log of total assets; PROVISION is the loan loss provisions; RISK(-1) is the lagged ratio of risk-weighted assets to the sum of total assets; NCD is the ratio of negotiable certificate of deposits to total deposits, TIER 1 is the ratio of Tier1 capital to total capital, and CONC is the square of the ratio of total loans of each bank to the total loans of all banks.

significant relationship between GDP and the capital buffer of internationally active banks may be due to the different customers and revenue sources, leading to the sensitivity of the capital adjustments of internationally active banks to macro-economic conditions.

ROE and SIZE are quite robust through all regressions. The coefficients on this variable are significantly positive across all specifications, indicating that banks use retained earnings to increase their capital buffer levels. The positive and significant coefficient of SIZE across all specifications shows that concern about TBTF does not seem to exist in the Japanese banking sector. In fact, larger banks with high revenues and better diversification opportunities in portfolios leave them with more room to improve their capital adjustment.

The coefficient of NCD is significantly positive across all specifications, revealing that market discipline affects the retention of capital buffers. However, market concentration proxied by CONC has no effect on capital buffers in statistical terms.

Finally, I add crisis dummies to explore the effect of different economic conditions on capital buffers. CRISIS DUMMY 1 represents the first period of 2002-2004, when the level of non-performing loans in the Japanese banking sector peaked and the capital adequacy ratios of major Japanese were at their lowest levels. CRISIS DUMMY 2 represents the second period, 2008-2009, when economic conditions fluctuated due to the global financial crisis in 2008. I also included the cross-term of INTER and each time dummy.[5]

Table 5, columns 1 and 3, indicate strongly negative and significant relationships between capital buffer and cross term of INTER*CRISIS DUMMY 1, suggesting that the capital buffers of internationally active banks behaved pro-cyclically in this period. The result in columns 1 and 3 imply that a one percent increase in GDP will lead to around a 1.25% decrease in capital buffers. The overall marginal effect GDP on the capital buffers of internationally active banks was negative during this period. Since 1988, the Japanese government injected funds to banks by purchasing subordinate bonds and preferred stocks to encourage banks to write-off non-performing loans. Given the history, one possible explanation of this negative relation is that Japanese major banks suffered serious damage to their financial soundness and were in the transition period to restore their financial soundness when the economy recovered. Thus, in this challenging situation, banks had almost no room to strengthen their capital buffers during that period, as writing off non-performing loans was the main target. The non-performing loans problem ended in 2005, when banks met the target of reducing the non-performing loans level by half (4%).

In Table 5 columns 2 and 4, I find that capital buffer is statistically significant and negatively correlated with the cross term of INTER*CRSIS DUMMY 2. In other words, it behaves pro-cyclically. The result in columns 2 and 4 imply that a one percent increase in GDP will lead to around a 1.90% decrease in capital buffers. The overall marginal effect GDP on the capital buffers of internationally active banks was negative during this period. Compared to the cross term of INTER*GDP, which covered the whole sample period, the change in capital buffer patterns implies that the counter-cyclical behavior of capital buffers is offset by the effects of the global financial crisis, and the counter-cyclical behavior did not continue once banks achieved a certain capital buffer level. I do not find positive signs on the cross term of INTER*GDP for the whole sample period when I include the crisis dummies. This result indicates that a loss in resiliency during crises or that shocks to Japanese commercial banks result in pro-cyclical behavior, which raises concerns about their financial soundness during crisis periods. Compared to the CRISIS DUMMY 1 period, in which the financial soundness of the Japanese banking sector was perceived as seriously damaged due to high levels of non-performing loans, the magnitude of the cross term INTER*CRSIS DUMMY 2 was larger. Despite the relatively small effect of the global financial crisis on Japan compared to other countries, it still prompted an unfavorable pro-cyclical pattern in capital adjustment.

For a robustness check, I employ both GDP_A and GDP_P considering that GDP_P might be a better alternative measure of GDP. Table 6, row 2, columns 1 and 2 show that capital buffers are positively and significantly correlated with GDP_A. Moreover, the capital buffers are

[5] CRISIS DUMMY 1 and CRISIS DUMMY 2 were dropped from the analysis due to collinearity.

TABLE 5. ESTIMATION RESULTS: CYCLICAL PATTERN OF CAPITAL BUFFER WITH THE DIFFERENT TIME FRAMES DUMMIES

| | Expected Signs | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| (1) BUF(-1) | + | 0.284 *** | 0.293 *** | 0.280 *** | 0.289 *** |
| | | (0.048) | (0.046) | (0.046) | (0.045) |
| (2) GDP | +/- | -0.013 | -0.024 ** | | |
| | | (0.012) | (0.012) | | |
| (3) INTER | +/- | -1.009 *** | -1.027 *** | -1.007 *** | -1.028 *** |
| | | (0.306) | (0.259) | (0.308) | (0.261) |
| (4) INETER*CRISIS DUMMY 1 (2002-2004) | +/- | -1.242 *** | | -1.256 *** | |
| | | (0.283) | | (0.287) | |
| (5) INETER*CRISIS DUMMY 2 (2008-2009) | +/- | | -1.882 *** | | -1.877 ** |
| | | | (0.234) | | (0.235) |
| (7) ROE | +/- | 0.025 *** | 0.030 *** | 0.025 *** | 0.028 *** |
| | | (0.009) | (0.009) | (0.008) | (0.008) |
| (8) SIZE | - | 0.396 *** | 0.352 *** | 0.401 *** | 0.358 *** |
| | | (0.111) | (0.118) | (0.109) | (0.119) |
| (9) PROVISIONS | +/- | 0.180 | 0.167 | 0.183 | 0.175 |
| | | (0.143) | (0.151) | (0.141) | (0.152) |
| (10) RISK(-1) | +/- | -0.024 | -0.028 | -0.024 | -0.029 |
| | | (0.028) | (0.029) | (0.029) | (0.028) |
| (11) NCD | + | 0.091 ** | 0.094 ** | 0.092 ** | 0.095 ** |
| | | (0.038) | (0.039) | (0.038) | (0.040) |
| (12) TIER 1 | +/- | 0.004 | 0.002 | 0.004 | 0.003 |
| | | (0.007) | (0.007) | (0.007) | (0.007) |
| (13) CONC | +/- | -0.039 | 0.012 | -0.041 | 0.008 |
| | | (0.075) | (0.079) | (0.074) | (0.078) |
| N | | 1795 | 1795 | 1795 | 1795 |
| AR(1) | | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | | 0.222 | 0.089 | 0.298 | 0.181 |
| Hansen Test | | 0.524 | 0.458 | 0.588 | 0.506 |
| YEAR | | Yes | Yes | Yes | Yes |

*Notes:* Standard erros in parentheses *p<0.10, **p<0.05, ***p<0.01. The Hansen is a test of the over-identifying restrictions for the GMM estimator. AR1 and AR2 are tests for the first-order and second-order serial correlation. N denotes the unmber of observations. Year denotes whether the regression contains the year dummy variables. BUF (-1) is the lag of bank's capital buffer, GDP is the growth in gross domestic prodcuts; INTER is a dummy variable that takes 1 for internationally active bank; CRISIS DUMMY 1 is a dummy equal to 1 for the period in which the Japanese banking sector recorded a high level of non-performing loans (2002-2004). CRISIS DUMMY 2 is a dummy equal to 1 for global financial crisis (2008-2009). ROE is the return on equity; SIZE is the log of total assets; PROVISION is the loan loss provisions; RISK(-1) is the lagged ratio of risk-weighted assets to the sum of total assets; NCD is the ratio of negotiable certificate of deposits to total deposits. TIER 1 is the ratio of Tier1 capital to total capital and CONC is the square of the ratio of total loans of each bank to the total loans of all banks.

highly statistically significant and positively correlated with the INTER dummy and the cross term of INTER*GDP_A. This result further confirms the results in Table 4. However, Table 6, column 3 shows, I find no significant relationships when using GDP_P. Using the second lag AR (2) as instruments is not valid in this analysis. Therefore, I cannot draw definitive conclusions.

TABLE 6. ROBUSTNESS CHECK: ALTERNATIVE MEASURES OF GROSS DOMESTIC PRODUCT GROWTH (ANNUAL & PREFECTURE), 2002-2012

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (1) BUF(-1) | 0.735 (0.045) *** | 0.735 (0.043) *** | 0.734 (0.044) *** | 0.711 (0.048) *** |
| (2) GDP_A | 1.300 (0.334) ** | 1.273 (0.317) *** | | |
| (3) GDP_P | | | 0.011 (0.018) | -0.018 (0.020) |
| (4) INTER | | -1.116 (0.191) *** | | -1.155 (0.202) *** |
| (5) INTER*GDP_A | | 0.623 (0.065) *** | | |
| (6) INTER*GDP_P | | | | 0.322 (0.061) *** |
| (7) ROE | 0.0011 (0.002) *** | 0.012 (0.002) *** | 0.011 (0.002) *** | 0.012 (0.002) *** |
| (8) SIZE | 0.140 (0.040) *** | 0.218 (0.052) *** | 0.141 (0.040) *** | 0.250 (0.052) *** |
| (9) PROVISIONS | -0.006 (0.101) | -0.023 (0.082) | -0.005 (0.100) | -0.033 (0.089) |
| (10) RISK(-1) | 0.001 (0.015) | -0.016 (0.014) | 0.001 (0.015) | -0.014 (0.014) |
| (11) NCD | 0.037 (0.014) *** | 0.046 (0.013) *** | 0.038 (0.014) *** | 0.051 (0.014) *** |
| (12) TIER1 | 0.005 (0.002) ** | 0.004 (0.002) * | 0.005 (0.002) ** | 0.005 (0.003) * |
| (13) CONC_P | 0.002 (0.004) | 0.002 (0.003) | 0.002 (0.004) | 0.002 (0.004) |
| Obsevations | 1127 | 1127 | 1127 | 1127 |
| AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | 0.001 | 0.326 | 0.001 | 0.004 |
| Hansen | 0.020 | 0.027 | 0.026 | 0.009 |

*Notes:* Standard errors in parentheses *p<0.10, **p<0.05, ***p<0.01. The Hansen is a test of the over-identifying restrictions for the GMM estimator. AR1 and AR2 are tests for the first-order and second-order serial correlation. N denotes the number of observations. Year denotes whether the regression contains the year dummy variables. BUF(-1) is the lag of bank's capital buffer; GDP_A is the annual gross domestic products growth; GDP_P is the prefecture gross domestic product; INTER is dummy variable that takes 1 for internationally active bank; ROE is the return on equity; SIZE is the log of total assets; PROVISION is the loan loss provisions; RISK(-1) is the lagged ratio of risk-weighted assets to the sum of total assets; NCD is the ratio of negotiable deposits to total deposits; TIER 1 is the ratio of Tier 1 capital to total capital and CONC_P is the square of the ratio of total loans of each banks to the total loans of all banks in a particular areas or prefecture.

## VII. *Concluding Remarks*

Overall, Japanese commercial banks maintain capital ratios that are well above the capital requirements. Banks maintain high capital buffers to in anticipation of potential losses or shocks, and to avoid breaching regulatory minimums, which may impose huge costs in the case of a regulatory intervention. Financial intermediaries face some constraints and trade-offs in

FIGURE 1. CAPITAL BUFFER AND THE GROWTH IN GROSS DOMESTIC PRODUCT

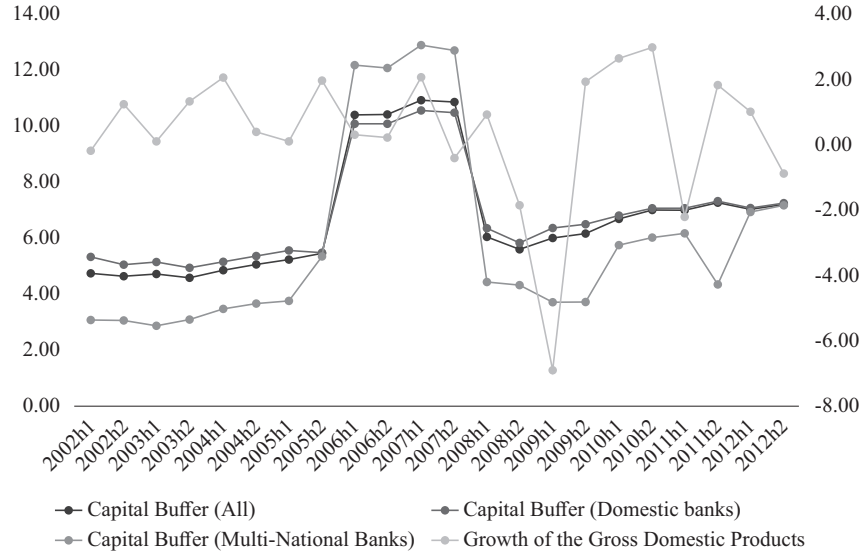
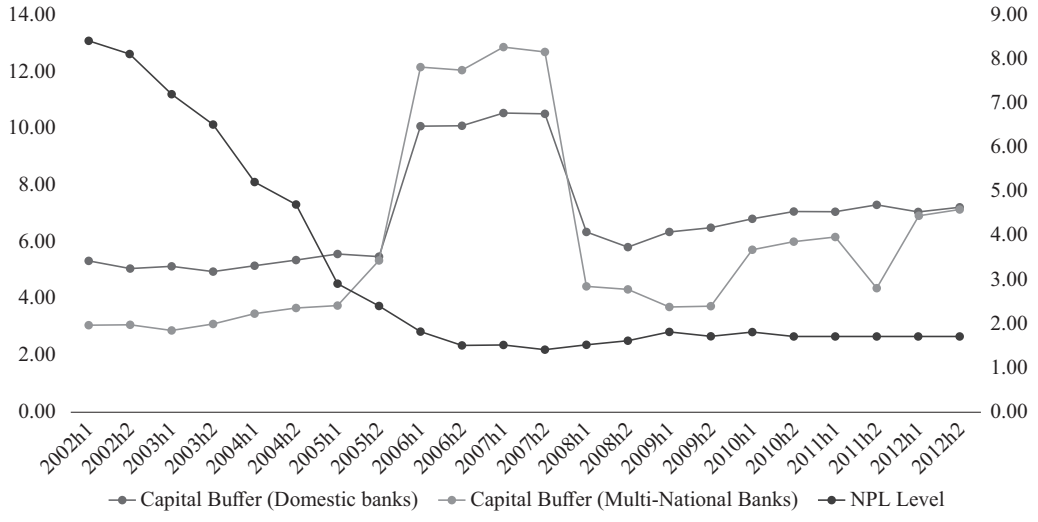



FIGURE 2. CAPITAL BUFFERS AND NON-PERFORMING LOAN LEVELS




*Data Source: Japan Ministry of Finance*

their capital adjustment process. Moreover, financial intermediaries are exposed to external pressure due to market and economic conditions, which influence their behavior.

In this study, I employ a dynamic empirical model adopted from prior studies to analyze the determinants of banks' capital buffers. One of the focuses of this study was the dual capital

adequacy requirements in Japan, and how the diverging standards influence the behavior of capital buffers. I find that the capital buffers of internationally active banks behave counter-cyclically in the baseline specifications. The positive signs of the cross term INTER*GDP indicate that internationally active banks built up capital buffers during favorable economic conditions and the procyclical behavior of capital buffer does not seem to dominate the capital buffer adjustment in the overall sample period estimations. Japanese commercial banks built up their capital buffers during relatively favorable economic conditions. During an economic upturn, when the cost of capital financing is low, Japanese commercial banks increased their capital buffers to prepare for potential losses, which are likely to increase during an economic downturn. Additionally, during economic downturns, banks can utilize their built up capital to cover their losses.

Another important result relates to the crisis dummies. The results reveal that Japanese commercial banks show pro-cyclical behavior in their capital adjustment during the distress and recovery periods. Though I find counter cyclical behavior during the whole sample period, which covered relatively favorable economic periods, the counter cyclical behavior seems weak in response to crises, and the counter-cyclical effect of capital buffers was offset and lost its resiliency in the counter-cyclical pattern after the global financial crisis. The unfavorable procyclical behavior of capital buffers rebounded in response to crises. The inconsistent patterns in capital buffers show that economic conditions doubtless affect the capital management practices of Japanese commercial banks. Of note is the fact that the effect for domestic banks shows no significant positive sign, regardless of whether I analyze a crisis period or the overall period. This result indicates that the weaker counter cyclical behavior of capital buffers seems to be more of a generalized problem in domestic banks.

In summary, although this study finds counter-cyclical behavior of capital buffers, indicating forward-looking capital management practices, I find inconsistent patterns in capital adjustments and a counter-cyclical pattern of capital adjustment only in internationally active banks, suggesting a remaining need to promote and strengthen the counter cyclical capital adjustments with regulatory measures. The new Basel III requirement that promote financial soundness and stability with high quality capital, namely the counter-cyclical buffer requirement, should be strengthened. Another concern is that the domestic banks did not show any significance or patterns in capital adjustments. I leave research into the capital requirements to justify the optimum capital requirement setting for the future.

The business cycle amplifies the pro-cyclicality problem, especially during a downturn, and prolongs the recovery of financial stability from a crisis. Thus, regulators, policymakers, and academics worldwide are still searching for methods to cope. The economic conditions of Japan, specifically the long-term economic stagnation, allowed for an analysis in a unique context. The results provide some insight into the extent of banks' capital decisions during a long period of economic stagnation and provide some new directions for banks' capital decisions developed countries currently trapped in a trend of economic stagnation. Specifically, the insights on whether to implement stricter capital adjustments for domestic banks and how regulators can help banks promote counter-cyclical patterns in capital buffers, even during a crisis, in order to maintain financial stability. Moreover, these findings can assist policymakers and regulators deal with pro-cyclicality as they design more efficient and comprehensive capital regulations.

## *References*

Acharya, S., 1996, Charter value, minimum bank capital requirements and deposit insurance pricing in equilibrium, *Journal of Banking and Finance* 20, pp.351-375.

Arellano, M., and S. Bond, 1991, Some tests of specification for panel data: Monte Carlo evidence and application for employment equation, *Review of Economic Studies* 58, pp.277-279.

Arellano, M., and S. Bond, 1995, Another look at the instrumental variable estimation of error-component models, *Journal of Econometrics* 68, pp.29-51.

Ayuso, J., D. Pérez, and S. Jesús, 2004, Are capital buffers pro-cyclical? Evidence from Spanish panel data," *Journal of Financial Intermediation* 13, pp.249-264.

Berger, A.N., R.J. Herring, and G.P. Szego, 1995, The role of capital in financial institutions, *Journal of Banking and Finance* 19, pp.393-430.

Bikker, J., and P. Metzemakers, 2004, Is bank capital pro-cyclical? A cross-country analysis, *De Nederlandsche Bank Working Paper* 009/2004.

Blundell, R., and S. Bond, 1998, GMM estimation with persistent panel data: An application to production functions, *Econometric Reviews* 19, pp.321-340.

Bond, S., and F. Windmeijer, 2002, Finite sample inference for GMM estimators in linear panel data models, (Cemmap Working Paper, vol.04/02), Institute for Fiscal Studies and Department of Economics, University College, London.

Borio, C., and H. Zhu, 2012, Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism? *Journal Financial Stability* 8, pp.236-251.

Carvallo, O., A. Kasman, and S. Kontbay-Busun, 2015, The Latin American bank capital buffers and business cycle: are they pro-cyclical? *Journal of Intermediate Financial Markets, Inst. Money* 36, pp.148-160.

Chan, S., 2012, Within the Fed worries of deflation, *The New York Times,* 29 July.

Chen, Y.K. and C. L. Hsu, 2014. Are bank capital buffers cyclical? Evidence of developed and developing countries. *Journal of Financial Studies* 22, pp.27-56.

Estrella, A., 2004, The cyclical behavior of optimal bank capital, *Journal of Banking and Finance*, 28, pp.1469-1498.

Francis, W., and M. Osborne, 2010, On the behavior and determinants of risk-based capital ratios: revisiting the evidence from UK banking institutions, *International Review of Finance* 10, pp.485-518.

Francis, W., and M. Osborne, 2012, Capital requirements and bank behavior in the UK: Are there lessons for international capital standards? *Journal of Banking and Finance* 36, pp.808-816.

Fukada, S., 2018, *Nijyuiseki no choukiteitairon* [The long stagnation in 21st century], Heibonsha, Tokyo.

García-Suaza, A.F., J.E. Gómez-González, A.M. Pabón, and F. Tenjo-Galarza, 2012, The cyclical behavior of bank capital buffers in an emerging economy: Size does matter. *Economic Modelling* 29, pp.1612-1617.

Gordy, M.B., and B. Howells, 2006, Pro-cyclicality in Basel II: Can we treat the disease without killing the patient? *Journal of Financial Intermediation* 15, pp.395-417.

Gursoy, G., and G. Atici, 2012, The determinants of capital buffer in the Turkish banking

system, *International Business Research* 6, pp.224-234.
Hakenes, H., and I. Schnabel, 2011, Bank size and risk-taking under Basel II, *Journal of Banking and Finance* 35, pp.1436-1449.
Haq, M., R. Faff, R. Seth, and S. Mohanty, 2014, Disciplinary tools and bank risk exposure. *Pacific Basin Finance Journal* 26, pp.37-64.
Heid, F., 2007, The cyclical effects of the Basel II capital requirements, *Journal of Banking and Finance* 31, pp.3885-3900.
Huang, X., and Q. Xiong, 2015, Bank capital buffer decisions under macroeconomic fluctuations: Evidence for the banking industry of China, *International Review of Economics and Finance* 36, pp.30-39.
Jokipii, T., and A. Milne, 2008, The cyclical behavior of European bank capital buffers, *Journal of Banking and Finance* 32, pp.1440-1451.
Keeley, M.C., 1990, Deposit insurance, risk, and market power in banking, *The American Economic Review* 5, pp.1183-1200.
Kontbay-Busun, S.K., and A. Kasman, 2015, A note on bank capital buffer, portfolio risk and business cycle. *Ege Academic Review* 15, pp.1-7.
Linquist, K.G., 2004, Banks' capital buffer: How important is risk? *Journal of International Money and Finance* 23, pp.493-513.
Miller, M., and F. Modigliani, 1958, The cost of capital, corporation finance, and the theory of investment, *The American Economic Review* 48, pp.261-297.
Milne, A., and E. Whalley, 2001, Bank capital and incentives for risk-taking, *Cass Business School Research Paper*. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=303176.
Myers, S., and N. Majluf, 1984, Corporate financing and investment decision when firms have information that investors do not have, *Journal of Financial Economics* 13, pp.187-221.
Nickell, S., 1981, Biases in dynamic models with fixed effects, *Econometrica* 49, pp.1417-1426.
Nier, E., and U. Baumann, 2006, Market discipline, disclosure and moral hazard in banking, *Journal of Financial Intermediation* 15, pp.332-361.
Repullo, R., and J. Suarez, 2013, The procyclical effects of bank capital regulation, *Review of Financial Studies* 26, pp.452-490.
Rime, B., 2001, Capital requirements and bank behavior: Empirical evidence for Switzerland, *Journal of Banking and Finance* 25, pp.1137-1178.
Saadaoui, Z., 2014, Business cycle: Market power and bank behavior in emerging countries, *International Economies* 139, pp.109-132.
Schaeck, K., and M. Cihák, 2012, Banking competition and capital ratios, *European Financial Management* 18, pp.836-866.
Shim, J., 2012, Bank capital buffer and portfolio risk: The influence of business cycle and revenue diversification, *Journal of Banking and Finance*, 37, pp.761-772.
Stolz, S., and M. Wedow, 2011, Banks' regulatory capital buffer and the business cycle: Evidence for Germany, *Journal of Financial Stability* 7, pp.98-110.
Valencia, O.C. and A.O. Bolanos, 2018. Bank capital buffers around the world: Cyclical patterns and the effect of market power. *Journal of Financial Stability* 603, pp.119-131.
Vu, H., and S. Turnell, 2015, The behavior of Australian banks' capital buffers: Pro-or counter cyclical? *Applied Economics and Finance* 2, pp.110-118.
Windmeijer, F., 2005, A finite sample correction for the variance of linear efficient two-step

GMM estimators, *Journal of Econometrics* 126, pp.25-51.
Wooldridge, J. M., 2002, *Econometric Analysis of Cross Section and Panel Data* (MIT Press, Cambridge).