BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL TEST

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Foreword

Countercyclical capital buffer (CCCB) has been incorporated in the Basel III framework with the aim of ensuring that banking sector capital requirements take account of the macro-financial environment in which banks operate. It is likely to address pro-cyclicality in the banking business and its adverse feedback effect on the real economy. The countercyclical capital buffer is designed to build-up buffer during good periods, which could then be used during the economic downturns. Unlike other components of capital requirements, the countercyclical buffer incorporates considerable judgment of the relevant authorities in the decision of the timing for the build-up, release and on the quantum of buffer implementation.

So far however, not many economies, including those of SEACEN, have implemented the CCCB initiative or even established a framework. In view of the various stages of economic development, institutional frameworks and emerging nature of the markets, this study was undertaken with the main aim of looking at processes for the smooth implementation of the CCCB as well as to encourage further research in this area. This study, therefore, analyses the progress made so far in advanced countries and in the participating SEACEN economies. It also highlights the challenges such as data availability and methodological issues relating to CCCB. It proposes steps and recommendations that could help smoothen the implementation of CCCB in these economies. This research project, which comprises the integrative chapter and subsequent chapters by the participating SEACEN member central banks/monetary authorities, would hopefully set the stage for further debate and deliberation on crucial issues, which would facilitate the implementation of the CCCB in SEACEN economies.

This collaborative research was led by Dr. Saurabh Ghosh, Visiting Research Economist at The SEACEN Centre in FY 2014, and is currently an Assistant Adviser in the Department of Economic and Policy Research at the Reserve Bank of India. It was participated by 13 project team members from 8 SEACEN member central banks. SEACEN wishes to express it sincere gratitude to Dr. Ghosh for his efforts as the Project Leader, the participating member central banks and their respective project team members, namely, Ms. Sarun Helyda from National Bank of Cambodia; Ms. Justina Adamanti and Ms. Rieska Indah Astuti from Bank Indonesia; Dr. Chuah Lay Lian from Bank Negara Malaysia; Mr. Tanu Irau from Bank of Papua New Guinea; Ms. Roselle R. Manalo from Bangko Sentral ng Pilipinas; Ms Huang Shu-Chun and Mr. Wei Hsi-Pin from Central Bank, Chinese Taipei; Ms. Panita Piyaoui from Bank of Thailand and

Mr. Tran Viet-Dung, Ms Nguyen Ngan Bich, Ms Nguyen Thi Phuong Luyen and Ms Nguyen Thi Thanh Nhan from State Bank of Vietnam.

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The view expressed in this study, however, are those of the authors and do not necessarily reflect those of The SEACEN Centre or the SEACEN member central banks/monetary authorities.

Hookyu RHU April 2015
Executive Director

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Executive Summary

The global economic crisis unveiled inherent pro-cyclicality and capital inadequacy in the banking sector. The multilateral institutions (e.g. G20, FSF, IMF and BCBS) in discussions with national authorities have come up with the Countercyclical Capital Buffer (CCCB henceforth) as a policy prescription to address these problems.

Historically, unusually strong and rapid growth in credit and asset price preceded banking crises. The objective of a countercyclical buffer is to protect the banking sector from excess credit growth associated with the build-up of system wide risk. This would be achieved through the building up of banking capital in good times that will act as a cushion between the banking and real sector and its drawing down in bad times. The CCCB is designed to act as an automatic stabiliser, which will build up capital when it is cheap (good period) and its usage to absorb losses or to maintain supply of credit when funding is costly (crisis period).

However, disguised in this apparent simple framework is the fact that the potential output is unobserved while estimates can differ considerably, making it difficult to forecast, classify and to apply a simple rule of thumb. The Basel Committee, after considerable research and debate, has come up with a guideline on key variables, thresholds for buffer accumulation and release, and the timing and communications for the CCCB. However, considering the inherent problem in forecasting cycles, the build-up of systemic risk and in cognisance of the fact that the same size may not fit all, the guidelines for national authorities emphasised the role of judgement in buffer decisions. While using their judgements, authorities are expected to employ, the best available information and quantitative analysis to gauge the build-up of system wide risks.

Our survey of a large number of countries indicate that only a handful of them (Switzerland, Norway, UK, Peru) have implemented the CCCB as of end-2014, based on principles of the Basel recommendations, albeit tailored to suit the countries' requirements. The majority of other countries are presently in the process of preparing technical notes and guidelines for its implementation. Our survey of the SEACEN member economies that are participating in this study, indicate that they are at the early stages of preparation. Almost all feel that extensive research on the topic would help members with the implementation of the CCCB in their respective economies.

The Basel countercyclical buffer framework is not a rigid set of rules but rather gives relevant authorities considerable discretion based on sound principles complemented by quantitative analysis. This study performs a battery of quantitative analysis, which include calibrating the best indicator in terms of credit-to-GDP ratio using different 'lambda' values and one-sided or two-sided HP filter. The Lead-lag regression was used to evaluate whether the selected indicator could provide an early signal for policy makers to take appropriate decisions. To decide the crucial threshold values of the variables used, the study estimates Threshold-regressions and also evaluates performances in terms of 'Noise to Signal' ratios. This report also attempts to identify high frequency supplementary variables in terms of their correlations with non-performing assets and gap. Finally, a panel framework is used to identify the performance of the gap variable for the participating members. The key findings of this analysis and their policy implications are as follows:

- The starting point of the CCCB analysis for the participating members could be the credit-to-GDP gap, as most of the participating economies have found it appropriate. However, other variables such as the credit growth gap and the output gap may also be considered as they may provide a better signal for some economies. In line with the Basel recommendations, many of the participating-members find that the one-sided HP filter to be suitable for estimating the gap. However, in view of the data limitation in emerging markets, the use of the two sided HP filter to evaluate gaps is also suggested.

- The choice of the 'lambda' variable (HP filter) differs considerably among members due to perhaps differences in relative amplitude and duration of the financial cycles vis-a-vis the business cycle, which is consistent with the theory. The general consensus is that in the authorities' choice of key variables, they would need to consider whether the selected variable(s) could signal good and bad times, build up sufficient buffers in good times to absorb losses subsequently, robust to regulatory arbitrage and are resistant to manipulation.

- The empirical estimates of the threshold indicate 'L' to be generally higher than the Basel recommendation (L=2). This could be because of the emerging nature of the members, where credit growth also incorporates the effect of financial deepening. The average value of the upper threshold was higher than that of the Basel recommendation (H=10), although there are some members that find a lower (less than 10) threshold more suited to their economies.

- While most of the economies' financial markets are emerging in nature, empirical results indicated the use of return on assets, equity returns, NPA ratio, housing prices to be useful supplementary indicators for CCCB decision.

- For early warning properties of the anchor variables, it is observed that the CCCB decision may be pre-announced with a lead time of 3-4 quarters. Many of the members prefer a linear build-up of the buffer; but the possibilities of in-steps (non-linear) build-ups are not ruled out. It is felt that the exact value of the CCCB buffer as a percentage of RWA (in the range of 0-2.5%) is best decided, contingent on the underlining economic conditions during the buffer announcement or subsequent revisions, as in the case of Switzerland, Norway and U.K.

- Although the variables that are in use for activation may be employed for the release phase of the CCCB, this study strongly advocates the use of judgement in the decision of the timing and speed of the buffer release, depending on the nature and voracity of the economic crisis. The buffer may be released to absorb losses and/or to maintain credit supply during crisis periods.

- In view of the emerging nature of these economies, and volatility observed in the variables considered, CCCB decisions should be subjected to regular reviews, research and empirical testing at least once a year for their efficacy and for the possible selection of appropriate new indicators.

In examining the broad factors that have posed challenges or constrained CCCB implementation for participating members, a few common issues are identified. These include the lack of long, uniformly defined/comparable time series data, lack of deep and liquid financial market, high volatility in financial series and the different stages in development in the member economies. In view of these issues, some measures and recommendations are proposed for future research and policy implementation:

- There is a need to improve the quantitative and qualitative aspects of the key variables (namely quarterly GDP, credit and banking stress indicators). The Basel guide uses a broad definition of credit that will capture all sources of debt funds in the economy. In case of the non-availability of such a variable, economies may specify a close proxy and attempt to back-cast data for the proxy for at least a 10-year period to facilitate future decision making relating to the CCCB.

- Reporting of lengthy financial data for at least a few relatively deep and relevant financial markets can provide indications for the build-up of systemic risk. This could be helpful for authorities to make judgements on CCCB accumulation and release. Considering the importance of the retail sector and housing in these economies, relevant authorities may monitor/publish suitable indices or survey based indicators for these sectors. Moreover, composite indicators representing financial sector stress may also be helpful in making policy decisions.

- Spreading awareness of CCCB and its role in financial stability among bankers, supervisors and auditors is also vital. Presently, the main objective of CCCB as a countercyclical tool is unclear among many banking professionals. In view of this, increased communication, research publications, and inclusion of countercyclical buffer as a topic in regulation and supervision related discussions, workshops, conferences and training programmes could help build up awareness, thus ensuring the effective implementation of the buffer through signalling and behavioural channels.

This study is an early research initiative on the CCCB in selected SEACEN economies. It analyses the suitability of different variables, threshold anchors during build-up and release phases and attempts to identify what constitutes good and bad times across the cycle. It also identifies certain limitations; volatility in variables considered and makes recommendations to overcome some of them. In sum, these research papers are likely to set the stage for further debate and deliberation on crucial issues, which would facilitate the implementation of the CCCB in the SEACEN economies.

Chapter 1

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL TEST[1]

By
Saurabh Ghosh[2]
(Project Leader)

1. Introduction

Pro-cyclicality is an inherent character of banking business. Banks are exposed to the performance of businesses and corporates to which they extend credit. The business cycles impact the performance and profit of these companies cumulating in the pro-cyclical performances of the banking sector. Further, risk-based capital requirements of banks can decline considerably during good times and shoot up during downturns. This coupled with herding behaviour of economic agents, reinforces pro-cyclicality in the banking system. Credit demand is naturally pro-cyclical, and the literature (Reinhart and Rogoff, 2009) has unanimously documented that excessive credit growth during expansion phases lead to a build- up of systemic risk that impairs all or parts of the financial system and could have severe negative consequences for the real sector. During economic downturns, the same set of factors, e.g. low profitability, risk aversion, herding behaviour, leads to a low credit disbursement and a complex mutually reinforcing feedback process between the real and financial sectors that spills over across regions through capital flows and trade routes, leading possibly to a global financial crisis.

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1. This paper reports consolidated findings of a collaborative research led by Dr. Saurabh Ghosh, CFA, FRM, Ph.D., ASP, CAIIB. The sample set includes 8 SEACEN economies, namely, Cambodia, Chinese Taipei, Indonesia, Malaysia Papua New Guinea (PNG), Philippines, Thailand and Vietnam. While this paper presents the key findings; details of data, empirical analysis and conclusion can be found in the project team papers of the respective participating members.
2. Department of Economic and Policy Research, Reserve Bank of India, deputed as Visiting Research Economist for FY2014 to The SEACEN Centre. Views expressed here are the author's personal, based on the sample set of the member economies analysed, and not of the institution that he belongs to. The author is grateful to all project team members for their inputs and cooperation. The usual disclaimer about errors and omissions applies.

The global economic crisis of 2008 brought to fore two important issues, the inadequacy of capital in the banking system and the pro-cyclicality of risk based capital requirements. In its 2008 report, the Financial Stability Forum (FSF) explicitly noted that it would examine the forces that contributed to pro-cyclicality in the financial system and develop policy options to mitigate it. In April 2009, the FSF came out with its report on addressing pro-cyclicality in the financial system, where it emphasised the role of the Basel Committee on Banking Supervision (BCBS) to strengthen the capital framework so that the capital in the banking system could increase during good times and it could be drawn down during periods of economic stress. After rounds of discussions the oversight body of the Basel Committee on Banking Supervision finally introduced a comprehensive set of measures, to strengthen regulation supervision in the banking system by strengthening microprudential regulations and introducing macroprudential measures.[3]

Subsequently, the Group of Central Bank Governors and Heads of Supervision (GHOS) of Basel Committee issued a press release (September 2009), which noted its commitment towards raising the quality, consistency and transparency of the Tier one capital base, internationally harmonized leverage ratio and the minimum funding liquidity ratio. The same press release also indicated that GHOS is working on a framework of a countercyclical buffer (CCCB) over and above the minimum capital requirement of the banks to ensure that the banking system has an adequate capital buffer to protect against future potential losses. On 16 July 2010, the Committee issued a proposal for consultation on the CCCB, which will be imposed when, in the view of national authorities, excess aggregate credit growth is judged to be associated with a build-up of system-wide risk. In December 2010, the BIS released the Guidelines to national authorities for the practical implementation of the CCCB.

2. Objectives of Countercyclical buffer (CCCB)

In theory, if banks hold sufficient buffers, accumulating them during good periods to withstand losses during downturns, it would help in the reduction of pro-cyclicality in credit. However, financial stability may not come free of cost, although the subsequent benefits are likely to far out-weigh the cost. As Steve

3. The decision was reached involving national authorities, the BCBS, BIS, Committee on Global Financial System (CGFS), International Monetary Fund (IMF), International Organisation of Securities Commissions (IOSCO), International Accounting Standards Board (IASB) and the US Financial Accounting Standards Board (FASB), the Group of Central Bank Governors and Head of Supervision (GHOS).

Bartlett[4] puts it, every “dollar of capital is one less dollar working in the economy”. The increase in buffer requirement, although acting as a shock absorber to financial shocks, could have negative influences on credit supply and thus on the GDP growth rate, which is an initial cost to society. The larger long-term benefits vis-a-vis short-term costs associated with such buffers call for appropriately designed prudential regulations in the implementation process. These will in all likelihood lead to the design of time varying buffers that will act as cushions between the financial sector and the real sector, thereby reducing the amplitude of financial and business cycles.

Time varying buffers can be effectively implemented through a combination of rule and discretion; while the rule part is likely to act as an automatic stabilizer the discretion part is designed to fine tune the automatic stabilizer to suit the underlying economic conditions. Among the time varying provisioning tools, dynamic provisioning and capital buffers are most often referred to in the literature. Dynamic provisioning, which depends on asset performance, has already been implemented in Spain, Peru and Columbia, mainly to absorb expected losses. Critics, however, argue that it does not take into account large unexpected losses that occur with small probability. In view of this, Basel III included two capital buffers, namely the conservation buffer (CCB henceforth) and the CCCB. Banks are required to add to the CCB during periods of high profit and use it during periods of low profit. This comes with an automatic capital-bucket wise restriction on banks’ profit distributions (e.g., dividends, share buy backs etc.). Banks, on the other hand, are likely accumulate the CCCB during good times when excessive credit growth is judged by the national authority to be associated with the build-up in system wide risk. CCCB would, therefore, lean against the excess build-up in credit in an economy. However, as noted by Basel-III, the CCCB is not designed to be an instrument for managing economic cycles or asset prices but may be best utilised as a macroprudential indicator, involving the building up of a buffer (capital) in times of excess credit growth and providing security in terms of the availability of additional capital in times of crises.

While both the CCB and CCCB are instruments designed to add to the capital buffer, over and above the minimum requirement CET1, the most subordinate claim in the liquidation of banks to meet unexpected loss and thereby maintain credit flows during the stress period, there are certain differences

4. Steve Bartlett, Financial Services Roundtable, 17 September 2010.

between these instruments. CCB is rule-based, which requires banks to add to its minimum capital requirement in a prescribed format while CCCB is largely discretionary, which is left to the national authorities. In particular, the build-up of the countercyclical buffer depends on an early warning indicator (credit-to-GDP gap suggested by BCBS) for economic cycles. However, the relationship between the early warning indicator and buffer capital is not mechanical. Although Basel III indicates a rule of thumb for the CCCB in its guide to national authorities, it allows for policy makers' judgement on how buffers are to be build-up and released.

3. Why CCCB Research for SEACEN Members?

The Basel Committee, while emphasising on the role of judgement in CCCB implementation, also noted that it should be firmly anchored to a clear set of principles to promote sound decision making (BIS, 2010). The role of judgement based on sound principles makes research a necessary input for the successful implementation of CCCB. So far, however, not many economies, including those of SEACEN have come out with explicit guidelines on CCCB However, as indicated in Table 1 (for selected group of the SEACEN economies), bank credit plays an important role in resource mobilisation in these economies with foreign, public and private sector banks co-existing and playing a crucial intermediation function in the region Also, the sectoral characteristic of credit indicate that certain sectors, e.g. manufacturing, household/retail, and SME sector dominate the credit allocation pie in these economies. In view of the different stages of economic development, institutional framework and emerging markets characteristics of the participating members (refer to Section 7 for details of challenges that member economies face), the SEACEN Board of Governors felt that an empirical assessment and consensus among the members would help to address important policy issues related to the CCCB. In light of this, the study looks into the issues relating to the implementation of the CCCB in the SEACEN member economies. Questions that the study would attempt to address are as follow:

1. Availability of key macroprudential variable(s) in line with Basel recommendations that can serve as the basic input/anchor variable(s) to the CCCB framework for the SEACEN members.

2. Since no single indicator could perhaps provide a perfect guide to systemic risk, what could be supplementary indicators for CCCB? How would these variables behave (their lead-lag relationship with banking-variables) over the business cycles for member economies?

3. Based on the above two, an estimation of thresholds for CCCB accumulation during economic upturn and release of the same during economic downturns.

4. Seeking consensus among members in other related issues, e.g., buffer accumulation, release, communication and policy review requirements.

These research findings are intended to provide initial insights for the SEACEN supervisory authorities to decide on the CCCB based on sound principles and implementation in the respective jurisdictions.

Table 1
Characteristics of the Banking Sector in the Member Economies

	Percentage of Resource Flow				Ownership Group*			Important Sectors with Large Credit Flow			Crisis	Banking	Major Reforms
Economies	Bank	Non-bank	Market	External	Public	Private	Foreign	Sector I	Sector II	Sector III	Year	Supervisor	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13
Cambodia	2	98	-	-	3	24	73	Wholesale Trade	Retail Trade	Manufacturing	-	NBC	2002, 2008, 2009, 2010, 2011
Indonesia	63	7	4	26	25	67	8	Manufacturing	Trading	SME	1997,2005, 2008	BI, IFSA^	Banking Reforms
Papua New Guinea	91.4	8.6	-	-	0	25	75	-	-	-	None	Bank of PNG	2000
Philippines	79.6	1.3	7.5	11.6	4.9	93.4	1.7	Real estate, renting business services consumer	Manufacturing	Wholesale/ retail	1997-98	BSP	1993-94, 2000
Chinese Taipei	43.6	29.4	20.3	6.7	-	-	-	Real estate/ construction	Manufacturing	Wholesale/ retail	Card Crisis 2006	Competent Authority	Regulatory Capital Reforms
Thailand	34.5	18.1	37.8	9.62	33.5	56	10.5	Consumer	Manufacturing	Wholesale/ retail	1997-98	BoT	2008, 2004-08, 2010-14
Vietnam	72.6	20#	6.2	1.2	40	43	17	Industry	Commercial	Construction	1997-99	SBV	1989-2008

#: Non credit Institutions; +: Physical network; ^Indonesian Financial Supervisory Authority.

4. BIS on CCCB - Highlights

The objective of the countercyclical buffer, as stated in the BIS Guidelines, is to protect the banking sector from the build-up of systemic risks, often associated with periods of excess aggregate credit growth. The relevant authorities, using the best available information, is required to make an assessment of whether a countercyclical buffer requirement is to be imposed, increased or decreased (in the broad range of 0-2.5% of risk weighted assets (RWA)). The BIS Guidelines list five principles that include objectives, common reference guide, risk of misleading signals, prompt release and other macroprudential tools, to promote a sound decision making process. They also include the credit-to-GDP ratio as a common reference point that national authorities can use for formulating buffer decision, since it relates directly to the objective and is widely available for a large number of jurisdictions. To take into account the financial systems at different stages of developments, BIS (2010) allows flexibility for the jurisdictions to choose variable(s) which they deem most appropriate for assessing the sustainability of credit growth and level of system-wide risk, taking into account domestic market conditions.

The main indicator suggested by the Basel Guidelines is the credit-to-GDP gap (i.e., the deviation of credit-to-GDP ratio from its long-term trend), as a large body of literature indicates that it can be a powerful predictor of banking crisis. The Guideline specifies that the CCCB buffer accumulation can be initiated when the gap variable crosses its lower threshold (L=2) in the range of 0-2.5% of RWA linearly until the gap reaches its upper threshold (H=10). However, the threshold values at which the buffer becomes active and reaches its maximum could vary from jurisdiction to jurisdiction, taking into account the underlying economic situations.

While Basel III envisaged a prompt release of the buffer in times of stress, the suggestion is for authorities to not depend solely on one indicator, as it is difficult for any single indicator to perform well during both the build-up and release phases. It highlights the possibility of misleading signals in the credit-to-GDP indicator and in any other variable, especially during the release phase. The Guidelines also list a large number of supplementary high frequency indicators (e.g., asset prices, CDS spread), while cautioning national authorities that these indicators could signal for the "too early" release of the buffer. In conclusion, the CCCB Guideline emphasise the importance of judgement for the release of the buffer when assessing the underlying economic conditions such as (a) losses to the banking system pose a risk to financial stability; and (b) problems elsewhere in the financial system that have the potential to disrupt the flow of credit and undermine the performance of real economy and banking system.

5. Literature on CCCB

Researches on macroprudential indicators in general and countercyclical buffer in particular are relatively new areas which are gaining momentum. This section briefly discusses the questions that research in this area have tried to address. These include the leading indicator of financial stress, debate surrounding the choice of a leading indicator, evidences of its application in advanced and emerging economies and the cost of building a capital buffer.

The global financial crisis has brought to fore the need to understand and implement policies to address the interaction between financial cycles and business cycles. Some of the stylized features of financial cycles include, much lower frequency than a typical business cycle and its peaks are closely associated with financial crises Borio (2012). Research also indicates that the length and amplitude of business cycles have increased markedly in recent times. It has, therefore, become important to analyze the interaction between the high-frequency business cycle and slower moving financial cycle in designing and implementing macroprudential rules.

In this context, the first question to start with perhaps relates to whether conditioning variables are bank-specific or system-wide. Drehmann et al. (2010) indicates that the idiosyncratic component can be sizeable when a bottom-up approach is employed. Among the system-wide indicators, the credit-to-GDP gap as a leading indicator of financial stress was mentioned in Borio and Lowe (2002). The BCBS study considering a large number of indicators and a large panel of member countries indicates that the credit-to-GDP ratio tends to rise smoothly above the trend before most of the serious crises. Drehmann, Borio and Tsatsaronis (2012) support the above findings and Drehmann and Juseliu (2012) applying this criteria to a set of potential early warning indicators (EWIs) conclude that the credit-to-GDP gap is the best indicator of financial stress over the long horizon. Other studies by Alessi and Detken (2011) and Behn et al.

(2013) applying different methods, find that the credit-to-GDP gap to be an excellent early indicator. Drehmann et al. also indicate that a strong performance of the credit-to-GDP gap before two or three years of a crisis has an operating advantage, as the Basel Committee (2010) requires regulators to announce additional capital build-up requirement before four quarters. The authors also mention that other indicators like credit spread perform better for the release phase, as they emit contemporaneous signals of banking sector distress.

The use of the credit-to-GDP ratio as a main indicator for CCCB did not go unchallenged. Repullo and Saurina (2011) show that the correlation between the credit-to-GDP gap and GDP growth to be negative. Therefore, the CCCB buffer build-up depending on the credit-to-GDP gap could signal for the reducing of banking capital requirement, when GDP growth is high and vice-versa, and thus end up exacerbating the inherent pro-cyclicality of risk based capital requirements, contradicting the mandate of the G-20. As an alternative, the authors propose a fully rule-based smoothing of the minimum capital requirement based on GDP growth. Edge and Meisenzahl (2011) note that ex-post revisions to the U.S. credit-to-GDP ratio gap are sizable; in presence of such revisions the gap could also lead to false signals and large volumes of lending may be inappropriately curtailed.

Drehmann and Tsatsaronis responding to Repullo and Saurina (2011) note that "closer examination of the data reveals that a negative sign is driven primarily by periods when the information from the indicator is of no consequence for the capital buffer; i.e., when the credit gap is low and the capital buffer would not have been activated, or periods following crises when the buffer would have already been released". If these periods are excluded, the authors argue that, the correlation between the gap and GDP growth are either positive or statistically insignificant. However, they note that the lack of coincidence between financial and business cycles does raise challenges – the timing to increase the countercyclical buffer may meet with stiff political resistance due to its impact on GDP growth.

The literature is not unanimous on the magnitude and directions of increase in capital on GDP growth. Noss and Toffano (2014)[5] indicate that an increase in 15 basis points in aggregate capital ratio lead to a reduction of around 1.4% in the level of lending after 16 quarters in the UK. Berrospied and Edge (2010), on the other hand, indicate that there exist a small effect of bank capital increase

5. http://www.voxeu.org/article/impact-bank-capital-requirements-during-upswing.

on loans. Recent studies (BCBS (2010)) put the median estimates for the impact of a 1 percentage point increase in capital requirements on GDP in the range of 0.1 to 0.2 percentage points.

Another question that is relevant for the present study relates to the application of such capital buffer for emerging market economies. In this context, Packer and Zhu (2012) show that many Asian economies adopted stricter provisioning requirement following the Asian economic crisis. However, one potential problem of such an aggregate credit measure, as observed in the Reserve Bank of India's report, relates to the changes in credit growth as the financial system in the emerging markets absorb policy changes and adapt to financial deepening. It becomes a challenge to segregate the impact of such policy changes from the excess which is beyond the absorptive capacity of the emerging economy.

6. Cross Country Experiences in CCCB Implementation

Before analysing the performance of CCCB implementation in the SEACEN economies, we conducted a brief analysis of the experience of CCCB implementation in other (mostly advanced) economies. We started with a bird's eye view of Basel III implementations across the economies, as summarised in Annex Table 3, before moving on to the progress of the countercyclical buffer as at end-2014. The broad assessments in this section are based on responses to a questionnaire sent to national authorities, BIS' Regulatory Consistency Assessment Program (RCAP) documents and web searches. They reveal that economies could be broadly divided into two groups - those that have already implemented the CCCB and those that are close to implementing it (Table 2).

6.1 CCCB Already Implemented

Switzerland implemented CCCB in July 2012 and the official press release by the Swiss National Bank (SNB) was made on 13 February 2013 stating that the buffer size of 1% is to be fulfilled by 30 September 2013. The buffer is to be increased to 2% by 30 June 2014, as mentioned in a SNB press release on 23 January 2014. The implementation of CCCB in Switzerland is coordinated among the SNB, the Swiss Financial Market Authority (FINMA) and the Federal Council. The SNB has responsibility for conducting regular assessments to determine whether the CCCB should be activated or deactivated. In Switzerland, the buffer can be implemented on a broad basis or targeted for specific segments of the credit market (Article 44). Key indicators for Switzerland include domestic mortgage volume indicators (the ratio of mortgages to gross domestic product) and domestic residential real estate prices. Others include interest rate risk, interest rate margins, credit condition indicator, and leverage. Depending on the severity of the crisis, the timeframe for the CCCB in Switzerland varies between 3 to 12 months – the greater the imbalance, the shorter the implementation period. The process for deactivating the CCCB is similar to its activation.

In Norway, the Regulation on the CCCB was adopted by Royal Decree on 4 October 2013. The Ministry of Finance decided on 12 December 2013, that banks shall hold a countercyclical buffer of 1% from 30 June 2015. On 26 September 2014, the Ministry decided to keep the level of the CCCB for banks unchanged. While a Norges Bank Staff Memo that clarifies detailed information of the CCCB has been published[6], no lower bound or upper variable other than that recommended by the Basel Committee has been explicitly defined there. For Norway, the key indicators are not well suited for signalling whether the buffer rate should be reduced. Other information such as market turbulence and loss prospects for the banking sector, may be more relevant. Each quarter, the Norges Bank draws up a basis for the decision on the level of the CCCB and also provides an assessment and explanation for the level. The Norges Bank's decision is published in the Monetary Policy Report with financial stability assessments. The Norges Bank and the Finanstilsynet (the Norwegian Financial Supervisory Authority) cooperate by exchanging relevant information and assessments to arrive at the decision[7].

The CCCB was implemented in the United Kingdom (UK) on 1 May 2014. The Financial Policy Committee (FPC) of the Bank of England, is responsible for setting the CCCB rates for UK firms. Firms are required to use those CCCB rates when calculating their countercyclical buffers with supervisors' rules. The UK's first CCCB rate was set in June 2014 and thereafter in late 2014 (set at 0% on both occasions). The FPC looks at a number of 'core indicators' when setting the CCCB, which include the credit-to-GDP gap. The FPC also uses

6. http://www.norges-bank.no/en/Published/Papers/Staff-Memo/2013/Staff-Memo-132013/http://www.norges-bank.no/en/Published/Publications/Norges-Bank-Papers/2013/12013-Criteria-for-an-appropriate-countercyclical-capital-buffer/

7. Norges Bank's basis for the decision on the level of the countercyclical capital buffer is published in the quarterly Monetary Policy Report on financial stability in www.norges-bank.no. The decision of the Ministry of Finance on the level of the countercyclical buffer is published in www.regjeringen.no/en/dep/fin.

judgment in setting the CCCB, taking into account, core indicators as well as supervisory and market intelligence and information from stress tests. The FPC's approach to setting the CCCB is set out in its Policy Statement[8].

For South American economies, Galindo et al. (2013) notes that Colombia and Peru have been the most active in the implementation of countercyclical regulation. For instance, in Peru, the countercyclical rule is conditioned to the behaviour of GDP growth, which is different from the Basel III Guidelines. For the Peruvian Authorities, this choice is justified on the basis of Peru's low levels of financial intermediation, unlike the advanced economies (AE).

Among the SEACEN member economies, the Hong Kong Monetary Authority, as part of the implementation of the Basel III framework, announced on 27 January 2015, that the countercyclical capital buffer for Hong Kong will be 0.625% with effect from 1 January 2016. The decision on countercyclical buffer is based on a series of quantitative indicators and qualitative information including an "indicative buffer guide" (which is a metric based on the gap between the ratio of credit to GDP and its long-term trend, and between the ratio of residential property prices to rentals and its long term trend)[9].

The Reserve Bank of India (RBI) published the Final Guidelines on CCCB in July 2014, where the credit-to-GDP gap is to be used for empirical analysis, to facilitate decisions on the CCCB. However, it may not be the only reference point in the framework for banks in India. The lower threshold (L) where the CCCB is activated may be set at 3 percentage points of the credit-to-GDP gap, provided its relationship with GNPA remains significant, while the upper threshold (H) where the CCCB is at its maximum may be kept at 15 percentage points of credit-to-GDP gap. The Final Guideline (July 2014) note that the rate of increase of the buffer would be different based on the level/position of credit-to-GDP gap. In a notification dated 5 Feb 2015, the RBI announced that the framework for CCCB would take immediate effect in India. The activation of CCCB will take place when circumstances warrant, and currently, as mentioned in the notification, circumstances do not warrant CCCB activation[10].

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8. http://www.bankofengland.co.uk/financialstability/Documents/fpc/policystatement140113.pdf; Prevailing CCB decisions is available in http://www.bankofengland.co.uk/financialstability/Pages/fpc/ccbrates.aspx

9. http://www.hkma.gov.hk/eng/key-information/press-releases/2015/20150127-4.shtml

10. http://www.rbi.org.in/scripts/NotificationUser.aspx?Id=9546&Mode=0

Table 2
CCCB Progress

	CCCB Guideline	Progress Anchor Variable	Continuous Discrete	Threshold(s) Symmetry Add-variables	Other Observations	Regulators Supervisor Banking	Reference Document
Australia	From Jan 2016 ADI may be required to maintain CCCB	Bal III in progress since Jan 1, 2013	Operational framework to be introduced		On track to meet the 2016 cap req.	APRA	Prudential Std. APS 110
Brazil	Incorporated in Macroprudential framework	To publish technical note with details of guidelines on activation release etc. before Jan 2016					
Canada	Not published	Credit-to-GDP gap is viewed as one useful indicator among many, and is regularly monitored			Bank capital under the CCCB has not been fully established and requires additional research		
China	CCB and CCCB incorporate in Capital Rule	To publish technical note			BIS RCAP China (Basel III) found capital CCB, CCCB compliant	PBoC CBRC	
Colombia*	Countercyclical Policy & DP (2007-08)	Loan quality	Continuous	Asymmetric from downturn			
Hong Kong	Press Release (Jan 2015)	Credit-to-GDP Gap Property Price/rent Gap	Mapping		0.625% of RWA from Jan 1, 2016	Hong Kong Monetary Authority	Press release
India	Final Guidelines issued in July 2014	Credit-to-GDP Gap	Rates would be different based on the level/position of credit-to-GDP gap	Stock Prices, C-D ratio, Housing prices, Business Conf. Index as supplementary indicators	Release to Depend on key supplementary high Frequency Financial Variables	RBI	Final report on CCCB Framework (IWG)
Japan	Guideline Expected in 2014/15	Compliant with Bal 2.5				JFSA	
Korea	In the process of Basel III implementation						
Norway	Buffer Size 1% RWA for June 30, 2015	Credit-to-GDP gap, other indicator of systemic risk	Monetary policy report or financial assessment	Housing price/disposable income; commercial property price; wholesale funding ratio		Norges Bank, Finanstilsynet, Ministry of Fin	Norges Bank Press Release
Peru*	Countercyclical Policy & also (DP-2008)	GDP Growth, Stressed RWA	Discrete		When deactivated, up to 60% of capital buffer can be used.		
Russia	Currently being assessed				Current capital adequacy is high	CBR	
Spain*	Follow EU Process CRD-IV also (DP-2000)	Credit stock and growth	Continuous				
South Africa	Credit-to-GDP gap remains well below its long-term average, suggesting that there is currently no need to consider a CCB add-on for South African banks (FSR).					SARB	
Switzerland	CCCB implemented	Mortgage Volume to GDP, property prices	Presently at 2% of RWA	Combination of judgement and high freq indicator	Deactivated under Normal Circumstances	SNB, FINMA	
UK@	Capital requirement and regulation directives; consultation paper	Credit-to-GDP gap	Quarterly disclosure with PRA and FCA as monitor	Bank and non-banks' B/s stress indicators	CRD IV Requirements; same as other EU Members	BOE, Financial Policy Committee (2012)	
US	In 2013		Starting in 2016 and phasing in through 2019,		Could require most complex US banks to hold additional 2.5 %	Federal Reserve and the other U.S. banking agencies	The Federal Reserve is currently considering how best to implement the CCCB

Table based on responses received from the questionnaire sent to different central banks and material available on web (up to end-2014). The author is grateful to Michelle Wright, RBA; Graydon Paulin (BoC), Mike Thornley (BoE), Sachiko Abby Suematsu (BoJ), Magdalena D. Riiser (NB) and Irina Pantina (BoR) for their responses.

* The dynamic provisioning rule has been used in many countries including Spain (2000), Columbia (2007), Bolivia (2008), Peru (2008), and Ecuador (2012). @: In line with the decision of European Union to adopt BASEL III, the CRD IV is published by European Parliament on 16 April 2013, and implemented by 1 January 2014 through national laws.

6.2 CCCB to be Implemented

Australia has a prudential standard in force that gives the Australian Prudential Regulation Authority (APRA), Australia's supervisory authority, the power to apply a CCCB from 1 January 2016. The Reserve Bank of Australia (RBA) will, however, continue its role in monitoring financial stability developments and APRA will likely draw on the RBA's analysis to aid its decision-making. While Australia does not yet have a framework for the buffer; work is currently underway to develop an operational framework by 2015.

The Bank of Canada (BoC) was actively involved in the international development of the CCCB, and remains active in the context of ongoing work by the Basel Committee. It believes that it is an important component of a broader tool set that is available to the authorities. While there have been discussions among the relevant authorities in Canada on the implementation of the buffer and anchor variable(s), the lower bound (L) and upper bound (H) have been identified, the specific guidelines have yet to be published. The Bank of Canada currently evaluates financial system risks in a comprehensive manner, using a framework to identify domestic vulnerabilities and potential triggers (domestic and international). An assessment is made of these risks using both judgement and a suite of models, including stress-testing and early warning indicator models. The credit-to-GDP gap is viewed as one useful indicator among many, and is regularly monitored. However, activation/release of the CCCB is unlikely to be based on threshold levels related to only a small number of indictors, but rather on a broader risk assessment by the authorities. The timing of the activation/release of the CCCB remains a challenge given BoC's lack of experience in using this tool, and the ongoing need to further develop its framework for the identification and analysis of financial system risks. The impact of time-varying changes in the level of bank capital for CCCB on financial system behaviour, and ultimately the economy, has not been fully established, requiring additional research.

The European Commission has proposed the Capital Requirements Regulation (CRR) and Capital Requirements Directive (CRD) to the European Parliament (CRD IV). CRR is a set of regulations that can be directly applied across the EU members, while CRD is a set of directions that has to be implemented through national law. Some EU members have already started to build the CCCB framework under CRD IV such as UK and Norway while other countries are working closely to develop a suitable framework.

In Japan, the main authority handling CCCB implementation is the Financial Services Agency (FSA) which promulgated the Basel III rules in March 2012. Draft regulations on the CCCB are expected in to be in place between the year 2014 and 2015.

In the context of the CCCB, the Federal Reserve and other U.S. banking agencies issued the final rule for Basel III implementation in 2013. These rules could require the largest U.S. banks to hold additional capital of up to 2.5% of their RWA, if the US agencies deem it necessary for increasing risks. The Federal Reserve is currently considering the best modes for CCCB implementation[11].

Brazil has incorporated both the CCB and CCCB in its prudential framework. However, it has yet to publish the guidelines on the CCCB. The Banco Central do Brasil (BCB) is presently in the process of developing a technical note on the functioning of the CCCB, which is likely to be in place before 2016 (the Basel III timeline for both buffers by 1 January 2016)[12].

The CCCB is treated as part of China's macroprudential framework. The Regulatory Consistency Assessment Programme (RCAP) (BIS, 2014) find that the Chinese banking sector is compliant on capital buffer (CCB and CCCB), with no deviations from Basel requirements[13]. The China Banking Regulatory Commission (CBRC) is currently in the process of developing the operational modalities together with the People's Bank of China to be finalised before January 2016.

In South Africa, an assessment of total credit extension was made in its Financial Stability Report[14], aimed at considering the appropriateness of the current financial stability stance on the CCCB for banks. It showed that there is currently no reason to change the level of buffer capital that banks need to hold to influence the rate of credit extension. The South African Reserve Bank is, therefore, not yet considering the application of the CCB on the banking sector or specific loan categories[15].

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11. http://www.bis.org/review/r141208e.pdf
12. BIS RCAP Brazil (2013) http://www.bcb.gov.br/pec/appron/apres/RCAP_Brazil_assessment_report.pdf
13. RCAP assessment of Basel III regulations, China (Basel 2014), Http://www.bis.org/bcbs/implementation/l2_cn.pdf
14. http://www.centerforfinancialstability.org/fsr/zaf_fsr_201403.pdf
15. https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/6470/FSR%20Sept%202014(1).pdf

The Financial Services Commission in consultation with the Ministry of Strategy and Finance, Financial Supervisory Service and the Bank of Korea, decided to put into effect the Basel III rules from 1 December 2013. The decision was made in light of other major Asian economies having adopted Basel III capital rules in 2013. A Bank of Korea (BOK) report stated that Korea needs to take into account risks of household debt in deciding the level of CCCB, along with the BCBS' recommendation of using a gauge for banks' credit exposure[16].

The Department of Financial Stability of the Bank of Russia (BoR) would coordinate the implementation process for the CCCB, expected to come into force by 2016. While the effects of CCCB implementation are currently being analysed, the standard European approach may not be applicable to Russia, and the BoR is expected to make some enhancements to the model.

7. Progress and Challenges in Implementing CCCB in SEACEN Member Economies

The cross country analysis indicates that only a handful of economies have actually implemented the CCCB, while in most other jurisdictions, the research, studies and guidelines have only been recently published or are still on-going. Among the 20 SEACEN member economies, India and Hong Kong have already put in place the framework for the CCCB implementations, while in other member economies, depending on their development stages, state of regulation and supervision and depth of the financial markets, research related to CCCB implementation is in progress. For comparison, this section looks at a snapshot of the progress of 8-participating SEACEN member economies in the CCCB implementation. The major parameters for the CCCB implementation have been summarised in Table 3, which clearly indicate that they are in still at the early stages. Among the eight economies considered, Basel II implementation is still in progress in three while others are in the process of Basel III implementation. Some of the members have an indicative timeline for Basel III or for the conservation buffer implementation, but for most, no guidelines on the CCCB have been issued so far, albeit with many conducting on-going research.

16. http://english.yonhapnews.co.kr/fullstory/2013/03/05/77/4500000000AEN20130305002900320F.HTML

An attempt to analyse the broad factors that have posed challenges or constraints for a CCCB has surfaced certain common issues. The most obvious problem relates to the availability of long and uniformly defined/comparable time series data (Section 8). Some of the economies find that due to the emerging nature of their markets, the credit and GDP figures are too volatile for the implementation rules to be based on. The lack of developed financial markets, especially high frequency financial variables (e.g., credit spread, housing prices or commodity prices) as indicated in the BIS Guidelines are likely to be major constraints when making decisions on buffer capital release. For some economies, the banking sector is already adequately capitalised, far above the BIS prescribed limit, even after including for CCB and CCCB. For others, their banking sectors have never faced a major crisis for the last few decades, which therefore constrains the scope for calibration of limits based on historical data and crises experiences. Further, some economies such as Papua New Guinea and Vietnam are only starting to implement the Basel II framework. The participating members were unanimous in their opinion about the lack of available research for emerging markets, which was felt to be absolutely essential as part of analysis for CCCB framework implementation in this region.

The study makes an attempt to address some of these challenges and provides a roadmap for CCCB implementation in the SEACEN region. The following provides an integrated view of the SEACEN members participating in the project. While Annex Table 2 provides a brief summary of findings for these economies, details of their empirical findings, estimated trend and cycles, and other empirical details are in reported in the project team papers.

Table 3
CCCB Policy Progress (SEACEN Members)

Economies	CCCB Guideline Published	Policy Measures Taken	Policy Variable Other Variables	Policy Hurdles	Proposed Implementation	Supervisory Authority	Other Obs.
Cambodia	No	Basel II	-	Data availability	-	NBC	-
Indonesia	Regulation for Capital Adequacy Ratio Based on BASEL III (PBI No. 15/12/PBI/2013)	Basel III in progress	-	-	2016	IFSA and BI	Two research papers on CCCB
Malaysia	-	Basel III in progress	-	-	-	BNM	Large loan and NPL share of household debt
Papua New Guinea	Not committed on the time frame	Basel II in Progress	-	Not implemented Basel II completely	-	BPNG	-
Philippines	No CCCB Guideline	Included capital buffer consistent with Basel III, conservation buffer included	-		No fixed timeline	BSP	1.Presently banks adequately capitalised 2.Future study on appropriate tools needed
Chinese Taipei	In Progress	Basel III in progress	-	Volatile Credit-GDP Gap	Conservation Buffer after 2018	Competent Authority, CBC	-
Thailand	No CCCB Guidelines yet	Basel III in progress	-	More research required	-	BoT	Significant improvements in banking system after the crisis and post reforms
Vietnam	No	Basel II in progress	-	Low capital adequacy and high NPL of Banking sector	-	SBV	Synchronised financial and business cycle

8. Data Availability and Gaps

As indicated in the Section 7, availability of long series data without significant structural breaks are perceived to be major problems. In view of this, a survey on data availability was made, the results for which are summarised in the Annex Table 1. As can be observed, among the three broad sets of indicators (namely, macro-indicator, banking sector and financial variables), data on financial sector variables are especially limited (e.g., Cambodia and Vietnam) as these sectors are relatively newly established and do not necessarily have deep and liquid markets. For the banking sector, while quarterly GNPA data are mostly available, in some cases, these have gone through definitional changes and appropriate adjustments have to be made for the changes. Among the macro-indicators, banking sector credit data is available for most economies. In the Basel guidelines for CCCB, the definition of credit covers both bank credit and non-bank credit to the commercial sector including bond and cross-border credit. For the participating members, however, it was not possible to use this all-encompassing definition of credit because of the paucity of sufficiently long series of data. In most cases, bank credit, which constitute the major portion of credit in these economies, is used as a proxy for the broad definition of credit as suggested by the Basel Committee. The exact definition of the credit variable used is mentioned in detail in the respective team project papers.

For some members, GDP data is available only on an annual frequency basis. In such cases, common lower to higher frequency conversion methods are used to convert the GDP data into uniform quarterly frequency. For trend estimation, it is essential to use sufficiently long time series (at least 10 year) to arrive at meaningful estimates. Keeping in view the importance of the time span, data for the longest available time period are used by the project team members to achieve reliable estimates. The credit-to-GDP ratio is annualised in line with the Basel Guidelines[17]. Even with these adjustments, the dataset indicates different trends and underlying characteristics due mainly to the emerging nature of the respective economies and different time periods for crises and reforms. Chart 1 plots the credit-to-GDP ratio for the sample set of member economies for a common sample period. Chart 1 clearly indicates that the credit-to-GDP ratio had built-up prior to the global financial crisis (shaded region 2008-09) for selected member economies, which coincides, with the Basel observation of the variable.

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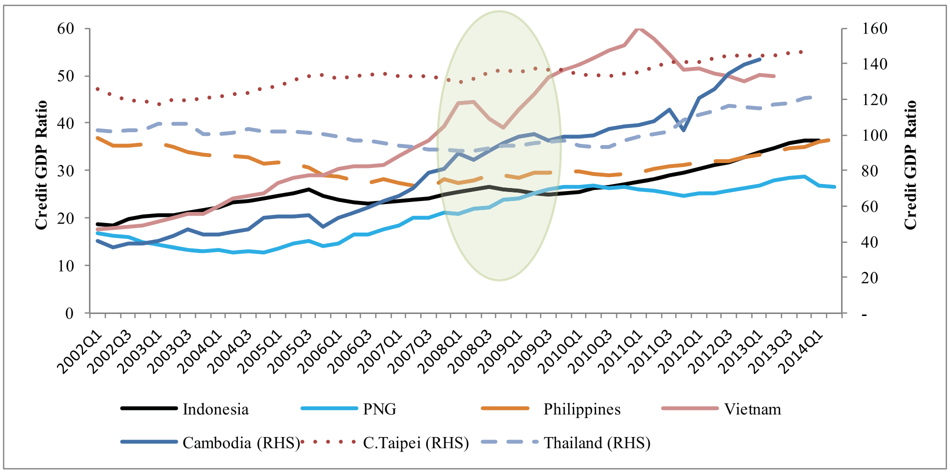
17. Credit-to-GDP Ratio for Qi= {Qi credit stock /sum(GDP(Qi-3):GDP(Qi))]*100, i.e., credit in each quarter divided by rolling GDP sum of last 4 quarters, commonly referred it as annualized credit-to-GDP ratio. Any departure from this definition are noted in the members' research papers (subsequent chapters).

Chart 1

Credit-to-GDP Ratio of the Sample Set of Member Economies*(Credit-to-GDP ratio generally high and rising before Crisis 2008-09)*



9. Methodologies for Empirical Analysis

This section examines the methodologies used for estimating the credit-to-GDP gap, evaluates the early warning properties of the selected key (gap) variables, calibrates the threshold values (L and H) and evaluates the performance of supplementary variables. As the team project papers delve in detail the specifics, this section only briefly highlights the methodologies used and economic rationale for their application.

9.1 Credit-to-GDP Gap

As shown in Section 5 (on literature), the credit-to-GDP gap has been identified by the Basel Committee to be the main indicator for the countercyclical capital buffer considering its properties as an early warning indicator. However, the quality of the gap estimation depends on the appropriate segregation of the cyclical component from the trend. This in reality poses considerable challenges, as the movement fluctuates around the trend while the trend itself changes, leading to possibilities of deviation from the cumulative equilibrium (Landau, 2009). Moreover, applications of different filter methodologies lead to different gap outcomes. The available literature offers a large number of filters which include purely statistical process e.g. Hodrick Prescott filter (HP), (Geršl and Seidler (2011)), time series filter (Harvey's unobserved components), frequency domain (Bandpass) filters and structural model filters. The Basel Committee suggests the use of the HP filter for de-trending, considering its large scale use in estimation of business cycles, ease of implementation, statistical properties (as it gives more weight to recent observations) and capability to efficiently deal with structural breaks. However, it has been argued that HP filter outputs crucially depend on the selection of the smoothing parameter (λ) and algorithms used for estimations[18]

The value of the smoothing component, λ, is crucially important for the segregation of trend and cyclical component of the estimation. A high value λ makes the trend component linear and incorporates more cyclical variation in the estimate. Ravn and Uhlig (2002) specify a power rule to determine the λ values[19]. In this context, it may be mentioned that the credit-to-GDP ratio incorporates variables representing the financial cycle (credit) and business cycle (GDP). Ravn and Uhilg also indicate that the credit cycle is generally three to four times longer than the business cycle. The Basel Committee recommends λ =400,000 to capture the long-term trend in behaviour of the credit-to-GDP ratio. The empirical analysis by Drehmann et al. (2010) indicates that the trend calculated using λ at 400,000 performs well in picking up the long- term trend in private sector indebtedness.

Another criticism of the HP filter relates to the end-sample bias, which makes it sensitive to data revisions, a common feature for macroeconomic data across regions. One possible way out of this problem is using an one-sided HP filter, which considers data up to the particular point in time series for which the trend value is being estimated, while the commonly used two-sided filter uses the entire sample. The BCBS endorses the use of the one-sided HP filter when estimating the credit-to-GDP gap for the CCCB. However, in using the one-sided filter, the sample size is increased by one point for each iteration

18. In the generic form HP filter estimate trend by

$$\min \sum_{t=1}^{T} \{[CTG_t - Trend_t]^2 + \lambda[Trend_{t+1} - 2Trend_t + Trend_{t-1}]^2\}$$

Where λ is the smoothing parameter.

19. Where λ = (observation frequency ratio)^4*1600, (for quarterly data). Assuming credit cycle is three time longer than business cycle λ = (3)^4*1600=129,600, and assuming credit cycle is four time longer than business cycle λ =(4)^4*1600=409,600.

resulting in (a) varying size for each point and (b) initial estimates being based on a small sample size. Given the data availability problem in the emerging market economies, especially for quarterly GDP series, the use of the one-sided HP filter may have its limitations. The trend component is also not observed, which naturally gives rise to some uncertainties in using gaps in policy making (Swanson, 2000). In the case of estimating the credit-to-GDP gap for the CCCB, interactions of (a) the financial and business cycles; (b) the possibility of data revision; and (c) the choice of algorithm in estimating the HP filter, intensify the degree of uncertainty for the SEACEN economies. As a way out, the credit-to-GDP gap is estimated using different lambda values (λ=1600; 125,000; 400,000) and using both the one-sided and two-sided HP algorithms. From the six estimates, the credit-to-GDP gaps are selected for the participating members, based on their performance as early indicators, 'noise to signal' ratios and their correlations with the banking sector's non-performing asset growth.

9.2 Early Warning Indicator (EWI) Property of Credit-to-GDP Gap

The Basel Committee requires national authorities to announce the capital requirement for the countercyclical capital buffer four quarters in advance, so that banks have sufficient time for preparation and implementation. This implies that the credit-to-GDP gap, in order to act as an effective indicator variable, has to signal the build-up of systemic risk in the member economies at least 4 quarters ahead. This section will delve into the empirical evaluation of the lead-lag relationship between the banking sector stress variable (proxied by year-on-year NPA growth) and the lead indicator, i.e., the estimated gap series for member economies. Empirical evidences generally suggest that non-performing loans (NPLs) increase sharply during the onset of a major banking sector crisis (Laeven and Valencia (2008)). Nkusu (2011) indicates that adverse macroeconomic developments are associated with rising NPLs which in turn play a central role in linkages between credit market frictions and macroprudential vulnerability. Therefore, including NPA growth as a banking sector stress indicator in the regression equation is as follows:

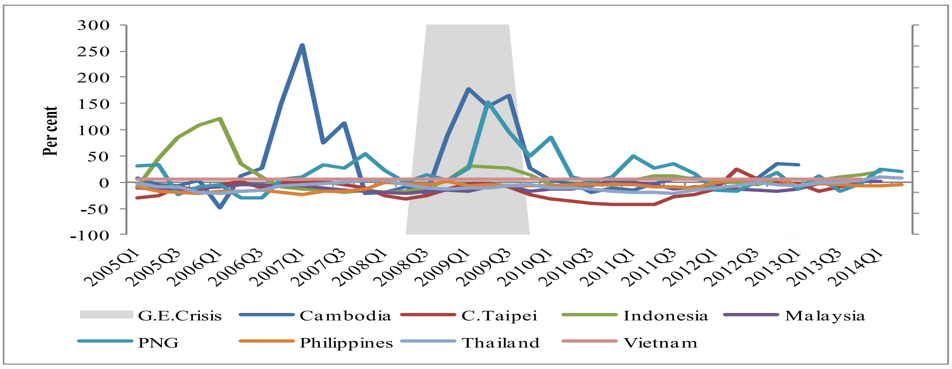
$$NPA\ Growth = f(credit - to - GDP\ gap\ (-1\ to - i) \qquad (1)$$

Where the selection of 'i' (>4) depends on the availability of data points (degrees-of-freedom in the regression analysis) for the economies. The early indicator property of the variable has been identified considering *'t-stat', 'F-stat' the AIC, SBC and* R^2 values from equation-1 for the respective economies (regression results in respective team project papers).

Chart 2

The NPA Growth Rates for Sample Set of Member Economies

(generally indicates increase in NPA growth during GFC)



9.3 CCCB Thresholds (L, H) Estimation

In the Basel Framework, the lower thresholds (L) corresponds to the gap value when the banks would be required to accumulate the CCCB capital, and the upper threshold 'H' corresponds to the gap value when the buffer reaches its maximum value (thereafter additions to capital under the CCCB will be zero until further announcement). L and H play crucial role, as they determine the time and speed for capital accumulation. While the Basel Guidelines recommend L=2 and H=10, they note that these threshold values provide only a starting guide for the relevant authorities responsible for deciding on buffer add-ons. The Guidelines allow for authorities' judgement for implementing different buffer add-ons depending on underlying economic conditions. The broad criteria set out by BCBS for the selection of L and H are as follows:

- "L should be low enough, so that banks are able to build up capital in a gradual fashion before a potential crisis. L should be high enough, so that no additional capital is required during normal times.

- H should be low enough, so that the buffer would be at its maximum prior to major banking crises."

These thresholds are empirically estimated for each of the members in the sample. The Sarel (1996) methodology is used, employing a single regression equation with iteration over different threshold cut-offs (e.g., L=1, 2...) for the explanatory variable in the sample. Thresholds are then decided on the basis of the explanatory power of the equation (i.e. R^2 value) and the significance of the coefficients in question (for a particular gap threshold). In this context, the explanatory variable is the credit-to-GDP gap (as estimated in Section 9.1*)*, and an interactive dummy variable incorporating different threshold values. Gaps and the dummy variable based on the same are as follows:

$$dummy(i) = \begin{cases} 0, & credit\ gap\ < threshold(i) \\ 1, & credit\ gap \geq threshold(i) \end{cases}$$

Interactive dummy variable X(i)= $dummy(i) \times credit\ gap$

The dependent variable is the bank NPA growth rate (y-o-y) and the OLS regression equation is given as below:

$$NPA\ Growth = f(Gap,\ X_i) \tag{2}$$

It should be mentioned that while Sarel's method was originally used for inflation threshold estimation in 1996, the above algorithm has been used for estimating the CCCB thresholds by the Reserve Bank of India (2013, 2014).

9.4 Noise to Signal Ratio

At times, regression analysis can produce mixed results due to the lack of data points, presence of structural breaks or deviation from some classical assumptions. To complement the regression analysis results, we further use the "noise to signal" (NS) ratio as pioneered by Kaminsky and Reinhart (1999) and later used by Drehmann et al. (2011) in analysing systemic banking crisis,

The credit-to-GDP gap is first estimated as described in Section 9.1 while a signal variable (S=S(gap)) that takes the value 1 is considered, whenever it is above the threshold (i=1, 2,....) otherwise zero. A signal (S=1) is considered to be correct, if a crisis occurs within the next three years (12 quarter) rolling window. Otherwise this observation is classified as a Type II error, i.e. when a signal is issued but no crisis occurs. On the other hand, depending on the gap and when the threshold S=0, this is an indication of no occurrence of crisis for the next three years. If the following three-year rolling window indeed has no crisis, it is then a correct signal. Otherwise, in the presence of a crisis (conditional upon no signal), it gives a Type-I error. The trade-off between these two types of errors is that if the threshold value 'i' is low, depending on the value of the underlying gap, the signal variable indicates large number of crisis (S=1), and the chances of a Type II error (signal but no crisis) goes up. If, on the other hand, the threshold is high, then depending on the gap, the total number of no-crisis signals (S=0) go up. In case of a crisis in such a period, the chances of a Type I error go up. While a regulator will try to minimise a Type I error, the optimal indicator has to have the right trade off, which will depend on the relative cost of these two types of errors (Borio and Drehmann, 2009). Attempts are, therefore, made to minimise the loss function, L, as follows:

$$Min\big(L(i = 12,..18)\big) = Min(\frac{T2}{1-T1}\ subjected\ to\ (1-T1) > X) \qquad (3)$$

The combined effect of these to error is summarised in the NS ratio, which is computed as a ratio of Type II error to 'one minus Type I error'[20]. Based on this specification, the lower the NS ratio, the better is the EWI property of the variable and the threshold selection (Kaminsky and Reinhart). However, the mixed approach is mostly used, i.e., minimising the NS, subject to predicting a minimum number of cases 'X' consistent with Borio and Lowe (2002) and Borio and Drehmann (2008).

Following the above specification, the EW-properties is analysed (9.2) for the gap variable. The NS ratio is also calculated for different thresholds (9.3) of the gap variable to identify the optimal threshold levels for the participating SEACEN economies. To attain a minimum success rate, the success ratio[21] is also examined, which is the probability of identifying and signalling a crisis correctly. Following Drehmann (2011), we do not consider signals immediately in two years, after the beginning of a crisis. One shortcoming of this methodology is that it requires well defined crises in the member economies and relevant data for about 3 years prior to the crisis.

20.

	Crisis (within j quarters)	No Crisis (within j quarters)
Signal	A	B
No signal	C	D

$$NS\ Ratio = \frac{Type\ II\ error}{1-Type\ I\ error} = \frac{\frac{B}{B+D}}{1-\frac{C}{A+C}} = \frac{B*(A+C)}{A*(B+D)}$$

Where j=8,12

21. the probability of an indicator correctly signalling a crisis is given by

$$P(crisis|signal) = \frac{A}{A+B}$$

9.5 Identification of Supplementary Variables

In its Guidelines to national authorities, the Basel Committee indicated the role of high frequency data in identifying the build-up of systemic risk in the banking system, especially during the buffer release period. However, our survey of data for the member economies reveals a paucity of deeply liquid financial markets, which limits the availability of high frequency financial market indicators. Notwithstanding this limitation, available financial market variables of the members were evaluated for the lead-lag correlation with the variable indicating banking sector systemic risk (i.e., NPA growth rate). These correlations and their statistical significance have been used to determine the time and speed for buffer release during the crisis phase.

9.6 Panel Data Analysis

While the analysis so far has only considered members' data individually, this section attempts to stack together data for members for a common sample period to acquire a balanced panel. The panel data analysis, although poses a considerable challenge in face of heterogeneous cross-section data, is nevertheless commonly used for cross country analysis as it allows for large degrees of freedom. The early warning properties of the credit-to-GDP gap, with NPA-growth as a dependent variable, is analysed and the fixed effect specification of the panel equation is estimated as below:

$$NPA\_Growth_{it} = \alpha_i + \lambda_t + \Sigma b(i) * gap_{t-i} + \varepsilon_{it} \quad (4)$$

Where '*i*' represents the members and 't' is the time (quarters), while ε_{it} is assumed to follow a normal distribution. Similarly, we attempt to estimate thresholds with the panel framework. The estimate panel data model and the fixed effect equation is specified as below:

$$NPA\_Growth_{it} = \alpha_i + \lambda_t + b_{1*}Gap_t + b_{2*}X_{it} + \varepsilon_{it} \quad (5)$$

Dummy = 1 if credit-to-GDP gap > threshold value (i), where i=1,2...........20
= 0 otherwise

Interactive dummy variable X_i= Credit-to-GDP gap * Dummy(i);
The panel data regression results and the test statistics for selecting among the pool, random and fixed effect models are reported in Section 9.

9.7 Judgement

The Basel Committee has emphasised the role of relevant authorities' judgements in setting the buffer level and its release. Therefore, while emphasising on sound quantitative techniques in this research, the participating members were encouraged to use appropriate judgment, wherever necessary, to arrive at reasonable and implementable indicator(s), threshold values and release phase. The findings of the empirical analyses with some degree of judgement are summarised in Table 4. Annex Table 2 summarises the major findings for each of the participating members. The detailed estimates, NS ratio, other analyses are found in the respective project papers.

Table 4
Summary Findings for the Participating SEACEN Members

	Key Variable	Filter	Supplementary Indicators	Lead	L	H	Level 0-2.5	Accm.	Releases	Purpose	Communication	Review
Basel III	C- GDP Gap	HPOS,400000	Asset prices	4q	2	10	Max 2.5	Linear	Judgment Immediate	Absorb losses	At least once a year	Regular Interval
Cambodia	C-GDP Gap	HPOS 1600	Credit and GDP growths (For release phase)	6q	5	11	0-2.5	Linear	Judgement based on relevant market indicators	Absorb losses and reduce the risk of the supply of credit	At least on annual basis	Regular Disclosure
Indonesia	C- GDP Gap	HPOS, 25000	Property Price Index Inflation Index Return on Asset	8 q	3	6	Max 2.5	Linear	Judgment Immediately or Gradually (depends on the situation)	Maintain credit growth and absorb unexpected losses	At least once a year	Regular Interval
Malaysia	Credit Growth Gap	Two sided perform better	Equity price gap Housing prices gap	Needs further investigation					Exercise of Judgement	Help banks to absorb losses		
Papua New Guinea	C- GDP Gap	HP0S,400000	Asset price	7q	2	7	Max 2.5	Linear	Judgement	Absorb losses	Annually	Annually
Philippines	C- GDP Gap	HPOS, 25000	Growth of stock market returns & growth in residential capital values	8-10q	4	12	0-2.5%	Linear	Supplementary indicators and judgment	Sustain supply of credit	FSR	Annually
Chinese Taipei	C- GDP Gap	HPOS 1600	Credit growth and housing price gap	6q	2	13	0-2.5	Judgement, Volatile Gap	Judgement	Prevent systemic risk	When necessary	Regularly
Thailand	C- GDP Gap	HPOS 400,000	NPL Ratio	5q	8	16	Max 2.5%	Linear	Immediate	Absorb losses	At least once a year	Regularly
Vietnam	C- GDP Gap	HPOS 1600	VNindex (stock index)	2q,4q	3	13	0-2.5	Linear	In steps	Absorb losses, Maintain credit flow	Bi-yearly	At least once in year

Note: C-GDP gap is Credit-to-GDP Gap; HPOS, 25000 is HP 1-sidefd with lambda-25,000; similarly for others; Accm. Accumulation of buffer, Brief findings for the participating members are reported in Annex Table II, details of empirics can be found in the team project papers.

10. Empirical Findings and Their Policy Implications

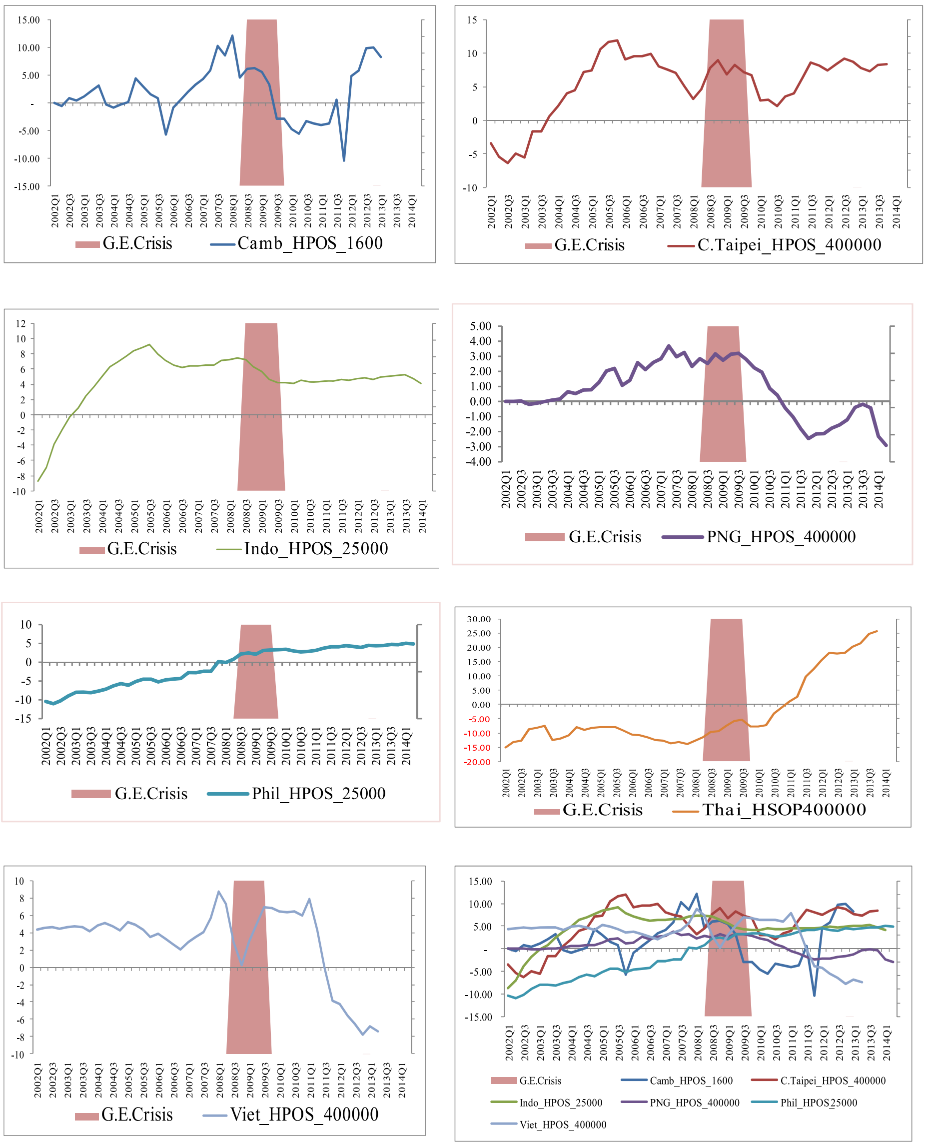
10.1 A Main Indicator

After calibrating with a large number of indicators, most of the members[22] find that the credit-to-GDP ratio and the credit-to-GDP gap derived from the same, may be considered as a key/starting point indicator for countercyclical capital buffer estimation. As indicated in the Table 4 (column 2), the gap variable is found to be suitable for seven economies. However, member economies are encouraged to analyse other indicators such as the credit growth gap, GDP gap etc., as alternative variables. For instance, in Malaysia, the credit growth gap appears to have better indicative properties for the CCCB during the sample period.

The analyses with different lambda (λ=16k, 25k, 400k) values and one-sided vis-a-vis two-sided estimations, however, disclose some interesting results. Between the one-sided and two-sided, the former is found to be more robust in terms of data. Concurring with the Basel Guidelines, the one-sided filter seems to perform better for most of the members, except for Malaysia, where the two-sided filter registers a better performance. However, when the performance of the credit-to-GDP gap is evaluated in terms of the different lambda values, the members find that different λ values are more appropriate for the different economies (Table 4, column 3). For instance, PNG and Thailand find that λ=400k performs better, Indonesia and Philippines, it is λ =25k and for Cambodia, Chinese Taipei and Vietnam, λ=1600 seems to exhibit better EWI properties. The suitability of different λ-values for member economies is consistent with the theory, (e.g., Ravn and Uhlig) as it crucially depends on the relative length of the financial and business cycles, which can differ between members. It is, therefore, recommended that members calibrate with different λ parameters for the appropriate gap selection. In general, gaps, as plotted in Chart 3 indicate an upward trend for the majority of member economies before the 2008 Global Financial Crisis (GFC).

22. Here and henceforth "members" refer to the 8 economies that participated for this study, and not the Group of 20 SEACEN members, unless otherwise explicitly stated.

Chart 3
Credit-to-GDP Gap for the Sample Set of Member Economies[23]
(Gap indicator generally picked up before GFC)



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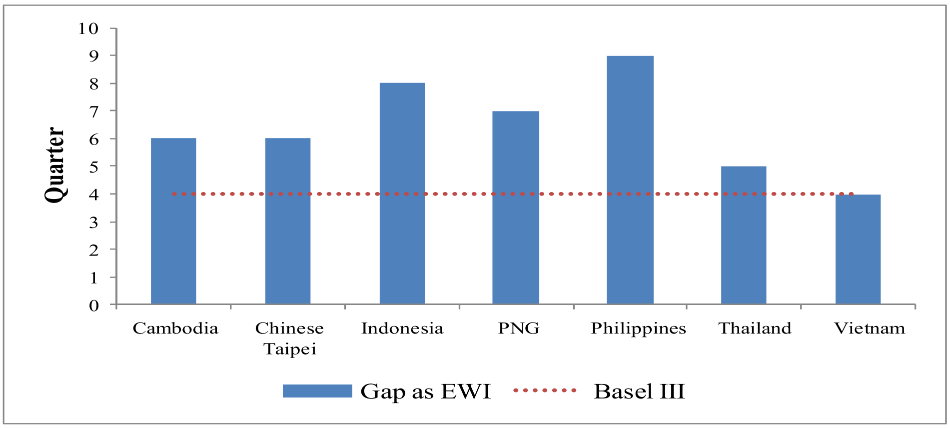
23. In Chart 3, 4 and 5, Malaysia is not plotted as credit growth gap is found to perform superior compared to the credit-to-GDP gap.

10.2 EWI Property

The objective of this section is to evaluate whether the credit-to-GDP gap can provide an indication for the build-up of systemic risk sufficiently in advance so that the banking sector has enough time to build up the required buffer. The lead time is summarised in Table 4 (column 5) and Chart 4. These are presented as estimated coefficients of equation (1) and results as shown by the NS ratio. For most of the members, it can be seen that the time between the pick-up in the credit-to-GDP gaps and any systemic risk build-up is more than 4 quarters, giving supervisory authorities sufficient time to implement the CCCB.

Chart 4
Early Warning Indicator Property of Credit-to-GDP Gap
(Credit-to-GDP gap indicates lead indicator property)

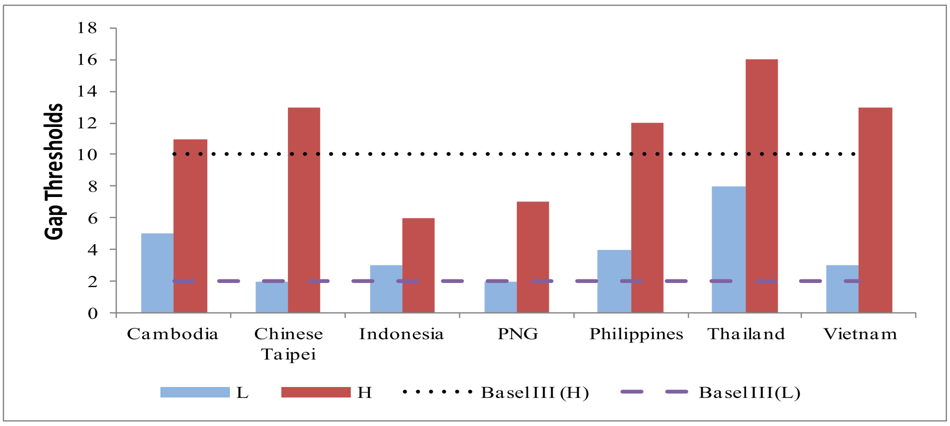


10.3 Threshold Levels

Estimations of thresholds are crucial to the whole exercise and we have endeavoured to derive them using the R^2 value from the step-wise regression equation (2) or Sarel's method for identifying thresholds, the NS ratio obtained from the non-parametric test and judgement where appropriate. The results tend to suggest that for all members, the lower bounds are greater than or equal to two (L>=2)). The upper bound (H), that will halt further capital accumulation, is found to be more than 10 for most of the members. However, the upper bound for Indonesia and PNG is less than 10 (the Basel recommendation for

H). On average, the L and H values were both higher than the Basel Guidelines. It must be mentioned that the Basel Guidelines do specify these values (L=2, H=10) as a starting rule for national authorities. These higher thresholds are consistent with the emerging nature of the participating members, where credit growth plays a crucial role in economic development and where it is more characteristic of progressive financial inclusion and deepening rather than the build-up of systemic risk.

Chart 4
Threshold Levels for Countercyclical Capital Buffer
(On average, L and H higher than Basel Guidelines)



10.4 Panel Regression Results

Notwithstanding the heterogeneity among the members, an analysis is made using stacked data together with a panel data exercise, as indicated in equation-(4) [24]. NPA growth y-o-y as a dependent for cross-section of members and lagged GAP variables as independent set of variables are used. For this exercise, 4 to 8 quarter lags are applied as per Basel suggestion that national authorities has to announce the CCCB buffer accumulation at least four quarters ahead. Table 5 shows the coefficient estimates in a pooled regression, which has a low R-square value. Time and cross section specific effects on member economies

24. Seven members were considered for this analysis, as they had comparable data during the time of the analysis. Period 2005Q1-2012Q4 was considered as data for all the seven members were available during the period, and occurrence of the global economic crisis in the sample period. Malaysia is not considered in this group, as the credit growth gap (rather than credit-to-GDP gap) performs better as the key CCCB indicator for Malaysia.

are depicted with a random effect panel model, however the Houseman test strongly indicates that the random effects are correlated. We, therefore, use the different fixed effect models (with cross section dummies, time dummies and both cross-section and time dummies), and based on the redundant fixed effect test (cross-section and period specific F-test and Chi-square test) fixed effect model with cross-section and period specific effects is selected. The estimated parameters, Prob-values and R-square value of the fixed effect model reveal that the gap variable 6-quarters ahead is significant at 5% level. We also perform a redundant variable likelihood ratio test for the GAP(-6) series with both the F-Test and the likelihood ratio test strongly rejecting the Null that the GAP(-6) is a redundant variable. This result generally supports the early warning property of the gap variable for the members in combination.

Table 5
Panel Regression Results

Variable	Pooled Model		Random Effect		Fixed Effect	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	5.11	0.11	5.06	0.24	2.50	0.40
GAP(-4)	1.46	0.36	1.66	0.28	2.52	0.07
GAP(-5)	-4.19	0.08	-4.32	0.06	-4.48	0.08
GAP(-6)**	5.52	0.03	5.34	0.04	5.46	0.02
GAP(-7)	-3.20	0.23	-3.41	0.19	-3.37	0.14
GAP(-8)	1.08	0.57	1.42	0.44	1.92	0.28
Time Dummy	-		-		Included	
Cross Section Dummy	-		-		Included	
R-Sq	0.06		0.05		0.48	

We also attempt to estimate a threshold figure for the seven members, by estimating equation (5), which is a panel application of Sarel's approach for threshold determinations. Equation (5) was estimated using several methodology, (i.e., pooled, random effect and fixed effect models) for different threshold levels (i=2, 3, 4, 5, 6). However, only the fixed effect model find that the coefficient of *X(L=3)* is significant, at about 10%, with a very low R-square value. This result is not surprising, given the divergence in the respective member's estimate of the L and H values, as reported in Chart 5. It also perhaps re-emphasises the importance of economy specific estimates and judgement in setting the (L and H) threshold values.

10.5 Accumulation and the Buffer Target

Regarding accumulation of the capital buffer, the members observe that the build-up could be linear between the thresholds (L and H) as suggested by the Basel Guidelines. On the exact percentage of capital build-up (in the range of 0-2.5% RWA), it is generally felt that appropriate decisions can be taken by each jurisdiction after closely evaluating the underlying economic conditions and using due judgement. It must be mentioned in this context that countries that have already implemented the CCCB generally took a call on the CCCB capital level based on the underlying economic conditions (refer to Section 6.1 for more details).

10.6 Supplementary Indicators

Due to the emerging nature of the participating economies, the availability of high frequency financial market variables is a challenge. However, a correlation (lead-lag) analysis with the available set of financial indicators and growth rate of NPA of the banking sector, have shown that some of these financial variables can be considered as systemic risk indicators along with the credit-to-GDP ratio as summarised in the Table 4, column 3. It shows that the return on equity can be used as an indicator for PNG, Philippines and Vietnam while it is the property (housing prices) for Indonesia Malaysia and Philippines, and the NPL level for Thailand.

10.7 Release of Buffer

There is generally a consensus that the judgement of the relevant authorities and the underlying economic conditions are major considerations for the release of buffers. These should be complemented by the main CCCB indicator and supplementary set of indicators. The participating members further emphasised the role of judgement in deciding whether the buffer release should be immediate or taken in stages.

10.8 Review and Communication

Regular reviews and research related to the CCCB are essential given the emerging market nature, volatility of the key CCCB indicator and the role of judgement for the participating economies. It is suggested that, in line with Basel recommendation, a review, at least once in a year, is absolutely essential while a more frequent review would be preferable for this region. The review and the recommendations should be communicated to the banking sector and market participants at regular intervals, and could be incorporated in the regular release of financial stability reports or monetary policy statements.

10.9 Key Findings

The key findings of this analysis and policy implications are as follows:

- The starting point of the CCCB analysis for the participating members can be the credit-to-GDP gap, as most of the economies have found it to be appropriate. However, other variables such as the credit growth gap and the output gap may also be considered as they may provide a better signal for some economies. In line with the Basel recommendations, most of the members find that the one-sided HP filter to be suitable for estimating the gap. However, in view of the data limitation, the use of the two-sided HP filter to evaluate gaps is also recommended.

- The choice of the ‘lambda’ variable (HP filter) differs considerably among members due to perhaps differences in the relative amplitude and duration of the financial cycles vis-a-vis the business cycle, consistent with the theory. The general consensus is that the choice of the key variable(s) should depend on whether the selected variable(s) is able to reliably signal good and bad times so that sufficient buffer is accumulated in good times to absorb subsequent expected losses and at the same time robust for regulatory arbitrage and is difficult to manipulate.

- The empirical estimates of the threshold indicate that ‘L’ is generally found to be higher than the Basel recommendation (L=2). This could be due to the emerging nature of the member economies, where credit growth also incorporates the effect of financial deepening. The average value of the upper threshold is higher than that for Basel (H=10), although there are some members which find that a lower (than 10) threshold more suited to their economies.

- Empirical results have indicated that use of variables such as the return on assets, equity returns, NPA ratio, housing prices, to be useful supplementary indicators for decisions on the CCCB.

- As for early warning properties of the anchor variables, it is observed that CCCB decisions may be pre-announced with a lead time of 3-4 quarters. Many of the members prefer a linear build-up of the buffer; but the possibilities of in-step (non-linear) build-ups cannot be ruled out. It is felt that the exact value of the CCCB buffer as a percentage of RWA (in the range of 0-2.5%) is best decided, contingent on the underlying economic conditions during the buffer announcement or subsequent revisions, as in the case of Switzerland, Norway and U.K.

- Although the variable used for signalling activation may be employed for the release phase of the CCCB, this study strongly advocates the use of judgement in the decision for the time and speed of the buffer release, depending on the nature and voracity of the economic crisis. The buffer may be released to absorb losses and/or to maintain credit supply during crisis periods.

- In view of the emerging nature of the participating economies and volatility of the variables taken into consideration, it is recommended that CCCB decisions be subjected to reviews, research and empirical testing at least once a year, if not more, for their efficacy and for considerations of possible new indicators.

11. Way Ahead

For many of the member economies, this study is an early research initiative for implementing the CCCB in the future. For some, regulatory authorities are only presently in the process of implementing Basel II recommendations while for others, the extreme volatility of the credit-to-GDP gap make it a challenge to implement the CCCB at this juncture. In light of this, some of the difficulties and challenges are discussed in the following sections. It is felt that appropriate policy measures in response to the challenges would benefit future research analysis and policy implementations on CCCB in the member economies.

- There is a need to examine the quantitative and qualitative nature of the main variables, namely quarterly GDP, credit and banking stress indicators, etc. The Basel Guidelines use a broad definition of credit that captures all sources of debt funds for the economy. As data on the variable may not be available at present, economies may have to use a close proxy and back-date the data for a minimum of a 10-year period to facilitate research analysis and decision making related to the CCCB.

- Reporting more financial data derived from relatively deep and relevant financial markets is imperative for analytical indications on the build-up of systemic risk, which would help authorities to make judgements on the CCCB accumulation and release phases.

- Besides broad credit, sectoral credit data could also be monitored in the CCCB framework. For instance, in Switzerland, domestic mortgage volume indicators (the ratio of mortgages to gross domestic product) and domestic residential real estate price indicators are the main indicators for the CCCB.

- In some member economies, particular sectors, e.g., the retail and housing sectors play major roles in bank credit. Considering the importance of retail and housing in the region, national authorities may consider compiling and monitoring the housing price index or consumer confidence index. Further, Borio and Lowe (2002) suggest that composite indicators of banking crisis can be useful for assessing future financial distress with a reasonable degree of confidence. These member economies could, therefore, consider tracking these composite indicators (e.g., financial stress indicator, business confidence indicator) to signal the build-up of systemic risk.

- In analysing the credit-to-GDP gap as an indicative key variable, the observation is that the variable has exhibited considerable volatility over the last decade, making its application as a rule difficult. To meet this challenge, future research might utilise, when data permits, a longer time series as well as analyse performance of a seasonally adjusted or smoothed credit-to-GDP gap with appropriate moving averages, as well as incorporate end-point estimation techniques. These may also address some of the problems with data revision and end-point biases associated with filters.

- Future empirical work should also look at the relationship between macro-indicators and sources of financial vulnerability. One extension could be the introduction of the credit-to-GDP gap in the modified Taylor Rule to evaluate the impact of the gap variable on central bank's policy rate. Others could include the suitability of the 0% - 2.5% RWA range of additional capital and the suitability of different buffer accumulation types (e.g. linear, in-step).

- Finally, raising awareness of the CCCB among bank supervisors, inspectors and auditors is crucial going forward. The main objective of the CCCB as a countercyclical tool is still not very clear among banking professionals, as their main reference is still the overall banking capital, which is (for some economies) currently higher than the combined capital requirement after including the conservation buffer and countercyclical buffer. The crucial function of the CCCB, which is to impose restrictions on banks during credit booms to minimise loss or maintaining credit during a downturn, seems to be an unfamiliar concept. This problem can be addressed by increasing awareness among banking professionals on the CCCB through various platforms such as discussions, workshops, conferences and training programmes.

12. Conclusion

The CCCB has been incorporated in Basel III as one of the crucial policy measures that would address pro-cyclicality and inadequacy of capital in the banking system. The distinct feature of the CCCB is that it combines rule with appropriate judgment in its implementation. The latter would crucially depend on the underlying economic situation, stages of economic development and institutional framework. In view of the emerging character of most SEACEN economies, this project sets out to empirically assess and arrive at some implications for policy issues relating to the CCCB.

Although there are significant differences among the participating members, with some in the advanced stages of the Basel III implementation and others only currently at the Basel II requirements, we endeavour, nonetheless, to assess the viability of key macroprudential variable(s) as advocated by the Basel Guidelines. The objectives are to classify variables that can be used as a basic input for identifying good and bad times, act as an early warning indicator for systemic risk and indicate thresholds, accompanied by appropriate judgements, for triggering the accumulating and releasing buffers. While it is a challenging task to come to a consensus on the above, this research has derived some significant output using robust quantitative analysis.

Our research indicates that the credit-to-GDP gap can be considered as a viable variable for CCCB in the SEACEN economies but with the caveat that other macroprudential variables such as the credit growth gap, output gap, etc., may also be important. Empirical findings generally indicate that the early warning properties of the gap variable will enable relevant authorities to pronounce decisions on CCCB build-up three to four quarters ahead. The thresholds (L and H), on an average, are found to be higher than those indicated in the Basel recommendation. However, given the features of financial inclusion, financial deepening and emerging nature of the participating members, higher threshold values may augur well for these economies. Notwithstanding problems with the availability of high frequency data, empirical findings indicate that stock prices, housing index and non-performing asset growth can be useful supplementary indicators during the accumulation and release phases.

In the process of this research, the scarcity of lengthy macro-time series data (free from structural break or definitional changes) or high frequency financial market data posed major challenges. For some members, the estimated gaps are found to be too volatile to be a rule for policy implementation. It is, therefore, felt that improvements in the quality and availability of macroprudential variables and high frequency financial time series could significantly help in CCCB policy implementations. Members may also consider publishing composite indicators that may represent cyclical changes and systemic risk build-up in their economies. Increasing awareness among bankers, supervisors and regulators about the critical role of the CCCB as a countercyclical tool would also enhance the effectiveness of policy implementation.

This research provides suggestions and recommendations which set the stage for further work on the implementation of the CCCB. While many questions remain for future research to answer, this study clearly indicates that the success of a countercyclical capital buffer for the SEACEN members would crucially depend on a balance between a simple, robust transparent rule and an element of judgement in all phases of implementation.

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Annex Table 1
Data Matrix

Economies	Macro-indicators			Banking Data				Financial Indicators*			Data	Breaks Crisis	Major Reforms
	GDP	Credit	Deposit	Profit	GNPA	Restructured Assets	CRAR	Asset Prices	Commodity Housing Prices	Business / Credit Surveys	Availability & Frequency	Year	Year
Column	1	2	3	4	5	6	7	8	9	10	11	12	13
Cambodia	Annually	Monthly	Monthly	Monthly	Monthly	Quarterly	Monthly	Shallow And Newly Established	-	-	Limited	-	1999
Indonesia	Quarterly	Quarterly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	-	Good	1997, 2005, 2008	2000 - 2003
Malaysia	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Good	1997	Since 2010
Papua New Guinea	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	-	-	Quarterly	-	-	Limited	No crisis	No major reform
Philippines	Quarterly*	Quarterly	Quarterly	Quarterly	Quarterly	-	-	Quarterly	-	-	-	-	2000**
Chinese Taipei	Quarterly	Quarterly	-	Quarterly	Quarterly	-	-	Monthly	Monthly	Available	Good	1998, 2001, 2005, 2008	-
Thailand	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Monthly	Quarterly	Quarterly	Quarterly	Good	1997-98	1990, 2004-08, 2010-14
Vietnam	Quarterly	Quarterly	-	-	Quarterly	-	Available	-	-	-	Limited	1997-98; 2008	2011-15

*Annual series converted to a quarterly series in EViews; ** Central Banking Act was passed by Parliament.

Annex Table 2
Summary of Research Findings for Member Economies

- **Cambodia**

The paper seeks to provide the baseline information for the design of Basel III capital requirement, in particular the CCCB in Cambodia. Following the BCBS' Guidelines, the calibration of the CCCB is guided by calculating the deviations of credit-to-GDP ratio from its long-term trend. Unlike in many past studies, the credit-to-GDP gap as the main candidate variable is estimated based on both one-sided and two-sided HP filters with three different smoothing parameters λ (1600, 25K, and 400K). Results show that the credit-to-GDP gap using one-sided HP filter (λ=1600) is a leading indicator which can signal the build-up of financial imbalances, approximately 6 quarters ahead of the actual crisis. The lower and upper thresholds of 5% and 11% of the gap value are found to be the most appropriate range in which the capital buffer should be accumulated. In addition to the credit-to-GDP gap, credit and GDP growths are also helpful in the release phase of the buffer. It is suggested that the indicators and thresholds should be subject to continuous research and empirical tests and as new indicators become available; they should be explored for their usefulness in the CCCB decisions. Above all, national authorities are expected to apply judgment by flexibly calibrating the buffer by measuring the build-up of system-wide risk rather than relying mechanically on the credit-to-GDP guide.

- **Chinese Taipei**

The authors seek to provide a rational interpretation to the seeming ambiguity about identifying the best predictor variables and the thresholds which can be viewed as a basis for the calculation of the countercyclical buffer add-on. Different from previous papers, the candidate variable (i.e., credit-to-GDP gap) is calculated by using both one-sided and two-sided Hodrick-Prescott filters with three different smoothing parameters λ (i.e. 1,600, 144,000 and 400,000). The empirical result shows that the setting of the lower threshold of 2 and the upper threshold of 13 are appropriate for Chinese Taipei. It is noted that high fluctuation in the credit-to-GDP gap can reflect the excess credit condition in Chinese Taipei. Nevertheless, given that the gap is extremely volatile, it's impossible to implement countercyclical capital buffer measure solely using the indicator. As a result, according to this analysis, it seems too conservative for a newly industrialised economy like Chinese Taipei to impose the maximum buffer of 2.5% when the credit-to-GDP gap is just above 10%.

- **Indonesia**

The CCCB is a macroprudential policy introduced by the BCBS. The main objectives of CCCB are for preventing the build-up of systemic risk from the excess credit growth and maintaining credit supply in the downturn. As the member of G-20, Indonesia will implement CCCB since its credit growth is proven to have pro-cyclicality behaviour on the economy. Based on the empirical result, the standard CCCB setting of the BCBS Guidelines is found to be inappropriate for Indonesia. The appropriate main indicator is the bank credit-to-GDP gap and thresholds range between 3 and 6 (L=3, H=6). In addition, some supplementary indicators useful for activating and releasing CCCB are the NPL, CPI and ROA.The Basel III framework in Indonesia came about as a result of the 2008/2009 Global Financial Crisis (GFC). It is BCBS' continuous effort to enhance the banking regulatory framework. The proposed implementation of Basel III is expected to complement Basel I and II during periods of stress. The CCCB would ensure that banks hold sufficient capital that will enable them to absorb unexpected losses when faced with a negative systemic shock and therefore not compromise lending to the real economy.

- **Malaysia**

The aim of this paper is to examine the reliability of the credit-to-GDP gap in signalling financial imbalances for Malaysia. Correlations between each of the macro indicators and the seasonally adjusted GDP growth show a positive relationship, with the exception of the credit-to-GDP gap. The negative correlation for credit-to-GDP implies that this indicator signals a reduction in capital requirements when the GDP growth is strong and therefore demonstrates pro-cyclicality. The paper uses the two approaches (Sarel, 1996 and Kaminsky and Reinhart, 1999) to identify thresholds for the macro-indicators. Based on the empirical evidence, indicators such as the credit growth and asset prices tend to perform better in terms of giving "correct" signals prior to an economic distress. Nonetheless, the analysis suggests that the practical application of the model-based results still needs to be balanced with elements of judgement and discretion.

- **Papua New Guinea**

Authorities in Papua New Guinea (PNG) are yet to commit to the implementation of Basel III and therefore this study is an early research initiative in this direction. With the partial implementation of Basel II, it would require a great deal of progress before the authorities can commit to implementing Basel III. In this research, the credit-to-GDP gap can be used to indicate a possible banking crisis. However, during the period 2002 – 2014, the banking sector in PNG did not experience any banking crisis and therefore using the gap variable as the key indicator may have its limitations. An interesting finding from the analysis is that during the GFC, there was a significant growth in NPLs which was reflected in the decline in the Kina Shares Index (KSI). The gap variable did not quite capture the GFC due to the fact that financial institutions' (mainly banks) lending and deposits do not have significant international exposure. In PNG's case, the maximum credit-to-GDP gap is found to be around 3.6%, hence BCBS' lower thresholds can be accepted. However, based on PNG's credit-to-GDP gap values for the period 2002Q1 to 2014Q2, an upper threshold can be lower than 10. Based on Sarel's estimation method and judgment, a lower threshold of 2 can be set and a more conservative H can be set at 7.

- **Philippines**

The author provides an analysis of appropriate indicators to be used in designing a CCCB in the Philippines. Empirical results suggest the use of the credit-to-GDP gap as a choice variable in taking buffer decisions especially in the build-up phase of a CCCB. Findings suggest the use of alternative filter iteration, threshold levels and supplementary indicators in implementing the buffer measure. In particular, high frequency financial indicators perform well in the release phase of the buffer. Further, the paper identifies issues on the conduct of the CCCB measure specifically on the optimal buffer add-on to be applied and on the need to design a communication plan that allows for an efficient announcement of the entry and exit decision by regulators.

- **Thailand**

This paper provides an empirical study of the CCCB estimation from Thailand data. Both the credit-to-GDP ratio and credit growth variables are found to have power to capture the "imbalance" condition in the economy for some time before the actual financial crisis occurred in 1997 to 1998. However, from empirical findings, the results support only the credit-to-GDP variable to be used as a key reference indicator in the CCCB framework to determine the add-on CCCB, along with the NPL variable as a supplementary indicator. The policy preannouncement period is recommended with a lead-time at least 4 quarters, consistent with the BCBS guidance.

- **Vietnam**

In this research, the authors investigate the anchor for setting the level of the CCCB for the State bank of Vietnam. Unlike the other developing economies, early warning indicators for a credit crunch and an economic crisis are not available in Vietnam. However, the non-performing loan ratio, credit-to-GDP gap and VNINDEX (stock index) are chosen as the early signals. The empirical study points out that with HP one-side filter and lamda value equals to 1600, the lower threshold of 3% gap and higher threshold of 13% cap fit in the case of Vietnam's economy. The lagged value of VNINDEX is found to be correlated with the change in NPL.

Annex Table 3
Summary of Basel III Progress

RCAP: assessment of implementation of Basel III capital regulations (2012–2016)* Table 3

Basel Committee member jurisdiction	Assessment status	(Tentative) publication date of assessment report
European Union	Preliminary assessment	Published October 2012
United States	Preliminary assessment	Published October 2012
Japan	Completed	Published October 2012
Singapore	Completed	Published March 2013
Switzerland	Completed	Published June 2013
China	Completed	Published September 2013
Brazil	Completed	Published December 2013
Australia	Completed	Published March 2014
Canada	Completed	Published June 2014
European Union	Technical work completed	December 2014
United States	Technical work completed	December 2014
Hong Kong SAR	Under way	March 2015
Mexico	Under way	March 2015
India	Under way	June 2015
South Africa	Under way	June 2015
Saudi Arabia**	Planned	September 2015
Russia**	Planned	December 2015
Argentina**	Planned	March 2016
Turkey**	Planned	March 2016
Korea**	Planned	June 2016
Indonesia**	Planned	September 2016

* Assessments of implementation of Basel III standards relating to liquidity, leverage and G-SIBs, and follow-up assessments on capital regulations, will start from 2015.

** The assessment work will be initiated or undertaken during 2015. Ahead of that, these BCBS members will undertake self-reviews based on the RCAP assessment questionnaire.

Source: Implementation of Basel standards; A report to G20 Leaders on implementation of the Basel III regulatory reforms; November 2014 (http://www.bis.org/bcbs/publ/d299.pdf)

Chapter 2

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL ANALYSIS FOR CAMBODIA

By
Sarun Helyda[1]

1. Introduction

Financial crises can be highly contagious that, “keeping individual financial institutions sound is not enough and which a broader macroprudential approach is needed to safeguard the financial system.” The regulatory countercyclicality, a tool once viewed in isolation and with less importance, has become a central focus of policymakers initially from Europe, immediately after the global financial crisis (Griffith-Jones; Ocampo; and Ortiz, 2009). Its key role is to stabilise the economy from the boom-bust cycles caused by the risks originating in the financial sector. It is now a growing consensus among regulators to adopt an internationally consistent macroprudential tool aimed at mitigating procyclicality in financial markets regulations and supervisory systems.

The countercyclical capital requirement proposed by the Basel Committee on Banking Supervision (BCBS) has been widely discussed to have far-reaching effects in discouraging lending booms in good times and preventing credit crunches in the downturn. However, while certain policies and guidelines have been issued in some countries, more in Europe, there is limited evidence of such in Asia. This is possibly due to a number of implementation issues, counting from the relevance and applicability in these markets, mainly owing to their emerging nature and potential structural transformation; data and resource constraints, institutional framework and regulatory capacity, among others. Survey on the regime implementation is therefore scarce, while adopting the Basel III capital requirement in these developing economies will possibly be seen as too early.

The objective of this paper is firstly to discuss the stage of policy adoption and implementation, if any, with regards to the Basel III recommendation on

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countercyclical capital buffer (CCCB), in Cambodia. This analysis will shed light on whether there is a need for the buffer, and if so, how the national authority should go about it. In line with the BCBS's guidance document of December 2010, this study will examine the role of the credit-to-GDP gap as a conditioning variable for the CCCB in the context of Cambodia's financial system. In addition, potential complementary indicators will be explored. The results of this evaluation will lay the foundations for macroprudential policy formation serving overall to strengthen the system-wide resilience.

The current paper is divided into seven sections, starting with the introduction where the rationale behind the CCCB consensus among the SEACEN members is given. Section 2 offers the comparative evidences by briefly revisiting the BCBS's proposal, reviewing Cambodia's banking sector performance and the status of the Basel accord implementation, and finally comparing it with the CCCB's progress in the United Kingdom. Literatures on how the CCCB evolved as well as those in favour of and against it are covered in Section 3. Sections 4, 5, and 6 present the assessment of the credit-to-GDP gap's performance as an indicator to signal banking crises, by following the guidelines prescribed by the Basel Committee, meanwhile testing some alternative macroeconomic and financial variables, for both the build-up and release stages. Policy suggestions are provided together with the concluding remarks in Section 7.

2. Comparative Evidences

2.1 Overview of the Countercyclical Buffer Proposal

Crises teach us that credit booms can be a recipe for financial disaster. Procyclicality in banking is seen to have helped exacerbate the shocks from banking crisis that are later transmitted to the real economy. The CCCB has been introduced by the Basel Committee to reduce this amplification that is caused in particular by excessive credit growth. A distinction, however, should be made, as clearly pointed out in the Basel III document: "Protecting the banking sector in this context is not simply ensuring that individual banks remain solvent through a period of stress, as the minimum capital requirement and capital conservation buffer are together designed to fulfill this objective. Rather, the aim is to ensure that the banking sector in aggregate has the capital on hand to help maintain the flow of credit in the economy without its solvency being questioned, when the broader financial system experiences stress after a period of excess credit growth" (BCBS, 2010a). The CCCB is, therefore, aimed at preventing the so-called credit crunch to the economy following the financial distress. As an additional *soft* buffer built up from expensive form of funding, the capital, the CCCB works as a disincentive for banks to go excessive in their credit expansion. The credit-to-GDP gap – the deviation of the credit-to-GDP ratio from its long-term trend – has been proposed as a guiding indicator for accumulating the buffer, owing to its best signaling properties among other variables, low proportion of false signals and to the fact that the credit gap tends to systematically rise as early as 3-4 years before the crisis.

The guidance document specifies the range of the buffer from 0-2.5% of risk-weighted assets (RWAs) (Annex 1). The CCCB should be turned on when there is a clear signal of the build-up of system-wide risks and well in advance of the actual crisis, while releasing it should be done corresponding to the level of stress in the financial sector. The decision to raise the CCCB will be pre-announced by up to 12 months, and the decision to decrease it will take effect immediately. Both announcements will be made public by a designated authority with the whole responsibility to set, activate, release and deactivate the buffer add-ons. Failure to meet the proposed buffer will result in banks being restricted from earnings distribution in the form of dividends, share repurchases, and discretionary bonuses. The transitional regime will begin on 1 January 2016 with an initial level of 0.625% and with an annual increase of 0.625 percentage point; the buffer will reach its maximum 2.5% by 1 January 2019. Since the CCCB, as a common reference point, may give misleading signals if used as a standalone measure, it is recommended that each national regulator bases its decision in combination with other macroprudential tools as deemed suitable for the given markets.

To ensure a level playing field between domestic and foreign banks, the Basel Committee has proposed some form of reciprocity when applying the CCCB. While purely domestic banks are subject to the buffer add-on set by the home supervisor, banks with overseas exposures shall adhere to the CCCB level required by their host supervisor. The home authorities take the lead in ensuring the correct calibration of the buffer requirement based on the geographical location of their exposures and may demand higher (but not lower) buffer if the requirement by the host authorities is deemed inadequate. The home authorities can set their own buffer add-on in jurisdictions that do not have such requirement in place. In jurisdictions where there are different supervisory bodies, a good coordination among microprudential, macroprudential and monetary authorities is required, in order to minimise the conflicts between the policy options.

2.2 Cambodia's Banking Sector – Features and Performance

The banking system in Cambodia has maintained a strong and steady growth over many years. Immediately after the end of the civil war in 1979, the National Bank of Cambodia (NBC) – the country's national central bank – with support from the Vietnamese occupation was re-established. Under the centrally-planned economy, the country adopted a mono-banking system in which the NBC functioned not only as the currency issuer but also as lender to the state and private sectors. Following the country's economic reform from a centrally-planned to market economy in the 1990s, the new generation of banking emerged, with a transformation from a mono- to a two-tiered system, allowing for the privatisation of commercial banks, and thus separating the private sector lending from the central bank's role. It was not until the beginning of the new millennium that the banking sector was regulated and supervised. The Law on Banking and Financial Institutions, enacted in 1999, had conferred the sole supervisory power on the NBC, which, without delay, took valiant measures in nurturing stronger institutions via a restructuring in 2002.

Since then, the sector has been making notable progress, with an average 25% growth of assets during the past five years. According to the NBC (2013), a combination of 35 commercial banks (25 locally-incorporated and 10 foreign branches), 9 specialised banks, 38 licensed microfinance institutions (7 eligible for collecting voluntary deposits), 35 registered microfinance operators, and 2 licensed financial lease companies, constitute the banking system of the country (Annex 2). With only one state-owned, the banking institutions are largely foreign owned with more than 70% ownership share. The absence of sophisticated financial products within the banking sector alongside the shallow and newly-established stock exchange market characterises the nascent stage of the country's financial sector development.

As operations keep expanding, Cambodia's banking sector moves progressively forward in a sound and prudent manner. According to the regulation on banks' Solvency Ratio[2], banks are required, at all time, to observe their solvency at not below 15%, the level exceeding the Basel requirement for internationally active banks (NBC, 2011). The ratio has been maintained well above the limit, notwithstanding the downward trend brought by the increase in RWAs attributable to the credit expansion in the aftermath of the global crisis

2. Capital Adequacy Ratio.

(Annex 3). With more than 90% of total net worth covered in core capital (Annex 4), the banking system is highly capitalised. Strong capital base and the insignificant level of international capital flows enabled the country to weather the crisis well back in 2009. Except for the minor contraction in lending, the banking sector has proven resilient and immediately picked up, helping sustain the financial system as a whole. On the regulatory front, the NBC, as the supervisory authority, offers continuous support, specifically in issuing regulations and guidelines and keeping close and immediate oversight on banks and financial institutions to ensure the safety and soundness of the entire system. While some regulations were undergoing amendments, a number of new directives were passed during the past few years, in order to account for more stringent capital requirement and risk management.

2.3 Basel Accord Implementation in Cambodia

Cambodia, like many countries in the region with emerging financial system, has not reached a comprehensive degree of the Basel accord implementation. While the country is currently in transition to Basel II, full compliance with Basel II and partial compliance with Basel III have been set to be the long-term priorities (Ban, 2013). In this fashion, a number of requirements have been met. Under Pillar I and II, the calibration of capital adequacy ratio and the regulatory capital and supervisory regime[3] have been revised. Some key regulatory frameworks including those for capital, liquidity, assets quality, and governance have been improved to be aligned with the Basel III requirement. The NBC has doubled the banks' minimum capital, revised assets classification and provisioning according to Basel, adopted new calculation of banks' net worth, and altered their approach from rule- to risk-based supervision. The regulator has also adjusted for a more prudent calculation of risk weights (Annex 6).

Even though certain requirements have been satisfied, challenges remain. First and foremost, data availability and reliability pose great difficulty in the area of implementation. To investigate excess lending requires a sufficiently long time-series data and in Cambodia's banking system, more informative data was only available from 2005 while back-testing for crisis is rather challenging. Given the low level of financial intermediation, supplementary indicators such as assets prices and cost of funds are not readily available, let alone the limited banking

3. Starting from the beginning of 2011, the supervisory framework has moved from rule- to risk-based and forward- looking supervision.

sector variables. Secondly, deficient infrastructure support, particularly the absence of credit rating agency, recently-founded credit bureau and less-than-standardised accounting framework and practices, hinders effective credit risk assessment and capital charge on credit risk. Furthermore, human resource constraints on both supervisor and bankers' sides cannot be overlooked and, for that, capacity building programmes on the Basel requirements remain relevant. Legal frameworks, on the other hand, are incomplete and are currently undergoing amendments to be in line with the Basel requirements. Enforcing the capital surcharge and leverage ratio which have already been adopted will not be an easy task due to their political nature.

2.4 Countercyclical Buffer from the Perspective of UK's Policy

The United Kingdom will have to adopt the CCCB in compliance with the revised Capital Requirements Directive and Regulation (CRD4/CRR) imposed on EU member countries. In this manner, the Financial Policy Committee (FPC), established under the Financial Services Act (2012), has been designated with a primary role to "protect and enhance the resilience of the UK financial system" (BOE, 2013). One of its two main responsibilities is to act as a decision-making body on the exercise of the CCCB, a tool to be applied to certain financial institutions including banks, building societies and large investment firms incorporated in the UK. The FPC will make use of the credit-to-GDP gap as a key indicator incorporated with a broad set of indicators from bank balance sheet stretch, non-bank/macro variables and conditions and terms in the markets. In the meantime, the Committee will apply judgment to shape the policy decision which is supported by a wide and time-varying set of measures from market and supervisory intelligence and stress-tests of banking sector resilience.

The FPC will, on a quarterly basis, assess and set the appropriate rate of the CCCB and the decision will be communicated online in the FPC's quarterly record subsequent to its policy meeting. The ground on which the decision is made as well as its estimated costs and benefits are justified in the financial stability report. The Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA), as the regulators, will take charge in monitoring the compliance with the CCCB. Concerned institutions are given a 12-month[4] period to meet the buffer add-on and, in the case of failure or violation, they will be refrained from distributing dividends and discretionary bonuses and are obliged to provide an implementation plan within a reasonable deadline. For the policy

4. The legislation provides for a shorter implementation period in exceptional circumstances.

to be carried out effectively, the CRD4/CRR has provided for the close coordination between the FPC and the relevant overseas regulators, including the European Systemic Risk Board (ESRB) and via the international fora, such as the IMF, the Committee on the Global Financial System and the BCBS.

3. Related Literatures

The literature on macroprudential policy, specifically on the CCCB is relatively new. It was initially discussed in the work of Borio (2003) where a financial stability factor should be attached to financial regulation and supervision. In the aftermath of the subprime crisis, there was an urge to instill specific risk-mitigating tool into the regulators' approach to safeguard financial stability. Against this backdrop, a new macroprudential instrument, the CCCB, emerged in the BCBS' consultative document in late 2010. Subsequent to this proposal, extensive analyses have been conducted to date, attempting to find the best performing indicators for taking buffer decisions, both at the build-up and release phases. In the studies by Drehmann, et al. (2010), Drehmann, et al. (2011), Alessi and Detken (2011), and Behn, et al. (2013), though applying dissimilar methods, the credit-to-GDP gap appears to have an excellent early warning properties ahead of the crises in many of the sample countries studied. As funding cost (credit spreads) and banking (loan losses) indicators can well signal the release, some credit variables, assets prices (equity and real estate), and banking sector variables (earnings, losses, and assets quality) are the good leading indicators of banking crisis, but should be collectively employed for better predictive capabilities. Giese, et al. (2014) expanded the prominent role of the credit-to-GDP gap as an advance signal of the UK's crises over the past 50 years, but were less confident of its merit if applied in the future actual crisis episodes. They also found other complementary proxies for the releasing phase which encompass flow- and market-based indicators.

The choice over anchor and trigger variables have also attracted some criticisms. Repullo and Saurina (2011), based on the negative correlation between the credit-to-GDP gap and GDP growth, concluded that the guiding indicator seems to work in the opposite direction to the Basel III's mandate by signaling the decrease of the buffer during high growth periods and raising it when the economy turns, thus intensifying procyclicality. While helping to trim down the shocks on the economy once hit, the CCCB tends to incentivise banks on doing correlated activities (banks interconnectedness) prior to the crisis which in turn magnifies the systemic risks, particularly in the cross-sectional dimension (Hovàth and Wagner, 2013). Therefore, it was suggested that macroprudential measures to deal with procyclicality and correlation risks no longer be assessed in isolation, as they have often been. Meanwhile, Edge and Meisenzahl (2011) claimed that the credit-to-GDP gap is an unreliable real-time measure because it "can yield false positives by signaling excessively high levels of credit that later – based on longer time series of data – do not appear to be so extreme." These false positives could translate into capital constraint which leads to potential cuts in credits.

The concept of countercyclical macroprudential measures is far less familiar in the developing world and, as such, there is virtually no empirical evidence that allows assessing its effectiveness. Due to the low degree of financial intermediation which is not the case in the developed countries, the Peruvian supervisor adapts the BCBS' recommendation to their country specific features by tying the deployment of the countercyclical capital requirements to the movement of GDP growth (Galindo, Rojas-Suarez and Valle, 2013). Credit demand can outperform economic growth in a structurally transforming economy like India, and, for this reason, it is almost impossible to tell what and how much is brought by the transformation or how much is caused by credit being excessive (RBI, 2013). In this case, relying on the credit-to-GDP gap to inform policy actions can be misleading. Geršl and Seidler (2012) argued that the HP filter is not a suitable measure to calculate the excess credit growth in Central and Eastern Europe as rapid expansion of credit in these developing countries can only mean the economy is converging to the more advanced nations. Instead, a more appropriate method, the out-of-sample technique, which can well reflect the economic fundamentals, was recommended.

Micro- and macroprudential objectives may come into conflict when it comes to the release of the buffer. Microprudential authorities, by acting procyclically, may require banks to hold larger capital when they judge the risks to be material whereas the macroprudential authorities may be concerned of activating it too soon, causing unnecessary delay for effective application of the tool (Bonfirm and Monteiro, 2013). It has been argued that no specific indicator (or set of indicators) can best signal the right moment of activation, release and deactivation of the CCCB for different jurisdictions at different time horizons. Empirical evidences show that, despite its proven leading properties, the credit-to-GDP gap and perhaps some other variables will not work well in all crisis scenarios. That is why judgment assumes a decisive role, potentially in every stage.

4. Data and Key Indicators

Cambodia's financial system has been dominated by banks which are the main channel for providing credit to the economy. Credit can grow rapidly for three reasons, including financial deepening (trend), normal cyclical upturns, and excessive cyclical movements (credit boom). At the outset, it is important to recognise that credit typically grows more quickly than the GDP as an economy develops, a process known as financial deepening. In Cambodia, the use of credit to indicate the build-up of systemic risks has a number of limitations. In this fast-changing economy, unlike in the advanced countries, the rapid growth in credit demand can be reflective of several reasons, including flow of credit to agriculture as a priority sector, financial deepening and financial inclusion.

Given its prominent role in the implementation of the CCCB, the credit-to-GDP gap and its performance as an anchor variable are discussed in the next sections, in which the data and methodology, estimations of the trends and credit-to-GDP gap, identification of the threshold and finally the computations of the buffer are analysed. Meanwhile, a separate section will explore how the BCBS's proposed CCCB recommendations fit in the context of Cambodia's financial system.

4.1 Data and Indicators

In light of the previous papers, particularly those of the Basel Committee, the credit-to-GDP gap will be tested for its property as main indicator in guiding the CCCB decision. Before arriving at whether this variable is appropriate in the Cambodian context, certain steps in calculating and transforming the original variables into gap variable and the estimations for its early warning property as well as the thresholds are performed. Even though Cambodia has not faced financial crisis, which then makes it difficult for back-testing, the paper will employ the growth of non-performing loans (NPLs) in the banking sector as a proxy for financial imbalances.

Credit: The current study uses the credit indicator, *Claims on Private Sector,* which includes gross credit from the financial system to individuals, enterprises, non-financial public entities not included under net domestic credit, and financial institutions not included elsewhere. The quarterly series of aggregate credits were obtained from IMF-IFS (32D) and cover a period from the last quarter 2001 (Q401) to the first quarter 2013 (Q113).

GDP: We obtain the quarterly data on GDP in real terms from IMF-IFS. Following the BCBS' guideline[5] (BCBS, 2010a), the series were transformed into nominal terms by deflation with the CPI[6] which is obtained for the same period.

Credit-to-GDP ratio: the ratio in each period t is calculated as follows:

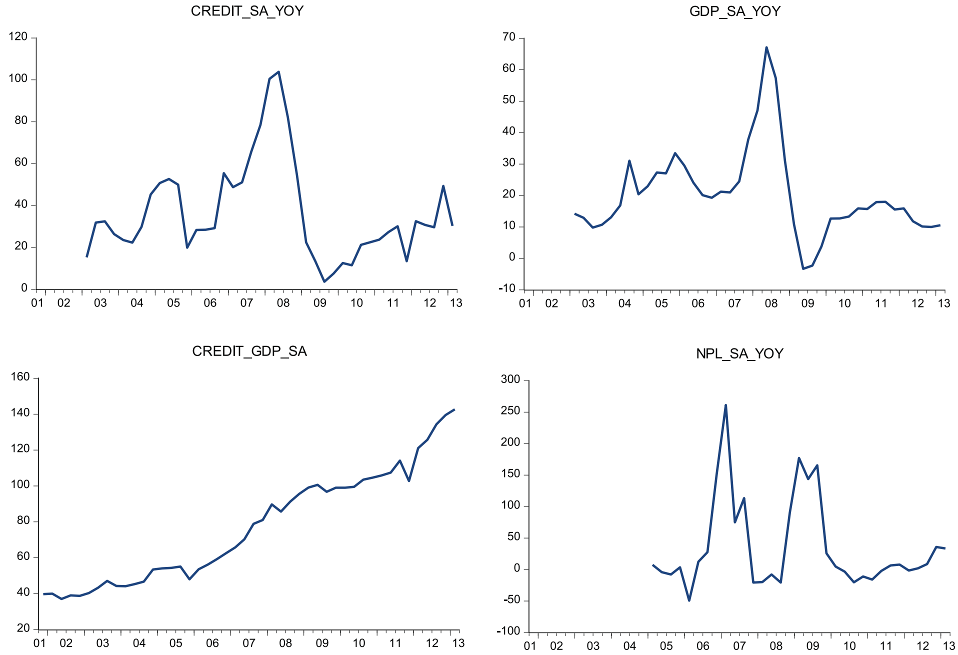
$$\text{Ratio}_t = \text{Credit}_t/\text{GDP}_t \times 100\%$$

Given the same coverage of the credit and GDP series, we have a series of the credit-to-GDP ratio starting from the Q401 to Q113. Meanwhile, we also compute the annual growth rates for both credit and GDP.

NPLs: Non-Performing Loans have been chosen as the indicator for financial imbalance, given the fact that Cambodia has not experienced any financial crisis, literally. With the dominant role of banking in the country's overall financial system, movement of the banks' NPLs can significantly capture the systemic risks. Therefore, the thresholds will be selected based on the relationship between the credit-to-GDP gap and the NPLs growth. The NPLs data is generated from the NBC's database, yet, only shorter series are available (Q104-Q113)[7].

5. BCBS' proposal suggests using both credit and GDP in nominal terms.
6. Quarterly series of Consumer Price Index (CPI) from IMF IFS.
7. Data description and statistics are in Annexes 7 & 8.

Figure 4.1
Original Variables



4.2 BCBS's Framework on CCCB – Cambodia's Case

It is worth noting that the CCCB setting should be done in a way that credit growth does not get choked. Given the different characteristics between the developed and developing economies, there is a need to test how the BCBS's framework performs in Cambodia's financial sector and see if any modifications are required. According to the Basel Committee, the reference indicator used for calculating the capital buffer is the credit-to-GDP gap which is the deviation of the credit-to-GDP ratio from its long-term trend based on the one-sided Hodrick- Prescott (HP) filter with the smoothing parameter 400,000. While the 100 and 1,600 lambda are commonly applied to annual and quarterly data, for credit cycles that have longer durations than the normal business cycle, BCBS recommended using higher penalty factor of 400,000 in order to better capture the long-term trend of the credits (BCBS, 2010a). If the ratio is significantly above its trend (i.e., there is a large positive gap), there is an implication that credit may have grown to excessive levels relative to GDP. The size of buffer add-on is determined as a linear function of the gap using the lower threshold L=2 and the upper threshold H=10.

Figure 4.2.1

Standard BCBS's Guideline on CCCB

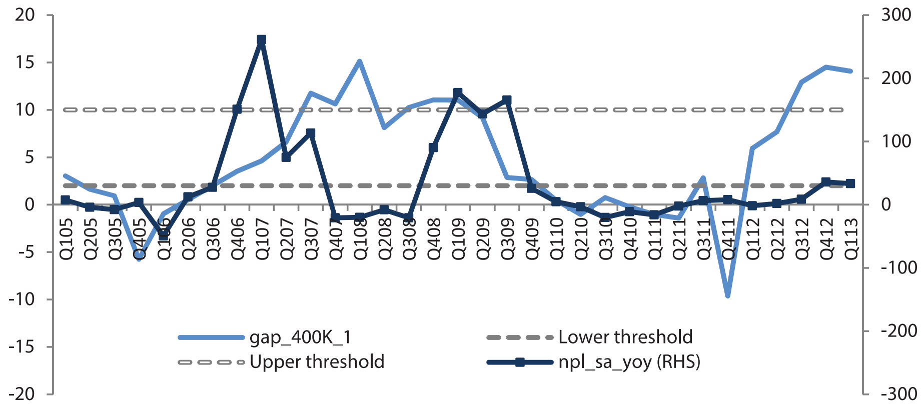


Figure 4.2.2 Capital Buffer Based on BCBS's Framework

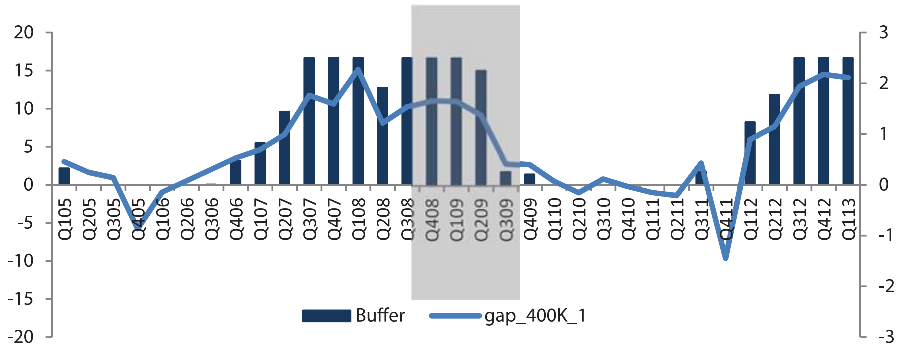


Figure 4.2.1 shows that the BCBS's CCCB framework based on the credit-to-GDP gap using the one-sided HP filter with smoothing parameter 400,000 performs relatively good in Cambodia's financial sector. However, the proposed thresholds of L=2 and H=10 are not an appropriate range in which the capital buffer should be accumulated. According to Figure 4.2.2, the CCCB should have been turned on since Q306 when the gap stood at 2.03%, which was about two years before crisis hit (Q408) and would reach its maximum 2.5% by Q307, which is exactly 12 months from its activation (Q306-Q307). This short span of time (4 quarters) would not provide banks with enough time to raise their capital. Further, if we were to use this as guidance, the CCCB would

have hit its maximum again at Q312 which gives the authority very limited amount of time (2-3 quarters) for the accumulation. Not only that it is not aligned with the Basel's recommendation, there could be a misleading signal of the crisis requiring the buffer to be at its top (starting from Q312), while the crisis indicator shows almost no sign of serious financial imbalance (steady low growth of NPLs). It can be concluded that the BCBS's standard CCCB framework is not suitable for the context of Cambodia's financial system and therefore a recalibration of the framework is required.

4.3 Filter Selection Iteration

To measure the credit-to-GDP gap, this study used the HP Filter in order to estimate the long-term trend of the credit-to-GDP ratio. The HP filter is a statistical tool that allows for the separation between the cyclical and the trend components of a time series. By using this de-trending method on the credit-to-GDP, one can extract its trend and determine the gap between the observed value and the corresponding trend value for each observation. Although the HP filter is a popular method of estimating the trend component of economic time series, it does have certain limitations which are widely discussed in the literature.

Two primary issues that need to be kept in mind when using the HP filter are, one concerns the choice of the smoothing parameter lambda and other about using a one-sided or two-sided filter. The one-sided filter uses only the data up to the particular point in time series, for which trend value is being estimated, while the two-sided filter uses the entire sample. Another crucial component of the HP filter is its smoothing parameter lambda (λ). This parameter changes the calculations by affecting the linearity of the trend component and is chosen based on how long the financial cycle compared to the business cycle (Drehmann, et al., 2010). Hodrick and Prescott suggest to set λ=1,600 for quarterly data. Over the years, λ=1,600 has become the standard for business cycle analysis, when quarterly data are used. For many economies, nonetheless, the credit cycles are not the same as the business cycles, which then require using different λ that fits the credit nature of specific countries. Therefore, we will investigate how various λ values provide a suitable characterisation of credit cycles in Cambodia and at the same time assess whether a one-sided or two-sided filter is more appropriate.

The implication of different choices of lambdas for the performance of the credit-to-GDP gap is as follow:

λ = 1,600 = 1^4*1,600, assuming that credit cycles have the same length as business cycles

λ = 25,000 = 2^4*1,600, assuming that credit cycles are two times as long as business cycles

λ = 400,000 = 4^4*1,600, assuming that credit cycles are four times as long as business cycles

Derived from the six exercises, the credit-to-GDP gap will be selected based on its most accurate property in signaling the crisis as characterised by the movement of NPLs growth. Figure 4.3.1 shows the performances of the six different gaps in relation to NPLs. The credit-to-GDP gaps using the two-sided HP filters are very volatile and provide narrower range and possibly less time for the accumulation of the buffer. Hence, they are opted out of our consideration as candidates for the main indicator, which then leave the other three estimated gaps obtained from one-sided HP filter (Figure 4.3.2).

As this Figure shows, not only that the credit-to-GDP gaps with λ = 25,000 and λ = 400,000 tend to have high values, they performed almost in parallel. There could be misleading signals when the two gaps remained high during the downturn (Q408-Q409), requiring the continuing build up of the buffer, while actually the buffer should have been drawn down already in order to cope with the rising NPLs. These signals became notably clearer from Q412, as these two gaps kept on escalating against the growing NPLs. Given the current rate of credit growth in Cambodia, the gaps using λ = 25,000 and λ = 400,000 are considered too high and as the authorities could possibly be given false signals, the gaps are definitely not the suitable indicator.

Unlike the rest, through graphical illustration, the credit-to-GDP gap using the one-sided HP Filter with λ = 1,600 performed well at all times in the sample period. The gap basically moved in an appropriate direction, indicating clearly the expansion period when additional capital should be accumulated or the stressed period when this capital needs to be drawn down. Moreover, the gap seems to provide a considerable length of time, both for the build-up and release phases. Nonetheless, we can confirm the use of this credit-to-GDP gap as an anchor variable only when proven by empirical tests in the following sections.

Figure 4.3.1
Performances of Different Credit-to-GDP Gaps

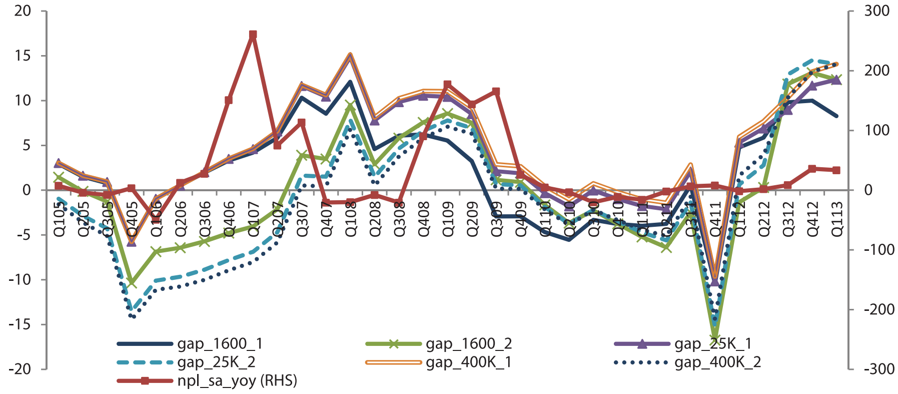


Figure 4.3.2
Credit-to-GDP Gaps (One-Sided HP Filter)

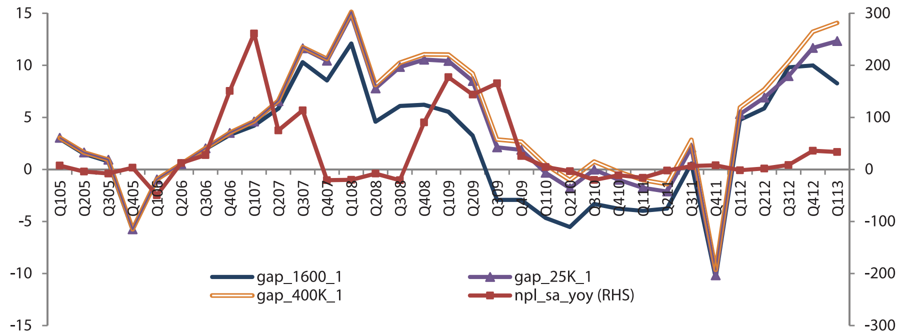
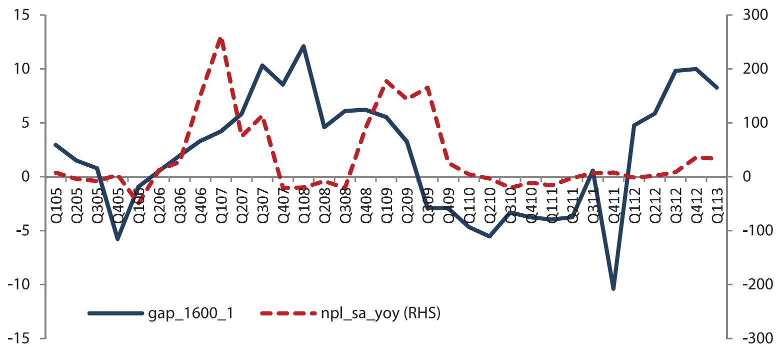


Figure 4.3.3
Credit-to-GDP Gap (1-Sided HP Filter with λ=1600)



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5. Empirical Analysis

5.1 Lag Length Determination

This section will test if the chosen main indicator so far contains the early warning properties which allow it to be a suitable guiding indicator. This can be done by observing the lead-lag relationship between the changes in banking variable (NPLs growth) to lagged value of the key variable (Credit-to-GDP Gap) as below:

$$fin\_imbalance\_indicator(\mathrm{t}) = f(main\_indicitor(-t)),\ \text{where } t = 1,2,3,\ \ldots$$

Table 5.1
Filter Iteration Selection

Growth of NPL = f {C-GDP-gap(-t)}							
Lag	**Coef**	**T-stat**	**P-value**	**R-sq**	**Adjusted R2**	**AIC**	**SBC**
1	3.59	1.58	0.12	0.07	0.05	11.4	11.49
2	2.98	1.25	0.22	0.05	0.02	11.43	11.52
3	3.18	1.29	0.21	0.05	0.02	11.42	11.51
4	2.42	0.96	0.35	0.03	-0.003	11.45	11.54
5	2.19	0.86	0.4	0.02	-0.008	11.45	11.54
6	**5.45**	**2.06**	**0.048**	**0.12**	**0.09**	**11.35**	**11.44**
7	3.97	1.45	0.16	0.06	0.03	11.41	11.5
8	4.84	1.76	0.09	0.09	0.06	11.38	11.47
9	2.69	0.92	0.36	0.03	-0.005	11.45	11.54
10	-1.18	-0.39	0.7	0.005	-0.03	11.47	11.56
11	-3.32	-1.09	0.28	0.04	0.006	11.44	11.53
12	-7.63	-2.59	0.014	0.18	0.15	11.28	11.37

As the CCCB should be turned on before the onset of systemic risk, it is necessary to determine the empirical lag at which the credit-to-GDP gap should be assessed with respect to the materiality of the systemic risk. To identify the lags between the credit-to-GDP gap and annual growth in NPL, a regression was run for up to 12 lags. The regression with lag of 6 quarters provides the best fit as can be seen from Table 5.1 (Highest coefficient and R-Square values).

The relationship between the credit-to-GDP gap and annual growth in NPL was obtained, and it was observed that the credit-to-GDP gap leads NPL growth, statistically significantly, by sufficient period with a peak statistical significant period of 6 quarters (18 months). It is thus proven that the credit-to-GDP gap based on the one-sided HP Filter with ë=1,600 can be used as a leading indicator for the CCCB accumulation, approximately 6 quarters before the banking crisis. This is in line with the BCBS's recommendation, in which the build-up of capital buffer should be pre-announced at least 12 months ahead of the actual crisis.

5.2 Identification of Lower and Upper Threshold

Building on the general principle that the objective of the countercyclical buffer is to protect banks from periods of excess credit growth, the Committee sent out the criteria to determine a threshold gap level L, when the rule should start building up capital buffers, and a gap level H, at which the maximum buffer should be reached. Given the current state of knowledge, the rule simply provides a starting guide to the relevant authorities responsible for deciding the buffer add-on. These authorities retain the right to implement a different buffer add-on other than indicated by this simple guide, subject to providing a public and transparent explanation of this decision.

The lower and upper thresholds L and H are keys in determining the timing and the speed of the adjustment of the guide buffer add-on to the underlying conditions. The BIS work has found that an adjustment factor based on L=2 and H=10 may provide a reasonable and robust specification based on historical banking crises. However, this depends to some extent on the choice of the smoothing parameter, the length of the relevant credit and GDP data, and the exact setting of L and H. From Section 4.2, it is clear that the thresholds suggested by the Committee are not suitable for Cambodia and thus we opted for a new calibration of the thresholds which are grounded in the criteria set out by the BCBS as below.

The criteria for the minimum threshold (L) when the guide will start to indicate a need to build up capital:

(1) L should be low enough, so that the banks are able to build up capital in a gradual fashion before a potential crisis. As the banks are given one year to raise additional capital, this means that the indicator should breach the minimum at least 2-3 years prior to a crisis.

(2) L should be high enough, so that no additional capital is required during normal times.

The criteria for the maximum (H) at which point no additional capital will be required, even if the gap will continue to increase:

(3) H should be low enough, so that the buffer will be at its maximum prior to major banking crises.

Identification of the CCCB trigger can be based on charting evidence on the stability of the relationship between the credit-to-GDP gap and NPL growth. However, we used a more formal method as suggested by Sarel (1996) in order to estimate the CCCB trigger threshold. This method uses a single regression with iteration over different threshold cut-offs for the range of values observed for the explanatory variable in the sample. The threshold is then determined both on the basis of the explanatory power of the equation and the evolving significance of the coefficient in question. Through the following steps, the threshold level of the trigger variable was evaluated by regressing the growth of banking sector's NPL with the credit-to-GDP gap and with a threshold variable X, representing the lower threshold (L).

- Create dummy : if credit-to-GDP gap > threshold, dummy =1, else dummy = 0
- X = dummy * credit-to-GDP gap
- Regression: **NPL(y-o-y) = C + b1.Credit-to-GDP Gap + b2.X**

Table 5.2
Threshold Estimation for Activating CCCB

NPL(y-o-y) = C + b1.Credit-to-GDP Gap + b2.X							
Threshold	**b2**	**T-stat**	**P-value**	**R-sq**	**Adjusted R2**	**AIC**	**SBC**
2	-2.16	-2.28	0.78	0.04	-0.02	11.49	11.63
3	-0.97	-0.13	0.9	0.04	-0.02	11.49	11.63
4	-6.25	-1	0.33	0.07	0.009	11.46	11.60
5	-6.96	-1.35	0.19	0.09	0.03	11.44	11.57
6	**-8.11**	**-1.83**	**0.08**	**0.14**	**0.08**	**11.39**	**11.53**
7	-6.92	-1.61	0.12	0.12	0.06	11.41	11.55
8	-6.92	-1.61	0.12	0.12	0.06	11.41	11.55
9	-4.01	-0.91	0.37	0.07	0.003	11.47	11.51
10	-2.04	-0.39	0.7	0.04	-0.02	11.49	11.63
11	-7.73	-1.23	0.23	0.09	0.03	11.45	11.58
12	-7.73	-1.23	0.23	0.09	0.03	11.45	11.58

The estimates in Table 5.2 above suggest that the CCCB trigger should be activated as soon as the credit-to-GDP gap reaches 6%. This is because for the coefficient of the credit-to-GDP gap for values above the threshold, the coefficient of determination is the maximum, at 10% significance and with highest R-Square. Thus, we felt that the lower threshold should be set around 6%. Based on the filter at lag 6^{th} as selected from Section 5.1 above, the buffer should be raised at least 6 quarters before banks' NPLs started going up. According to Figure 4.3.3, the banking crisis as reflected in the rising NPLs was felt starting from Q408, and therefore, the capital buffer should have been activated since Q207 when the credit-to-GDP gap was at 5.83%. Combining the regression results from 5.1 and 5.2, with support from the historical performance of the gap as explained so far, it is suggested that the L should be set at 5%. The lower bound of 5% should satisfy both criteria for L for: (1) it is low enough, so that banks are able to build up capital in a gradual fashion before a potential crisis; and (2) it is high enough, so that no additional capital is required during normal times.

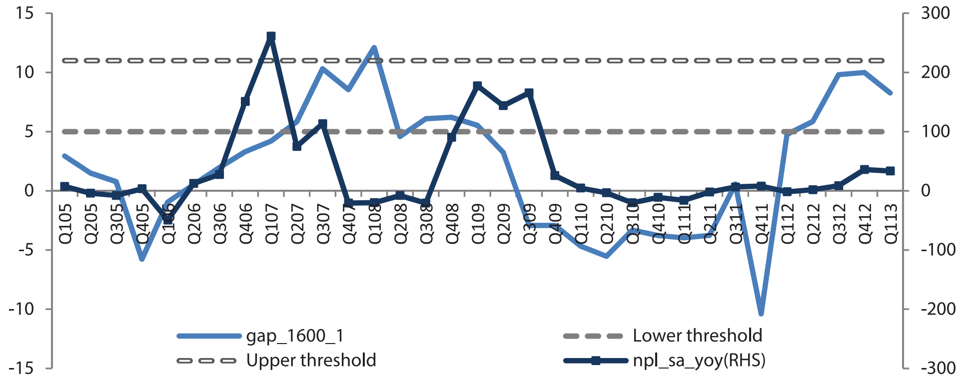
It can be noted in the guidance document that, there is a difference of 8% between the lower and upper thresholds (2%-10%). Following the rule of thumb, with the chosen L=5, the upper bound should then be 13% (L+8). However, the empirical evidence shows the highest credit-to-GDP gap for the sample period at 12.10% in Q108 (Annex 9), whereas the majority stayed below 10%. Further, the Basel Committee has suggested that H should be low enough, so that the buffer will be at its maximum prior to major banking crises and no additional capital will be required, even if the gap will continue to increase. In the test using H=13, the buffer add-on could never reach its maximum 2.5% despite the financial imbalances. Also, H=13 is not considered low enough for banks to stop accumulating their capital. Hence, setting H at 13% will be impracticable given the past banking data. One important reminder is that the range between the lower and upper thresholds should not be too narrow, so that banks have reasonably enough time to reserve their capital in a gradual manner. To prove that, and as observed from a number of experiments, the L+5 (or below) was found to be too low for effective use of the CCCB[8]. As L+8 and L+5 have been found unrealistic, therefore, we finally tested the L+6 (H=11%). The result shows that, based on the sample data, H=11% best fulfills the criteria for H.

Hence, as far as the credit-to-GDP gap guidance of Basel Committee is concerned, the CCCB may phase in once the credit-to-GDP gap reaches 5%,

8. The buffer would have been built in a sharp and immediate fashion, leaving less than 2 quarters lapse between L & H

provided its relationship with GNPL growth remains significant. In such a case, the CCCB shall linearly increase in value till it reaches 2.5% of the RWAs corresponding to 11% of the credit-to-GDP gap, after which, the CCCB will remain constant. Of course, the final decision on the CCCB will be made based on performance of other supplementary indicators, as discussed later in Section 6.1.

Figure 5.2
Lower and Upper Thresholds for Activating CCCB

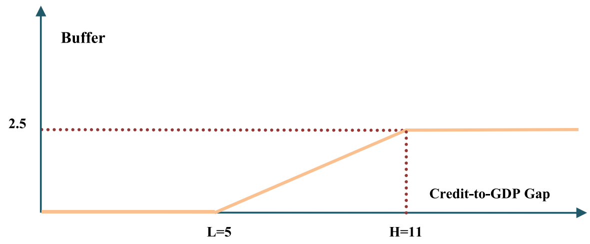


5.3 Buffer Level and Progression

After the thresholds having been identified at L=5 and H=11, it is equally important to determine the level of the buffer add-on that needs to be reserved corresponding to these bounds. As prescribed by the Basel Committee, the size of the CCCB as in percent of RWAs is zero when the gap is below the lower threshold (L). It then increases linearly with the gap until reaching its maximum value once the GAP exceeds the upper threshold (H). The buffer remains at its ceiling of 2.5%, regardless of the continuing increase of the gap. The capital buffer calculation is illustrated as below:

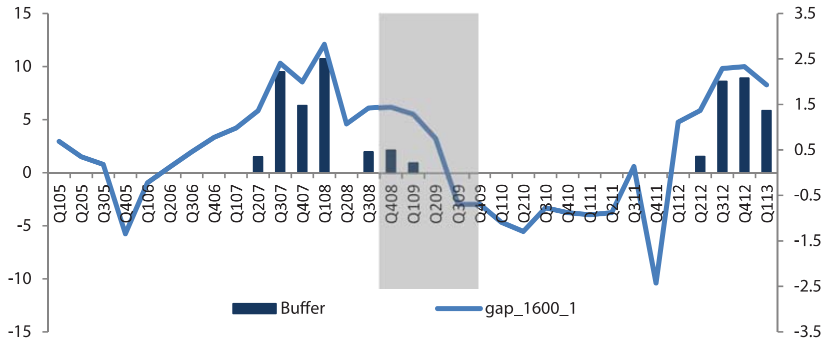
$$\left\{\begin{array}{ll} 0 & if \quad GAP < L \\ \dfrac{GAP - L}{H - L} 2.5 & if \quad L \leq GAP \leq H \\ 2.5 & if \quad H < GAP \end{array}\right\}$$

Figure 5.3.1
Buffer Level and Progression



The historical data show that the CCCB could have been built up from Q207 and hit its maximum only once at Q108 (Figure 5.3.2), which was well ahead of the downturn period. This could have allowed sufficient amount of time for the relevant authority to gradually draw down the buffer and at the same time not to give instant shock to the system.

Figure 5.3.2
Performance of the Capital Buffer



6. Release Phase

6.1 Supplementary Indicators

The empirical evidence has suggested that the decision to activate the buffer add-on should be guided by the credit-to-GDP gap. However, when it comes to the release phase, complementary indicators and judgment play a critical role. Though the credit-to-GDP gap has been found as a powerful predictor for banking crisis (Drehmann, et al., 2010), no single variable by itself could consistently indicate when to release the buffer. In the same study, a set of supplementary indicators such as macro, market, and financial variables were tested for their attributes in indicating the time for buffer release. Those include, but were not limited to, GDP growth, various asset prices, funding costs, credit condition survey, and so forth.

We recognised the limitation of the credit-to-GDP gap and therefore considered some complementary indicators that may be helpful in the CCCB decision. Unfortunately, in Cambodia's financial sector, not many choices of proxies are available. Our analysis was put under constraint due to the absence of equity prices, property prices, and credit spreads. Yet, rather than basing our judgment exclusively on the credit-to-GDP gap, we shall examine the performance of two possible conditioning variables – the credit and GDP growths. We shall investigate the impact of these supplementary indicators on systemic risks by examining their correlations with NPLs growth and the credit-to-GDP gap.

Table 6.1.1
Correlation of Credit Growth with NPLs Growth and Credit-to-GDP Gap

Lead/Lag	NPLs Growth, Credit Growth	Credit-to-GDP Gap, Credit Growth
1	0.0310	0.5419***
	(0.1726)	(3.5899)
2	0.1287	0.4809***
	(0.7225)	(3.0537)
3	0.3517**	0.3812**
	(2.0917)	(2.2960)
4	0.3992**	0.2357
	(2.4245)	(1.3502)
5	0.4357**	0.0887
	(2.6948)	(0.4960)
6	0.4681***	-0.0546
	(2.9494)	(-0.3044)

*** ** * Denote the significance at 1%, 5%, and 10% levels (t-value in brackets).

The empirical evaluations in Table 6.1.1 show the significant positive correlations of credit growth to NPL growth and to the credit-to-GDP gap, despite at different lags. This implies that the expansion in banking sector activities as reflected by credit growth could bring with it certain level of risks of banking losses, yet the effect is less immediate. In a shorter run, it is only rational to see a higher credit-to-GDP gap as a result of higher credit growth, provided the slower growth of a developing economy. Looking at its significant correlations, it is suggested that credit growth be included as one of the supplementary indicators to facilitate the CCCB decision.

Table 6.1.2
Correlation of GDP Growth with NPLs Growth and Credit-to-GDP Gap

Lead/Lag	NPLs Growth, GDP Growth	Credit-to-GDP Gap, GDP Growth
1	-0.1410	0.3246*
	(-0.7932)	(1.9109)
2	0.2222	0.3407*
	(1.2691)	(2.0180)
3	0.5069***	0.3173*
	(3.2744)	(1.8628)
4	0.6565***	0.2020
	(4.8455)	(1.1484)
5	0.6019***	0.0388
	(4.1969)	(0.2159)
6	0.3496**	-0.0253
	(2.0773)	(-0.1411)

*** ** * Denote the significance at 1%, 5%, and 10% levels (t-value in brackets).

Significant positive correlation between GDP growth and NPL growth is shown in Table 6.1.2, suggesting the inherent risks in the financial sector which might be caused by growth of the economy. Both the credit and GDP growths show significant relationships with the growth of NPLs, notably at similar lags. Meanwhile, they also indicate certain relationship with the credit-to-GDP gap, despite at a lower significance level. With these results, we felt that the credit and GDP growth variables can make suitable complementary indicators for taking the CCCB decisions.

6.2 Buffer Release

The CCCB is meant to provide the banking system with an additional buffer of capital to protect it against potential future losses, when excess credit growth in the financial system as a whole is associated with an increase in system-wide risk. In this fashion, the buffer may be released under certain circumstances. On the one hand, the release may be implemented when there are threats to financial system stability resulting from the losses in the banking system. In this case, the released capital can be used to help absorb losses and reduce the risk of the supply of credit being constrained by the regulatory capital requirements.

The relevant authorities can release the buffer gradually in situations where the credit growth slows and system-wide risks recede in a benign fashion. In other situations, given that credit growth can be a lagging indicator of stress, promptly releasing the buffer may be required to reduce the risk of the supply of credit being constrained by the regulatory capital requirements. In some cases this can be done by timing and pacing the release of the buffer with the publication of banking system financial results so that the buffer is reduced in tandem with the banking sector's use of capital to absorb losses or its need to absorb an increase in RWAs. In other cases, more prompt action may be called for based on the relevant market indicators of financial stress to help ensure that the flow of credit in the economy is not jeopardised by uncertainty about when the buffer will be released.

The precise timing of the buffer release is a definite challenge given the inexperience of the relevant authorities. The decision should be very cautious since releasing the buffer too early may harm market expectations, eventually leading to self-fulfilling losses, while releasing it too late may hinder the loss absorbency role of the buffer. Therefore, it is suggested that instead of hard rules-based approach, flexibility entailing use of judgment and discretion should be provided to the authorities for operating the release of the CCCB.

6.3 Communication

As far as the dominance of banking in Cambodia's financial system is concerned, it is the responsibilities of the banking regulator to set and communicate the buffer guidelines, monitor compliance and impose further supervisory measures if needed. In the future, however, these responsibilities may be shared with other supervisory agencies depending on the changing structure of the country's financial system. While communicating buffer decisions is the key to promoting accountability and sound decision-making, some authorities may currently have little experience in publicly commenting on macro financial conditions, much less explaining future buffer decisions. As a result, authorities should be given time to gain experience in operating the buffer and for them to take advantage of the transition period before the buffer is fully operational to develop a communications strategy prior to assuming the task of publicly explaining the buffer decisions.

In line with the Basel Committee's recommendation, the prospective buffer requirements should be pre-announced with a lead time of up to 12 months to give banks a reasonable time to adjust their capital plan. Given that the buffer in each jurisdiction is likely to be used infrequently, the Committee suggests that once the authorities have implemented their communication strategies, it will be appropriate for them to comment at least once annually using whichever means appropriate for their jurisdiction. We felt that the CCCB decisions may form a part of the Financial Stability Report (FSR) by the central bank and associated agencies. Moreover, at the time of communicating the CCCB decision, the authority may disclose, at its discretion, the mechanics of the CCCB approach, the information that was used to arrive at the decision, the time line of the CCCB activation, and so forth.

7. Conclusion and Policy Recommendations

Studies on the CCCB are non-existent in Cambodia and there is a need for research on the subject as financial sector, predominantly banking, is growing fast, while rapid credit growth can be a concern. As witnessed in the past financial crises, credit booms can be a recipe for financial disasters. With this in mind, the current study has explored the performance of the Basel III guidance on the CCCB in Cambodia's financial system. The findings of this paper will serve as the baseline information for the design of the Basel III capital requirement, when Cambodia decides to implement this framework in the future.

Based on the regression results, the credit-to-GDP gap with the one-sided HP filter of 1,600 lambda is the most appropriate leading indicator which gives the early warning signal of the banking crisis 6 quarters in advance. Hence, given the lag identified by the analysis, we felt that the CCCB should be triggered well before the expected increase in NPLs. In line with the Basel Committee prescription, the CCCB decision should be pre-announced with a lead time of up to 12 months.

It is suggested that the CCCB should be activated when the credit-to-GDP gap touches the lower threshold of 5% and should reach its maximum level at

2.5% of RWAs as soon as the gap hits the upper threshold of 11%. The CCCB should vary linearly from 0-2.5% for any gap values between 5%-11% and will not exceed 2.5%, though the gap continues to rise. No CCCB is required for the credit-to-GDP gap below 5%.

The indicators and thresholds used for the CCCB decisions should be subject to continuous research and empirical tests and, as new indicators become available, they should be explored for their usefulness in the CCCB decisions. While historically the credit-to-GDP gap can be a useful guide in taking CCCB decisions, it does not always perform well in all jurisdictions at all times. As such, a thorough and balanced assessment of a broad set of indicators is essential in facilitating the buffer decisions. This paper has found that, in addition to the credit-to-GDP gap as the signaling indicator, the credit and GDP growth variables are also helpful in the release phase of the buffer, given their significant relationships with banks' NPL growth. Above all, the national authorities are expected to apply judgment by flexibly calibrating the buffer by measuring the build-up of system-wide risk rather than relying mechanistically on the credit-to-GDP guide.

In Cambodia, where banks form the core of the financial system, it is the responsibilities of the banking regulator to set and communicate the buffer guidelines, monitor compliance and impose supervisory measures deemed necessary. In the future, however, these responsibilities may be shared with other supervisory agencies depending on the changing structure of the country's financial system. The CCCB requirement should be communicated on an annual basis and as part of the FSR.

List of Abbreviations

BCBS	Basel Committee on Banking Supervision
CCCB	Countercyclical Capital Buffer
CRD	Capital Requirements Directive and Regulation
ESRB	European Systemic Risk Board
FCA	Financial Conduct Authority
FPC	Financial Policy Committee
FSR	Financial Stability Report
GDP	Gross Domestic Product
IMF-IFS	International Monetary Fund – International Financial Statistics
NBC	National Bank of Cambodia
PRA	Prudential Regulation Authority
SEACEN	South East Asian (Central Banks) Research and Training Centre

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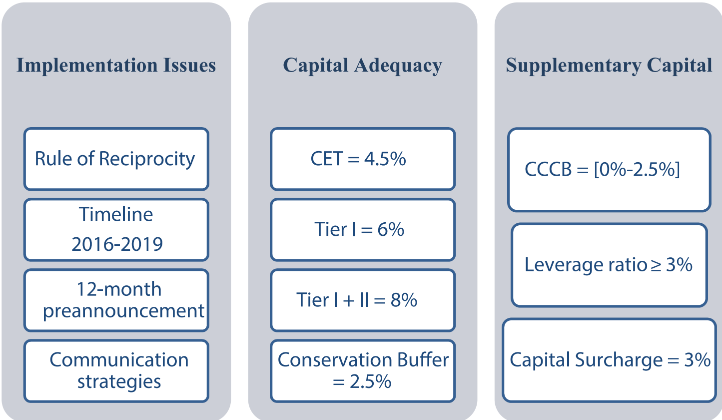
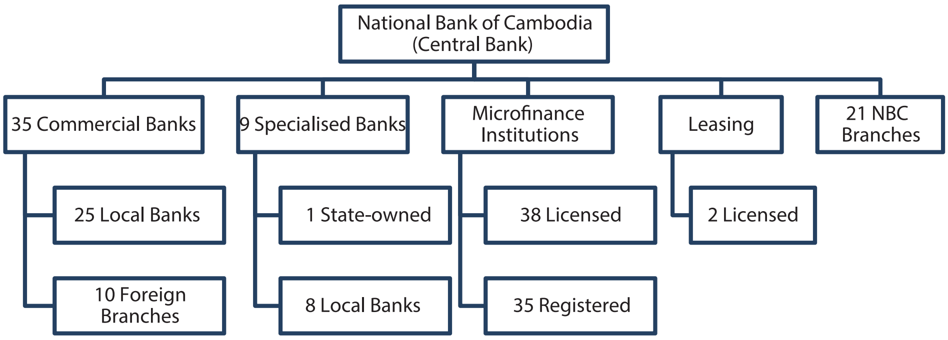
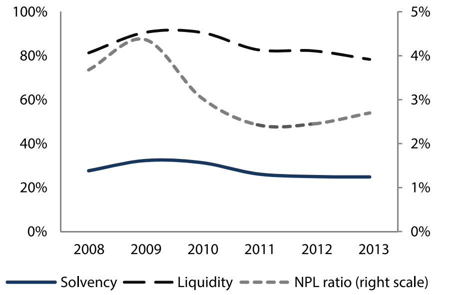
Annex 1: Key Elements of the Basel III's Capital Requirements



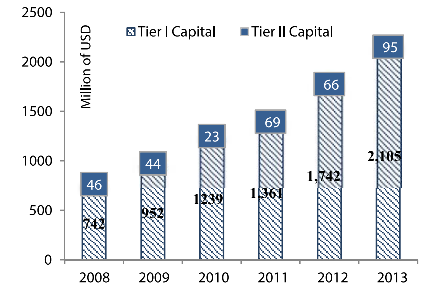
Annex 2: Banking System in Cambodia (Dec, 2013)



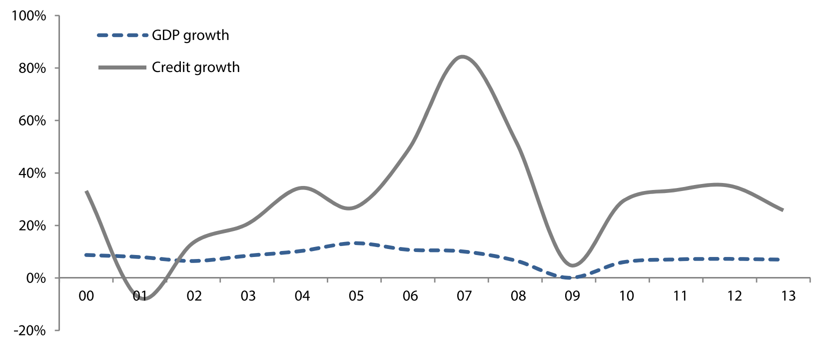
Annex 3: Banks' Prudential Ratios



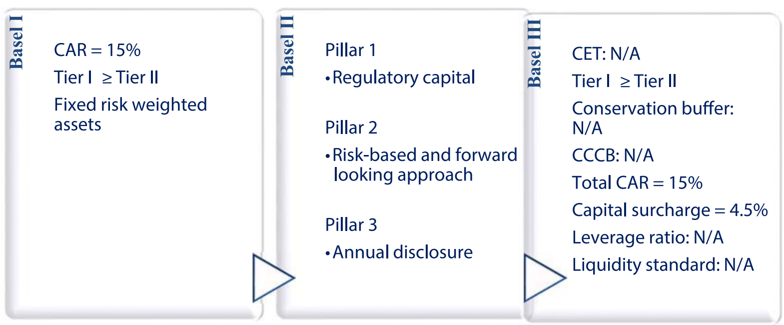
Annex 4: Combination of Banks' Net Worth



Annex 5: Cambodia's Economic and Banking Sector Evolution



Annex 6: Status of the Basel Accord Implementation in Cambodia



Annex 7: Data, Source and Availability

Data	Availability	Frequency	Unit	Source
Macro – Indicators				
GDP	Q4 2001- Q1 2013	Quarterly	Billion KHR	IMF-IFS
Banking Indicators				
Credit	Q42001- Q12013	Quarterly	Billion KHR	IMF-IFS
NPL	Q12004- Q12013	Quarterly	Billion KHR	NBC

Annex 8: Descriptive Statistics

Data	Credit y-o-y	GDP y-o-y	CREDIT_GDP ratio	NPL y-o-y
Mean	36.79	20.22	77.31	35.38
Median	29.83	16.84	74.57	6.45
Maximum	103.86	67.13	142.65	261.22
Minimum	3.63	-3.34	37.08	-49.43
Std. Dev.	23.42	13.82	31.29	71.76
Skewness	1.23	1.42	0.36	1.54
Kurtosis	4.16	5.72	1.92	4.60
Observations	41	41	46	33

Annex 9: Underlying Data for Calculating the Credit-to-GDP Gap for Cambodia

Time period	CREDIT[1]	GDP[2]	RATIO[3]	TREND[4]	GAP[5]
Q4 2001	929.66	2,340.42	39.72	39.72	0.00
Q1 2002	977.30	2,440.72	40.04	40.04	-0.00
Q2 2002	928.95	2,505.59	37.08	37.62	-0.55
Q3 2002	974.36	2,494.68	39.06	38.23	0.83
Q4 2002	1,052.46	2,714.26	38.77	38.36	0.42
Q1 2003	1,126.30	2,787.58	40.40	39.29	1.11
Q2 2003	1,224.95	2,828.97	43.30	41.18	2.12
Q3 2003	1,290.75	2,738.68	47.13	43.95	3.18
Q4 2003	1,330.17	3,004.09	44.28	44.65	-0.38
Q1 2004	1,391.17	3,151.51	44.14	45.06	-0.92
Q2 2004	1,498.29	3,305.29	45.33	45.70	-0.37
Q3 2004	1,675.83	3,589.98	46.68	46.55	0.13
Q4 2004	1,932.92	3,615.91	53.46	49.07	4.38
Q1 2005	2,096.96	3,874.81	54.12	51.17	2.94
Q2 2005	2,287.39	4,209.04	54.34	52.85	1.50
Q3 2005	2,512.95	4,561.06	55.10	54.32	0.78
Q4 2005	2,317.35	4,825.73	48.02	53.79	-5.77
Q1 2006	2,690.80	5,018.59	53.62	54.56	-0.95
Q2 2006	2,938.59	5,223.48	56.26	55.73	0.53
Q3 2006	3,246.74	5,478.35	59.26	57.30	1.96
Q4 2006	3,602.71	5,755.58	62.59	59.29	3.31
Q1 2007	4,002.59	6,084.00	65.79	61.59	4.20
Q2 2007	4,440.22	6,319.82	70.26	64.42	5.83
Q3 2007	5,378.66	6,819.32	78.87	68.56	10.31
Q4 2007	6,430.32	7,932.63	81.06	72.52	8.54
Q1 2008	8,024.56	8,945.97	89.70	77.60	12.10
Q2 2008	9,051.63	10,562.23	85.70	81.11	4.58
Q3 2008	9,790.67	10,733.26	91.22	85.13	6.09
Q4 2008	9,938.20	10,400.61	95.55	89.34	6.21
Q1 2009	9,826.05	9,915.97	99.09	93.56	5.53
Q2 2009	10,270.25	10,209.26	100.60	97.35	3.24
Q3 2009	10,146.48	10,487.15	96.75	99.68	-2.93
Q4 2009	10,687.02	10,793.86	99.01	101.94	-2.93
Q1 2010	11,058.65	11,169.94	99.00	103.67	-4.67
Q2 2010	11,450.31	11,505.52	99.52	105.06	-5.54
Q3 2010	12,300.83	11,882.16	103.52	106.84	-3.32
Q4 2010	13,089.03	12,507.67	104.65	108.42	-3.77
Q1 2011	13,683.36	12,924.64	105.87	109.84	-3.97
Q2 2011	14,577.17	13,567.29	107.44	111.21	-3.77
Q3 2011	16,001.83	14,020.68	114.13	113.56	0.57
Q4 2011	14,850.68	14,451.06	102.77	113.17	-10.40
Q1 2012	18,130.60	14,977.17	121.05	116.29	4.76
Q2 2012	19,063.46	15,168.08	125.68	119.82	5.86
Q3 2012	20,743.29	15,442.07	134.33	124.51	9.82
Q4 2012	22,180.01	15,898.02	139.51	129.52	9.99
Q12013	23,621.06	16,558.92	142.65	134.38	8.27

Note: (1) Nominal credit to private sector, (2) Nominal GDP, (3) In percent, (4) Trend based on a one-sided HP filter using a smoothing parameter (lambda) equal to 1600 and (5) GAP=RATIO-TREND

Chapter 3

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS AN EMPIRICAL TEST FOR INDONESIA

By
Justina Adamanti and Rieska Indah Astuti[1]

Introduction

1. Motivation

Credit growth is commonly procyclical to economic growth; it increases when the economy is in an expansion (boom) phase and then slows down when the economy goes into a downturn. The excessive credit growth in the expansion phase can lead to the build-up of systemic or system-wide risk. According to the work of IMF, FSB and BIS (2009), systemic risk can be defined as "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy."

In order to prevent the build-up of systemic risk from excess credit growth and maintain the ability of financial institutions to absorb losses, the Basel Committee on Banking Supervision (BCBS) introduced two additional capital buffers in the BASEL III framework. The additional capital requirements are the capital conservation buffer (CCB) and the Countercyclical Capital Buffer (CCCB). The main difference between these two additional capital requirements is on how to start the accumulation. The CCB is mandatory and accumulate all time, while the CCCB is discretional, based on the current situation of the financial system. The CCB is applied to all banks, where every bank has to add 2.5% capital on top of its minimal capital requirement based on its risk profile. The CCCB is dependent upon the state of systemic risk. When systemic risk tends to build up, banks have to start accumulating additional buffer with the range of around 0 – 2.5%.

Besides the CCCB, some countries have already implemented dynamic provisioning (DP), such as Spain, Peru and Colombia. DP is an additional provision

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1. Justina Adamanti and Rieska Indah Astuti are both Economic Researchers in Bank Indonesia.

that is accumulated based on asset performance. The main difference between DP and CCCB lies in the purpose; DP is accumulated for absorption of expected loss, while CCCB is for unexpected loss. The BCBS chose to develop the CCCB rather than DP because the international accounting standard did not support provision formation for non-incurred event at that time.

Based on the guideline from the BCBS, the primary objective of the CCCB is to maintain bank's supply credit in a downturn. Furthermore, the CCCB may also help banks to reduce excess credit growth by increasing the cost of credit. When the bank needs to accumulate additional capital buffer, it will reduce bank's supply of credit. Therefore, the demand of credit will decrease since bank has to charge higher loan interest rate.

The CCCB is a necessary macroprudential tool for Indonesia. The main reason is the high procyclicality of credit growth and capital build-up to the business cycle. Deriantino (2011) finds evidence of the high procyclicality of capital build-up in five ASEAN member economies (Indonesia, Singapore, Malaysia, Thailand and the Philippines)[2]. In addition, Utari, et al. (2012) also finds that credit growth in Indonesia has a positive correlation with economic growth. Bank Indonesia, as the macroprudential regulator in Indonesia, hopes that the implementation of the CCCB can help dampen excess credit growth and prevent the build-up of systemic risk.

The main objective of this research is to design a CCCB framework that will serve to guide the formulation of this policy for Indonesia. This framework will cover the main and additional indicators for triggering activation and deactivation of the CCCB, operational guidance, and arrival of some consensus, such as communication and reciprocity.

2. Special Feature of Indonesia's Banking System

2.1 Overview of Indonesian Banking System

The Indonesian Financial System is a large system, consisting of banking and non-banking sectors and capital market. The banking system consists of commercial banks, Islamic banks and rural banks. The non-banking system consists of insurance, pension fund, financial institutions and other financial

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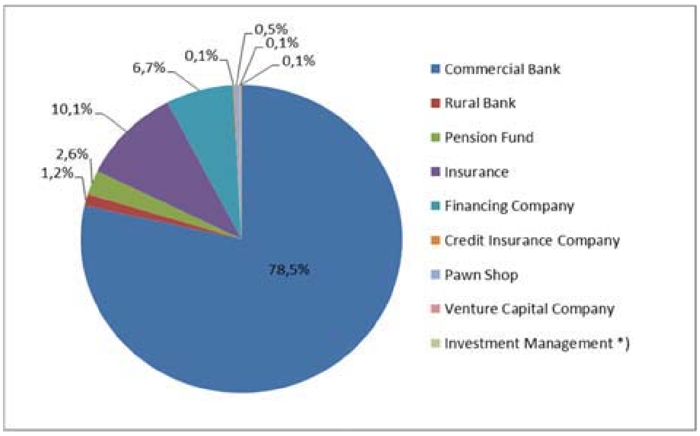
2. The model uses panel data of 63 banks in five countries, *capital buffer* = *f*(*GDP, NPL, ROE*). The procyclicality is shown by the negative coefficient of GDP to the capital buffer.

institutions. While the capital market system consists of stock market and bond market (Annex Graph 1).

As shown in Graph 1, the banking sector holds the biggest share of the total financial system asset, which is around 79.7%. It makes a large contribution to the economy, including serving as the financing source of the private sector.

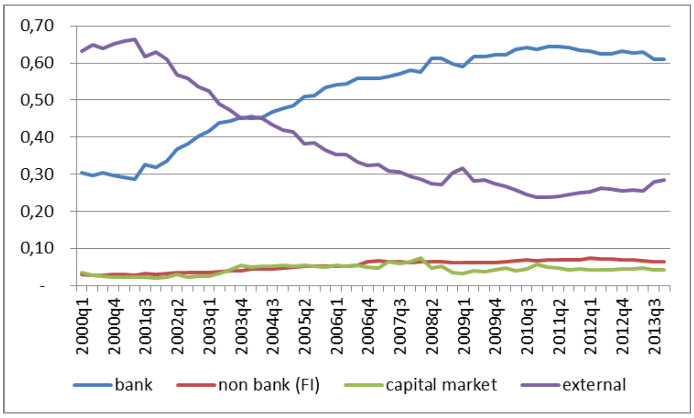
Graph 1
The Asset Share of Financial System



The private sector obtains finance from several sources, namely from banks, non-banks (financing institutions), capital market (equity[3] and bond) and external loans. Graph 2 shows that in the last five years, the major source of finance is from banks, which is around 63%. The other sources are from external loans (26%), financing institutions (7%) and market (5%).

3. As a proxy data for equity market is the new stock issuance, since there is no data for the outstanding stock.

Graph 2
Share of Source of Private Financing (2002 - 2013)



As the main source of private financing, Indonesia has a large number of banks - 120 banks in the last three years. There are 6 categories based on ownership, namely state-owned banks, foreign exchange commercial banks, non-foreign exchange commercial banks, regional development banks, joint-venture banks, and foreign-owned banks. Based on this categorisation, the smallest ownership share belongs to the state-owned banks which represent only 3% of the total bank group. Nevertheless, this smallest group of bank ownership holds around 35.5% of total assets.

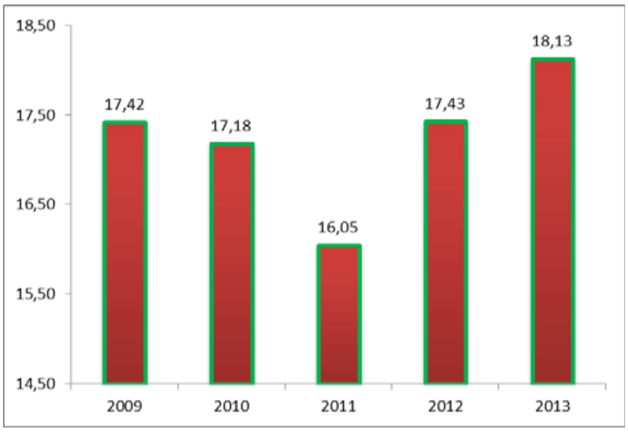
Simplifying the categories, the state-owned banks and regional development banks belong to the government (public), while the foreign exchange commercial banks, non-foreign exchange commercial banks and joint-venture banks are belong to the private sector. Therefore, the biggest share is private ownership (67%), followed by public ownership (25%) and foreign ownership (8%).

Table 1
Bank Ownership Group

Year	State-owned Banks	Foreign Exchange Commercial Banks	Non-Foreign Exchange Commercial Banks	Regional Development Banks	Joint-venture Banks	Foreign-owned Banks	Total
2009	4	34	31	26	16	10	121
2010	4	36	31	26	15	10	122
2011	4	36	30	26	14	10	120
2012	4	36	30	26	14	10	120
2013	4	36	29	26	15	10	120
Average in 5 years	3%	30%	25%	22%	12%	8%	

In the last five years, the capital condition of the Indonesian banking system is strong. This is reflected in the high Capital Adequacy Ratio (CAR), where the CAR average in the five last years is around 17.24%. This average is higher than the minimum capital obligation for the worst risk in the risk-based profile, which is 14%. At the end of 2013, 86% of the banks had CAR above 14%.

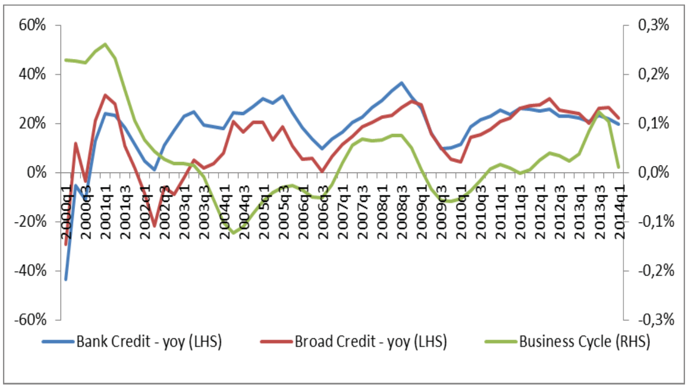
Graph 3
Bank Capital Adequacy Ratio
(end-of-year position, in %)



2.2 Economy of Indonesia

As mentioned before, the credit growth is found to have procyclical properties[4]. This can be seen in Graph 4, where both broad credit and bank credit have similar pattern as the business cycle. The broad credit is a summation of bank credit, outstanding private bond and private foreign loan.

Graph 4
Credit and Business Cycle

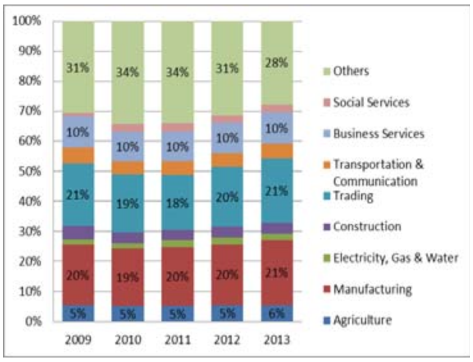


The distribution of bank credit can be categorised by: (i) the economic sector; (ii) size of business; and (iii) uses. As shown in Graph 5, bank credit is non-equally distributed across the economic sector. In the last five years, the two economic sectors which received the largest share of the credit are manufacturing and trading, which represent about 20% for each sector[5]. The next sector is business services, which includes financial intermediaries, real estate, business ownership and business services.

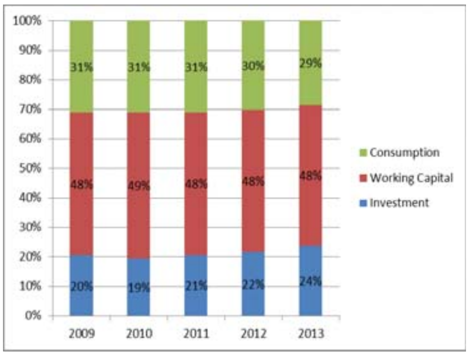
4. Business cycle is constructed from GDP growth using the band-pass filter with frequency 5 – 32 quartals Christiano and Fitzgerald (2003).
5. Excluding 'others' Sector which comprises uncategorised economic segments.

Graph 5
Share of Credit

Based on Economic Sector



Based on Uses



By size of business, the share of credit to Small and Medium Enterprises (SMEs) is around 19% in last three years. SMEs can be part of every economic sector.

Lastly, based on uses, credit is categorised as investment credit, working capital credit and consumption credit. The biggest share is taken up by working capital credit (48%), followed by consumption credit (30%) and investment credit (21%). Therefore, around 69% of the bank credit is used for production activity.

During the last 15 years, Indonesia experienced three economic crises, specifically: (i) the Asian financial crisis (AFC) in Q3 1997, (ii) the mini-crisis in Q4 2005; and (iii) global financial crisis (GFC) in Q4 2008. The most severe crisis was the AFC that was triggered by the rapid depreciation of rupiah against the US$. This crisis turned into a financial and economic crisis in Indonesia. Many companies went bankrupt and failed to pay their debt to domestic (which is bank) and foreign creditors. Along with non-resilient banking condition and high non-performing loans, this crisis was transmitted to the banking sector, which caused many banks to be merged or even closed. Before the AFC, the number of banks was 230 banks, and the number then decreased to 130 banks. Consequently, the real GDP growth declined by -13.20%, and inflation rate reached 77.63% in Q4 1998.

The second economic crisis was a “mini crisis” in 2005 that was not as severe as the AFC. The main cause was the rising world oil price. The Indonesian government subsidised fuel price, while the domestic oil production was not enough to fulfill domestic demand. Therefore, the government had to import both crude oil for domestic fuel production material and fuel itself. The increasing budget burden of the government led to fuel subsidy cut-off, which resulted in higher production cost and it transmitted the impact to the banking sector and resulted in high non-performing loans. However, even though this crisis impacted in increasing NPLs to 8.27% in Q2 2006 and slow-down in credit to 9.6% in Q3 2006, the banking system largely remained sound as banks became more prudent in approving new credit. In Q4 2005, the real GDP growth was 5.11% and the inflation rate was 17.11%.

The last crisis in 2008 was triggered by the GFC. The deceleration of the world economy during the GFC impacted mainly on international trading activities. Many countries experienced a drop in real GDP growth, including Indonesia. However, Indonesia still recorded positive real GDP growth around 4.63% in 2009. That was because the biggest share of the Indonesian GDP was domestic consumption (around 50%). As with the "mini crisis," the banking system remained sound, even though credit growth decreased to 9.6% in Q4 2009 because of negative market sentiment.

The banking system in Indonesia is undergoing major reforms in banking supervision due to the switch-over from the Central Bank to the Indonesian Financial Supervisory Authority (IFSA). The IFSA is a specialised institution that acts as regulatory and supervisory authority for all activities within the financial services sector, including the banking, capital market, and non-banking financial sectors. The decision for establishing this institution is mainly in anticipating the complexity in the global financial system.

3. Outline of Study

This study consists of 6 sections and is organised as follows: Section 2 provides the CCCB outline recommendation from the BIS, the CCCB progress in member economies, and some experiences of other countries that have already implemented or announced the CCCB. Section 3 highlights the literature reviews of the methodology and the choice of the CCCB main indicator. The sources of literatures include the BCBS, internal researches and external researches. Section 4 presents the empirical analysis for choosing the indicators, threshold and buffer size. Section 5 provides the policy recommendations for the implementation of the CCCB, including the procedure to accumulate, release and other issues, such as reciprocity and communication framework across related institutions. Section 6 summarises the chosen indicators and policy recommendations, with the graphs and related data presented in the Annexure.

4. Cross-country Evidences

4.1 CCCB Outline Recommendation from BIS

The BIS already published its guidance for national authorities operating the CCCB on December 2010. According to the BIS recommendations, the CCCB may start in 2016, but it can be started earlier, if needed. The document describes five principles that national authorities should follow in making buffer decisions, including the calculations of the CCCB rates. The principles consist of the objectives, common reference guide, risk of misleading signals, prompt release and other macroprudential tools.

The CCCB is an additional capital buffer that is built up to protect the banking system against potential future losses caused by the excessive credit growth that is associated with system-wide risk. The additional buffer can be calculated by determining an appropriate variable to be used as a main indicator. The main indicator suggested by the BCBS in its guidance for the building-up of the capital buffer is the credit-to-GDP gap, which is defined as the difference between the credit-to-GDP ratio and its long-term trend. According to the guidance, the definition of credit is credit that will capture all sources of debt funds for the private sector, including funds raise abroad. While the methodology used to obtain the long- term trend is the one-sided Hodrick-Prescott (HP) filter with smoothing parameter 400,000. The size of the additional buffer for the CCCB is in range of between 0% and 2.5% of the risk-weighted assets (RWAs), which is determined using the linear interpolation between lower threshold (L=2%) and upper threshold (H=10%).

To avoid the risk of misleading signals, national authorities should look for evidence that the main indicator is precisely signaling pre-crisis before taking a buffer decision in both the build-up and release phases. Therefore, it is important to consider other indicators that provide additional information in assessing financial imbalances. Thus, the information from the main and additional indicators has to be combined with judgment to avoid misleading information.

The authorities can release the buffer gradually in situations where the credit growth slows and system-wide risks recede. The BCBS does not mention the mechanism in releasing the buffer and leaves it to the judgment of the national authorities.

4.2 CCCB Progress in Indonesia

In compliance with the Basel III, Bank Indonesia published the regulation for CAR in PBI No. 15/12/PBI/2013 on December 2013, which includes the implementation of the CCCB. According to the regulation, the CCCB will be implemented in 2016, but it can be started earlier, if needed. In line with that, Bank Indonesia has also done some researches about the CCCB policy. Based on the research, the main indicator is the credit-to-GDP gap, while the other additional indicators are mortgage loan-to-GDP gap, consumer loan-to-GDP gap and property credit-to-GDP gap.

Recently, Bank Indonesia is conducting research for the CCCB implementation framework, which includes the main and additional indicators, operational guidelines, communication and coordination mechanism and other related issues. This framework will be used as a guideline for operating the CCCB in Indonesia. This implementation framework becomes a substantial issue starting from 2014. As banking supervision is under the IFSA, Bank Indonesia needs to work together with the IFSA for the CCCB implementation.

4.3 Implementation in Euro Area

In line with the decision of the European Union to adopt BASEL III, the European Commission proposed the Capital Requirements Regulation (CRR) and the Capital Requirements Directive (CRD) to the European Parliament. The CRR is a set of regulations that can be applied directly across the EU members, while the CRD is a set of directions that have to be implemented through national law. The CRR and CRD are simply called as 'CRD IV'. The CRD IV is published by the European Parliament on 16 April 2013, and implemented by 1 January 2014.

Regarding the implementation of the CCCB, some EU members already started to build the CCCB framework with reference to the CRD IV. Some countries have already published their framework, such as United Kingdom, Switzerland and Norway. The countries implementing the CCCB which have yet to publish their framework are Denmark and Sweden. The detailed explanations for the CCCB framework are described below.

4.3.1 United Kingdom

The responsible authority for CCCB implementation proposed by the government is the Bank of England (BoE), with the responsibility for policy decisions delegated to the Financial Policy Committee (FPC). The FPC was established under the Bank of England Act, 1998, through amendments made in the Financial Services Act, 2012. The members of the FPC are the BoE Governor, the three Deputy Governors, (namely, the Deputy Governors responsible for financial stability, prudential regulation, and monetary policy), the Chief Executive of the Financial Conduct Authority (FCA), four appointed external members and one representative from the Treasury. The main objective of the FPC is identifying, monitoring and taking action to remove or reduce systemic risks with a view of protecting and enhancing the resilience of the UK financial system. The FPC is empowered to give recommendations and direction to the Prudential Regulation Authority (PRA) and the FCA for adjusting specific macroprudential tools.

The main reason of UK in adopting the CCCB is in compliance with the CRD IV as an EU member. The implementation of the CCCB is to begin from 1 January 2014 or by 1 January 2016 at the latest. The CCCB will be applied to all banks, building societies, and large investment firms. In addition, the CCCB may be applied at individual entity level and consolidated group level in the same way as microprudential capital requirements.

The CCCB implementation in UK will use a combination of some economic and banking indicators, and also judgment. The main indicator for the CCCB is the credit-to-GDP gap, as suggested by the BCBS. This indicator can give good signal prior to past crisis, where commonly the gap becomes positive. However, this indicator may not be a good indicator for the reduction or release of the CCCB because the gap can still be positive in post-crisis periods. The main reason for this positive gap is that sometimes credit falls slowly, while GDP declines rapidly.

As additional indicators, the BoE uses some more prompt indicators for supporting the CCCB decision. There are 12 main additional indicators divided in 3 categories, namely: bank balance sheet stretch; non-bank balance sheet stretch; and the conditions and terms in markets. The bank balance sheet stretch category consists of capital ratio, leverage ratio, average mortgage risk weight, balance sheet interconnectedness and overseas exposure indicators. The non-bank balance sheet stretch category consists of credit growth, household debt to income ratio, public non-financial corporation (PNFC) debt-to-profit ratio and non-bank financial institution (NBFI) debt-to-GDP ratio. And lastly, the conditions and terms in markets consist of real estate valuations, real estate lending terms and spreads on new UK lending.

In addition, the FPC will conduct projections and stress testing annually and concurrently across institutions. The main purpose of the projection and stress testing is to provide a forward-looking, quantitative assessment of the capital adequacy of the UK banking system and individual institutions within it. The FPC will use the projection and stress testing results to decide whether they need to increase the CCCB or not.

The main factor for determining whether or not to reduce the CCCB is the size of the banks' capital buffer. Together with the microprudential regulator and bank investor, the FPC will judge whether the capital buffer is sufficient to absorb the banks' expected future loss, even after the buffers have been drawn down. If capital buffer is sufficient, then the CCCB can be reduced. However, if the buffer capital is insufficient and there is material risk that can threaten the banks' capital, then the CCCB cannot be reduced. In addition, if banks find that it is hard or expensive to have low capital ratio, then the CCCB cannot be reduced too. Some indicators used for the release decision are capital adequacy, the estimation of potential losses under stress, the market-based indicators of bank's resilience, the credit conditions, and the outlook for growth and bank profitability.

In the implementation of the CCCB, the PRA will explain to the banks how the CRD IV will be implemented, including the timeframe, and then the PRA will report back the progress to the FPC. Typically, banks will have twelve months to meet an increase in the CCCB rate. If the banks fail to meet the buffer level in the required time, they have to restrict the amount of the dividends and bonuses that they can pay out. They also have to explain how they will meet the buffer level within an appropriate timeframe that will be monitored by the PRA.

Several UK banks are operating overseas, and foreign banks are operating in the UK. Therefore, the FPC will cooperate with other overseas regulators in the CCCB implementation. Based on the CRD IV, banks that operate internationally will face a CCCB that "shall consist of the weighted average of the countercyclical buffer rates that apply in the jurisdictions where the relevant credit exposures of the institution are located." The weighted average is calculated on the basis of the proportion of each bank's own fund requirement that relates to the relevant credit exposures in each jurisdiction.

4.3.2 Switzerland

Switzerland is the first country which has already implemented the CCCB since July 2012. The CCCB policy was first announced on 13 February 2013 in the Swiss National Bank (SNB) press release, where the buffer size was 1% and was required to be fulfilled by 30 September 2013. The buffer was then increased to 2% by 30 June 2014, as mentioned in SNB press release on 23 January 2014. The main reason is the rising of cyclical imbalance risk from the domestic mortgage and real estate markets, which is driven by the persistently low interest rate since 2008 and a buoyant economic condition. The Swiss state that they implemented a sectoral-targeted CCCB, which is triggered from the developments in the domestic mortgage and real estate markets.

The implementation of the CCCB in Switzerland is the result of the coordination efforts between the SNB, Swiss Financial Market Authority (FINMA) and the Federal Council (FC). The SNB has the responsibility for conducting regular assessments to determine whether the CCCB should be activated or deactivated. If the SNB thinks it is necessary to activate the CCCB, then they will establish the buffer size and the timeframe. In the process, the SNB will consult with the FINMA before submitting an official proposal to the FC. Further, the FC will decide on the CCCB, including the buffer size and timeframe. The implementation of the CCCB at the individual level will be supervised by the FINMA.

According to the revised Article 44 of the Capital Ordinance, the implementation of the CCCB in Switzerland has two important characteristics. First, the buffer can be implemented on a broad basis or targeted at specific segments of the credit market. Second, the maximum level of the CCCB buffer is set at 2.5% of the total domestic risk-weighted assets of an individual bank. Furthermore, the CCCB is applicable to Swiss banks and subsidiaries of foreign banks in Switzerland.

The domestic mortgage volume indicators (the ratio of mortgages to gross domestic product) and domestic residential real estate price indicators are considered as the main indicators in Switzerland based on their ability to signal early warning for crisis. In order to support the decision, some additional indicators are also used, such as interest rate risk, interest rate margins, credit condition indicator, and leverage.

The SNB will propose an activation of the buffer to the FC if all the main indicators homogenously give signal of build-up in systemic risk that is usually followed by financial instability. The proposal consists of the buffer size and timeframe. The size of the buffer varies depending on the degree of imbalances measured by the main indicators. In addition, the SNB will do comparison of indicator behaviour during the previous crisis both internationally and domestically in order to obtain the appropriate buffer size. With regard to the timeframe, the proposal will be based on an assessment of the imbalance severity and the available time. The timeframe varies between 3 to 12 months, whereby the greater the severity of the imbalances and the stronger the dynamics, the shorter the implementation period. The FC then will make decision on the buffer size and timeframe, considering the proposal from SNB.

The process for de-activating the CCCB is similar as with activation. It also needs a combination of judgment and higher-frequency additional indicators since the impact of financial stability can materialise quite suddenly. In the de-activation process of the CCCB, the buffer is released gradually.

In terms of communication to the public, the SNB will publish the CCCB proposal after consultation with the FC. If there is no change in the CCCB policy within one year, the SNB will explain the position by publishing an annual statement.

4.3.3 Norway

According to the regulation on the CCCB, Norway has been implemented the CCCB since 15 October 2013. Currently, the implementation of the CCCB is based on the coordination of three authorities in Norway, namely, the Norges Bank (NB), the Finanstilsynet [Financial Supervisory Authority of Norway (FSAN)] and the Ministry of Finance (MoF). In the future, as stated in the Financial Market Report for 2011, the Norwegian government proposed the responsible authority for the CCCB to be assumed by the NB.

The MoF has the responsibility of setting the buffer level at the end of each quarter. Meanwhile, the NB is in charge of drawing up the decision basis and issuing advice on the buffer level of the CCCB. In drawing up the CCCB basis, the NB works together with Finanstilsynet by exchanging relevant information and assessments. The decision basis includes an overview of the credit-to-GDP ratio and the gap, as well as other indicators, and NB's assessment of the systemic risk that is building up. The basis will be published in NB's Monetary Policy Report with the financial stability assessment. Meanwhile, the advice on the buffer level will be submitted to the MoF, along with the summary of basis. Later, the NB will publish the advice once the MoF has made final decision on the buffer level.

The objective of the CCCB in Norway is to enhance the resilience of the banking sector from excessive credit supply fluctuation which will affect the economic cycle. The buffer should be increased when the imbalance in the financial system is built-up, where the pre-announcement is at least 12 months ahead. The buffer will be applied to all the activities of the banks in Norway, including foreign subsidiaries and branches. According to NB, the measures used to set the CCCB rate is based on four main indicators, namely: (i) the ratio of total credit (households and enterprises) to GDP; (ii) the ratio of house price to household disposable income; (iii) the commercial property price; and (iv) the wholesale funding ratio of Norwegian credit institutions.

Historically, the four indicators above provide the early warning signals of vulnerabilities and financial imbalances arising prior to a crisis. The most important indicator is the ratio of credit to GDP, since the households and corporate debt are rising sharply prior to a financial crisis, compared to another indicator. Besides that, Norway also uses other additional indicators for assessing financial imbalances, such as household credit growth and corporate credit growth, the debt servicing capacity of households and firms, and real house prices.

In the releasing phase, the buffer is not reduced automatically even though the indicators show that the financial imbalance has been receded. The main reason is because it is necessary to maintain resilience after a high-risk period. Norway uses some more contemporaneous indicators for releasing the buffer, such as market turbulence and loss prospects for the banking sector. The buffer only can be released for maintaining credit supply purposes, not for solving other particular banking problem.

The buffer size is the same as the BCBS guidance, between 0 to 2.5%, but if necessary can be increased to above 2.5%. When the buffer is above 2.5%, the branches of foreign banks in Norway have to be approved by their home country authorities.

In its advice on the CCCB to the MoF in the first quarter of 2014, the NB mentioned that the financial imbalances are not building up. But some indicators show the emergence of financial imbalance, such as high total credit to GDP and faster household debt growth than the disposable income. Therefore, the MoF set the buffer size at 1 % in 30 June 2015, pursuant to the advice of the NB to set the buffer at 1% in January 2015.

5. Literature Review

The operation of the CCCB requires some indicators as guidance to determine the appropriate time for starting the building-up and the releasing of capital buffer. The buffer accumulation needs leading indicators, while the buffer release needs contemporaneous or more prompt indicators. However, it is difficult in practice to find a system-wide or aggregate variable that can perform these two functions at once. Drehmann, et al. (2010) mention two main reasons; first, not all variables are able to capture the "temperature" of good times, a starting time when risk is starting to accumulate. Second, it is hard for a variable to act as leading and contemporaneous indicator. In addition, top-down variables are more appropriate than bottom-up (bank-specific) variables, since there are some evidence of high idiosyncratic component and are more volatile.

The main indicator suggested by the BCBS in its guidance for building-up capital buffer is the credit-to-GDP gap ("credit gap"), which is defined as the difference between the credit-to-GDP ratio and its long-term trend. Repullo and Saurina (2012) argue that the credit-to-GDP gap is not the appropriate indicator for indicating risk accumulation. Using data from 7 countries[6], they show that credit-to-GDP generally has negative correlation to the business cycle, GDP. This means the credit-to-GDP gap has procyclicality behaviour to the GDP; capital buffer will be accumulated when GDP is high and release when GDP is low. In addition, Repullo and Saurina argue that credit growth is more appropriate as the accumulation indicator, by showing that credit growth has positive correlation to GDP. As a response to that critique, Drehmann, et al. (2014) show that the credit-to-GDP gap has positive correlation to the business cycle, when the period during which the CCCB is deactivated because of low credit gap or released, is excluded in the correlation measurement. More importantly, Drehmann, et al. mention that the relevant cycle for the CCCB is not the business cycle, but the financial cycle which usually has greater amplitude and duration than business cycle fluctuation.

The credit gap is calculated using the one-sided HP filter with high smoothing parameter, 400,000. The one-sided HP filter is chosen because it gives higher weight to the more recent observations. Drehmann, et al. (2010) show that the

6. France, Germany, Italy, Japan, Spain, United Kingdom and United States.

trends calculated using high smoothing parameter (125,000 and 400,000) perform better as crisis leading indicator than using lower smoothing parameter (1,600 and 25,000)[7]. In practice, the appropriate smoothing parameter has to be tested to the credit gap series in every jurisdiction.

Besides its good performance as a leading indicator, the credit-to-GDP gap is chosen as the main suggested indicator because of its availability across countries, is easy to calculate and can facilitate communication between the policymaker, banks and the public. Some countries which use the credit gap as the main indicator are United Kingdom, Denmark, Norway, Canada, Sweden, United States and Iceland. However, some countries also use other leading indicators for accumulating capital buffer, for instance, Peru uses GDP growth and Switzerland uses mortgage volume indicators, real estate price indicators and general economic condition indicators.

In practice, the precision of the credit-to-GDP gap in signaling two or three years ahead of a crisis varies from country to country. In order to overcome this problem, the BCBS suggests to the authorities they are not to rely mechanically on the main indicator. The main indicator has a role as a common reference guide which has to be combined with information from other additional indicators and judgment. In line with this, almost all the authorities which have published their research or policy statement on the CCCB use a set of indicators in monitoring the build-up of systemic-wide risk. UK, Denmark, Norway, Canada, Sweden, United States, Iceland and Switzerland are the examples of such countries that have taken this approach.

According to the BCBS guidance, the range of additional capital buffer is from zero to 2.5%. The size of the capital buffer is determined using L and H parameters, which are the lower and upper threshold of the chosen indicator for buffer accumulation. According to the BCBS guidance, L is 2% and H is 10%. These thresholds are calculated statistically using Noise-to-Signal ratio (NSR) over Type 1 errors (a crisis occurs but no signal) and Type 2 errors (a signal occurs but no crisis) on data of credit-to-GDP gap of 24 countries. Using L and H, the capital buffer is calculated linearly. When the gap is below L, the additional buffer will be zero, and when the gap is upper L, the additional buffer will be 2.5%.

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7. $\lambda = n^4$, where n is the ratio of the credit cycle length to the business cycle length. λ = 400,000 means that credit cycle is four times as long as business cycle.

The decision for releasing the capital buffer needs more prompt and contemporaneous indicators. This is related to the two main purposes of releasing the capital buffer. First, when banks experience losses, they can use the capital buffer instead of their main capital. Second, financial instability can have impact on decreasing credit. Therefore, releasing the buffer can help banks to have more supply credit. In addition, according to Drehmann, et al. (2010), there are two scheme options for releasing the buffer. The first is instantaneous once the bad time occurs, and the second is gradually as the situation changes.

The BCBS does not explicitly mention some indicators for releasing the capital buffer in the guidance. They suggest using high frequency data such as asset price, CDS spreads and funding cost. However, almost all indicators as suggested come with weakness. For instance, using asset price can lead to the release of the buffer too early since it tends to fall before the crisis materialises. To overcome with this problem, most of the authorities decide to use more than one indicator to recognise the change in the financial stability after a crisis. Together with the main indicator, the set of indicators are used to decide on the financial stability condition.

As a member of the G-20, Bank Indonesia has to start the CCCB implementation in 2016. To date, BI had already done two researches in CCCB. The first research in 2012 concludes that the best indicator for buffer accumulation is the bank (narrow) credit-to-GDP gap. The gap is calculated using the one-sided HP filter with smoothing parameter 1,600. The smoothing variable is chosen based on the ratio of credit cycle to GDP cycle calculated using the Bry-Boschan method. The lower and upper thresholds for calculating the buffer size are 1% and 6%, respectively. The reason to depart from the BCBS suggested threshold is because the default threshold is late in signaling the crisis in 1997.

The second research in 2013 adds additional indicators for signaling the accumulation of system-wide risk, namely mortgage loan/GDP, consumer loan/GDP, and property credit/GDP. In addition, the second research also contributed to the design of the implementation framework, though still not in detail. The implementation framework became a substantial issue, since starting from 2014, banking supervision comes under the IFSA. Therefore, Bank Indonesia needs to work together with IFSA for the CCCB implementation.

Although the previous researches already decided the main indicator, some questions still remain, mainly about revisiting broad credit as the main indicator. In order to answer these questions, this year Bank Indonesia will conduct researches on financial cycle, recalibrate the CCCB indicator, and structure the detail implementation framework.

6. Data and Key Indicator

6.1 Data

In order to assess the main and the supplementary indicators for the CCCB, the data have to be able to capture all the crisis and downturn periods in financial stability. The range of crisis and downturn periods in Indonesia are: (i) Q3 1997 to Q4 1998; (ii) Q3 2005 to Q1 2006; and (iii) Q4 2008 to Q4 2009. Some indicators are available before 1997, such as GDP, CPI, Credit, CAR, residential property price index (IHPR)[8] and aggregate stock price index (IHSG). However, some of the banking data are only available from early 2000, such as deposit, Return of Asset (ROA) and non-performing loan (NPL). Based on data availability, econometric analysis commonly uses data from 2001.

The BCBS guidance on CCCB uses a broad definition of credit in the main indicator for calculating the additional capital buffer. It means that the credit has to be a total source of funds for the private sector, which includes domestic and foreign sources. However, it is interesting to analyse the possibility of bank credit as the main indicator, since it is the biggest financing source in Indonesia. Therefore, this research attempts to analyse credit as bank credit and broad credit. Broad credit is a summation of bank credit, outstanding private bond and private foreign loan[9].

Annex Graph 2 includes all the comparison graphs in relation to the business cycle. In general, credit (bank and broad credit) has a similar pattern of movement with the business cycle with some short lags. Commonly, credit growth increased significantly before a crisis period, and then fell deeply when the crisis happened. A similar pattern is also reflected in the ratio of credit to GDP. All these facts show that excess credit growth can lead to systemic risk. In addition, the Indonesian banking system is relatively resilient since early 2000. It can be shown from some banking indicators, such as high ROA, high CAR and low NPL. All the available data will be analysed to determine the main and supplementary indicator candidates.

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8. IHPR (Indeks Harga Perumahan Residensial) is a property price index calculated from a survey result. Since 1994, there have been some changes in the survey method and number of respondents.
9. Before Q2 1992, private foreign loan data in Indonesia is only available in yearly format. The interpolation to quarterly format is based on staff calculation.

6.2 Applying BCBS Guideline in CCCB

According to the BCBS, the main indicator for calculating the capital buffer is credit-to-GDP gap. The gap is constructed using the one-sided HP filter with smoothing parameter (λ) 400,000[10]. The size of additional capital buffer is determined linearly using upper (H) and lower (L) threshold, where L=2 and H=10[11].

Before discussing further, this sub-section will apply the standard BCBS guidance to the Indonesian data and see whether the setting needs any adjustments. In addition, it is interesting to apply the guidance to both the bank credit and broad credit data. Bank credit becomes the main source of private financing in last five years (almost 70%). However, it is also interesting to see how resilient is the financial system when other sources of financing (private bond and private foreign loan) are taken into account.

Graph 6 shows that the standard guidance is not appropriate for Indonesia. The gap fails to capture all the crisis and downturn periods 2 – 3 years ahead, and the gap is too high for the current condition. Concerning the impact, the additional buffer commonly does not reach its maximum (2.5%) before the crisis or downturn period, and the capital buffer is too high for the current condition.

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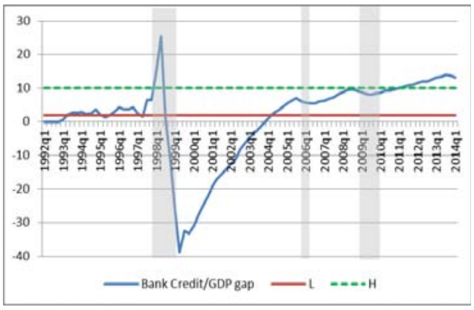
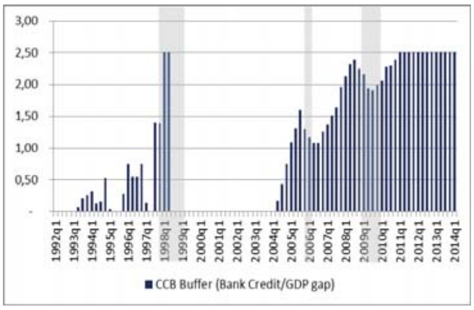
10. According to Drehmann, et al. (2010), the smoothing parameter (λ) is chosen based on how long the financial cycle is to the business cycle. They plotted the credit-to-GDP gap with various λ values to crisis periods in some countries, such as Canada, Germany, US, UK, Norway and Spain. The result shows that λ=400,000 performs well compared to other lambdas. This is in line with the finding of Drehmann, et al. (2012) that the financial cycle is 4 times longer than the business cycle in some advanced countries (United States, United Kingdom, Japan, Australia, Norway, Sweden and Germany).
11. These threshold are chosen based on the lowest noise-to-signal ratio, with loss function 2/3 of crises are predicted. See Drehmann, et al. (2010) for the details.

Graph 6
Bank Credit-to-GDP Gap

Standard CCCB Guidance Applied on Bank Credit-to-GDP Gap



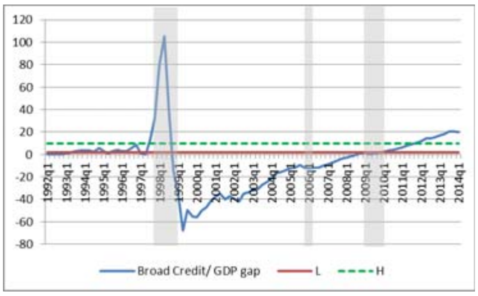
Capital Bufer Accumulation Using Bank Credit-to-GDP Gap



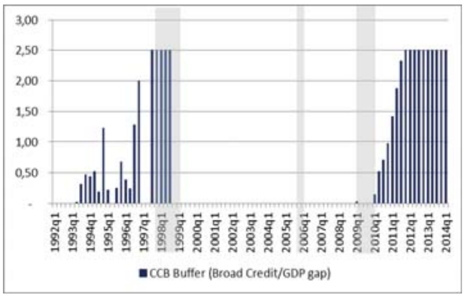
The result is even worse when the guidance is applied to broad credit-to-GDP gap. Graph 7 shows that the gap fails to capture all the crisis and downturn periods, and the gap is too high for the current condition. Concerning the impact, there is not enough time to accumulate the additional buffer before the crisis in 1997, no buffer accumulation for the downturn periods in 2005 and 2008, and the capital buffer is too high for the current condition.

Graph 7
Broad Credit-to-GDP Gap

Standard CCCB Guidance Applied on Broad Credit-to-GDP Gap



Capital Buffer Accumulation Using Broad Credit-to-GDP Gap



It is surmised that the standard BCBS guideline on the CCCB setting is not appropriate for Indonesia, even though some data from Indonesia was included in the calculation of the CCCB setting[12]. It is probably because the characteristic

12. Indonesia is included in the construction of the standard CCCB setting. See Drehmann, et al. (2010) and the BCBS guidance on CCCB (2010)

of Indonesia as an emerging country is different relative to the advanced countries, and the data used is not long enough. Therefore, the next sub-section will discuss the appropriate CCCB guidance for Indonesia.

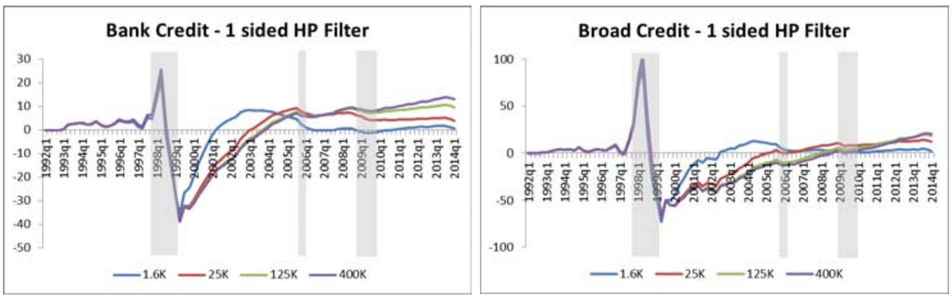
6.3 Candidate for the Main Indicator

The main indicator should be a leading indicator for financial imbalance as its main characteristic. This characteristic is reflected in some indicator such as NPL, residential price, stock price deposit, CAR, ROA and GDP. Some candidates for the main indicator in this research are credit-to-GDP gap (bank and broad), credit growth (bank and broad), NPL growth and NPL as ratio to total debt. The main indicator is selected after passing some processes by which it can be determined that: (1) it has high correlation with the financial imbalance indicator; and (2) can be a good leading indicator by running a simple regression model between the financial indicator (as dependent variable) and the main indicator in its lag (as independent variable).

However, the appropriate credit-to-GDP gap has to be chosen first, since the credit-to-GDP gap in the standard guidance cannot illustrate the financial imbalance in Indonesia. According to Drehmann, et al. (2010), the HP filter parameter (λ) is chosen based on how long the financial cycle is compared to the business cycle. Therefore, the lambda can be 1,600, 25,000, 125,000 and 400,000. Graph 8 shows the credit-to-GDP gap using various lambdas.

Graph 8
Various Credit-to-GDP Gaps with Different Smoothing Parameter (λ)

Bank Credit-to-GDP Gaps | **Broad Credit-to-GDP Gaps**



The credit-to-GDP gap is chosen based on the lowest noise-to-signal ratio (NTSR), where the loss function is 2/3 of crises are predicted. Table 3 shows that the lowest NTSR for the bank credit gap is when lambda is 25,000, while for the broad credit gap is when lambda is 1,600[13]. These two gaps will be included as the main indicator candidates.

Table 3
Noise-to-Signal Ratio for Various Gaps

	Lambda	Threshold	NSR	Predicted
Bank Credit Gap	1600	0,50	63%	70%
	25000	3,50	25%	74%
	125000	3,50	28%	67%
	400000	3,00	32%	67%
Broad Credit Gap	1600	2,50	21%	74%
	25000	0,50	60%	67%
	125000	-	-	-
	400000	-	-	-

6.4 Selection of Main Indicator

The candidates for the main indicator are bank credit-to-GDP gap (λ=25,000), broad credit-to-GDP gap (λ=1,600), bank credit growth, broad credit growth, NPL growth and NPL as ratio to total debt. The first process for choosing the main indicator is to check the correlation of all the candidates with some financial imbalance indicators. The high correlation shows that the main indicator has better possibility as the leading indicator of financial imbalance. Based on the correlation result in Table 4, the candidates for the main indicator are reduced to bank credit-to-GDP gap, bank credit growth, broad credit growth and NPL as ratio to total debt.

13. The complete result for the NTSR is in Annex Table 4.

Table 4
Correlation Matrix for Main Indicators and Financial Imbalance Indicators[14]

Main Indicators	Financial Imbalance Indicator							
	NPL_YOY	NPL_(%)	IHPR_YOY	GDPR_YOY	IHSG_YOY	DPK_YOY	CAR	ROA
NC_GDP25K	0,49	-0,68	-0,54	0,69	0,25	0,35	-0,32	0,83
BC_GDP16K	0,28	-0,34	-0,27	0,24	0,27	-0,21	0,14	0,60
NC_YOY	0,14	-0,50	-0,29	0,70	-0,26	0,32	-0,39	0,44
BC_YOY	0,19	-0,76	-0,19	0,80	-0,24	0,66	-0,69	0,62
NPL_YOY			-0,09	0,25	-0,02	0,37	-0,14	0,29
NPL_(%)			0,28	-0,74	-0,03	-0,49	0,65	-0,84

The next process is to see how the main indicator can be a good leading indicator by using a simple regression model between the financial imbalance indicator as the dependent and main indicator in its lag as the independent. The model is as below:

$$fin\_imbalance\_indicator(t) = f\,(main\_indicator(-t)), \text{ where } t = 1,2,3, \ldots$$

Based on the regression result in Table 5, the best main indicator is the bank credit-to-GDP gap, since it is a good leading indicator for NPL for 18 quarters before. The result also concluded that the main financial imbalance indicator is NPL as a ratio to total debt.

Table 5
The Lag Regression Result

Variables		lag	Coef.	Std. error	T-stat	Prob (t)	R-sqr	adj. R-sqr	SE Reg	F-stat	Prob (F)	AIC
dependent (y)	independent (x)											
NPL (%)	Bank Credit Gap	18	-0,29	0,03	-9,64	0,00	0,81	0,81	0,82	135,60	0,00	2,50
GDP Real (yoy)	Bank Credit Gap	1	0,00	0,00	9,27	0,00	0,51	0,50	0,01	50,58	0,00	-7,31
ROA (%)	Bank Credit Gap	1	0,07	0,01	7,31	0,00	0,60	0,59	0,27	70,59	0,00	0,26
GDP Real (yoy)	Bank Credit (yoy)	1	0,07	0,02	3,91	0,00	0,38	0,36	0,01	29,08	0,00	-7,06
GDP Real (yoy)	NPL (%)	1	0,00	0,00	-7,07	0,00	0,58	0,57	0,01	67,20	0,00	-7,46
CAR (%)	NPL (%)	4	0,54	0,05	10,21	0,00	0,63	0,62	1,34	76,05	0,00	3,47
ROA (%)	NPL (%)	3	-0,08	0,01	-6,66	0,00	0,54	0,53	0,23	53,21	0,00	-0,04
NPL (%)	Broad Credit (yoy)	1	-18,25	2,72	-6,71	0,00	0,53	0,52	2,01	54,05	0,00	4,27
GDP Real (yoy)	Broad Credit (yoy)	1	0,05	0,01	5,87	0,00	0,47	0,46	0,01	43,08	0,00	-7,23
Deposits (yoy)	Broad Credit (yoy)	1	0,26	0,05	5,13	0,00	0,42	0,41	0,04	34,51	0,00	-3,80
CAR (%)	Broad Credit (yoy)	1	-14,13	1,62	-8,70	0,00	0,56	0,55	1,47	60,83	0,00	3,64
ROA (%)	Broad Credit (yoy)	1	2,31	0,47	4,89	0,00	0,40	0,39	0,33	32,57	0,00	0,65

14. NC_GDP25K = Bank credit-to-GDP gap (λ=25K), BC_GDP16K = Broad credit-to-GDP gap (λ=16K), NC_YOY = Bank Credit growth (yoy), BC_YOY = Broad Credit growth (yoy), NPL_YOY = NPL growth (yoy), NPL_(%) = NPL as ratio to debt, IHPR_YOY = IHPR growth (yoy), GDPR_YOY = GDP growth (yoy), IHSG_YOY = IHSG growth (yoy), DPK_YOY = deposit growth (yoy), CAR = Capital Adequacy Ratio, ROA = Return on Asset.

7. Empirical Analysis

7.1 Threshold Determination

The additional capital buffer is determined using the upper and lower thresholds of the main indicator. The BCBS gives some criteria for the upper and lower thresholds as follows:

Criteria for the minimum threshold (L) when the guide would start to indicate a need to build up capital:

1. L should be low enough so that banks are able to build up capital in a gradual fashion before a potential crisis. As the banks are given one year to raise additional capital, this means that the indicator should breach the minimum at least 2 – 3 years prior to a crisis.

2. L should be high enough so that no additional capital is required during normal times.

Criteria for the maximum (H) at which point no additional capital would be required, even if the gap would continue to increase

3. H should be low enough, so that the buffer would be at its maximum prior to major banking crises.

Drehmann, et al. (2010) use the NTSR for determining the lower and upper thresholds. However, this method cannot be used directly for the case of Indonesia. Based on the NTSR result, the lower threshold is 0.5 and the upper threshold is 3.5. Both of these thresholds are too low, since the credit gap in Q4 2003 is above 3.5. These non-proper thresholds may originate from the difference of data behaviour before and after the Asian financial crisis. The credit gap is relatively lower before 1997 crisis as compared to after 2000.

As an alternative method, this research uses a combination of econometric analysis and judgment. The upper threshold is determined using econometric analysis, where the interaction variable is used to see which threshold can explain better the financial imbalance indicator (NPL). The model is as follow[15] :

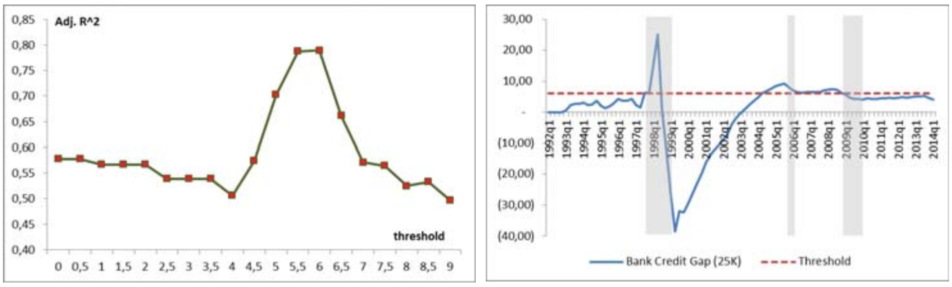
$$dummy = \begin{cases} 0, & credit\ gap\ < threshold \\ 1, & credit\ gap \geq threshold \end{cases}$$
$$x = dummy \times credit\ gap$$

$$NPL = c + b1.credit\ gap + b2.x$$

Graph 9 shows that the best threshold for the credit-to-GDP gap is when it is equal to 6, since it has highest adjusted R^2 and smallest AIC[16]. This threshold is appropriate for Indonesia at least for the last 10 years. Before the downturn periods in 2005 and 2008, the credit gap is above the upper threshold. In addition, it is suitable for the current condition, where the financial system is relatively stable.

Graph 9
Credit-to-GDP Gap Threshold

Adjusted R^2 for Different Threshold | **Applying the Threshold to Credit Gap Date**



This threshold can be considered as the upper threshold (H), since it fulfills the criteria for H. The gap is already above the upper threshold before 2005 and 2008, so that banks have time to accumulate additional buffer to its maximum size.

15. Refer to “Nonlinear Effects of Inflation on Economic Growth,” (Michael Sarel, 1996).
16. The complete results for the econometric analysis are given in Annex Table 5.

The lower threshold is determined using graphical analysis and judgment, where the candidates are chosen based on the mean of the credit gap for n years before financial crisis/ stress. Table 6 shows that the mean of the credit gap for 2 and 3 years before are around 3 and 5. Therefore, the candidates for the lower threshold are 3, 4 and 5. In addition, the mean of the credit gap for one year before financial crisis/ stress is close to the upper threshold determined before.

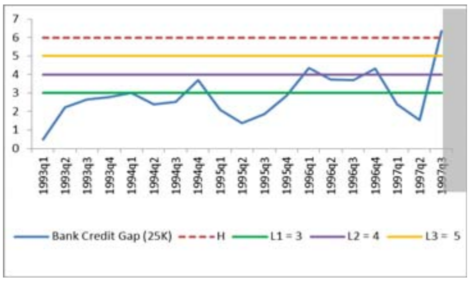
Table 6
The Mean of Credit Gap for N Years before Financial Crisis/ Stress

n years before	credit gap mean
Y-3	2,70
Y-2	4,67
Y-1	6,05

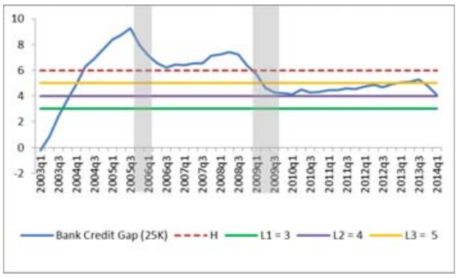
Graph 10 below shows that L = 4 and L = 5 are too high. Banks do not have enough time to gradually increase the additional buffer mainly for the crisis in 1997. Therefore, L = 3 is more appropriate, even though it is too conventional.

Graph 10
The Credit Gap and the Lower Threshold Candidates

Period 1993 – 1997



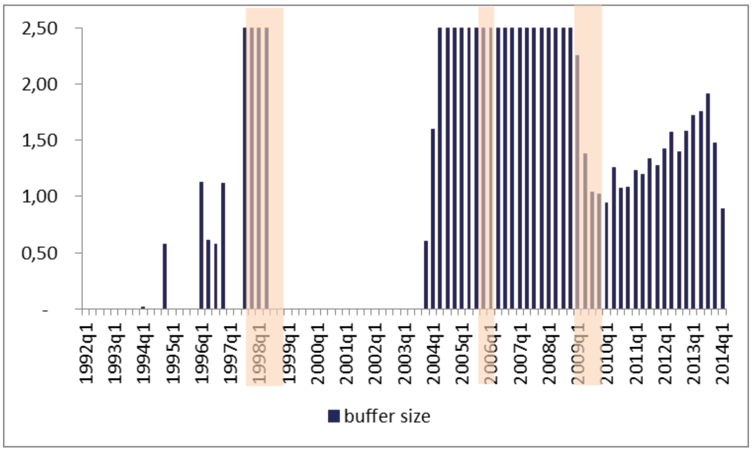
Period 2003 - 2014



7.2 Buffer Level and Progression

Using the new configuration set for the Indonesian CCCB, the additional buffer size commonly reach its maximum long before crises, except for the crisis in 1997. If the CCCB is already implemented, the additional buffer size is around 0.89% in the first quarter of 2014.

Graph 11
Additional Buffer Size



8. The Release Phase

8.1 Supplementary Indicators

The credit-to-GDP gap is commonly a good crisis leading indicator for activating the CCCB in many countries. However, it is better to have other supplementary indicators to make sure that the main indicator does not give a wrong signal. Besides that, supplementary indicators are mostly needed for releasing the CCCB. This is because the main indicator, the credit-to-GDP gap, is usually late in giving a downturn signal. When a crisis happens, the GDP falls faster than credit. Therefore, the credit-to-GDP gap tends to increase, rather than decrease.

One simple way to determine the supplementary indicator is using the cross-correlation between indicators in its lag and NPL (%) as the main financial imbalance indicator for activating or releasing the CCCB. There are three indicators that can be considered as candidates for supplementary indicators, namely IHPR, CPI and ROA. These indicators are chosen because of their high correlation with NPL.

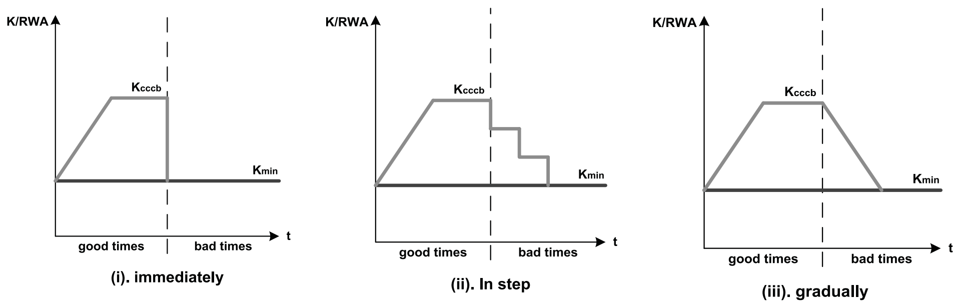
Based on the cross-correlation analysis (Annex Table 6), the IHPR can be used as a supplementary indicator for activating the CCCB since it has the highest correlation with NPL for 8 quarters before. While, the other two indicators, the CPI and ROA, can be used as supplementary indicators for releasing the CCCB since their high correlation with NPL are only a quarter before.

8.2 Buffer Release

The purposes of the buffer release mainly are for absorbing unexpected losses and maintaining credit flow. As mentioned before, releasing the CCCB requires some supplementary indicators since the main indicator sometime fails to signal the beginning of bad times. In addition, the supplementary indicators can be combined with professional judgment to strengthen the buffer releasing decision.

Commonly, there are three procedures for releasing the CCCB: immediately, in steps, and gradually (Graph 12). The procedure chosen for the buffer releasing is dependent upon the financial system condition. As a crisis occurs suddenly and worsens, the buffer may be released immediately to absorb losses and maintain credit flow. On the other hand, when the credit decline is still under control, the buffer can be released gradually.

Graph 12
Procedures for Releasing CCCB



8.3 Communication

A good communication and coordination strategy involving the related authorities are necessary for the successful implementation of the CCCB. This has to be considered for Indonesia since there are several authorities involved in the CCCB implementation. The macroprudential policy, including the CCCB, is conducted by BI, while the bank supervision is conducted by the IFSA.

BI will regularly conduct assessment to determine whether the CCCB should be activated or deactivated. If it is necessary to activate the CCCB, BI will establish the buffer size and the timeframe. In the process, BI will coordinate with the IFSA through the Financial Sector Stability Coordination Forum (FKSSK). After the CCCB is implemented, BI will communicate to the public at least once a year. The implementation of the CCCB at the individual bank level will be supervised by the IFSA.

9. Conclusion

Credit growth and capital growth have high procyclicality behaviour to the business cycle in Indonesia. Thus, it is necessary for Indonesia to implement the CCCB since it has a potential of systemic risk. According to the BCBS guidance for national authorities operating the CCCB, the additional buffer size is estimated based on the main indicator and thresholds. The main indicator is the credit-to-GDP gap, which is defined as the difference between the credit-to-GDP ratio and its long-term trend, constructed using the one-sided HP filter with smoothing parameter (λ) 400,000. The size of the additional capital buffer then is determined linearly using the upper (H) and lower (L) threshold, where L=2 and H=10.

As stated in the previous section, the standard CCCB setting from the BCBS guidance is empirically found not to be appropriate for Indonesia. The characteristic of Indonesia as an emerging country may be different compared to the advanced countries and that may account for the difference in the CCCB calibration settings. Based on the empirical results, the most appropriate main indicator for Indonesia is the bank credit-to-GDP gap and the thresholds range between 3 and 6 (L=3, H=6). Based on this set of configuration, the additional buffer size is around 0.89% in the first quarter of 2014.

However, successful implementation of the CCCB cannot rely only on the main indicator. Some supplementary indicators are needed, coupled with some professional judgement, to help indicate the right time for activating and releasing the CCCB. Based on the empirical results, the property price index (IHPR) can help to indicate the time for activating the CCCB, while the inflation index (CPI) and the return-on-asset ratio (ROA) can help to indicate the time for releasing the CCCB. In addition, a good communication and coordination strategy involving the related authorities is also necessary for Indonesia, since the decision for activating the CCCB is conducted by the central bank, but the banks are supervised by the IFSA.

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Annex Table 1
Data, Source and Availability

Data	Availability	Frequency	Unit	Source
Macro - Indicators				
GDP	1992Q1 - 2014Q1	Quarterly	IDR	CEIC
CPI	1992Q1 - 2014Q1	Quarterly	Index	BI
Banking Indicators				
Credit (Bank)	1992Q1 - 2014Q1	Quarterly	IDR	BI
Broad Credit *)	1992Q1 - 2014Q1	Quarterly	IDR	CEIC. BI
Deposit	2000Q3 - 2014Q1	Quarterly	IDR	BI
ROA	2000Q3 - 2014Q1	Quarterly	%	BI
NPL (in nominal and ratio to total credit)	2000Q3 - 2014Q1	Quarterly	IDR	BI
CAR	1995Q4 - 2014Q1	Quarterly	%	BI
Asset Prices				
Aggregate Stock Price Index (IHSG)	1992Q1 - 2014Q1	Quarterly	Index	CEIC. BI
Residential Property Price Index (IHPR)	1992Q1 - 2014Q1	Quarterly	Index	BI (Survey)
*) Broad Credit = Bank Credit + Outstanding Private Bond + Private Foreign Loan				

Annex Table 2
Descriptive Statistics for Macro Indicators and Asset Prices

Data	Macro		Asset Price	
	GDP	CPI	IHSG	IHPR
	yoy, real	*yoy*	*yoy*	*yoy*
Mean	0,05	0,11	0,19	0,05
Median	0,06	0,07	0,18	0,05
Maximum	0,12	0,83	1,15	0,14
Minimum	-0,10	-0,01	-0,50	0,02
Std. Dev.	0,04	0,14	0,34	0,03
Skewness	-2,12	3,94	0,27	1,02
Kurtosis	-2,12	16,56	0,12	0,03
Observations	85	85	85	77

Annex Table 3
Descriptive Statistics for Banking Indicators

Data	Banking Indicators								
	Bank Credit	Broad Credit	Bank Credit/GDP	Broad Credit/GDP	Deposit	ROA	NPL		CAR
	yoy	*yoy*	*ratio*	*ratio*	*yoy*	*%*	*yoy*	*% to debt*	*%*
Mean	0,20	0,22	0,35	0,63	0,14	2,46	0,04	6,44	13,71
Median	0,23	0,21	0,27	0,51	0,15	2,70	0,00	4,48	17,44
Maximum	1,16	2,72	0,96	2,37	0,22	3,46	1,21	28,97	24,79
Minimum	-0,63	-0,60	0,18	0,38	0,05	-1,43	-0,38	1,77	-57,30
Std. Dev.	0,23	0,41	0,16	0,33	0,05	0,88	0,32	5,34	12,70
Skewness	-0,66	3,76	1,38	3,08	-0,40	-2,46	1,94	2,15	-3,33
Kurtosis	7,67	20,06	1,77	11,77	-0,75	6,93	4,86	5,45	13,77
Observations	85	85	89	89	51	55	51	55	74

Annex Table 4
The Noise-to-Signal Ratio Result

Bank Credit-to-GDP Gap

λ	Threshold	Type 1 error	Type 2 error	Predicted	Noise to signal ratio
1600	0,0	26,09	50,00	73,91	67,65
	0,5	30,43	43,75	69,57	**62,89**
	1,0	39,13	34,38	60,87	56,47
	1,5	43,48	34,38	56,52	60,82
	2,0	50,00	34,38	50,00	68,75
25000	0,0	6,52	40,63	93,48	43,46
	0,5	6,52	37,50	93,48	40,12
	1,0	10,87	37,50	89,13	42,07
	1,5	13,04	37,50	86,96	43,13
	2,0	17,39	37,50	82,61	45,39
	2,5	23,91	31,25	76,09	41,07
	3,0	26,09	21,88	73,91	29,60
	3,5	26,09	18,75	73,91	**25,37**
	4,0	34,78	18,75	65,22	28,75
	4,5	43,48	3,13	56,52	5,53
	5,0	47,83	-	52,17	-
125000	0,0	10,87	40,63	89,13	45,58
	0,5	13,04	37,50	86,96	43,13
	1,0	15,22	37,50	84,78	44,23
	1,5	17,39	37,50	82,61	45,39
	2,0	23,91	37,50	76,09	49,29
	2,5	28,26	31,25	71,74	43,56
	3,0	30,43	21,88	69,57	31,45
	3,5	32,61	18,75	67,39	**27,82**
	4,0	39,13	18,75	60,87	30,80
	4,5	45,65	18,75	54,35	34,50
	5,0	45,65	18,75	54,35	34,50
400000	0,0	13,04	40,63	86,96	46,72
	0,5	13,04	37,50	86,96	43,13
	1,0	17,39	37,50	82,61	45,39
	1,5	19,57	37,50	80,43	46,62
	2,0	23,91	37,50	76,09	49,29
	2,5	28,26	31,25	71,74	43,56
	3,0	32,61	21,88	67,39	**32,46**
	3,5	34,78	18,75	65,22	28,75
	4,0	41,30	18,75	58,70	31,94
	4,5	47,83	18,75	52,17	35,94

Broad Credit-to-GDP Gap

λ	Threshold	Type 1 error	Type 2 error	Predicted	Noise to signal ratio
1600	0,0	6,52	50,00	93,48	53,49
	0,5	13,04	40,63	86,96	46,72
	1,0	15,22	25,00	84,78	29,49
	1,5	15,22	21,88	84,78	25,80
	2,0	19,57	21,88	80,43	27,20
	2,5	26,09	15,63	73,91	**21,14**
	3,0	45,65	9,38	54,35	17,25
	3,5	54,35	3,13	45,65	6,85
	4,0	56,52	-	43,48	-
25000	0,0	26,09	46,88	73,91	63,42
	0,5	32,61	40,63	67,39	**60,28**
	1,0	41,30	37,50	58,70	63,89
	1,5	41,30	37,50	58,70	63,89
	2,0	43,48	37,50	56,52	66,35
125000	0,0	47,83	46,88	52,17	89,84
	0,5	50,00	40,63	50,00	81,25
	1,0	56,52	37,50	43,48	86,25
400000	0,0	54,35	46,88	45,65	102,68
	0,5	58,70	40,63	41,30	98,36
	1,0	65,22	37,50	34,78	107,81

Annex Table 5
The Sarel's Regression Result

Dependent Variable: NPL (%)

Threshold	Coef. b2	std. error b2	T-stat b2	Sig. of b2	R-sqr	adj. R-sqr	SE Reg	Fstat	Prob	AIC
0	1.05	0.51	2.07	0.04	0.59	0.58	2.08	35.25	0.00	4.36
0.5	1.05	0.51	2.07	0.04	0.59	0.58	2.08	35.25	0.00	4.36
1	0.97	0.50	1.92	0.06	0.58	0.57	2.10	33.76	0.00	4.38
1.5	0.97	0.50	1.92	0.06	0.58	0.57	2.10	33.76	0.00	4.38
2	0.97	0.50	1.92	0.06	0.58	0.57	2.10	33.76	0.00	4.38
2.5	0.78	0.48	1.62	0.11	0.56	0.54	2.17	30.26	0.00	4.45
3	0.78	0.48	1.62	0.11	0.56	0.54	2.17	30.26	0.00	4.45
3.5	0.78	0.48	1.62	0.11	0.56	0.54	2.17	30.26	0.00	4.45
4	0.56	0.43	1.30	0.20	0.53	0.51	2.25	26.67	0.00	4.51
4.5	0.50	0.15	3.24	0.00	0.59	0.57	2.09	34.70	0.00	4.37
5	0.56	0.12	4.51	0.00	0.71	0.70	1.75	60.01	0.00	4.01
5.5	0.63	0.12	5.19	0.00	0.80	0.79	1.47	93.71	0.00	3.67
6	0.62	0.12	5.10	0.00	0.80	0.79	1.47	94.80	0.00	3.66
6.5	0.49	0.14	3.42	0.00	0.68	0.66	1.86	49.87	0.00	4.14

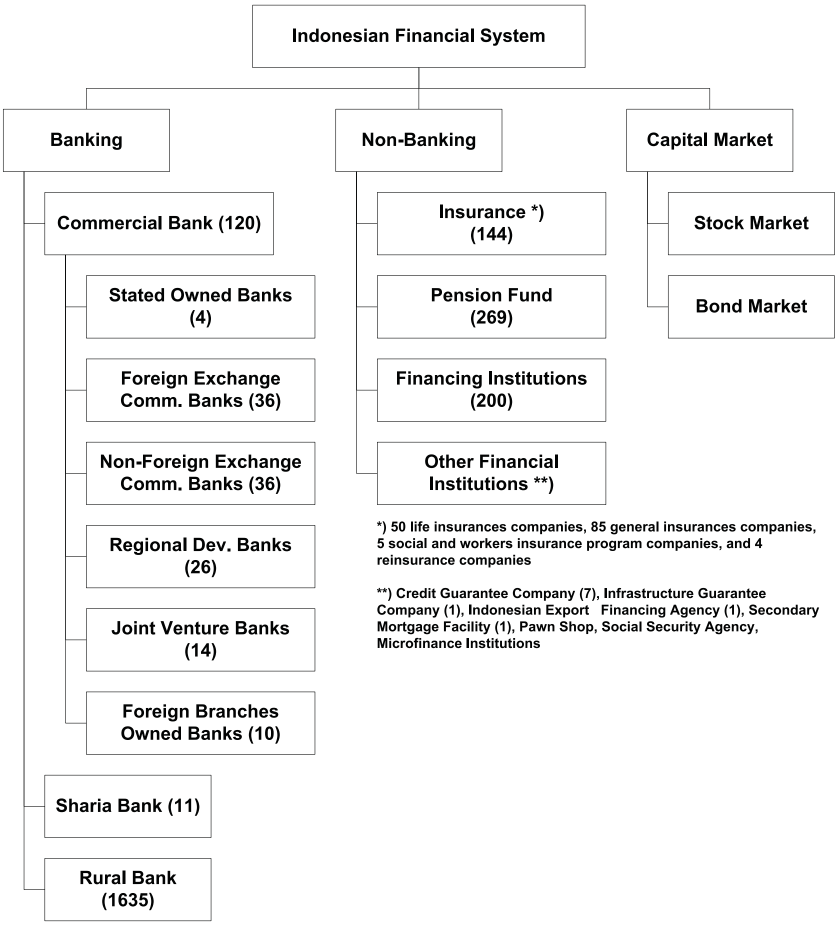
$$NPL = c + b1.credit\ gap + b2.x$$
$$x = dummy \times credit\ gap$$
$$dummy = \begin{cases} 0, & credit\ gap < threshold \\ 1, & credit\ gap \geq threshold \end{cases}$$

Annex Table 6
The Cross-correlation Analysis Result
between Supplementary Variables and NPL (%)

Lag	IHPR	CPI	ROA
1	-0,192112	0,552298	-0,469166
	(-1,253464)	(4,242126)	(-3,401761)
2	-0,10925	0,539345	-0,353659
	(-0,703751)	(4,101124)	(-2,420977)
3	-0,00102	0,514638	-0,30994
	(-0,00653)	(3,843317)	(-2,087375)
4	0,135876	0,459601	-0,282212
	(0,878174)	(3,313587)	(-1,883599)
5	0,329119	0,389535	-0,246078
	(2,231722)	(2,708155)	(-1,625655)
6	0,430384	0,308556	-0,258284
	(3,053026)	(2,077068)	(-1,711911)
7	0,469605	0,21917	-0,324656
	(3,405843)	(1,438344)	(-2,197865)
8	0,51521	0,163294	-0,370121
	(3,849136)	(1,059816)	(-2,5511)

* The value in the parentheses presents the t-statistics

Annex Graph 1
Scheme of Indonesian Financial System

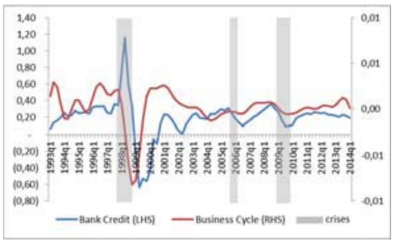


*) 50 life insurances companies, 85 general insurances companies, 5 social and workers insurance program companies, and 4 reinsurance companies

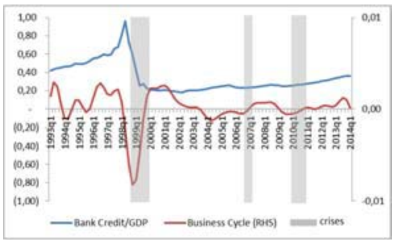
**) Credit Guarantee Company (7), Infrastructure Guarantee Company (1), Indonesian Export Financing Agency (1), Secondary Mortgage Facility (1), Pawn Shop, Social Security Agency, Microfinance Institutions

Annex Graph 2
The Business Cycle and Various Indicators

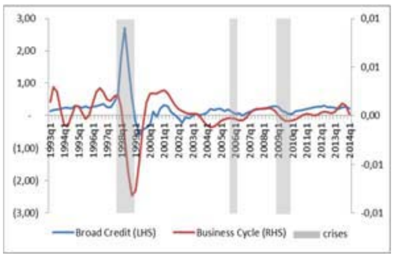
Bank Credit



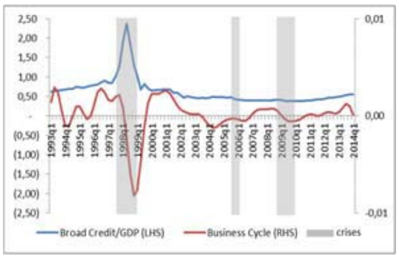
Bank Credit/GDP



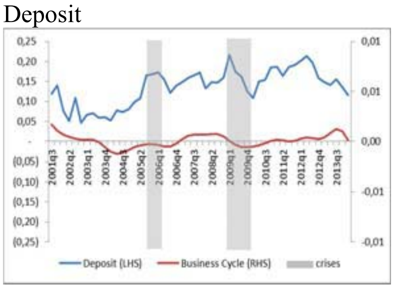
Broad Credit



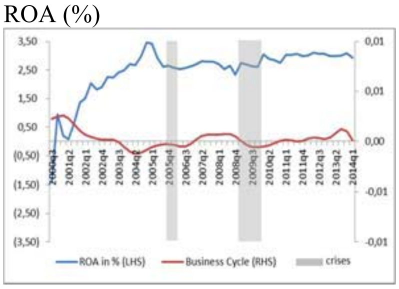
Broad Credit/GDP



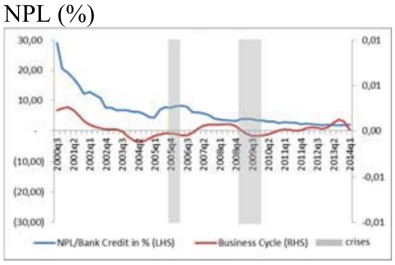
Deposit



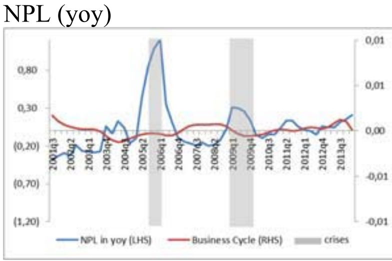
ROA (%)



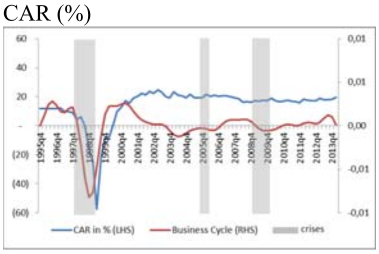
NPL (%)



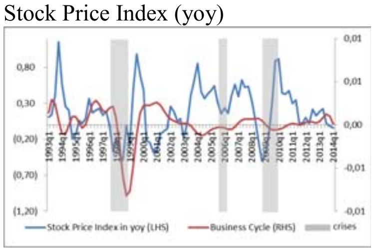
NPL (yoy)



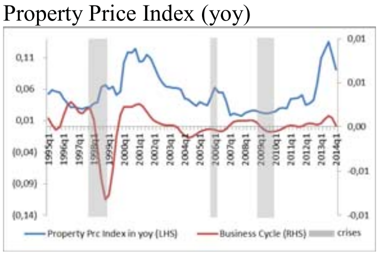
CAR (%)



Stock Price Index (yoy)



Property Price Index (yoy)



Chapter 4

BUILDING ON THE COUNTERCYCLICAL CAPITAL BUFFER CONSENSUS: ASIAN EMPIRICAL TEST

By
Chuah Lay Lian [1,2]

1. Introduction

Basel III introduced a countercyclical capital buffer (CCCB) in 2010 to the banking sector regulatory framework and it is aimed at strengthening the banks' defences against the build-up of systemic risks. Specifically, the countercyclical capital buffer is meant to protect the banks from periods of excessive credit growth, which have often been associated with systemic risks. It works as such that a buffer of regulatory capital will be built up during a credit up cycle period and will be released thereby easing the constraints on the flow of credit in the economy during a credit down cycle. In doing so, the CCCB reduces the procyclicality of credit that can amplify the credit cycle though periods of boom and bust and in turn, reduces the build-up of financial vulnerabilities.

While periods of rapid credit expansions tend to be associated with a build-up in financial and macroeconomics instability, credit can grow rapidly for three reasons: (i) financial deepening, which is seen to support economic growth; (ii) driven by factors of demand and supply of the credit market and; (iii) excessive cyclical fluctuations such as credit booms. Therefore, the question arising from these reasons is that, is rapid credit growth necessarily a strong signal for growing financial imbalances that will typically lead to a financial crisis. Although, evidence from Elekdag and Wu (2011) show that Asian credit booms have been characterised by a higher incidences of crisis, the link between rapid credit expansion and crisis need to be further examined before deciding the threshold

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for too much or too little credit. As Edge and Meisenzahl (2011) and Buncic and Melecky (2013) point out the credit-to GDP gap, the measure recommended by Basel III may not necessarily reflect the equilibrium level of credit for an economy.

The aim of this paper is to examine the reliability of the credit-to-GDP gap in signalling financial imbalances for Malaysia. The motivation of this analysis is to determine the suitability of Basel III's recommendation in using the Hodrick-Prescott (HP) filter to derive the credit-to-GDP gap which is then used as a benchmark to determine excessive credit levels in the economy. The HP method may not be ideal as it is sensitive to the choice of the smoothening parameter (ë), susceptible to end point bias and lacks economic fundamentals. Given the weakness in this approach and in using the credit-to-GDP as an indicator for financial distress, the Basel Committee allows regulators to exercise discretion and specify different methods for setting the benchmark and appropriate thresholds for countercyclical capital buffers (CCCB). Therefore, this paper will also assess the feasibility of using other key macroprudential indicators as anchors for the CCCB.

The structure of the paper is as follows. Section 2 provides the backdrop for the paper by examining the rationale behind Basel III's recommendation with regards to CCCB and the risks associated with excessive credit expansion. This section also discusses the phase-in schedule of Basel III for Malaysia, and the credit trends as well as the financial soundness of the banking system of the country vis-a-vis other regional countries. Section 3 examines the literature on the risks of excessive credit expansion and the role of credit-to-GDP as a forward-looking indicator for financial imbalances. Section 4 takes a closer look at using the HP method to decompose the credit-to-GDP series into trend and cycle; and examine the usefulness of the credit-to GDP gap in identifying periods of a build-up in financial imbalances. This section will also examine other possible macro indicators that meet the information requirement for CCCB setting decisions and the two methodologies in identifying appropriate thresholds for buffer decisions, namely (i) Sarel's (1996) approach and; (ii) the noise-to-signal ratio approach. Section 5 discusses the empirical results of the two main approaches in the identification of suitable thresholds. Finally, Section 6 includes policy recommendations and conclusions.

2. Comparative Evidence

2.1 The Rationale behind Basel III

The main cause of the Global Financial Crisis (GFC) in 2007-2009 can be traced back to the build-up of excessive optimism, resulting from a period of world-wide high economic growth, low real interest rates and subdued volatility of financial prices as well as the flood of liquidity (Morgan and Pontines, 2013). The International Monetary Policy highlighted that macroeconomic policies did not take into account the build-up in systemic risks as they failed to detect the threat of a growing asset price bubble. In this context, the US Federal Reserve underestimated the build-up of financial imbalances that emerged from housing price bubbles, the proliferation of unsound credit practices, in particular subprime loans to borrowers and the highly leveraged financial institutions which was further aggravated by the interconnections of financial markets[3].

As a result of the GFC, certain shortcomings of the Basel II regulatory framework were identified. Most banks that failed, or nearly failed were typically "well-capitalised" at that time. However, the systemic contagion highlighted the need for global capital standards to be harmonised. Also, the events which led to losses in the banking sector evoked debates on role of excessive credit in destabilising the banking sector and exacerbating the downturn in the real economy[4]. The debates are premised on observations that a financial crisis is usually preceded by periods of excess credit growth. The vicious cycle of excessive credit growth is further reinforced when the financial crisis spills over to the real economic, causes a recession which later feedbacks into the banking sector. The interconnectedness of financial markets and institutions across countries and the global macroeconomic financial links increases the systemic risk and therefore, underscores the importance of the banking sector in building up its capital defences during periods when credit has grown to excessive levels. As capital is more expensive than other forms of funding, the building up of these defences is expected have the additional benefit of helping to dampen pro-cyclical credit growth (Figure 2.1).

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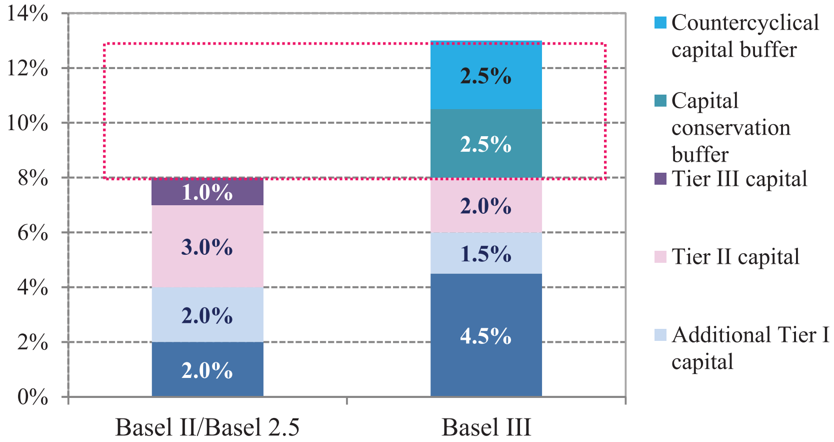
3. The Fed was inclined not to lean against emerging asset bubbles, as it believed that such bubbles were difficult to identify, and that it could move swiftly to clean up the damage afterward (Morgan and Pontines, 2013).
4. BCBS (2010), Elekdag and Wu (2011) and Reinhart and Rogoff (2009).

Figure 2.1
Basel III Capital Requirements



The Malaysian banks have managed to withstand the negative effects of the GFC, helped partly by their substantial capital and liquidity buffers and a lack of exposure to the subprime crisis and affected counterparties. However, being a small and open economy, Malaysia was not completely immune to the global economic downturn as real GDP growth declined by 5.8% in the 1Q 2009 (2009: 1.5%). To mitigate the negative impact of the GFC, Bank Negara Malaysia (BNM) undertook several pre-emptive and timely measures. BNM eased monetary policy and put in place measures to ensure that small- and medium-scale enterprises continued to have access to financing. These measures complemented the fiscal stimulus measures that helped to contain the increasing risk aversion of banks and consequently helped the economy to quickly move out of a recession in the 4Q 2009.

2.2 Implementation of Basel III

2.2.1 Financial Soundness of Malaysian Banking Institutions

The banking institutions in Malaysia will be able to transition into Basel III from a position of strength as a result of the reform initiatives undertaken by BNM and the banking sector since the Asian Financial Crisis (AFC). The reform initiatives which are outlined in the 10-year Financial Sector Master Plan (FSMP) are expected to develop the financial sector through institutional capacity building and regulatory reforms that can increase the resilience of the banks (Table 2.1).

Table 2.1
Banking Sector Progress from FSMP

1997: Pre-Asian Financial Crisis (AFC)	2010: Progress from Financial Sector Masterplan
• Fragmented banking system	• Consolidation and rationalisation of the banking industry, from 77 domestic banks (pre-AFC)) to 8 domestic banking groups
• Under developed bond market • Heavy reliance by corporations on the banking system for financing	• Diversified financial sector with an active debt securities market, comprising both conventional and Islamic.
• More rigid and prescriptive rules-based regulation and supervision	• Strengthened corporate governance and risk management practices • Robust surveillance, regulatory & supervisory framework.
• Limited prominence of Islamic finance	• Malaysia as an international Islamic financial hub • Significant development of Islamic banking and takaful, Islamic equity, Islamic fund management and sukuk market.
• Rigid price mechanism	• Greater market orientation
• Gaps in access to financing	• Comprehensive consumer protection framework • Enhanced access to financing especially for SMEs and micro enterprises.

Source: Bank Negara Malaysia.

The consolidation and rationalisation exercise in the aftermath of the AFC made the Malaysian financial system less fragmented. The consolidation exercise which reduced the number of domestic commercial banks from 22 in 1986 to 8 banking groups presently, has, increased the capacity of banks to compete and withstand economic shocks. The banks in Malaysia remained stable during the 2008 GFC due to healthy capital and liquidity levels. As such, domestic banking groups are expected to be able to meet Basel III capital requirements, barring any unforeseen tail-risk scenarios. Although the full implementation of Basel III only starts in 2019 (Table 2.2), maintaining high equity capital buffers should enhance stability and enables hybrid capital to be retired when they reach maturity or call dates (IMF, 2014).

Table 2.2
Malaysia's Timeline to Phase-In Basel III

	2012	2013	2014	2015	2016	2017	2018	2019
	Observation period reporting						Standard in force	
Min. common equity (A)		3.50%	4.00%	4.50%	4.50%	4.50%	4.50%	4.50%
Capital conservation buffer (B)					0.625%	1.25%	1.88%	2.50%
(A)+(B)		3.50%	4.00%	4.50%	5.13%	5.75%	6.38%	7.00%
Min. Tier I capital		4.50%	5.50%	6.00%	6.00%	6.00%	6.00%	6.00%
Min. Tier I capital+conservation buffer		4.50%	5.50%	6.00%	6.63%	7.25%	7.88%	8.50%
Min. total capital		8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Min. total capital+conservation buffer		8.00%	8.00%	8.00%	8.63%	9.25%	9.88%	10.50%
Capital instruments no longer qualify as non-core Tier I and Tier II capital		Phased out over a 10 year horizon beginning 2013						
Liquidity coverage ratio	Observation period reporting		Standard in force					
Net stable funding ratio	Observation period reporting						Standard in force	

Note: All dates are as at 1 January unless otherwise indicated. Shaded area indicates transition periods.

Source: Bank Negara Malaysia.

According to BNM, the Basel III Capital Framework has already been implemented since 2013 and the Bank is in the process of assessing the industry's feedback on the proposed Liquidity Coverage Ratio Framework, which will be implemented starting mid-2015. Malaysian banks are presently well capitalised with comfortable Tier 1 risk weighted capital ratios, on par with other regional economies such as Singapore and Hong Kong (Figure 2.2).

Figure 2.2
Tier 1 Capital/Risk Weighted Assets (%)

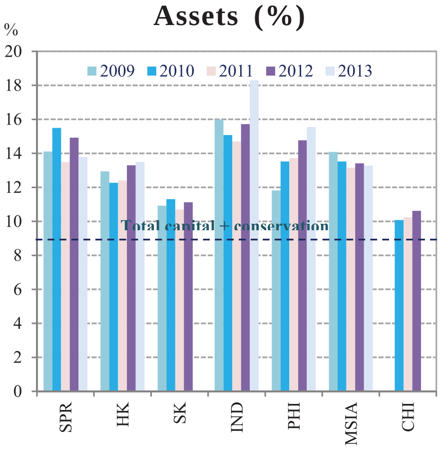
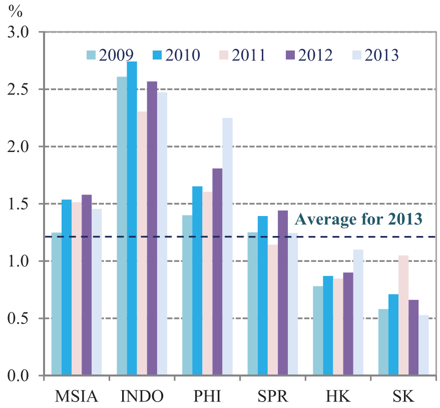


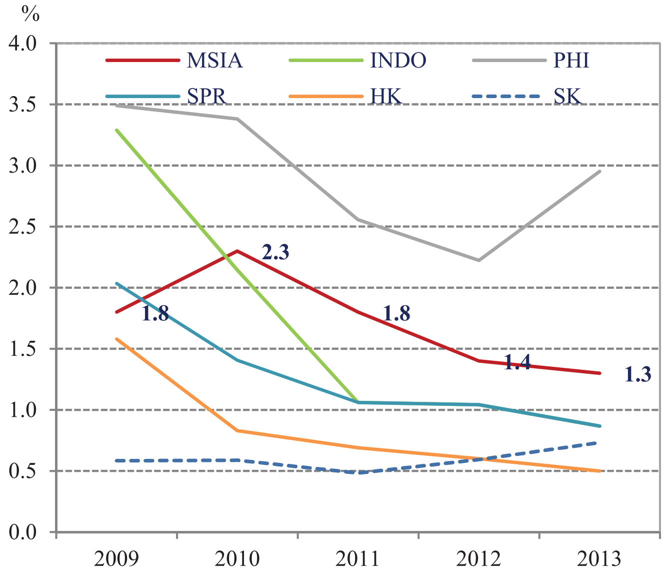
Figure 2.3
Return on Assets (%)



In addition to the Tier 1 capital financial soundness indicator, the banks in Malaysia are also showing reasonable profits, with return on assets (ROA) comparable to the banks in Singapore and Hong Kong (Figure 2.3). The asset quality of Malaysian banks has been improving in recent years. The non-performing loans (NPLs) to total gross loans have been on a declining trend since 2009 and are at a relatively low level of 1.3% in 2Q 2014 compared to 3.2% as at end-2007. However, the ratio is still slightly above the ratios recorded by Singapore (SPR), Hong Kong (HK) and South Korea (SK) (Figure 2.4).

In the case of Malaysia, strong credit growth rates (an average of 11.1% between 1Q 2009- 1Q 2014) is accompanied by the long-term improvement in asset quality, evidenced by the declining trend in the amounts of impaired loans. Banks' provisions cover nearly 100% of all impaired loans. Banks' holdings of government and corporate securities comprised about 16% of total assets in August 2013, of which federal government securities are 4.5%. However, accounting for government-guaranteed securities increases the potential exposure. Nevertheless, with many of these securities held to maturity, there was no significant impact on banks' capital from higher MGS yields in 2013.

Figure 2.4
Non-Performing Loans/Gross Loans (%)



Source: IMF and Bank Negara Malaysia.

2.2.2 Stylised Facts on Loans Growth

Excessive loans growth is a risk to macroeconomic stability, given that excessive lending can over-stimulate aggregate demand beyond the potential output of an economy. This causes the economy to overheat, which in turn increases prices pressures. The build-up of excessive loans growth often leads to a credit bubble which may burst and have negative implications on macroeconomic developments and cause banking sector difficulties. The risk of excessive loans growth is highlighted in literature, particularly, in studies which uses information on excessive loans growth as a predictor of potential banking sector crises (Borio and Lowe, 2002; Borio and Drehmann, 2009; Jimenez and Saurina, 2006; Saurina et al., 2008).

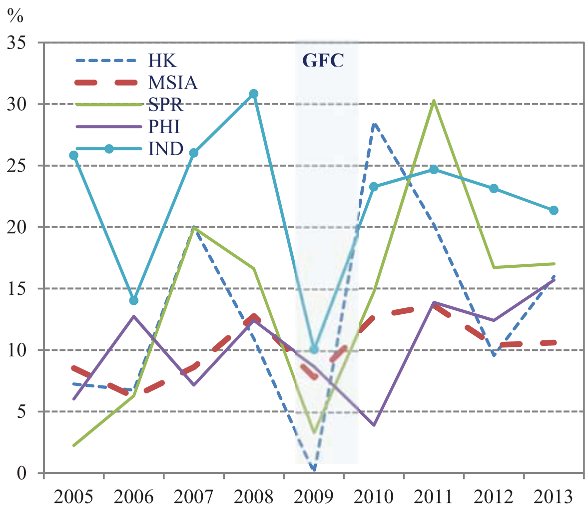
Comparatively, loans growth for Malaysia in 2013 (10.6%) was the lowest amongst the regional economies - Hong Kong (16%), Singapore (17%) and the Philippines (15.7%) (Figure 2.4). The loans growth rates after the GFC (2011-2013) increased for most economies, except for Korea. For example, Malaysia's CAGR increased by 4.1 ppt, but was broadly in line with the other regional economies. The increase in loans growth during the post-GFC period reflects the recovery of the domestic economies of these economies.

Table 2.3
CAGR of Loans Pre- and Post GFC

	MY	SP	TH	PHI	KR	HK	IND
2000-2007	6.4	6.1	9.6	5.4	14.5	4.1	20.7
2011-2013	10.5	16.9	13.3	14.0	4.2	6.8	22.2

Source: Haver Analytics.

Figure 2.4
Loans Growth for the Regional Economies

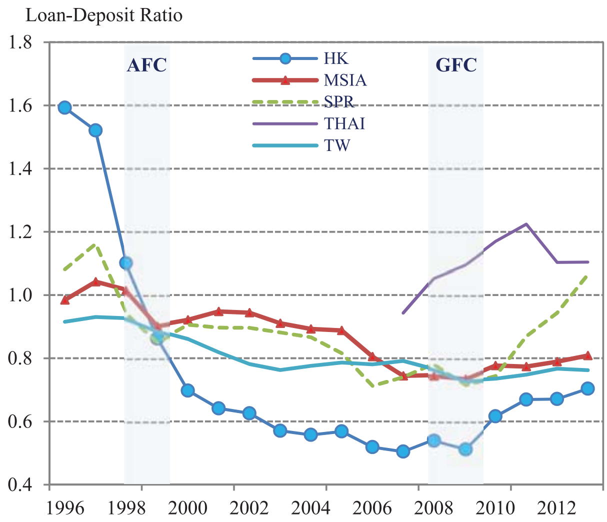


Source: Haver Analytics.

Despite registering double digit growth by selected economies pre-GFC, the loans-to-deposit ratio exceeded the 1.0 ratio only in periods pre-AFC (Figure

2.5). The loans-to-deposit ratios were below 1.0 for all the regional countries for periods pre-GFC. Post GFC, the ratios have increased modestly for most regional economies, except for Thailand and Singapore. As such, most regional economies still have ratios below the 1.0 threshold, except for Thailand and Singapore whose ratios were at 1.06 and 1.1 respectively in 2013. Therefore, loans growth in the periods leading up to the GFC did not appear to be excessive and portend excessive risks to these economies' domestic banking sector.

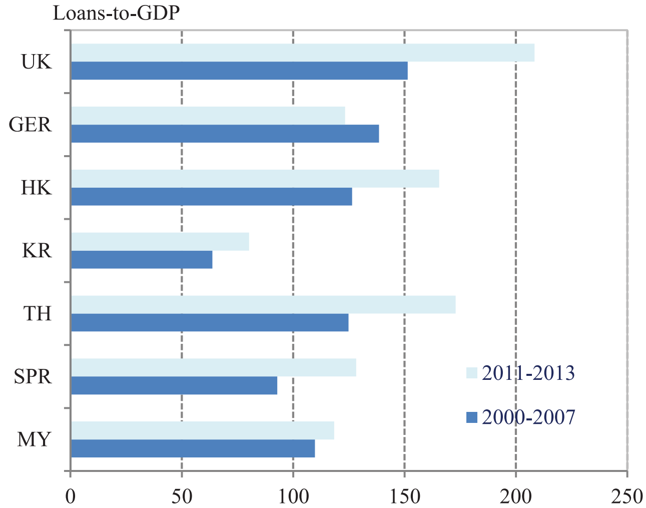
Figure 2.5
Loans-to-Deposit Ratio for Regional Economies



Source: Haver Analytics.

Measuring the average stock of loans of the regional economies against their GDP pre-GFC shows that Asian economies have lower ratios than the European countries, the UK and Germany (Figure 2.6). However, as loans growth increased more rapidly than the recovery of the domestic economies post-GFC, the ratios for Thailand, Singapore and Hong Kong are comparable to the ratio registered by Germany. While the ratios for all regional economies increased post-GFC, Germany registered a decline. Therefore, the question arising from the two different measurements of loans namely, one which benchmarks against income (GDP) and the other against deposits is, which of the indicators provide a better signal for excessive loans growth and growing risks to the banking sector.

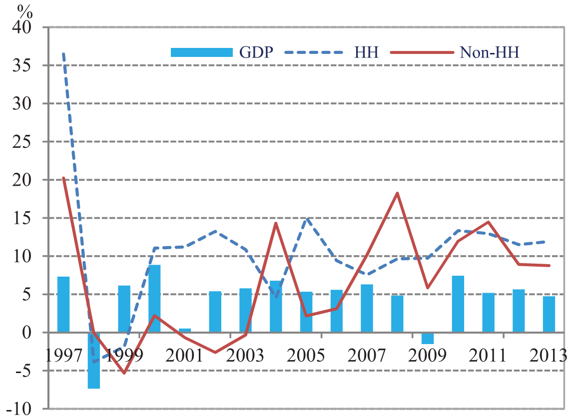
Figure 2.6
Loans-to-GDP Ratios Pre- and Post GFC



Source: Haver Analytics.

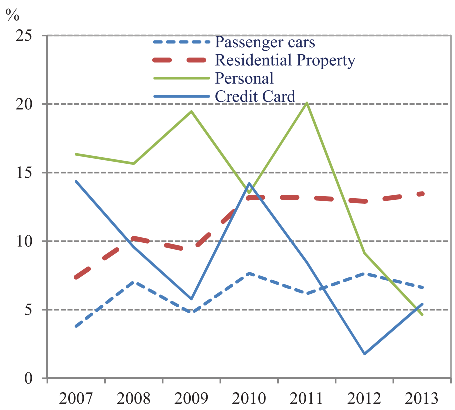
In the case of Malaysia, there has been a significant growth in lending to the household sector, which is driven by sustained economic growth (Figure 2.7). Personal loans and credit card lending have been growing, together with housing loans (Figure 2.8). Lending to households accounted for 57.9% of total bank lending and household debt has risen to 87.4% of GDP in 2013, from 55.7% of GDP in 2006. About half of the debt is on residential property (Figure 2.9), of which nearly 70% is contracted at variable rates tied to the Base Lending Rate (BLR).

Figure 2.7
Households, Non-Households Loans Growth (%) and GDP Growth (%)



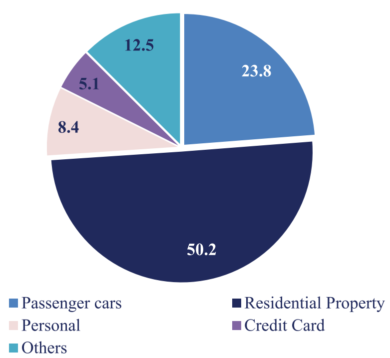
Source: Bank Negara Malaysia.

Figure 2.8
Household Loans Growth (%), by Purpose



Source: Bank Negara Malaysia.

Figure 2.9
Breakdown of Household Loans, by Purpose for 2013



While the high household debt may not be an immediate concern, potential risks may emerge if a global economic downturn adversely affects the labour market and in turn exert pressures on households' balance sheets. This could weaken household's ability to service their loans and in turn deteriorate the asset quality of financial institutions[5]. Over the past 10 years, the ratio of household debt-to-GDP has been on an increasing trend. Household debt-to-GDP in 2013 appears to be at similar levels to that of advanced countries with higher per capita income (Figure 2.10). However, the rising trend in household debt coincided with a growing economy, stable employment conditions and rising income levels. According to Bank Negara Malaysia[6], household financial buffers are at comfortable levels as the growth in household debt has generally been accompanied by a corresponding expansion in households' financial assets. Households' financial assets as at 2013 was about 2.2 times of their debts and about 60% of these debts were backed by deposits.

The non-performing loans (NPLs) to households accounted for 39.2% of total NPLs in 2013 and the rest was from lending to the business sector. Within the household sector, borrowings is concentrated in the residential properties (23%) followed by passenger cars (8%) (Figure 2.11). As about half of the household debts are tied to the housing market, the potential risks of the speculative purchases of residential properties was pre-empted by a series of macroprudential policies. Beginning November 2010 and in the 2014 budget, the authorities have imposed a series of targeted and gradual macroprudential policies directed at speculative purchases of homes and unsecured credit (Table 2.3). There appears to be some signs that the more recent measures have slowed down the approval of new loans and begun to cool the housing market (Figure 2.12). If credit growth remains strong, additional macroprudential policies may be needed, and the scope and stringency would depend on the evolving stance of monetary policy.

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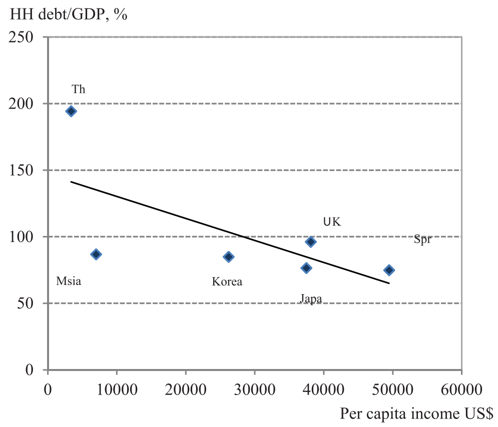
5. Evidence from the studies by the IMF show that economic downturns tend to be more severe when they are preceded by significant build-ups in household debts.

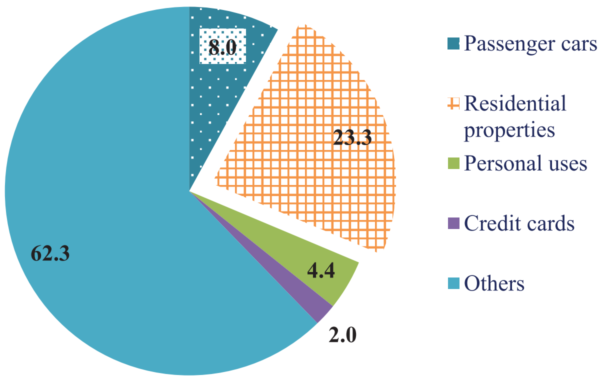
6. Bank Negara indicated that further efforts have been made to enhance data collection on households. This will enable the Bank to conduct a more granular and robust assessment on households' debt position by income category.

Figure 2.10
Household Debt/ GDP and Per capita Income (2013)



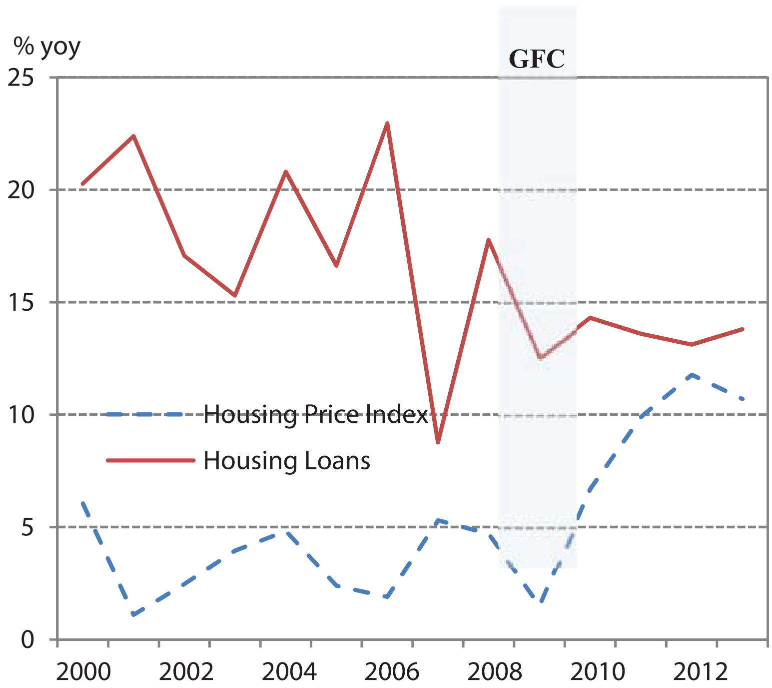
Source: Haver Analytics.

Figure 2.11
Non-Performing Loans (NPLs) by Purpose, 2013



Source: Bank Negara Malaysia.

Figure 2.12
Housing Price Index and Housing Loans (%)



Source: Bank Negara Malaysia.

Table 2.3
Malaysia: Macroprudential Measures Since 2010

	Macroprudential Measures
Jan-10	Reintroduced 5% Real Property Gains Tax (RPGT) for properties sold in less than 5 years
Nov-10	Imposed caps of 70% on third and subsequent mortgages
Jan-11	Imposed a 5% RPGT on properties sold between 3-5 years and increased the RPGT rate to 10% on properties sold less than 2 years
Mar-11	The minimum income eligibility for new credit card holders was set at RM24,000 per annum.
	Cardholders earning less than RM36,000 per annum were limited to 2 credit card issues and the max credit per issuer capped at 2 times monthly income.
Nov-11	Issued guidelines on responsible financing and the computation of debt service ratios (DSR) based on a borrower's net income. Capital risk-weights were raised to 100% of mortgages with LTVs exceeding 90% and were also raised for personal loans with tenure more than 5 years.
Dec-11	Introduced an LTV cap of 60% on housing loans for corporates
	The minimum house price for foreigners was increased from RM500,000 (from RM250,000)
Jan-13	Increased the RPGT rate to 15% on properties sold before 2 years and to 10% on properties sold between 3-5 years
Jul-13	Imposed a minimum mortgage term of 35 years and a maximum tenure of 10 years on financing extended for personal use. Prohibited the offering of pre-approved personal financing products.
Oct-13	Distinguished between RPGT for Malaysians, foreigners and corporates. For foreigners, the RPGT is 30% for properties sold between 5 years and 5% after 5 years; For Malaysians, the RPGT is 30% for properties sold up to 3 years; 20% between 3-4 years; 15% between 4-5 years; 0% for individuals after 5 years and 5% for corporations.
	Increased minimum house price for foreigners to RM 1 mil. Banned Developers Interest Bearing Scheme (DIBS).

Source: IMF (2014).

3. Literature Review

3.1 The Countercyclical Capital Buffer (CCCB)

The objective of Basel III is to enhance the resilience of financial institutions. It does that through several mechanisms, namely:

(i) It creates global standards for liquidity;

(ii) It introduces a leverage ratio as a complement to the risk based Basel II framework;

(iii) It raises the quantity, quality, consistency and transparency of Tier I capital base;

(iv) It introduces capital conservation buffer of 2.5% of risk-weighted assets, which is above the minimum capital requirement; and

(v) It introduces countercyclical capital buffer, ranging from 0-2.5% of risk-weighted assets.

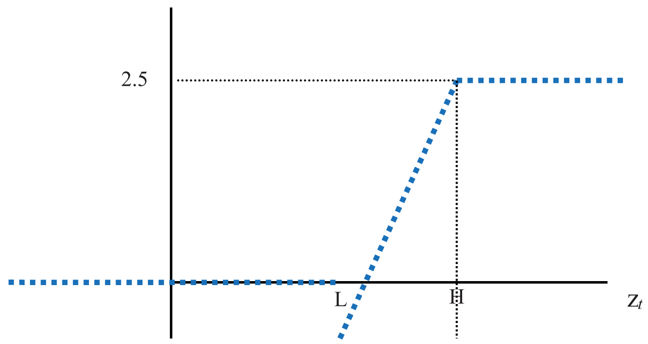
The countercyclical capital buffer (CCCB) extends the newly introduced capital conservation buffer by up to 2.5% of risk-weighted assets during periods of excess credit growth associated with an increase in system wide risk. The CCCB and the conservation buffer share the same objective which is, to build up adequate buffers above the minimum so that it can be drawn down during periods of stress. For the CCCB, Basel III requires the authorities to monitor credit growth and other indicators that may signal a build-up in systematic wide risk. The idea behind CCCB is that it wants to ensure that the banks have adequate capital to maintain the flow of credit in the economy during the correction period of financial imbalances caused by excessive credit growth.

The CCCB helps to offset the frequency and the extent of credit booms by requiring banks to build-up capital buffers during periods of excessive credit growth. The opposite action is required from the banks during periods of credit bust, consequently easing the constraints on the flow of credit in the economy during periods of economic difficulties. The countercyclical action of capital buffer decisions moderates the inherent pro-cyclicality of the financial system and, hence, reduces the likelihood of a bust by arresting the build-up of a system-wide risk.

The Basel III framework allows the authorities to use their discretion on when to activate the CCCB and the size of the buffer during the period of excessive credit and increasing system-wide risk. Decisions on the buffer add-on would be announced a year in advance to give banks time to react but reductions in the buffer could take place immediately. The consequences of a bank's capital falling below the level set by the countercyclical capital buffer will be similar to the conservation buffer, where the constraints on distributive earnings for the banks will become binding.

The Basel III framework proposes a methodology to calculate an internationally consistent buffer guide that serves as a common reference point for making buffer decisions. The framework suggests the use of the credit-to-GDP gap as an indicator to guide the authorities on whether to increase or decrease the buffer and, also as a tool to communicate the buffer decisions. In this approach, a zero add-on buffer is expected when the credit-to-GDP is near or below its long-term trend and a positive add-on buffer when the credit-to-GDP exceeds its long-term trend by an amount which, based on past experiences, is deemed to be excessive. The benchmark CCCB (b_t) will be set to zero when the credit-to-GDP gap (z_t) is below the lower threshold of L and will be set to the maximum of 2.5 when z_t is above the upper threshold H (Figure 2.13). Between L and H, the buffer increases linearly with the size of gap.

Figure 2.13
Relationship between CCCB and credit-to-GDP Gap



Source: Repullo and Saurina (2011).

3.2 Basel III: The Role of Credit as an Indicator for Financial Imbalances

Episodes of severe financial sector stress are typically preceded by extended periods of unusually low perceived risk, marked by booming financial sector activity and strong asset price growth (Reinhart and Rogoff, 2009). During periods of financial stress, the losses in the banking sector can be large. The losses are aggravated by the interaction between the real and financial sectors of the economy as the interaction tends to amplify the business cycle. This can further destabilise the financial sector.

Kindleberger (2000) and Minsky (1982) also concur with Reinhart and Rogoff's (2009) findings that financial crises result from a mutually reinforcing processes between the financial and real side of the economy. In their view, financial imbalances are not driven by, but spurred by an unsustainable economic expansion, which manifests itself in excessive growth in credit and asset prices.

When the economy expands, cash flows, incomes, asset prices and risk appetite increase in tandem with weakened funding constraints. This, further facilitates risk-taking activities. During this period, the financial system which has not build up sufficient capital and liquidity buffers to safeguard against the emerging risks, may eventually cause a downturn in the economy. Therefore, the unwinding of the financial imbalances can potentially lead to a crisis, characterised by losses and credit crunch in the financial sector. The close link between the real and financial sector provides justification for safeguarding the banks from financial pro-cyclicality and for banks to build-up capital in periods when there is excessive credit growth.

While studies (Reinhart and Rogoff, 2009; Kindleberger, 2000 and Minsky, 1982) show that credit is an important indicator for financial imbalances, others (Repullo and Saurina, 2011; Edger and Meisenzahl, 2011) argue that the credit-to-GDP is an unsuitable guide for the buffer because it does not meet the buffer's objectives. In particular, the credit-to-GDP gap guide may trigger pro-cyclical changes in the buffer. Repullo and Saurina (2011) show that the correlation between the credit-to-GDP gap and GDP growth is generally negative, which means that the credit-to-GDP gap tends to signal a reduction of capital requirements when the GDP growth is high and an increase of capital requirements when the GDP is low. Consequently, the credit-to-GDP gap guide exacerbates the fluctuations in GDP. However, their analysis and findings focuses on advanced countries such as France, Germany, Italy, Japan, Spain and the United States[7].

In addition to the pro-cyclicality argument, Edger and Meisenzahl (2011) argue that the credit-to-GDP gap measure is unreliable in real time since it is subjected to significant data revision. As such, it provides a poor foundation for policymaking as there is a tendency for the measure of the gap to give a false signal. For example, signalling excessive credit conditions which later may not appear to be so, when a longer time series of data is used. The false signal can result in an increase in CCCB which in turn results in capital shortfalls in the banking sector. Edger and Meisenzahl (2011) investigate and find instances of which the credit-to-GDP gap produces a false positive, and in such episodes, the impact on loan volumes can be significant.

7. But the negative correlation is also found by Drehmann et al. (2012) for a panel of 53 countries. For Malaysia, the correlation between credit-to-GDP gap and seasonally adjusted GDP is negative. See section 5.3 for details.

From a practical perspective, there are issues with the measurement approach for the credit-to-GDP gap. Critics highlighted that this measure is susceptible to the length of the time series and structural breaks in the data. In this regard, Geršl and Seidler (2011) point out that the Hodrick-Prescott (HP) filter technique which is recommended in Basel III, is a statistical filter which does not take into account the economic fundamentals which affect the equilibrium of stock of loans. In this sense, the statistical approach does not rigorously establish the relationship between the credit-to-GDP and the economic development of a country. An alternative method which estimates the equilibrium of loan levels in relation to the economy's fundamentals may show that countries at different stages of development will have different levels of loan equilibrium. While the HP filter approach is simple to adopt in calculating excessive credit, Geršl and Seidler (2011) suggest that the better approach would be the one which reflects the evolution of a country's economic fundamentals. They also argued that a broader set of indicators and methods should be employed to determine a country's position in the credit cycle. Chen and Christensen (2010) in their study highlights the need to base the buffer decision on a broader range of indicators and to cross check these indicators with the credit-to-GDP gap guide. The reason is that they find that, in the case of Canada, an increase in credit-to-GDP ratio in late 2006, pre-GFC, was in line with the economic activity. This implies that the gaps do not signal excessive credit. However, the other indicators such as house prices and equity prices were already steadily increasing, signalling a build-up in imbalances in the asset markets.

While the main arguments against the use of credit-to-GDP gap as a guide for CCCB decisions are valid, Drehmann and Tsatsaronis (2014) point out that the critics have misinterpreted the objectives of the role of credit-to-GDP as a buffer guide. They argue that the CCCB framework provides the authorities with an instrument to base their decisions on, but not as an instrument to manage the credit cycle. Based on this viewpoint, the usefulness of the credit-to-GDP must be judged exclusively on whether it provides policymakers with reliable signals on when to raise the buffer. After reviewing the evidence, they found that the credit-to-GDP gap is on average (across many countries including emerging economies and for several decades) the best single indicator. Furthermore, there are caveats in the Basel III framework with respect to the mechanical usage of the credit-to-GDP gap. In particular, the Basel Committee acknowledged that the gap may not be a good indicator of stress in downturns and proposed to authorities to use judgement in making decisions to release the buffer. This is a central feature of the CCCB framework which combines rules and discretion.

Nevertheless, Drehmann et al. (2011) point out that the choice of the anchor variable should meet four criteria namely: (i) It is able provide signals of good and bad times; (ii) It should ensure that the size of the buffer build-up in good times is sufficient to absorb subsequent losses when they materialise; (iii) It should be robust to regulatory arbitrage. The implementation of the guide is difficult to be manipulated by individual institutions as well as being applicable to banking organisations that operate across borders and; (iv) It should be transparent and cost-effective.[8]

4. Methodology and Data

4.1 Choosing the Anchor Variable

The Basel Committee[9] recommends the credit-to-GDP ratio as the anchor variable in determining the countercyclical capital buffer but this has be disputed by Repullo and Saurina[10] (2011) and Edger and Meisenzahl[11] (2011). While the Basel Committee recommends the use of the credit-to GDP as an anchor for buffer decisions, there are also a number of other research papers on the subject that recognises that the usefulness of other macro indicators[12]. This is because the credit-to-GDP ratio may not always be able to fully capture the information on the financial cycles. There are several other indicators suggested in the literature that could indicate a build-up of system-wide risk, such as house price and equity price indices. Therefore, the paper analyses other macro variables which are related to the real economic and financial activities. The behaviour of these variables is assessed during the episodes of financial stress. The macroeconomic variables examined are:

(i) Output gap, an indicator of the business cycle. The business and the financial cycles, although is closely linked, may not synchronise. However, in most

8. However, the Basel Committee allows the use of discretion by authorities. But, buffer decisions must be communicated clearly to the public.

9. However, the Basel Committee recognises the fact that the credit-to-GDP gap may not always work in all jurisdictions at all times. Nonetheless, for evolving the CCCB framework, it is expected that the national authorities would be transparent.

10. Repullo and Saurina (2011) argue that credit usually lags the business cycle. During periods of downturns, the credit-to-GDP ratio continues to be high due to greater credit demand by households and firms which need credit o finance inventory accumulation.

11. Edge and Meisenzahl (2011) as well as Buncic and Melecky (2013) point out that the credit-to-GDP gap is not necessarily an equilibrium notion of credit for the economy. They doubt that the credit gap can correctly identify periods of "excessive" credit growth.

12. See Chen and Christensen (2010) and Reserve Bank of India (2013).

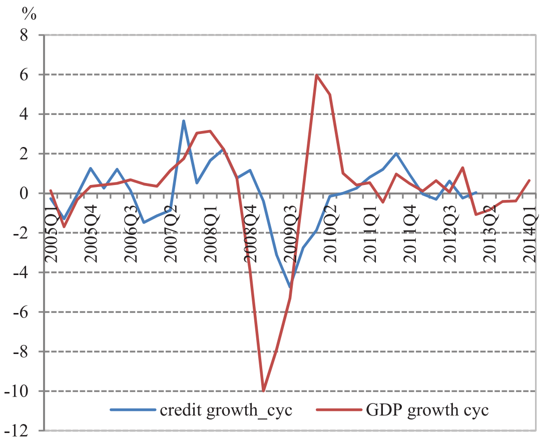
cases, the spill overs of an overheating economy are evidenced in the asset markets and rapid credit growth;

(ii) Credit-to-GDP gap and credit growth. The credit-to-GDP gap benchmarks credit growth with the overall economic activity and assess if credit is growing too fast compared with GDP; and

(iii) Asset prices. In general, property prices tend to show excessive increases prior to a financial crisis and sharp declines during periods of financial stress (Drehmann et al., 2011). This paper examines equity and property price gaps. The deviations from their long-term trends namely, the equity and property price gaps have proven useful in predicting banking crises (Borio and Drehmann, 2009).

The performance of the anchor variables for the countercyclical capital buffer is typically benchmarked against an indicator of financial crises (Drehmann et al., 2011). However, dating of the financial crisis involves judgement. While the financial cycles may not be fully synchronised with the business cycle, historical episodes for Malaysia show that the periods of financial stress tend to be associated with periods of economic stress. Figure 4.1 shows that the periods of financial stress typically coincide with economic downturns.

Figure 4.1
Malaysia GDP Growth and Credit Cycle



4.2 Estimating the Gaps of Macro Variables Using the Hodrick-Prescott (HP) Filter

This paper derives the gaps for all the macro variables, namely the output, the credit-to-GDP, the house price and equity prices by using the two-sided Hodrick-Prescott (HP) filter. Although, the one-sided Hodrick-Prescott filter is recommended by the Basel Committee to address the bias end point problem[13], the results from the two-sided HP filter tend to produce a more precise estimate of the trend as it uses all available information (Gerdrup, Bakke Kvinlog and Schaanning, 2013). The paper analyses the performance of the gap estimates from the one-sided and two-sided HP filter and finds that the two-sided filter produces gap estimates that are more indicative of the financial stress periods[14]. Furthermore, to derive a reasonable trend using the one-sided HP filter would require a long time series (Reserve Bank of India, 2013). Given the limitations of data availability, in particular, the quarterly property prices (sample starts from 1Q 1999), using the one-sided filter may not feasible. Furthermore, the two-sided filter is found to provide a more precise estimate of the trend (Gerdrup et al., 2013).

Ravn and Uhlig (2002) show that for cycles with longer durations, such as the credit cycle, a higher λ value is considered appropriate as the smoothing parameter for the HP filter. Their findings were adopted and used as recommendation by the Basel Committee[15], where long-term trends in credit are extracted using the smoothing parameter of $\lambda = 400{,}000$. Drehmann et al. (2011) also set λ at 400,000 as crises occur on average in 20-25 years in their sample. However, the paper sets the smoothing parameter λ to 1600, a conventional value for quarterly data since the average length of Malaysia financial cycles is almost similar to its business cycle (Figure 4.1). The decision is also based on the ad-hoc tests conducted on various values of lambda. The study finds that $\lambda = 400{,}000$ produces a higher noise-to-signal ratio compared to $\lambda = 1600$ (see Table 5.3).

13. The end point bias from the two-sided HP filter results from unavailability of observed values towards the end of the sample. When the future observations of the series are unavailable, the last point of the series will have an exaggerated impact on the trend. Another drawback of the HP filter is in its inability to account for structural breaks (Sarmento, 1998). To address the end-point bias, literature suggests an extension of the sample period (Mohr, 2005).

14. See Section 5.5.

15. Ibid.

4.3 Identification of an Appropriate Threshold Level

The lower and upper thresholds, L and H set for the benchmark variable (credit-to-GDP gap) determines the timing and the speed of adjustment for the capital buffer add on. Based on historical banking crisis, the Basel Committee has found the lower threshold of L=2 and upper threshold of H=10 to provide a reasonable and robust specification. The Basel Committee recommends a maximum buffer add-on of 2.5% of risk weighted assets when the credit-to-GDP ratio exceeds its long-term trend by 10 percentage points or more. When the credit-to-GDP gap is between 2 to 10 percentage points, the buffer add-on will increase linearly between 0% to 2.5%.

While the thresholds for credit-to-GDP gaps are prescribed by the Committee, it can be calibrated to suit the domestic economic conditions. The calibration is to ensure that the implementation of capital buffers does not stifle economic growth. Therefore, in this study, the Basel framework is tested and if required, suitable modifications to the thresholds will been made.

In this context, various thresholds for the benchmark macro variables are tested and the appropriate level of threshold is identified based on two approaches: (i) Sarel's (1996) approach or; (ii) Kaminsky and Reinhart's (1999) approach.

In Sarel's (1996) approach, a regression with different thresholds is tested iteratively. The threshold is determined based on the explanatory power of equation (1) and the significance of the coefficient.

$$npl_t = \alpha_0 + \alpha_1 bigap_{t-i} + \alpha_2 th_{t-i} * (bigap_{t-i}) + ysa_{t-i} + npl_{t-i} \qquad (1)$$
$$i = 1,2,,3 \ldots \, . \, .,8 \; ; \; t = 1,2 \ldots \, . \, .,92$$

where npl is non-performing loans of banking system (based on 3 months classification), ysa is seasonally adjusted gross domestic product (GDP) growth, the benchmark indicator gap which includes credit-to-GDP, house price, equity price and output gaps, *th* value is value which the threshold is set.

th is a dummy, *th* = 1 if benchmark indicator gap > threshold value, and, *th* = 0 otherwise.

The second approach is a "signalling" approach which evaluates discrete thresholds by measuring the noise-to-signal ratios. The threshold for the benchmark indicator is chosen when a “correct” signal is issued whenever the indicator moves above the threshold eight quarters prior to the period of economic stress. The number of “correct” signals is measured against the “false” signals.

Table 4.1
Benchmark Indicator’s Performance

	Crisis within 8 quarters	No Crisis within 8 quarters
Signal was issued	A	B
No signal issued	C	D

The benchmark indicator that produces “correct” signals or observations grouped in cell “A”. These “correct” signals are compared with the “false” signals or observations in “B” and “C” cells.

The noise-to-signal (N-t-S) ratio $= \frac{B}{B+D} / \frac{A}{A+C}$. A preferred benchmark in-dictor and threshold are the ones which are able produce the lowest N-t-S ratio.

4.4 Data

The quarterly private sector claims[16] data (IFS: 32D…ZF) is obtained from the International Monetary Fund’s International Financial Statistics (IFS) database. House Price Index (HPI), Consumer Price Index (CPI), Equity Index (EI), nominal and real Gross Domestic Product (GDP) are from Haver Analytics. Data for private sector claims starts from 1Q 1991 to 4Q 2013, HPI starts from 1Q 1999 to 1Q 2014, EI from 1Q 1993 to 1Q 2014. The GDP and CPI series start from 1Q 1991 to 2Q 2014.

5. Empirical Results

5.1 The Behaviour of Macro Indicators around the Crisis Periods

The performance of the different indicator variables around the episodes of economic stress show that 12 quarters prior to the AFC (t=0), credit growth started to deviate from its long term trend and the size of the gap was at the maximum 4 quarters prior to the economic downturn (Figure 5.2). However,

16. As recommended by the Basel Committee.

the credit-to-GDP gap only started deviating from its long-term trend 4 quarters (t-4) prior to the onset of the economic downturn and continued to deviate 4 quarters after the onset of the crisis period (t+4).

Figure 5.3
Equity Price Gap

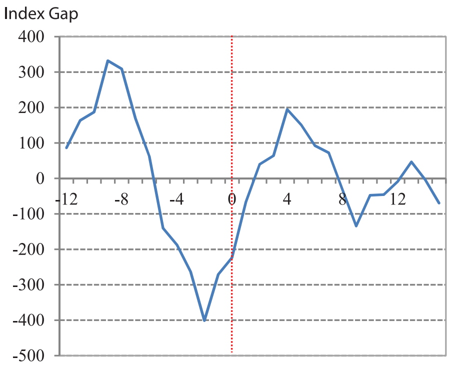
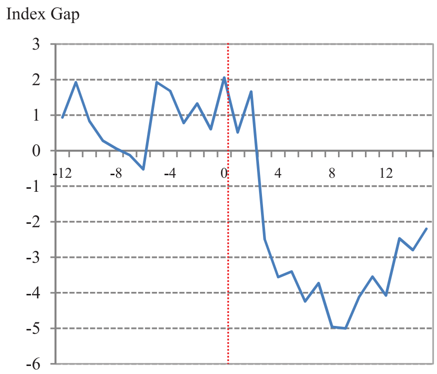
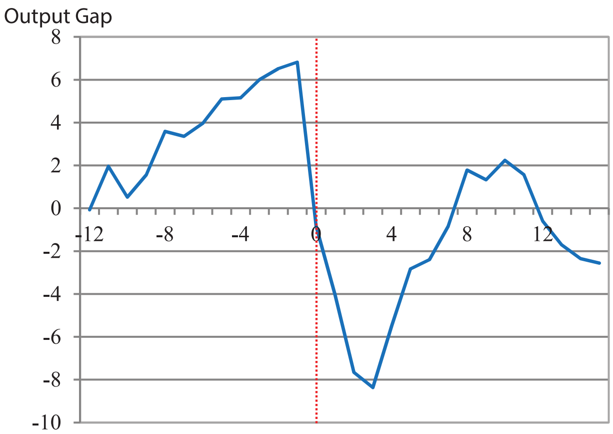


Figure 5.4
House Price Gap



In the case of equity prices, the build-up in gaps is evident t-12 quarters from the start of the AFC (Figure 5.3). In contrast, the house price gaps only started to build up 4 quarters prior to the economic downturn during the GFC (Figure 5.4). The build-up starts to slow down and turn negative after t+2 quarters.

Figure 5.5
Output Gap



The output gap show signs of a build-up as early as 12 quarters leading up to AFC. The output gap peaked at around 6%, one quarter prior to the economic crisis and it turned negative at t=0.

5.2 Correlation between Indicator Variables and GDP

Table 5.1
Correlation between GDP and Macro Indicator

Macro Indicator (bi_t) with seasonally adjusted GDP growth (y_t)	$Corr(y_t, bi_t)$
Credit-to-GDP gap	-0.524***
Credit growth gap	+0.137
House price gap	+0.248*
Equity price gap	+0.624***
Output gap	+0.643***

Note: * indicates significance at 10%, ** at 5% and *** at 1%.

The correlation between each of the macro indicators and the seasonally adjusted GDP growth shows positive relationships, except for credit-to-GDP gap (Table 5.1). The negative correlation for credit-to-GDP implies that this indicator will signal a reduction in capital requirements when the GDP growth is strong and therefore demonstrates pro-cyclicality[17]. This appears to contradict the objective of the countercyclical capital buffer requirements of Basel III, which requires banks to build buffers in good times so that they can draw down on those buffers when economic or financial condition deteriorates.

5.3 Identification of Thresholds for Indicator Variables

While the identification of the thresholds can be based on charting the relationships between each macro indicator and GDP growth, a more formal analysis involves the methodology suggested by Sarel (1996). This method uses the regression of equation (1) with different thresholds. The "appropriate" threshold is then determined on the basis of the explanatory power of equation (1) as well as the significance of the threshold.

The results from Sarel's method are presented in Table 5.2.

17. Repullo and Saurina (2011) also find a negative correlation between GDP growth and credit-to-GDP gaps for countries such as France, Germany, Italy, Japan, Spain, the UK and US. They argue that credit usually lags the business cycle, hence would not be a suitable early warning indicator.

Table 5.2
Identification of Thresholds for Indicator Variables

Threshold value for credit-to GDP ratio gap	Significance of data values above the threshold	Adjusted R square	AIC
2.0	0.047*	0.887	3.528
6.0	0.046*	0.888	3.526
10.0	0.050**	0.889	3.512
15.0	0.045*	0.888	3.519
20.0	0.029	0.885	3.546
Threshold value for credit growth gap	**Significance of data values above the threshold**	**Adjusted R-square**	**AIC**
1.5	0.380***	0.937	2.962
2.0	0.397***	0.932	3.042
3.0	0.335***	0.927	3.108
4.0	0.379***	0.951	2.714
Threshold value for house price gap	**Significance of data values above the threshold**	**Adjusted R-square**	**AIC**
0.5	0.217	0.979	1.660
1.0	0.276	0.979	1.735
1.5	0.197*	0.979	1.711
2.0	0.264*	0.979	1.698
Threshold value for equity price gap	**Significance of data values above the threshold**	**Adjusted R square**	**AIC**
50	0.005**	0.941	2.895
90	0.003*	0.939	2.932
95	0003	0.939	2.933
100	0.003*	0.939	2.927
130	0.004**	0.940	2.917
Threshold value for output gap	**Significance of data values above the threshold**	**R bar-square**	**AIC**
0.5	0.407***	0.980	1.781
0.8	0.395***	0.980	1.786
0.9	0.384***	0.980	1.789
1.0	0.382***	0.980	1.783
1.5	0.367***	0.980	1.765
2.0	0.336***	0.980	1.790

Results in Table 2 show that credit-to-GDP gap exceeding 10 has a positive and significant relationship with NPL and has the highest adjusted R-square. The results suggest that the upper threshold can be set as H=10 and the lower threshold, L=6, the lowest threshold value that is significant. The upper threshold for the credit-to-gap benchmark indicator appears to be similar to the one recommended by the Basel Committee. However, the lower threshold differs, which means the range is smaller and this would suggest a quicker pace of build-ups in capital buffers. In terms of the credit growth gap, the thresholds can be set at H=4.0 and L=1.5, suggesting that deviations of credit growth of between 1.5 and 4 ppt from its trend warrants a build-up in capital buffers. In the case of equity price gaps and output gaps, the upper and lower thresholds can be set at H=130 and L=50 and H=1.5 and L=0.5 respectively.

A linear build-up of capital buffers as illustrated in Figure 2.1 is being applied to values between L and H thresholds. The evolution of capital buffers derived from the gaps of each indicator variables is shown in Figures 5.6-5.9. Credit growth gap, equity price gap and the output gap indicators suggest that there should be a build-up in capital buffers prior to AFC, in particular, 1996-1997. The equity price gap and the output gap indicate that there should also be a build-up in buffers during periods leading to the economic slowdown in 2001. During the economic slowdown, the average NPL increased from 10.2 in 2000 to 11.3 in 2001.

Figure 5.6
Capital Buffers based on Credit Growth and Credit-to-GDP Gaps

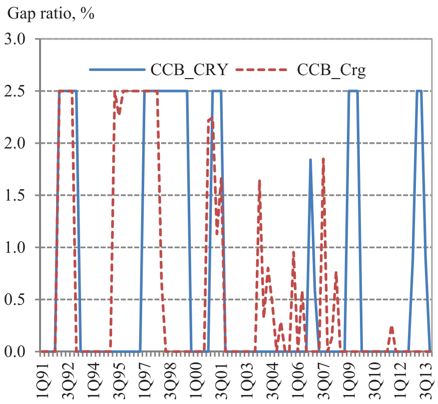


Figure 5.7
Capital Buffer based on House Price and Equity Price Gaps

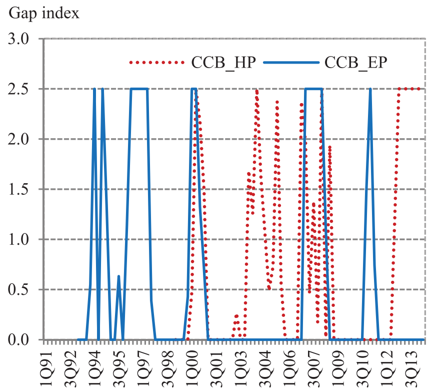


Figure 5.8
Capital Buffers based on Credit Growth, Equity Price and Output Gaps

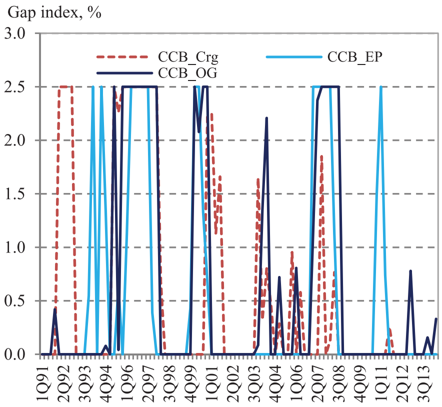
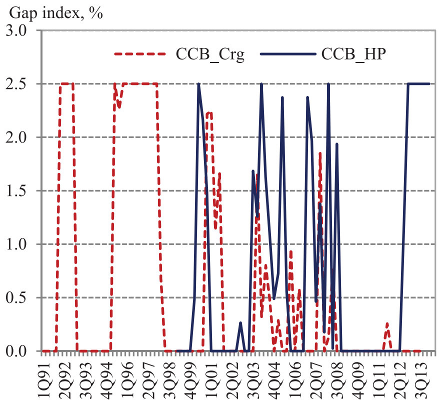


Figure 5.9
Capital Buffers based on Credit Growth and House Price Gaps



For periods leading to the GFC, 2006-2007, the credit growth, house price and output gaps signalled a build-up in buffers while the equity price gap only signalled a build-up in 2007-2008. Coincidently, the patterns of build-ups in buffers suggested by credit growth gaps and output gaps are quite similar for 3Q 2003 to 1Q 2006 horizon.

While the timing and size of the build-up in buffers depend on the subjective choice of the thresholds for the indictor variables, the approach adopted in this study is common in literature. Results show that each indicator variable gives a variation in the sequence and size of build-up in capital buffers. If the credit-to-GDP ratio gap is used as the reference indicator for the capital buffer decision, it signalled a build-up in capital buffer in 1997 and continued to do so until 3Q 1999, when the economy had already entered into a recession in 1Q 1998. Similarly, in 2009, the build-up signal persisted despite the fact that the economy was already entering into a recession. The results support Repullo and Saurina's (2011) criticism that credit tends to lag the business cycle and therefore, is not a reliable buffer setting guide. If it was used, the credit-to-GDP which continued to signal a build-up during an economic recession, would propagate the slowdown of economic activity through credit supply constraints.

5.4 Evaluation of Gaps and Thresholds based on the Noise-to-Signal Approach

Another approach in selecting appropriate thresholds is the "noise" and "signal" approach. The threshold is determined in such a way that the indicator variable is able to exhibit an excessive build-up and hence, crosses the threshold eight quarters prior to a financial distress[18]. Three major economic events are used in the dating of the financial cycle, namely, the Asian Financial Crisis (AFC) 1998/99, the Burst Tech Bubble 2000/01 and the Global Financial Crisis (GFC) 2008/09. The dating process is based on Malaysia's past episodes of economic distress when financial distress was also evident.

Since the Basel Committee recommends the use of the one-sided HP filter with λ=400,000, the results of the credit-to-GDP gap derived from both the one-sided and two-sided HP filters with different thresholds are compared and shown in Table 5.3. From the results, the two-sided HP filter consistently produces lower noise-to-signal ratios at each of the thresholds compared to the one-sided HP filter. From the results, appropriate thresholds for the credit-to-GDP gap derived from the two-sided HP filter L=2 and H=20, instead of L=6 and H=10 as suggested from Sarel's approach. A wider range for capital build-ups (L=2, H=20) suggests that the pace of the build-up of capital buffers will be slightly slower during periods of excessive credit-to-GDP gaps.

18. For details of the methodology, see Section 4.3.

Table 5.3

The Performance of the Credit-to-GDP Gap Indicator at Different

Threshold value for credit-to-GDP gap (2-sided HP filter, $\lambda = 1600$)	Noise-to-Signal ratio
2.0	0.391
6.0	0.400
10.0	0.285
15.0	0.264
20.0	0.144
25.0	0.211
Threshold value for credit-to-GDP gap (1-sided HP filter, $\lambda = 400{,}000$)	Noise-to-Signal ratio
5.0	0.438
10.0	0.438
15.0	0.438
20.0	0.613
Threshold value for credit growth gap (2-sided HP filter, $\lambda = 1600$)	Noise-to-Signal ratio
1.5	0.415
2.0	0.356
3.0	0.192
4.0	0.197
5.0	0.166
6.0	0.187
Threshold value for house price gap (2-sided HP filter, $\lambda = 1600$)	Noise-to-Signal ratio
0.5	0.503
1.0	0.503
1.5	0.533
2.0	0.578
3.0	1.244
Threshold value for equity price gap (2-sided HP filter, $\lambda = 1600$)	Noise-to-Signal ratio
10	0.434
50	0.153
60	0.172
90	0.159
95	0.143
100	0.115
130	0.070
Threshold value for output gap (2-sided HP filter, $\lambda = 1600$)	Noise-to-Signal ratio
0.5	0.239
0.9	0.068
1.0	0.072
1.5	0.040
1.96	0.025

A "suitable" threshold for the credit-to-GDP gaps produce by the one-sided HP filter cannot be determined decisively. The noise-to-signal ratios for threshold values between 5 and 15 are exactly the same, therefore suggesting that the "true" threshold values may lie somewhere within this range.

One noticeable drawback in using the credit-to-GDP gap as a guide for capital buffers is that, it continues to signal a build-up even when the economy has already entered into a recession. The continual imposition of credit constraints (as suggested by the buffer guide) could aggravate the economic distress. However, it is unclear how severe the impact is on the real economy when the wrong buffer decisions are made. According to Drehmann and Tsatsaronis (2014), the empirical literature fails to provide strong evidence on the link between higher bank capital requirements and a lower economic growth. Recent studies put the median estimates for the impact of a 1 percentage point increase in capital requirements on GDP in the range of 0.1 to 0.2 percentage points, while the long-term impact of better capitalised banks on economic output is estimated to be positive (BCBS, 2010). Nonetheless, Edge and Meisenzahl (2011) and Buncic and Melecky (2013) point out that the credit-to-GDP gap is not necessarily an equilibrium notion of credit for the economy. While the acknowledging that the buffers can protect banks from the consequences of financial booms, they doubt that the credit gap can correctly identify periods of excessive credit growth.

Based on the results in Table 5.3, the credit growth gap appears to be a better indicator. The noise-to-signal ratios for this indicator are lower than the ones calculated for the credit-to-GDP gaps. This finding is consistent with Repullo and Saurina (2011), who argue that credit growth is a better reference point for the countercyclical capital buffer as it is provides good signals of a build-up in systemic risk. More importantly, credit growth does not exacerbate the underlying pro-cyclicality of the capital requirements.

Based on N-t-S approach, appropriate thresholds for the credit growth are L=3.0 and H=5.0, different from the ones determined using the Sarel's approach (L=1.5 and H=4.0). The upper limit of H=5.0 is insignificant when tested using the Sarel's approach. The differences in thresholds suggest the need further investigation. Lower thresholds must be set not at too "low" a level that it picks up too many false signals or too "high" that it fails to detect the "true" signals.

The house and equity price gaps are equally important in providing information for financial distress as asset prices usually have a close relationship with the financial system through the credit channel. Therefore, an excessive price build-up in the asset markets can also signal financial distress. Results show that the noise-to-signal ratios for equity price gaps perform better than the house price gaps. The thresholds for both indicators are found to be at L=50, H=130 and; L=0.5, H=1.5 respectively. The appropriate lower and upper thresholds for equity price are similar to the ones identified from Sarel's approach. However, the range for the house price is narrower compared with the Sarel's approach. The narrower range suggests that the pace of the build-up in capital would need to be much quicker. These indicators do not only provide information on the developments of the asset markets at different business cycles, but they are also quicker in signally a release in buffers when the economic condition worsens. For example, during the economic downturns in 1998, 2001 and 2009, the gaps for these indicators, in particular the equity price indicator turned negative, therefore signalling a stop in the build-up of buffers. This is not evident from the credit-to-GDP gap indicator.

The output gap appears to contain important information on the build-up of financial risks. Given that credit supports consumption and investment, excessive growth in private sector loans can over stimulate aggregate demand beyond potential output. A build-up in output gaps signals an overheating of the economy with potentially rising price pressures and current account imbalances. Therefore, the link between the financial and the real sectors through the credit channel suggests that an overheating economy tend to be associated with a strong credit demand and a weak economy with a low credit demand[19]. From the findings, the output gap indicator registers the lowest noise-to-signal ratios among all indicators. The upper and lower threshold is found to be at L=0.9 and H=1.96, slightly different from the thresholds identified from Sarel's approach (L=0.5 and H=2.0).

6. Conclusion

The financial crisis in 2008 has amplified the weaknesses in the global regulatory framework and in the banks' risk management practices. This weakness propagated a vicious cycle where problems in the financial system spill over into the real economy which, in turn worsens the banking sector through the feedback loop. Consequently, the new Basel III framework which includes the introduction of countercyclical capital buffers (CCCB), aimed at increasing the resilience of the banking system and its capacity to absorb financial and economic shocks during crises. In particular, the CCCB is expected to mitigate the tendency of bank capital regulation which amplifies the pro-cyclicality in lending conditions. As such, buffers are expected to increase during periods of

19. VAR Granger Causality test shows that the output gap granger causes NPLs.

excessive credit growth which tends to be associated with increasing financial risks. They will be released during financial stress in order to help banks absorb losses.

The paper assesses the conceptual and practical criticisms of the credit-to-GDP gap as the recommended anchor for the implementation of the countercyclical capital buffers under Basel III. The credit-to-GDP indicator has two limitations: (i) While both nominal credit and GDP are falling, the ratio actually increases because the GDP (denominator) falls more rapidly - which will result in misleading buffer guides, and (ii) The credit-to-GDP ratio does not allow for the possibility of differing credit and output trends, which is important if countries are undergoing a process of financial deepening (Elekdag and Wu, 2011). The findings in the paper show that credit-to-GDP may trigger pro-cyclical changes in the buffers, in particular, it signals a continual build-up in capital buffers during periods of recessions. This concurs with the first limitation highlighted by Elekdag and Wu (2011). Other critics such as Buncic and Melecky (2013) argue that the one-sided filtered credit-to-GDP fails to adequately capture the shifts in equilibrium credit in line with the changing phases of development of a country.

The practical implementation of the one-sided filter with the recommended smoothing parameter of $\lambda = 400{,}000$, is also subjected to measurement issues. The length of the underlying credit-to-GDP cycle which is reflected in the choice of λ is subjective. Furthermore, the HP filter is a statistical approach that does not treat structural breaks in the data series adequately[20]. The HP filter account for varying levels of optimal of credit needed for countries at different stages of development. This statistical approach does not allow calibration of equilibrium credit to account for the development goals set by the policy makers (Buncic and Melecky, 2013).

The empirical findings show that thresholds identified for the credit-to-GDP indicator differ slightly from the thresholds suggested by the Basel Committee. However, as highlighted in the results, the signal for a build-up in capital continues even after the economy enters a recession. The empirical evidence in the paper shows that other indicators such as credit growth and asset price indicators tend to perform better in terms of giving “correct” signals prior to an economic distress. All the other indicators except for the house price indicator tend to produce lower noise-to-signal ratios. This suggests that composite indicators may provide

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20. Drehmann and Tsatsaronis (2014) found from their simulation that it takes at least 10 years for impact of the structural break on the credit-to-GDP to normalise.

a more broad-based view of the financial conditions rather than a single indicator at any given point in time[21]. Including the output gap expands the understanding of the conditions of the financial and real sectors, which are mutually dependent. Lowe (2002) as well as Behn et al. (2013) found that combinations of the credit gap and a similarly calculated asset price gap produce a more precise signal.

The findings in this paper highlight the challenges in using a single indicator and an identified threshold as the countercyclical capital buffer guide across all cyclical phases. Some indicators that perform better during certain periods may cease to be useful after a certain phase of economic development[22]. Since there is no perfect model that can deliver the decision for an effective rule-based countercyclical instrument, the policymakers are expected to use judgment as well as quantitative analysis within the parameters of the framework. This is supported by the empirical findings of the paper which requires some judgment in the interpretation of gaps and the thresholds and in turn, this would have an implication on the timing, the size and pace of build ups in capital buffers.

In addition, Malaysia is still a developing economy and therefore, the interaction between the real and financial sectors of the economy is changing over time. The strict application of the credit gap rule may impede financial deepening. As highlighted by the World Bank (2010) and the Reserve Bank of India (2013), economies that go through the process of financial development can experience prolonged periods of credit growth. Therefore, limiting credit growth could potentially affect financial deepening and slow the process of catching up with financially more advanced economies.

In summary, there is still no clear consensus on the best indicator to use for countercyclical capital buffer decisions. The lack of convincing evidence in using the credit-to-GDP gap as a sole indicator for countercyclical capital buffer decisions is highlighted in the findings of this paper. As such, the paper explores the information contained in a range of macro indicators in order to obtain a more balanced view about the build-up of financial risks in the economy. While empirical analysis does not provide a clear guidance for the countercyclical buffer decisions, it provides useful references for policy debates. The analysis suggests

21. While Drehmann and Tsatsaronis (2014) found the credit-to-GDP gap to be on average the best single indicator even for emerging market economies, they cannot discount the fact that composite indicators may perform better at any particular point in time.

22. Future work may be required to investigate the relationship between the macro indicators and the sources of financial vulnerability and the changing relationship during the different phases of economic development.

that the practical application of model-based results needs to be balanced with some elements of judgement and discretion. At this point, it may be premature to conclude from the findings that any rule-based decision can be formulated for Malaysia and would be sufficiently robust across time. The policymaker would still need to exercise judgement in assessing whether the credit-to-GDP gap or any macro indicator that crosses a pre-determined threshold is unsustainable and a source of financial vulnerability to the economy.

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Chapter 5

BUILDING ON THE COUNTERCYCLICAL CAPITAL BUFFER CONSENSUS: AN EMPIRICAL TEST FOR PAPUA NEW GUINEA

By
Tanu Irau[1]

1. Background

1.1 Background – Countercyclical Capital Buffer (CCCB)

Following the global financial crisis (GFC) in 2008/2009, the problem of procyclicality[2] was noted by the Group of 20 (G-20)[3] members. They attempted "to address the issue of procyclicality in financial markets regulation and supervision. The concern(s) were conveyed to international financial institutions, namely the International Monetary Fund (IMF), Financial Stability Board (FSB) and the Basel Committee on Banking Supervision (BCBS). The institutions were tasked to propose measures to mitigate procyclicality. These included the review of how valuation and leverage, bank capital, executive compensation, and provisioning practices may worsen cyclical trends (BCBS, 2009).

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1. Senior Research Analyst, Research Department, Bank of Papua New Guinea. The author would like to thank the Project Team Leader, Dr. Ghosh, for his guidance in getting the paper completed. Gratitude is also extended to Mr. Samson Wai and Mr William Sagir, BPNG Banking Supervision Department, for providing the required data and Mr. Sali David for his comments/edits.

2. Procyclicality refers to the tendency of economic/financial variables to fluctuate around a trend during the economic cycle. Increased procyclicality simply means fluctuations with broader amplitude. A broader definition of procyclicality will thus encompass three components, which cannot easily be distinguished in real life: (1) fluctuations around the trend (2) changes in the trend itself and (3) possible cumulative deviations from the equilibrium value. This point to the policy challenges that regulators face. They have to try and identify when pure cyclical fluctuations morph into something different: either a change in the trend itself or the start of a cumulative process (Jean-Pierre Landau, May 2009).

3. G-20 membership: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, United States, and European Union. G20 members represent around 85% of global GDP, over 75% of global trade, and two-thirds of the world's population.

The idea with the CCCB is to identify a macroeconomic variable which can be used to assess the extent to which credit growth can be excessive in an economy. The BCBS recommended the credit-to-GDP ratio minus its long-term trend (Gap) as the key indicator. The buffer will operate in such a way that when the Gap exceeds a pre-defined threshold, it will give rise to a benchmark buffer requirement. This can then be used to expand the size of the capital conservation buffer (briefly discussed in Section 1.2.2).

The first version of Basel III was published in late 2009, giving banks approximately three years to satisfy all the requirements. It is part of the continuous effort made by the BCBS to enhance the banking regulatory framework by building on Basel I and Basel II. It seeks to improve the banking sector's ability to deal with financial and economic downturns, improve risk management and strengthen the banks' transparency. A focus of Basel III is to foster greater resilience at the individual bank level in order to reduce the risk of system-wide shocks.

1.2 Objectives

1.2.1 Procyclicality

It was noted that losses incurred in the banking sector during the 2008 GFC were preceded by a period of excess credit growth. This destabilised the banking sector, which resulted in a downturn in the economy, further destabilising the banking sector. "These inter-linkages highlighted the significance of the banking sector building up its capital defences in periods when credit grew to excessive levels. As capital is more expensive than other forms of funding, the building up of these defences should have the benefit of helping to moderate credit growth" (BCBS, 2009).

A number of measures were proposed by the BCBS to address procyclicality with four key objectives[4]. These were: (1) to dampen any excess cyclicality of the minimum capital requirement; (2) promote more forward-looking provisions; (3) conserve capital to build buffers that can be used in stress; and (4) protect the banking sector from periods of excess credit growth.

4. Objectives 3 and 4 gave rise to *capital conservation buffer* and *countercyclical capital buffer*, respectively.

In summary, the main objective of the CCCB is to ensure that banks hold sufficient capital that will enable them to absorb unexpected losses when faced with a negative systemic shock and not compromising lending to the real economy.

1.2.2 Capital Conservation Buffer vs. Countercyclical Capital Buffer

The capital conservation buffer is designed to ensure that banks build up capital buffers during normal times which can be drawn down as losses are incurred during periods of stress. A capital conservation buffer of 2.5%, comprised of Common Equity Tier 1, is established above the regulatory minimum capital requirement. Capital distribution constraints will be imposed on a bank when capital levels fall within this range. Banks will be able to conduct business as normal when their capital levels fall into the conservation range as they experience losses (BIS 2011). During normal periods, banks should hold buffers of capital above the regulatory minimum. When buffers have been drawn down, one way banks can rebuild them is by generating capital internally whereby reducing the distribution of earnings. This includes a reduction in dividend payments, share-buybacks and staff bonus payments. Alternatively, new capital can be raised from the private sector. Greater efforts should be made to rebuild buffers the more they have been depleted. However, in the absence of raising capital in the private sector, the share of earnings retained by banks for the purpose of rebuilding their capital buffers should increase the nearer their actual capital levels are to the minimum capital requirement. Retaining some proportion of earnings during a downturn can help ensure that capital remains available to support the ongoing business operations of banks which should help reduce procyclicality.

When an economic downturn is preceded by a period of excess credit growth, the banking sector can incur large losses. These losses can destabilise the banking sector and spark a vicious circle, whereby problems in the financial system can contribute to a downturn in the real economy that then feeds back on to the banking sector. These interactions highlight the particular importance of the banking sector building up additional capital defences in periods where the risks of system-wide stress are growing markedly. The *countercyclical capital buffer (CCCB)* aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate. It will be deployed by national jurisdictions when excess aggregate credit growth is judged to be associated with a build-up of system-wide risk to ensure the banking system has a buffer of capital to protect it against future potential losses. The CCCB is a time-varying capital requirement on top of the minimum requirement. The aim of the CCCB is to ensure in an efficient way that the banking sector as a whole has enough capital to carry out its main functions. The requirement will be phased in gradually from 2016 to 2019. However, some countries have introduced the CCCB as early as 2013.

1.3 Why CCCB Research

PNG has experienced changes in a number of sectors, over the years since independence, and the financial sector is no exception. A notable financial sector reform occurred in 2000 when the Central Banking Act (CBA) was passed by Parliament. During the same year, the Banks and Financial Institutions Act (BFIA) was amended. This was followed by the passing of the Life Insurance Act (LIA) and the Superannuation General Provisions Act (SGPA) in the same year. Under the CBA 2000, amongst other changes, the Central Bank of Papua New Guinea (BPNG) is made more independent (from external influence). Financial system supervision and the formulation and implementation of monetary policy are two of BPNG's core functions. The BFIA 2000 aimed to broaden and improve regulation and supervision of the financial institutions. The LIA 2000 and SGPA 2000 expanded BPNG's regulatory and supervisory powers to include insurance companies and superannuation funds, respectively (BPNG, 2008).

With the developments in the real sector of the economy, the financial sector, to an extent, has kept pace with these changes. For instance, prior to 1995, electronic banking services such as Automated Teller Machines (ATMs) and Electronic Funds Transfer at Point of Sale (EFTPOS) were non-existent (BPNG, 2008). However, with developments in information technology, such services and products, including mobile and internet banking have been introduced in PNG. The recent introduction of the Kina Automated Transfer System (KATS)[5] is expected to enhance an efficient national payments system and also complement the electronic banking products/services. "BPNG and all commercial banks commenced using Real Time Gross Settlement System (RTGS) to improve interbank financial payments....……" (Bakani, L. March 2014).

The level of liquidity in the banking system at the end of June 2014 was K7,183.0 million Kina[6] (U$2,959.4 million). With such a high level of liquidity, there is potential for private sector credit to grow excessively which may result in adverse impacts on the economy. An empirical analysis on the CCCB in PNG

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5. KATS is the PNG's national payments system aimed at improving and settling of interbank payments instantaneously.
6. Papua New Guinea's national currency (PGK1.00 = US$0.4120 at the end of June 2014).

may provide useful information for policymakers to formulate and implement appropriate policies with regard to bank supervision and regulation, particularly in respect of credit growth at a time when the economy is experiencing positive growth.

Financial institutions in PNG are authorised/licensed under Acts of Parliament, namely the CBA 2000, BFIA 2000, SLA 1995, SGPA 2000 and LIA 2000 to facilitate intermediation between savers and borrowers. Figures A1.1 to A1.3 show the structure of PNG's financial system. BPNG is at the top in Figure A1.1 as it directly regulates and supervises other depository corporations (ODCs)[7] and some of the other financial corporations (OFCs)[8]. Figure A1.2 shows the institutions that are outside of BPNG's regulation and supervision. PNG's financial market is depicted in Figure A1.3 where the BPNG, the Securities Commission and the Registrar of Companies have supervisory roles over specific sub-sectors of the financial system.

Commercial banks play an important role in the financial system by offering various banking products and services. These include the core business of channelling funds from surplus areas (or savers) to deficit areas (or borrowers). In addition, banks facilitate international trade and play an important role in the payments system. As shown in Chart A1 in the Appendix, commercial banks accounted for 91.3% of total assets of the ODCs in PNG, LFIs had 4.3%, S&Ls with 3.3% and Micro-banks 0.6% at the end of June 2014. In terms of private sector credit, commercial banks provide the bulk of it whilst non-banks account for less than 10%. During the period 2009-2013, on average, banks accounted for 90.3% of total private sector credit and the remainder was provided by non-banks (see Appendix Table A1). Since the commercial banks are the dominant players in the market, the analysis is focused on this subsector as in the event when a bank is under stress, there is potential for the entire financial system to be adversely affected.

The rest of the paper is organised as follows. Section 2 briefly covers the motivation for such a study. This is followed by a discussion on the related literature on the CCCB in Section 3. Sections 4, 5 and 6 cover data, methodology and empirical results, respectively; whilst Section 7 concludes the paper.

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7. The International Monetary Fund (IMF) classifies commercial banks, finance companies, micro-banks and savings and loans societies as Other Depository Corporations.
8. OFCs include all non-bank financial institutions like superannuation funds, insurance companies, and development banks.

2. Motivation

2.1 Bank for International Settlements on CCCB

In response to the global banking crisis, the Bank for International Settlements (BIS) issued a press release on September 7 2009. The press release outlined the measures that were undertaken by a group of governors and heads of supervision of the major economies of the world to strengthen the regulation of the banking sector. The chairman of the Basel Committee emphasised that “the measures would result over time in higher capital and liquidity requirements and less leverage in the banking system, greater banking sector resilience to stress and strong incentives to ensure that compensation practices are properly aligned with long-term performance and prudent risk-taking”(Wellink, 2009).

Following the press release, in July 2010, the Basel Committee published for consultation the CCCB proposal (BCBS, 2010a) which basically gave more details on the measures that were being undertaken. It presented the BCBS’s proposal to strengthen global capital and liquidity regulations with the aim of promoting a more resilient banking sector. In December 2010, the BIS released a guideline for national authorities operating the CCCB. The document sets out the procedures for national authorities to follow with regard to capital buffer decisions and calculations. It is also an information source for banks and financial institutions to understand and anticipate the buffer decisions.

PNG authorities, particularly the BPNG has yet to commit to the implementation of Basel III, and such a study can provide some information on the usefulness of the CCCB.

2.2 Challenges

PNG like any other economy faces challenges and the authorities can only do all they can to address them. The challenges that may be faced by the PNG authorities in the implementation of CCCB may vary. A major challenge is the lack of long and reliable time series data for empirical analysis to be meaningful. For instance, PNG GDP numbers are compiled annually and the BCBS recommends the use of quarterly GDP for the calculation of the credit-to-GDP ratio. Appropriate techniques need to be employed to convert the annual numbers to quarterly. Volatility in the GDP and credit growth has to be taken care of. A major challenge will be the full implementation of Basel II which is really a pre-condition for the implementation of Basel III and the authorities committing to Basel III implementation. With very little research on CCCB implementation and Early Warning Indicator (EWI) in PNG, it will be difficult for the authorities to make decisions with regard to committing to Basel III and subsequently making buffer decisions in the event that the CCCB is implemented. More research is required on CCCB implementation and EWI and the challenge for the BPNG is to have the appropriate personnel and resources to undertake such research.

BPNG's macroeconomic surveillance is done by the various departments within the Bank to monitor and track movements in the macroeconomic indicators in order to formulate and implement appropriate monetary policy. This is surveillance at the national level whilst the IMF's annual Article IV mission is surveillance at the multilateral level whereby a broader coverage of the PNG economy and policies takes place. BPNG also has a close working relationship with the relevant government departments and agencies which are sources of necessary information/data for monetary policy formulation and implementation. Within the Bank, the Economics Department takes care of the monetary aspects whilst the Supervision Department focuses on prudential standards of the financial system. Primary data from various sources are used for surveillance. These include developments in inflation, interest rates, monetary aggregates, foreign reserves, exchange rate and fiscal operations.

BPNG has yet to fully implement Basel II and pre-conditions need to be met before implementing the Basel III recommendations. In addition, the authorities in PNG, particularly the BPNG has not committed to a timeframe for phased or complete implementation of Basel III (or even Basel II). The BPNG has implemented the 25 Core Principles of Effective Banking Supervision and some of the Basel I recommendations on capital adequacy. According to the IMF's Financial Systems Stability Assessment (FSSA) report of 2011, there are outstanding tasks that the BPNG needs to do to improve supervision. Generally, banks in PNG are well-capitalised and profitable; however, close monitoring is still warranted.

BPNG uses off-site surveillance and on-site reviews/examinations. Off-site surveillance includes collection and analysing of quarterly prudential reports, annual accounts and any other reports required by the regulator. On-site reviews involve on-site inspection by examiners and analysts on an institution's systems and processes, particularly those relating to risks and internal controls. Where necessary, BPNG takes regulatory actions on issues identified during these visits. Similarly, the issues identified from the quarterly prudential reports are acted upon immediately. BPNG through its supervisory role emphasises to the boards of these institutions to put in place policies and processes to identify and mitigate the risks. BPNG has been implementing Basel I. It is yet to fully implement Basel II. However, some of its supervisory practices are consistent with most of the key components of Basel II.

BPNG's twofold approach to supervision is focused on systems, policies and internal controls (Avel S. 2008).

1. During o*n-site reviews*, BPNG officers visit the Authorised Licensed Financial Institutions (LFIs) and perform a number of tasks to assess the condition of the institutions. These include: (a) the adequacy of the management's risk and internal control procedures; (b) the bank's systems and processes with regard to overall operations and conditions; (c) capital ratios; (d) relationships between capital and the rating system (CAMELS[9]); and (e) the bank's adherence to laws and regulations. For the institutions given a rating of 1 or 2, on-site reviews are done every two (2) years whilst those given ratings of 3-5, on-site reviews are done regularly which maybe be done annually or bi-annually, depending on the status of the institutions' problem.

2. Off-site reviews are done quarterly when call reports containing statistical data are submitted to BPNG's supervision department. Tests are normally conducted with statistics to ensure that the LFIs meet specific requirements with respect to capital, large exposures and concentration, provisioning and asset quality classification, foreign exchange overall and single currency exposure levels, and investment portfolio diversification.

As noted by the BIS, "BPNG has not progressed to Basel II and there is no decision on the implementation of Basel II and therefore questions on Basel III are not applicable" (BIS, 2012: Basel II, 2.5 and III Implementation).

2.3 Cross-country Experience

The implementation of the Basel III recommendations in most G-20 members and some emerging market economies is at an advanced stage. For some, they

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9. Soundness of a bank measured on a scale of 1 (strongest) to 5 (weakest). Bank examiners award these ratings on the basis of the adequacy and quality of a bank's Capital, Assets, Management, Earnings, Liquidity, and Sensitivity (to systemic-risk). Banks with a rating of 1 are considered most stable; banks with a rating of 2 or 3 are considered average, and those with rating of 4 or 5 are considered below average, and are closely monitored to ensure their viability.

have implemented Basel III ahead of the phase-in time. One such economy is Australia where the Australian Prudential Regulation Authority (APRA) applied the Basel III recommendations on 1 January 2013. It determined that Australian authorised deposit-taking institutions (ADIs) did not need the extended transition set by the BCBS as banks in Australia exceed the 2013 minimum capital requirements and are on track to meet the minimum requirements by 2016. Over the years, the APRA adopted a more conservative approach to its capital standards than the previous Basel II international minimum, both in terms of its common equity requirement and its treatment of deductions. During the 2008 GFC, the Australian banks were able to raise private capital and their profitability over subsequent years enabled them to strengthen their capital positions further (RBA, 2013).

3. Literature Review

3.1 Survey of CCCB Literature on Early Waring Indicator (EWI)

Procyclicality refers to the tendency of financial/economic variables to oscillate around a trend during the economic cycle. Increased procyclicality means fluctuations with broader amplitude. It is the opposite of countercyclicality. In business cycle theory and finance, any financial/economic variable that is positively correlated with the overall state of the economy is said to be procyclical. A broader definition of procyclicality will thus encompass three components, which cannot easily be distinguished in real life: (1) fluctuations around the trend; (2) changes in the trend itself; and (3) possible cumulative deviations from equilibrium value (Landau, 2009).

Drehmann, et al. (2012) argue that the most parsimonious description of the financial cycle is in terms of credit and property prices. These variables tend to co-vary closely with each other, especially at low frequencies, which confirm the significance of credit in the financing of construction and the purchase of property. In addition, the variability in the two series is dominated by the low-frequency components. By contrast, equity prices can be a distraction. They co-vary with the other two series far less and much of their variability concentrates at comparatively higher frequencies. The financial cycle has a much lower frequency than the business cycle [Drehmann et al. (2012)]. As traditionally measured, the business cycle involves frequencies from 1 to 8 years: this is the range that statistical filters target when seeking to distinguish the cyclical from the trend components in GDP. The study by Drehmann, et al. (2012) found that the average length of the financial cycle in a sample of seven industrialised countries was around 16 years.

The BCBS proposal was justified "to achieve the broader macro-prudential goal of protecting the banking sector from periods of excess credit growth that have often being associated with the build-up of systemic-wide risk." The proposal was to use the difference between the credit-to-GDP ratio and its long-term trend as the key variable that would determine the buffer.

The credit-to-GDP ratio provides a normalisation of the credit variable to take into account the fact that credit demand and supply grow in line with the size of the economy. Studies have shown that there is a strong association between faster than average credit-to-GDP growth and banking crises. Even though the credit-to-GDP gap normalises the volume of credit by GDP and corrects for changes in the long-run trend, it is essentially a statistical measure. Therefore, it may not take fully into account the equilibrium level of lending given the state of the economy. A study based on US data showed that credit-to-GDP gap provided the strongest signals ahead of a crisis (Borio and Zhu, 2008).

Research work on CCCB in PNG is non-existent. However, there is literature on other aspects of the PNG financial system. Avel (2008) discusses the BPNG's regulatory and supervisory framework and provides an analysis of the process of problem bank identification, intervention and resolution. Aipi (2008) provides the challenges faced by BPNG with regards to electronic payments. Capital flows and their implications on BPNG policies are discussed by Irau (2009) in a SEACEN collaborative research. The effectiveness of BPNG's policies choices during financial crisis are discussed by Rupa (2011). Jonathan (2013) provides an assessment of domestic interdependence of financial market infrastructures (FMIs) and concluded that PNG's limited exposure to international markets may have helped the FMIs and the financial system as a whole not being greatly affected by the GFC of 2008.

4. Data, Methodology and Empirics

4.1 Data

The analysis is based on quarterly data for the period 2003-2014, sourced from various issues of the BPNG's Quarterly Economic Bulletin (QEB) publication, PNG Department of Treasury (DoT), the National Statistical Office (NSO) and the International Financial Statistics (IFS) database. Descriptive statistics and a brief description of the data and the sources are provided in Tables A4.1 and A4.2 in the Appendix. The unit of measurement is the local currency[10]. Year-on-year growth rates are used in the analysis so as to reduce volatility. The Kina Shares Index (KSI) is selected as the supplementary indicator as it appears to track the movements in the NPL growth quite well. It should be noted that PNG's gross domestic product (GDP) is compiled on an annual basis and for this analysis the annual series was converted to a quarterly series using EViews frequency conversion option from low to high frequency data[11].

4.2 Key Indicator

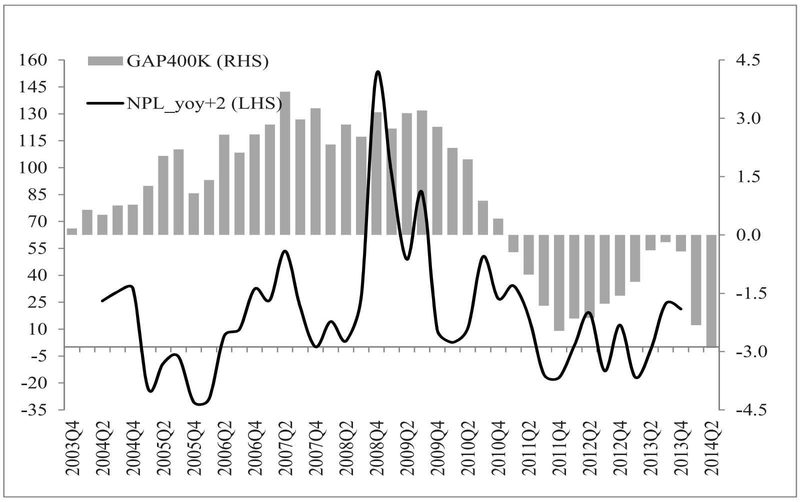
A number of key indicators are suggested by the Basel Committee and amongst these include the credit-to-GDP gap, credit growth and GDP growth. Correlation analysis was undertaken to determine the relationships the proposed key variables have with the growth in non-performing loans. It was established that the credit-to-GDP gap and annual credit growth have significant positive relationships with the annual growth in NPLs. The results of the correlation analysis are shown in Table A4.3 in the Appendix.

There is evidence of co-movement between the credit-to-GDP gap at time t and year-on-year growth of the NPL 2 quarters before [Chart 4.2(a)] as the gap variable is the lead indicator of the NPL growth. The correlation analysis shows a positive relationship with a p-value of 0.018, which is significant at the 5% level of significance. An increase in the credit-to-GDP gap is followed by an increase in the growth rate of NPL and vice versa.

---

10. At the time of writing, one domestic currency (Kina) was equivalent to US$0.4040.
11. This method fits a quadratic polynomial for each observation of the low frequency series, and then uses this polynomial to fill in all observations of the high frequency series associated with the period. The quadratic polynomial is formed by taking sets of three adjacent points from the source series and fitting a quadratic so that the average of the high frequency points matches the low frequency data actually observed. See EViews User's Guide I, pp. 119.

Chart 4.2 (a)
NPL Growth and Credit-to-GDP Gap



Similarly, credit growth and the growth in NPL track each other quite well [see Appendix Chart A4.2 (b)]. The correlation analysis between the two variables shows a significant positive relationship (0.37) with a p-value of 0.028 (significant at the 5% level of significance). The positive relationship can mean that growth in lending to the private sector is likely to result in NPLs increasing because certain loans may not be serviced. In other words, the greater the number of loans extended, there is a higher probability of borrowers defaulting, hence the positive relationship. GDP growth has a negative relationship with annual NPL growth and is significant at the 10% level [see Appendix Chart A4.2(c)]. The negative relationship implies that, during good times, NPLs tend to fall because borrowers are able to service their loans and the opposite happens when the economy is not doing so well.

The BPNG, through its Banking Supervision Department (BSD), monitors a number of major macroprudential indicators. These indicators basically provide information on capital, asset quality, earnings and liquidity & sensitivity of the supervised financial institutions. The performances of these macroprudential indicators are shown in Charts A4.1(a) – (h) in the Appendix.

Capital adequacy ratios (CARs) measure the amount of a bank's capital in relation to the amount of its risk-weighted credit exposures. The higher the CARs, the greater the level of unexpected losses a financial institution can absorb before becoming insolvent. The Basel Capital Accord recommends minimum CARs that banks should meet. Tier 1 Capital ratios are used by regulatory agencies to help determine the overall health and strength of a bank. Banks in PNG are well capitalised as indicated by the CAR. Over the years, CAR has been greater than 20% as shown in Chart 4.1 (a) and greater than 17% in Chart 4.1 (b).

The quality of assets as measured by the ratio of NPLs to total loans and the ratio of NPLs to total assets have been low during the period Q1 2005 – Q2 2014. The ratio of NPLs to total loans and NPLs to total assets, on average, have been 2.0% and 0.7%, respectively. The earnings by the financial institutions has been positive with an average of 31.2% for the Return on Equity (ROE) and 3.1% for the Return on Assets (ROA) for the period Q1 2005 – Q2 2014.

The financial institutions in PNG have sufficient liquidity as measured by the ratio of liquid assets to total assets and liquid assets to term deposits and short-term liabilities [Chart 4.1 (g) & (h)] which are well above 50%.

4.3 Filter Selection Iteration

The Hodrick-Prescott (HP) filter is a standard mathematical tool used in macroeconomics to establish the trend of a variable over time. It is an algorithm that smooths the original time series y_t to estimate its trend component, τ_t. The cyclical component is the difference between the original series and its trend, $c_t = y_t - \tau_t$.

Where is constructed to minimise:

$$\sum_{1}^{T}(y_t - \tau_t)^2 + \lambda\sum_{2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

The first term is the sum of the squared deviations of y_t from the trend and the second term, which is the sum of squared second differences in the trend, is a penalty for changes in the trend's growth rate. The larger the value of the (positive) parameter λ, the greater the penalty and the smoother the resulting trend will be. If for example, $\lambda = 0$, then $\tau_t = y_t$, t = 1,...,t. If $\lambda = \infty$, the τ_t is the linear trend obtained by fitting y_t to a linear trend modelled by ordinarly least squares (OLS.)

The calculation of the HP filter involves a key smoothing parameter, lambda (λ). It has become standard to set the λ to 1,600 for quarterly data. As proposed by the BCBS, the one-sided HP filter with a lambda value of 400,000 is used in the analysis. Only information available at each point in time is used for the construction. The smoothing parameter is set to 400,000 to capture the long-term trend in the behaviour of the credit-to-GDP ratio. The HP filter is used as it tends to give higher weights to more recent observations. This is useful as such a feature is likely to be able to deal more effectively with structural breaks.

5. Methodology and Empirics

5.1 Lag Length Determination

As suggested by the Basel Committee, the credit-to-GDP ratio, the long-term trend of the ratio and the gap were calculated. The long-term trend was calculated by employing the one-sided HP Filter with a lambda value of 400,000. This allowed for the calculation of the gap variable.

The annual growth rate of the NPL is chosen as the dependent variable. The explanatory variables are the credit-to-GDP gap, which is the difference between credit-to-GDP ratio and its long-term trend.

It was established that the key indicators do influence the growth in the dependent variable (NPL). In trying to establish if these key variables(s) have the properties of an EWI, the lag lengths of the key variables had to be determined. For the key variable credit-to-GDP gap, equation 5.1 was estimated and the results are presented in Table 5.1.

$$NPL\_yoy_t = \beta_0 + \beta_1 GAP_{t-1} + \varepsilon_t \qquad (5.1)$$

Where t = 1, 2 …., 8

Table 5.1
Regression Results

Lag	β_1	t-value	p-value	R^2	AIC	SC
0	7.589	2.640	0.012	0.159	9.863	9.949
1	7.362	2.522	0.016	0.147	9.877	9.962
2	6.630	2.228	0.032	0.118	9.910	9.995
3	6.768	2.267	0.029	0.122	9.906	9.991
4	7.397	2.462	0.019	0.141	9.884	9.969
5	7.946	2.601	0.013	0.155	9.868	9.953
6	8.286	2.634	0.012	0.158	9.864	9.949
7	8.778	2.662	0.011	0.161	9.861	9.946
8	7.552	2.099	0.043	0.106	9.923	10.009

From the estimation results, the lag length was found to be 7 quarters (1 year 9 months), where the R^2 is at a maximum and the Akaike information criterion (AIC) and Schwarz criterion (SC) are at a minimum. At lag 7, the coefficient on the GAP variable (β_1) is significant at the 5% level of significance. The results can be summarised as:

$$
\begin{array}{l}
NPL\_yoy_t = 7.37 + 8.78GAPt_{t-7} \\
\qquad\qquad\;\; (1.09) \quad\; (2.66)^{**}
\end{array}
$$

R2 = 0.161 Adj R2 = 0.138 SER = 32.668
DW = 1.08 F = 7.084 (p-val=0.011)

** indicates significant at the 5% level, *t*-stats in parenthesis

Similar regressions are done for both GDP and credit growth with NPL growth. The results are presented in Tables A5.2 and A5.3 in the Appendix. Credit growth has EWI properties and at lag 6 the coefficient is significant at the 1% level of significance whilst GDP growth does not have EWI properties. Having established that the credit-to-GDP gap has EWI properties at lag 7, the threshold levels are then identified by using Sarel's methodology. Sarel (1996) formulated an estimation procedure for inflation threshold which involves running a series of regression equations and finding the threshold value of inflation which maximises R-squared or minimises the Root Mean Square Error (RMSE). In this instance, the following are undertaken;

a. Setting the threshold (T) = 1, 1.5, 2, 2.5, 3 and 3.5
b. Dummy (Di) = 1 if credit-to-GDP Gap > T else Di = 0
c. Setting variable Xi = credit-to-GDP Gap*Di
d. Regressing Growth in NPL = f(credit-to-GDP Gap, Xi)

5.2 Lower (L) and Upper (H) Threshold Identification

An internationally consistent buffer guide serves as a common reference point for taking buffer decisions. The method is summarised below.

Let x_i denote credit-to-GDP ratio, $\bar{x}_t$ denote the long-term trend for the credit-to-GDP ratio. z_i is defined as $x_t - \bar{x}_t$. The buffer is then set using the following formula:

$$
buffer_t = \begin{cases} 0 \; if \; z_t < L \\ \frac{z_t - L}{H - L} 2.5 \quad if L \leq z_t \leq H \\ 2.5 \; if H > z_t \end{cases}
$$

Where L and H denote the lower and upper threshold for the credit-to-GDP gap.

The buffer will be zero if the gap is below the lower threshold and at a maximum level when the gap is above the upper threshold. Anything between the lower and upper thresholds, the buffer would be a linear function of the credit-to-GDP gap (increasing linearly). The BCBS has set the lower (L) threshold to be 2 and the upper (H) threshold to be 10. That is, when the credit-to-GDP gap is below 2, the CCCB add-on is zero and 2.5% of risk-weighted assets when the credit-to-GDP gap is above 10. In PNG's case, the maximum credit-to-GDP gap is found to be around 3.6%, hence a lower threshold can be set at 2 and the BCBS's recommended H = 10 can be taken as the upper threshold. However, based on PNG's credit-to-GDP gap values for the period Q1 2002 to Q2 2014, an upper threshold can be lower than 10. In the absence of a crisis and a low value of the gap variable observed so far, it is difficult to commit on the H value. So we suggest using judgement to decide on the H value while announcing the CCCB requirement, depending on the underlying macroeconomic situation. Being conservative, a starting value can be above two times of the threshold observed in the Sarel's regression (Table 5.2), and H can be set around 7.

Having identified the lag length for the key variable (credit-to-GDP gap) as 7, the following equation is estimated to determine the threshold. The results are given in Table 5.2:

$$NPL\_yoy_t = \beta_0 + \beta_1 GAP_7 + \beta_2 X_{\mathrm{i}} + \varepsilon_t \tag{5.2}$$

Where $i = 1, 2, 3$

Table 5.2
Regression Results

Threshold	β_0	β_1	β_2	R^2	RMSE	AIC	SC
1.0	1.887 (0.240)	6.700 (1.900) *	5.734 (1.347)	0.201	37591.1	9.863	9.991
1.5	1.009 (0.137)	5.804 (1.641)	7.816 (1.929)*	0.239	35785.7	9.814	9.941
2.0	0.973 (0.135)	5.915 (1.709)*	8.037 (2.043)**	0.248	35381.9	9.802	9.930
2.5	1.701 (0.277)	4.994 (1.518)	10.712 (2.878)***	0.318	32100.8	9.705	9.833
3.0	5.138 (0.844)	5.858 (1.904)*	14.366 (3.244)***	0.351	30553.9	9.655	9.783
3.5	6.992 (1.025)	8.526 (2.564)**	7.529 (0.832)	0.177	38740.9	9.893	10.021

*** indicates 1% level of significance; ** indicates 5% level of significance and * indicates 10% level of significance. t-statistic in parenthesis.

From the repeated regression results using a range of threshold levels, it shows when the credit-to-GDP gap is greater than 3%, the coefficients on the credit-to-GDP gap and the dummy variables are significant at the 10% and 1% levels of significance, respectively. The R-squared is at a maximum (0.3506) and the RMSE is at a minimum. The two information criteria (AIC and SC) are also at a minimum. Charts 5.2A and 5.2B in the Appendix depict the information in Table 5.1, with Chart 5.2B showing the effect of the credit-to-GDP gap on NPL growth with plus or minus 1 standard error.

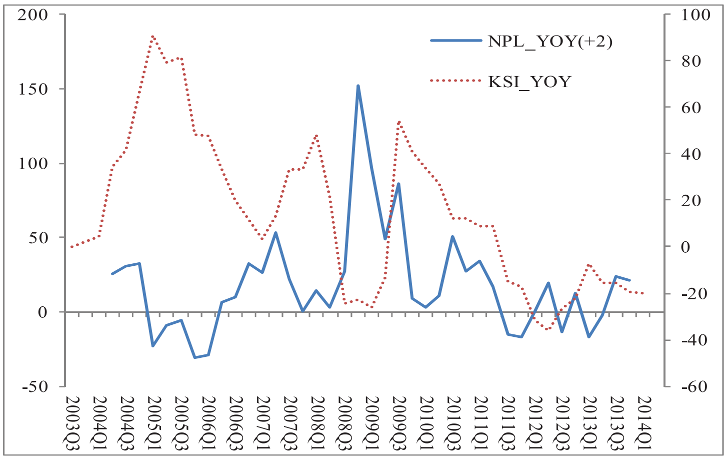
5.3 Buffer Level and Progression

In PNG the minimum capital requirements are more conservative in that they are higher than those of international standards. The minimum capital requirements for total, tier 1 and leverage are set at 12%, 8% and 6%, respectively (BPNG). With the capital conservation buffer set at 2.5%, it will mean that banks will now have to hold 2.5% additional capital on top of the current minimum requirements. In the event that BPNG commits to Basel III and implements CCCB, a further 0 – 2.5% of capital will be required.

6. Supplementary Indicator(s)

The KSI tends to co-vary with the movements in the growth in NPLs in PNG. Correlation analysis (Appendix Table 4.3A) shows a negative (-0.43) relationship between the two and is significant at the 5% level. The negative relationship implies that when businesses are performing well, NPLs tend to decline and vice versa. That is, when businesses are doing well, it can be inferred that the economy is also doing well and as such borrowers are able to service their loan obligations resulting in NPLs being reduced. It may also mean that businesses are cashed-up and using own funds, therefore not resorting to bank credit.

Chart 6.1
NPL and Kina Shares Index Growth



The chart shows that between 2003 and 2005 the KSI trended upwards whilst the NPLs were trending downwards. From 2006 to 2007, the KSI was on a decline whilst the NPL trended upwards. In 2008 and 2009 (the GFC period), the KSI dipped which resulted in the NPLs increasing significantly and when the KSI recovered in 2010, the NPLs declined. However, in 2011, both seemed to move in the same direction, but then reverted to their long-term relationship from 2012.

6.1 Buffer Release

The domestic (PNG) financial system has yet to experience a banking crisis and therefore it is quite difficult to test the credit-to-GDP gap as an indicator for the build-up and release of the capital buffer using noise-to-signal ratio as indicated in Drehmann (2011)[12]. However, the supplementary variable does provide some indication of a crisis with regard to the GFC (Chart 6.1). In late 2007, the KSI declined sharply and this was followed by a sharp increase in the growth of NPLs. As such, the credit-to-GDP gap and the supplementary variable, combined with judgement, can be used to guide PNG authorities to indicate a release of the buffer. The mode and purpose of the buffer release will be at the discretion of the authorities. The release of buffer can be immediate, in steps or gradual, depending on the circumstances and the purpose of the release can be either to absorb losses or maintain credit flows.

6.2 Communication

Since the CCCB is in its infancy stage for most countries, it will take time for the authorities to gain experience in its implementation and communicating it publicly. A communication strategy has to be developed over time in order to explain the buffer decisions. The BCBS proposes that the buffer framework be implemented through a combination of minimum standards and best practice guidance (BCBS, 2010). With the minimum standards, the mechanics of the buffer approach which is the information the banks need to comply with as well as the rules, and relevant information that the authorities need to disclose, must be communicated. In order for the authorities to promote accountability and transparency concerning the buffer decisions, the best practice guidance will have to set out the recommendations. The minimum standards will ensure that the CCCB regime is operationalised within a set timeframe whilst the best practice guidance will make it clear that publicly explaining the buffer decisions is the ultimate goal.

7. Conclusion

The PNG economy has experienced positive changes over the years since independence. With the developments in the real economy, the financial sector, to an extent, has kept pace with the changes. The sector as a whole has been profitable resulting in the expansion of banking services throughout the country

12. BIS Working Paper, No. 355.

and the region, particularly to the neighbouring Pacific Island nations. The banking sector has also played a significant role in the development of the domestic economy. As indicated by the macroprudential ratios, with ratios well above the required minimum levels, the financial institutions in PNG have been complying with the prudential and regulatory requirements.

Given the small size of the PNG financial system/market, ensuring competition among financial institutions to innovate and strive for efficiency is a challenge that BPNG as a prudential regulator faces in formulating market access policies. Information and communication technology has become an important part of the financial sector as can be seen from the increased use of ATMs, EFTPOS, credit/debit cards, money transfer services, internet banking, transferring of market information and security. The growth of the PNG financial sector is thus likely to be closely linked to developments in the country's telecommunications as well as general economic policy and conditions (Biggs, 2007).

The BCBS's Basel III framework came about as result of the 2008/2009 global financial crisis. It is BCBS' continuous effort to enhance the banking regulatory framework by building on Basel I and Basel II. This is to improve the banking sector's ability to deal with financial and economic downturns, improve risk management and strengthen the banks' transparency. A focus of Basel III is to foster greater resilience in order to reduce the risk of system-wide shocks. The proposed implementation of Basel III will complement Basel I and II, especially during periods of stress. The CCCB has been proposed by the BCBS to ensure that banks hold sufficient capital that will enable them to absorb unexpected losses when faced with a negative systemic shock and not compromising lending to the real economy.

The authorities in PNG are yet to commit to the implementation of Basel III and therefore this study is an early research initiative in this direction. With the partial implementation of Basel II, it will require a great deal of progress before the authorities can commit to implementing Basel III.

As suggested by the BCBS, the credit-to-GDP gap can be used to indicate a possible banking crisis. However, during the period (2002 – 2014) the banking sector in PNG did not experience any banking crisis and therefore using the gap variable as the key indicator may have its limitations. An interesting finding from the analysis is that during the GFC, there was a significant growth in NPLs which was reflected in the decline in the KSI. The gap variable did not quite capture the GFC due to the fact that financial institutions in PNG, mainly banks, lending and deposits do not have significant international exposure (Jonathan, 2014).

In PNG's case, the maximum credit-to-GDP gap is found to be around 3.6%, hence BCBS' lower thresholds can be accepted. However, based on PNG's credit-to-GDP gap values for the period Q1 2002 to Q2 2014, an upper threshold can be lower than 10. Based on Sarel's estimation method and judgement, a lower threshold of 2 can be set and a more conservative H can be set at 7.

In conclusion, it is highly recommended that PNG authorities need to undertake further detailed research into the CCCB and Basel III as a whole before committing to its implementation.

List of Abbreviations

ADIs	Authorised Deposit-taking Institutions
AIC	Akaike Information Criteria
APRA	Australian Prudential Regulatory Authority
ATM	Automated Teller Machine
BCBS	Basel Committee on Banking Supervision
BFIA	Banks and Financial Institutions Act
BIS	Bank for International Settlements
BPNG	Bank of Papua New Guinea
BSD	Banking Supervision Department
CAMELS	Capital, Assets, Management, Earnings, Liquidity, Sensitivity
CBA	Central Banking Act
CAR	Capital Adequacy Ratio
CCCB	Countercyclical Capital Buffer
DoT	Department of Treasury
EFTPOS	Electronic Funds Transfer Point of Sale System
EWI	Early Warning Indicator
FMI	Financial Market Infrastructure
FSB	Financial Stability Board
FSSA	Financial System Stability Assessment
G-20	Group of 20 members
GDP	Gross Domestic Product
GFC	Global Financial Crisis
HP	Hodrick-Prescott
IMF	International Monetary Fund
IFS	International Financial Statistics
KATS	Kina Automated Transfer System
KSI	Kina Shares Index
LFIs	Licensed Financial Institutions
LIA	Life Insurance Act
NPL	Non-performing loans
NSO	National Statistical Office
ODC	Other Depository Corporations
OLS	Ordinary Least Squares
OFC	Other Financial Corporations
PNG	Papua New Guinea
QEB	Quarterly Economic Bulletin
RBA	Reserve Bank of Australia
RMSE	Root Mean Square Error
RTGS	Real Time Gross Settlement
SC	Schwarz criterion
SEACEN	South East Asian Central Banks
SGPA	Superannuation General Provisions Act

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Figure A1.1
Other Depository Corporation and Other Financial Corporation Structure

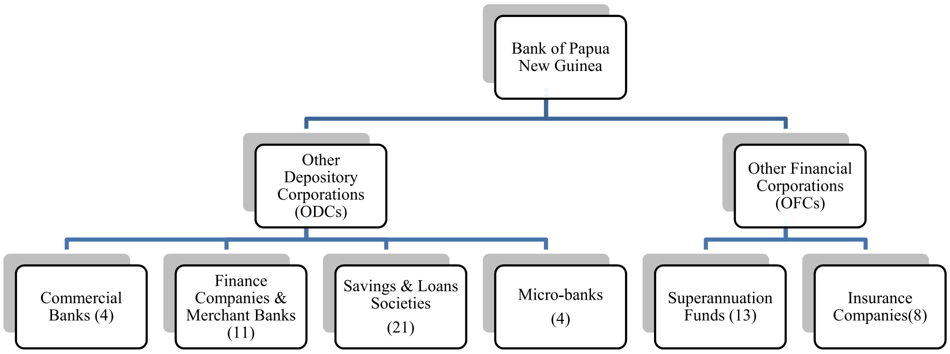


Figure A1.2
Other Financial Corporations

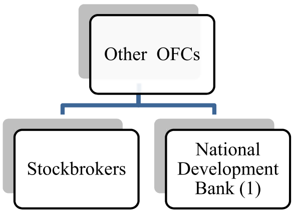


Figure A1.3
PNG Financial Market

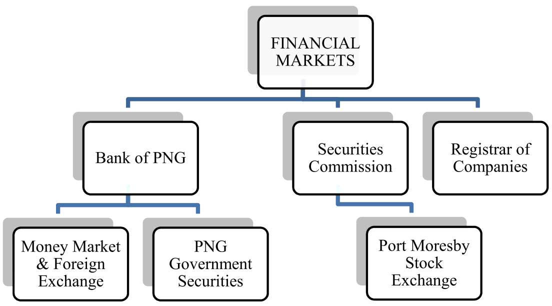


Chart A1
Composition of Assets (June 2014)

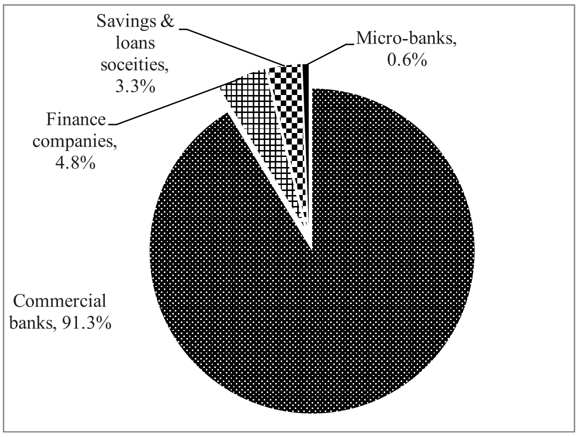


Table A1
Characteristics of the Banking Sector in Papua New Guinea

Private Sector Credit (2009-2013 average)		
Banks	Non-banks	
90.3	9.7	
Ownership of Banks		
Public	Private	Foreign
None[13]	25%	75%
Targeted Credit		
Agriculture	Manufacturing	Small-Medium Enterprises
Not applicable	Not applicable	Not applicable
Crises Year	Banking Supervisor	Major Reforms (Year)
None	Bank of PNG	2000

13. Prior to 2005, the largest commercial bank (Papua New Guinea Banking Corporation, PNGBC) was state-owned.

Table A4.1
Descriptive Statistics

	Credit	GDP	Credit/GDP	HP1STrend	GAP	Non-performing loans	Kina Share Index	Profit (Loss)
Mean	5,293.1	5,914.9	21.7	20.8	0.8	129.5	4675.7	99.8
Median	5,277.5	5,483.8	24.0	21.3	1.0	98.9	4577.5	116.9
Maximum	9,925.1	9,689.5	28.6	29.3	3.2	265.7	7345.7	782.5
Minimum	1,672.5	3,281.9	12.8	12.0	-3.6	42.5	1372.3	-287.0
Std. Dev.	2,722.7	1,944.0	5.42	6.34	1.93	70.5	1649.1	223.5
Skewness	0.15	0.29	-0.49	-0.11	-0.53	0.31	-0.23	0.49
Kurtosis	1.68	1.78	1.69	1.41	2.07	1.58	2.37	3.34
Jarque-Bera	3.28	3.30	4.84	4.60	3.53	4.31	1.08	1.96
Probability	0.19	0.19	0.09	0.10	0.17	0.12	0.58	0.37
Sum	227,604	254,342	932	894	33	5,569	201,055	4,290
Sum Sq. Dev.	311,000,000	159,000,000	1234	1689	157	208,781	114,000,000	2,097,148
Observations	43	43	43	43	43	43	43	43

Table A4.2
Data Matrix

Macro Indicators	Data Availability	Data Frequency	Breaks	Reforms
Gross Domestic Product (GDP)	Annual	1977 – 2014	1994[14]	
	Quarterly	1977Q1 - 2014Q2	1994Q4	
Private Sector Credit (Credit)	Monthly	2002M1 – 2013M03	2002Q2	SRF[15]
	Quarterly	2002Q1 – 2014Q2	2002Q2	SRF
Total Commercial Bank Deposit	Monthly	2002M1 – 2014M03	2002Q2	SRF
	Quarterly	2002Q1 – 2014Q2	2002Q2	SRF
Banking Data				
Non-Performing Loans (NPLs)	Quarterly	2003Q1 – 2014Q2		
Profit /Loss	Quarterly	2003Q1 – 2014 Q2		
Prudential Ratios	Quarterly	2003Q1 – 2014Q2		
Financial Indicators				
Stock Prices (Kina Share Index)	Monthly	2001M1 – 2014M06		
	Quarterly	2002Q1 – 2014Q2		

14. Revision of annual data series by the National Statistical Office for the years 1994 – 2006.
15. International Monetary Fund introduced the Standardised Reporting Format (SRF) in which the coverage was extended to include Other Depository Corporations (ODCs) and Other Financial Corporations (OFCs). ODCs include commercial banks, finance companies, merchant banks, savings and loans societies and micro-banks. OFCs include superannuation funds,

Data Sources and Descriptions

Nominal GDP: Sourced from PNG's National Statistical Office (NSO). The annual series was converted to a quarterly series through interpolation in Eviews8. For the annual series, there was a break in series in 1994, as data from 1994 to 2006 were revised. GDP numbers from 2007 to 2014 were sourced from the Department of Treasury (National Budget documents).

Private Sector Credit: The quarterly series for private sector credit was sourced from IMF's International Financial Statistics (IFS) e-library database (http: http://www.elibrary.imf.org/).

Total Deposit: Data is sourced from BPNG's Quarterly Economic Bulletin.

Profit/Loss: The quarterly data series on profit and loss is obtained from the quarterly reports submitted by financial institutions to the BPNG (Supervision Department).

Non-performing loans: Sourced from Banking Supervision Department (BSD), BPNG.

Prudential Ratios: Sourced from the BSD, BPNG.

Kina Share Index (KSI): Sourced from the Port Moresby Stock Exchange

Table A4.3
Correlation Analysis

	GAP 1.6K	GAP 25K	GAP 400K	NPL	NPL1	NPL2	NPL3	NPL4	GDP	CREDIT	KSI
GAP1.6	1.000 --- ---										
GAP25K	-0.783 (-7.226) [0.000]	1.000 --- ---									
GAP400K	0.879 (10.565) [0.000]	-0.624 (-4.581) [0.0001]	1.000 --- ---								
NPL	0.051 (0.293) [0.771]	0.1500 (0.872) [0.390]	0.290 (1.742) [0.091]	1.000 --- ---							
NPL1	0.104 (0.599) [0.553]	0.095 (0.546) [0.589]	0.338 (2.062) [0.047]	0.523 (3.524) [0.001]	1.000 --- ---						
NPL2	0.205 (1.202) [0.238]	0.072 (0.415) [0.681]	0.416 (2.625) [0.013]	0.263 (1.568) [0.126]	0.527 (3.577) [0.001]	1.000 --- ---					
NPL3	0.223 (1.315) [0.198]	0.069 (0.398) [0.694]	0.398 (2.490) [0.018]	0.171 (0.995) [0.327]	0.253 (1.505) [0.142]	0.521 (3.511) [0.001]	1.000 --- ---				
NPL4	0.231 (1.364) [0.182]	-0.003 (-0.016) [0.987]	0.357 (2.193) [0.036]	-0.098 (-0.567) [0.574]	0.175 (1.020) [0.315]	0.267 (1.594) [0.121]	0.546 (3.746) [0.001]	1.000 --- ---			
GDP	-0.135 (-0.784) [0.438]	-0.033 (-0.187) [0.853]	0.074 (0.423) [0.675]	-0.218 (-1.282) [0.209]	-0.324 (-1.967) [0.058]	-0.134 (-0.778) [0.442]	0.088 (0.504) [0.617]	0.181 (1.059) [0.297]	1.000 --- ---		
CREDIT	0.742 (6.351) [0.000]	-0.461 (-2.980) [0.005]	0.765 (6.832) [0.000]	0.032 (0.183) [0.856]	0.148 (0.861) [0.396]	0.331 (2.016) [0.052]	0.398 (2.494) [0.018]	0.336 (2.051) [0.048]	0.195 (1.141) [0.262]	1.000 --- ---	
KSI	0.418 (2.646) [0.012]	-0.690 (-5.480) [0.000]	0.402 (2.523) [0.017]	-0.146 (-0.845) [0.404]	-0.276 (-1.651) [0.1082]	-0.425 (-2.693) [0.011]	-0.286 (-1.711) [0.096]	-0.049 (-0.283) [0.779]	0.422 (2.674) [0.012]	0.139 (0.808) [0.425]	1.000 --- ---

t-statistics in curly brackets, ( ); p-values in square brackets, [ ]

Chart A4.1
Macro-prudential Indicators (Q1 2005 – Q2 2014)

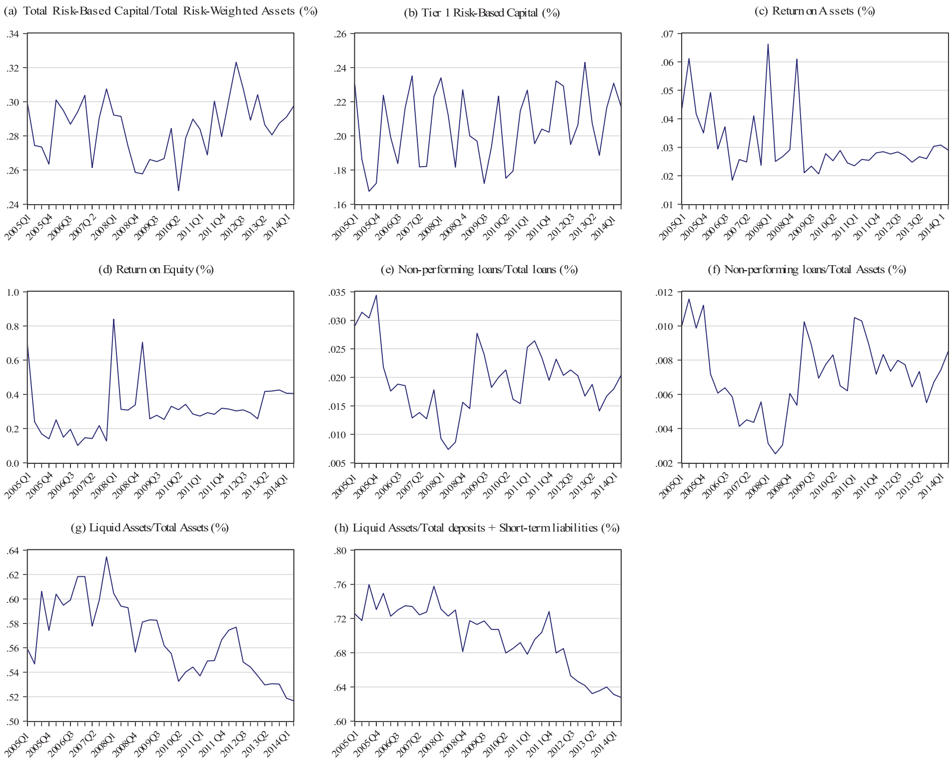


Chart A4.2 (b)
NPL and Credit Growth

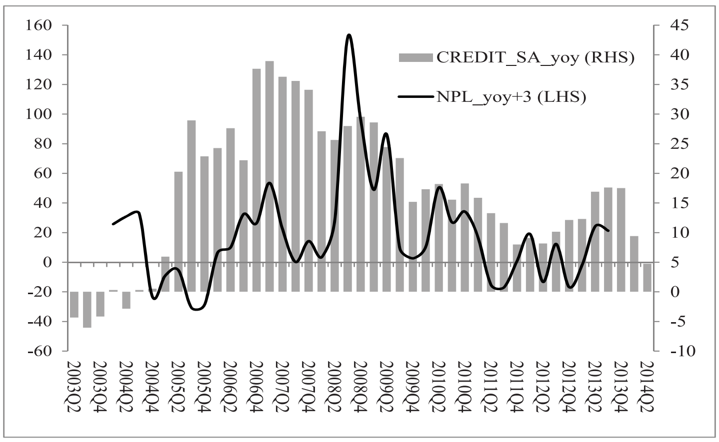


Chart A4.2 (c)
NPL and GDP Growth

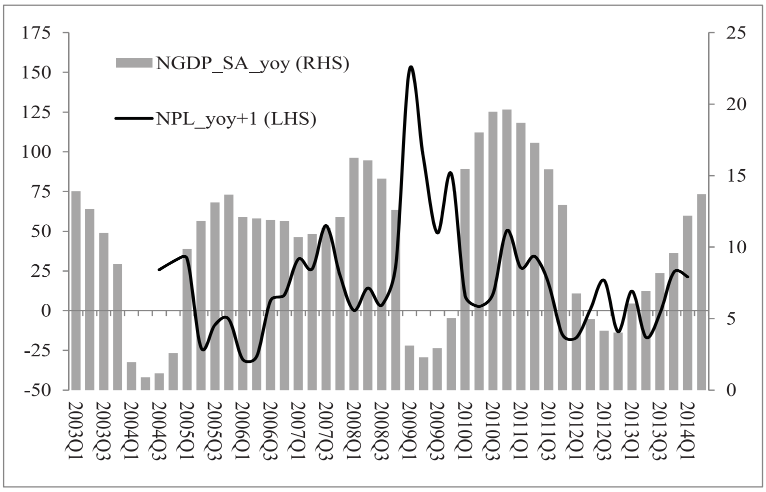


Table A5.1
Regression Results

Lag	β_1	t-value	p-value	R^2	AIC	SC
0	0.9254	1.8262	0.0827	0.0729	9.9495	10.0348
1	0.8273	1.7150	0.0947	0.0736	9.9593	10.0446
2	0.8387	1.8464	0.0728	0.0844	9.9476	10.0329
3	1.0752	2.5532	0.0149	0.1498	9.8735	9.9588
4	1.2513	3.1807	0.0030	0.2147	9.7941	9.8794
5	1.4421	3.7727	0.0006	0.2833	9.7303	9.8164
6	1.6940	4.7021	0.0000	0.3871	9.6001	9.6871
7	1.6457	4.4010	0.0001	0.3629	9.6647	9.7526
8	1.0298	2.3688	0.0239	0.1453	9.9519	10.0408

Note: $NPL\_yoy_t = \beta_0 + \beta_1 credit\_yoy_{t-1} = \varepsilon_t$ (5.2) where t = 1, 2 …., 8

Table A5.2
Regression Results

Lag	β_1	t-value	p-value	R^2	AIC	SC
0	**-2.0749**	**-1.9639**	**0.0571**	**0.0944**	**9.9366**	**10.0219**
1	-0.9713	-0.9231	0.3619	0.0225	10.0130	10.0983
2	0.2067	0.2033	0.8424	0.0011	10.0347	10.1200
3	1.1087	1.0897	0.2829	0.0311	10.0042	10.0895
4	1.6176	1.6117	0.1155	0.0656	9.9679	10.0532
5	1.3935	1.3671	0.1798	0.0481	9.9865	10.0718
6	0.7352	0.6982	0.4894	0.0130	10.0227	10.1080
7	0.2551	0.2329	0.8172	0.0015	10.0619	10.1481
8	0.2029	0.1798	0.8583	0.0009	10.0888	10.1759

Note: $NPL\_yoy_t = \beta_0 + \beta_1 GDP\_yoy_{t-1} = \varepsilon_t$ (5.3) where t = 1, 2 …., 8

Chart 5.2A

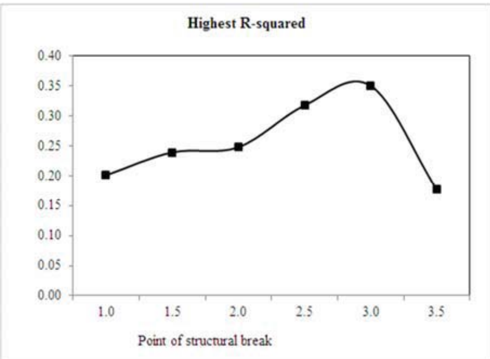
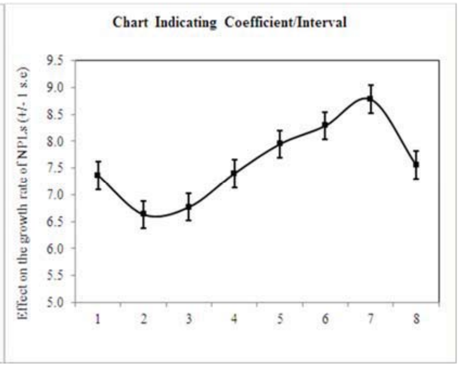


Chart 5.2B



Chapter 6

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL TEST FOR THE PHILIPPINES

By
Roselle R. Manalo[1]

1. Introduction

The global financial crisis that began in 2007 highlighted the weaknesses in the prevailing regulatory framework for banks. In particular, the crisis emphasised the need to address the procyclical nature of banks' behaviour, with the financial system amplifying the business cycle by boosting credit in good times and contracting credit in bad times. Prior to a crisis, risks are deemed low and credit expanded rapidly which usually requires low amount of capital. During a crisis, the measure of banks' riskiness climbs, prompting for higher capitalisation that is more costly and difficult to source during stress period. Against such environment, existing regulations on bank capitalization have somehow increased the pressure for banks to reduce the size of their balance sheets through sharp deleveraging and constriction of credit supply, which negatively affects overall economic activity.[2]

The recent crisis also showed that static capital requirements are not enough.[3] Loan loss provisions and capital ratio requirements, which fail to increase in economic booms, contribute to the procyclicality of the financial system. Borio, et al. (2010) noted that financial stability will be enhanced if such provisioning will also increase in good times, tracking risks better and acting as a built-in

1. Roselle R. Manalo is Bank Officer V of the Department of Economic Research (DER) of the Bangko Sentral ng Pilipinas (BSP). The views expressed in this paper are those of the author and do not necessarily represent those of the BSP or BSP policy. The author is most thankful for the technical assistance provided by Mauro E. Jasmin, Jay G. Pineda, and Merzinaida Donovan and helpful comments of Evelyn R. Santos.

2. Chen, D. X. and I. Christensen, (2010), "The Countercyclical Bank Capital Buffer: Insights for Canada," *Bank of Canada Financial System Review.*

3. Riksbank Studies, "Countercyclical Capital Buffers as a Macroprudential Instrument," December 2012, p. 7.

stabiliser when capital is generally cheaper and easier to raise in normal times than in recessions.[4]

In reducing the procyclicality of bank lending to improve bank's capacity to withstand future losses and help maintain the continued flow of credit in the economy, the Basel Committee on Banking Supervision (BCBS) in 2010 finalised the third installment of the Basel Accords which include among others the establishment of a countercyclical capital buffer (CCCB).[5]

In the Philippines, where the banking sector remains the core of the financial system and the primary source of credit for the economy (see Annex Table 1), the establishment of a CCCB appears beneficial. Banks in the country provide almost 80% of credit with the total loan portfolio amounting to ₱4,892 billion as of end-December 2013. Domestic banks capture the largest share of the physical landscape at 98% while the rest of the 2% are foreign banks. In 2013, bank funds are channeled to real estate, renting and business activities (RERBA) and financial intermediation sectors.[6] The said sectors accounted for the highest shares in the total loan portfolio (TLP) of the banking system at 18.5% and 17.0%, respectively, followed by loans to the manufacturing at 13.7% and wholesale and retail trade at 12.8%. Loans extended to agriculture, on the other hand, comprised 4.4% of the banking system's TLP.[7]

With banks as the primary provider of funds in the Philippines, any failure to efficiently intermediate in the system can have significant adverse effect to the economy. This is evidenced by the substantial losses incurred by the public sector in periods where the government has to provide liquidity and guarantees to bring stability to the system. For instance, Gochoco-Bautista (2000) noted that when the Philippines experienced severe banking distress in the early 1980s, the crisis led to the contraction of the economy in 1984-1985. Prior to this crisis, the ratio of domestic credit to GDP recorded a sustained increase which only

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4. Borio, C.; C. Furfine and P. Lowe, (2001), "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options," *Bank of International Settlements Paper,* No. 1.
5. Basel Committee on Banking Supervision (2010), "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking System," December, Rev. June 2011.
6. Inclusive of interbank loans, loans to BSP and reverse repurchase (RRP) transactions
7. The Agrarian Reform Credit Act of 2009 (Section 6) states that all banking institutions, whether government or private, shall set aside at least 25% of their total loanable funds for agriculture and fisheries credit in general, of which at least 10% of loanable funds shall be made available for agrarian reform beneficiaries.

shows the procyclical nature of banks' behaviour in the country. Bank closures reached a peak in 1985 as 2 commercial banks, 6 thrift banks, and 35 rural banks closed.[8] Closures continued in 1986 and 1987 as efforts to weed out the system with weak and inefficient banks became the main focus of the then Central Bank of the Philippines. By mid-1990s, the number of closed banks rose again particularly in 1997 as the Asian financial crisis tested the strength of the local banking system. In 1998, 40 banks closed, higher than the 14 banks that closed in 1997.

Since 1980s, the Philippine banking system had gone through several episodes of policy reforms which aimed to improve the capacity of banks to face adverse shocks and reinforce the institutional framework to deal with problem banks. After the crisis, the BSP embarked on an aggressive and wide-ranging reform process in order to promote a sound, stable and globally-competitive banking system geared towards greater commitment to risk management, strengthening of supervisory framework, restructuring of the local banking system and promotion of corporate governance. More recently, the banking reforms were focused on the implementation of macroprudential measures to enhance the economy's resilience against systemic shocks and reduce the build-up of aggregate risks. In particular, on 1 January 2014, the Philippines implemented the capital requirements consistent with Basel III, which include the capital conservation buffer applicable to universal and commercial banks.

This paper aims to arrive at a consensus in terms of finding appropriate indicators and framework to be used in the establishment of a CCCB in the Philippines. The first part of the study (Sections 1-3) introduces the basics of the Basel III capital requirements, focusing on the motivation and mechanics in designing a countercyclical capital buffer component. A survey of literature on the challenges and cross-country experiences follows along with a brief survey on early warning indicators. The second part (Sections 4-6) focuses on the selection of appropriate indicators and threshold levels in the establishment of a CCCB mechanism in the Philippines. The rest of the paper discusses issues concerning the amount of optimal buffer to be used, indicator, mode and timing of release, and on the methods of communicating the CCCB measure.

8. The number of rural banks closure rose drastically to 20 in 1980 and further to 30 in 1981 when a financial scam involving millions of pesos in debt owed to various financial institutions triggered a financial crisis and a spate of insolvencies in investment houses and finance companies.

2. Comparative Evidences

2.1 The Road to Basel III Reforms

The severity of the 2007 global financial crisis was traced to banks' excessive build-up of on- and off-balance sheet borrowings while the level and quality of their capital base eroded significantly. Banks were holding insufficient buffers that made them incapable of absorbing the resulting trade and credit losses. The procyclical deleveraging process where banks constrain credit in bad times while becoming increasingly interconnected, amplified such losses which rapidly eroded confidence in the banking system, affecting overall liquidity and solvency condition of the financial system.[9]

This prompted the public sector to step in via liquidity injection, capital support, and credit guarantees while regulators examined the market failure unveiled by the crisis. It appears that existing capital requirements are not enough to address systemic risks that vary over time, and that the most efficient way to handle such risks is to let the capital requirement vary over time as well.[10] The procyclicality of banks' capital management led to the amplification of losses, which could have been addressed by appropriate buffers that adjust during the boom and bust cycles of the economy.

By building on the pillars of Basel II, the Group of Central Bank Governors and Heads of Supervision (the oversight body of the BCBS) introduced a comprehensive set of measures to strengthen the regulation, supervision, and risk management of the banking system with the aim of reducing the probability and severity of economic and financial stress. In September 2009, the group agreed to improve the Basel II framework by introducing macroprudential measures that shall address the risks arising from the increasingly systemic and interconnected banking system.

These measures include capital conservation tools such as constraints on capital distribution that are expected to result in "higher capital and liquidity requirements and less leverage in the banking system, less procyclicality, and greater banking sector resilience to stress and strong incentives to ensure that

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9. Stefan Walter, (2010), "Basel III and Financial Stability," Speech Delivered at the 5th Biennial Conference on Risk Management and Supervision, Financial Stability Institute, Bank for International Settlements, Basel, 3-4 November.
10. Borio, et.al., *Procyclicality*, p.1

compensation practices are properly aligned with long-term performance and prudent risk-taking."[11]

The following are the agreed measures in strengthening the regulation of the banking sector: 1) raise the quality, consistency and transparency of the Tier 1 capital base which should comprise primarily of common shares and retained earnings; 2) introduce a leverage ratio as a supplementary measure to the Basel II risk-based framework; 3) introduce a minimum global standard for funding liquidity that includes a stressed liquidity coverage ratio requirement, underpinned by a longer-term structural liquidity ratio; and 4) introduce a framework for countercyclical capital buffers above the minimum requirement.

2.2 The Countercyclical Capital Buffer under the Basel III Regime[12]

To guide supervisors in the transition towards a higher level and quality of capital in the banking system, the oversight group endorsed the framework on building countercyclical capital buffer as part of the requirements of banks to strengthen their capital base.

The BCBS confirmed the framework in September 2010 with the CCCB as part of the reform package to global capital standards. In December 2010, the BCBS issued the procedure and guidelines for national authorities in operating the countercyclical capital buffer. The implementation of a CCCB, as part of the Basel III reforms on capital framework, aims to protect the banks from periods of excess credit growth that has often been associated with the build-up of a system-wide risk. More specifically, this macroprudential tool aims to ensure that the banking system as a whole has sufficient capital to help maintain the flow of credit in the economy in a period of great financial stress.

Table 1 shows the calibration of the capital framework under the Basel III regime. The minimum common equity capital ratio was set at 4.5% of risk-weighted asset, minimum Tier 1 ratio at 6%, and total capital at 8%. From these minimum requirements, a 2.5% capital conservation buffer is added to increase

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11. "Comprehensive Response to the Global Banking Crisis," Bank of International Settlements Press Release: 7 September 2009.
12. "Guidance for National Authorities Operating the Countercyclical Capital Buffer," Basel Committee on Banking Supervision, Bank of International Settlements, December 2010.

the ability of banks to absorb shocks in periods of stress.[13] On top of these capital requirements, the Basel III recommends the activation of a CCCB when credit growth is perceived to be associated with the rise in system-wide risk.

Table 1
Calibration of the Capital Framework
(in percent)

Capital Requirements	Common Equity Tier 1	Tier 1 Capital	Total Capital
Minimum	4.5	6.0	8.0
Conservation Buffer	2.5		
Minimum + Conservation Buffer	7.0	8.5	10.5
Countercyclical Buffer Range*	0 - 2.5		

Source: BCBS (2010a).

*Consistent with the conservation buffer, the Common Equity Tier 1 ratio in this context includes amounts used to meet the 4.5% minimum Common Equity Tier 1 requirement but excludes any additional Common Equity Tier 1 needed to meet the 6% Tier 1 and 8% Total Capital requirements.

In activating a CCCB, the buffer add-on is raised to the recommended 2.5% of a bank's risk-weighted assets in normal times, which effectively extends the capital conservation buffer. When the CCCB is deactivated in period of distress, or when bank losses tend to deplete capital, the CCCB will return to zero for banks not to curtail the availability of credit in the system. Moreover, the activation of a CCCB should be preannounced 12 months in advance (or even shorter than 12 months) to give time for banks to meet the higher capital requirement. However, reductions in the buffer rate should be announced immediately to help reduce the risk of a credit crunch.

13. The 2.5% additional capital buffer that banks are required to hold above the regulatory minimum should be in the form of Common Equity Tier 1 capital, the higher quality form of capital. Operationally, the BCBS proposes that Common Equity Tier 1 must be first used to meet the minimum capital requirements (including the 6% Tier 1 and 8% Total Capital requirements, if necessary) before the remainder can be included to the capital conservation buffer. Capital distribution constraints will be imposed on banks when capital levels fall within this range.

The CCCB may vary between zero and 2.5% of total risk-weighted assets (RWA) depending on the judgment of the national authorities as to the extent of the build-up of system-wide risk. Banks must meet this buffer with Common Equity Tier 1 or other fully loss absorbing capital or be subject to the restrictions on the distribution of earnings such as dividends and share buybacks, in particular.

For banks with purely domestic credit exposures, they will be subject to the full amount of the add-on determined by the national authorities. For banks with international credit exposures, the buffer add-ons will be calculated for each of the jurisdictions in which they have credit exposures using the buffers implemented in each of these jurisdictions. Moreover, the national authorities should ensure that the CCCB requirements are calculated and publicly disclosed at least with the same frequency as their minimum capital requirement.

The CCCB is targeted to be implemented gradually in parallel with the capital conservation buffer from 1 January 2016 up to end-2018 and fully effective by 1 January 2019. Countries should begin to set-up their CCCB framework as the requirement for international reciprocity at 0.625% of RWA in 2016, which is subject to increase gradually to 2.5% in 2019. Should a country experience significant credit growth within this period, the establishment of their CCCBs can be accelerated while the reciprocity will still apply according to schedule.

2.3 Progress of Basel III Implementation in the Philippines[14]

The Philippines officially implemented the capital requirements consistent with Basel III on 1 January 2014 which covers the enhancement of the risk-based capital adequacy framework and introduction of a capital conservation buffer. The adoption of the reform aims to strengthen the quality and level of capital and to enhance the risk coverage against financial and economic stress. It also seeks to improve risk management and governance and strengthen banks' transparency and disclosure practices.

To give banks ample time to raise the higher capital requirements, the implementing guidelines on capital adequacy was released on 15 January 2013, a year before the target implementation under Circular No. 781 which applies

14. Box Article 4, "Basel III Implementation in the Philippines," Bangko Sentral ng Philipinas Annual Report: 2013.

to universal and commercial banks (U/KBs)[15] and their subsidiary banks and quasi-banks.[16] For foreign bank branches (FBBs), which operate under the U/KB license, a calibrated Basel III framework was issued under Circular No 822 dated 13 December 2013.

The 10% minimum capital adequacy ratio (CAR) was retained which is higher than the minimum international standard of 8%. However, the composition of eligible capital and the minimum sub-ratios that go into the 10% CAR threshold were changed. Relative to Basel II, Tier 3 capital has been eliminated. A new form of Tier 1 capital is introduced and it is referred to as Common Equity Tier 1 (CET1).[17] The CET1 is at the core of the capital reform and this is set at 6% of RWAs at the minimum. Tier 1 capital as a ratio to RWA must be at 7.5% at the minimum while Tier 2 capital makes up the rest of eligible bank capital.

To further ensure that banks have sufficient capital during periods of economic downturn, the BSP also adopted the 2.5% capital conservation buffer which can only be complied with using CET1 instruments.[18] Thus, when you consider the buffer, the CET1 minimum effectively is set at 8.5% of RWAs. The Table 2 shows a comparison of the minimum ratios (with and without the conservation buffer) under the Basel III and BSP guidelines.

Table 2
Basel III and BSP Capital Requirements
(in percent)

Capital Requirement	Under Basel III		BSP guidelines		
	Minimum Ratios	With Conservation Buffer	Old Minimum Ratios	New Minimum Ratios	New Minimum with Conservation Buffer
CET1 ratio	4.5	7.0	None	6.0	8.5
Tier 1 ratio	6.0	8.5	5.0	7.5	8.5
CAR	8.0	10.5	10.0	10.0	10.0

Source: Bangko Sentral ng Pilipinas.

15. Banks operating in the Philippines are classified according to their authorities. The main bank categories are universal, commercial, thrift, rural and cooperative bank. Special types of banks include microfinance and Islamic banks (Section 3, General Banking Law of 2000 or Republic Act No. 8791).
16. Standalone thrift banks and rural banks are still under the Basel 1.5 regime.
17. For foreign bank branches (FBBs), a “Permanently Assigned Capital” is designated which is the CET1 equivalent for FBBs.
18. For the capital conservation buffer, it shall be applied on both solo and consolidated basis.

Banks that do not meet the 2.5% capital conservation buffer will be restricted from paying dividends, buying back shares and paying discretionary employee bonuses. The intention is to build up the required capital by retaining what otherwise will be distributed through dividends and bonuses. The restriction on the distribution shall be implemented as follows:

Table 3
Restriction on Distribution of Earnings
(in percent)

Level of Capital Conservation Buffer	Minimum Capital Conservation Ratios*
0 - 1.25	100
> 1.25 - 2.50	50
>2.50	0

Source: Bangko Sentral ng Pilipinas.
* Expressed as a percentage of earnings.

2.4 Progress of Basel III Implementation in Korea[19]

As a member of the Basel Committee and a founding member of the G20, Korea is committed to comply with the implementation of the Basel III components. The rules and implementation of Basel III was finalised on 30 May 2013 and took effect on 1 December 2013. Banks are required to maintain a minimum common equity capital ratio of 3.5%, a minimum Tier 1 Capital Ratio of 4.5% and a minimum Total Capital Ratio of 8% in the first phase.

With the capital of most Korean banks comprised mostly ofcommon equity and the amount of capital measured against their assets is relatively large, the impact of the Basel III rules is expected to be manageable. Despite the series of financial crises over the past 15 years, Korean banks were able to maintain their strong liquidity and high capital buffer positions. The exposure to securitised products is also not significant. As of end-2013, Korean banks' CAR for common equity is at 11% with total capital at 14%, higher than the 10.5% required by 2019 under the Basel III regime. The Basel III leverage and liquidity standards will be implemented beginning 2015.[20]

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19. "Korea to Implement Basel III Capital Regulations from December 2013," Financial Services Commission, Press Release, 30 May 2013.
20. Statistics lifted from Bank of Korea website.

Meanwhile, the implementation of CCCB in Korea remains a challenge. Business cycle differs from industry to industry, hence, depending on portfolio exposure, it will be difficult to assess whether to accumulate or use down a buffer. The accuracy of the implementation of the buffer will also be problematic since business cycles also differ from region to region (i.e., some parts of the Korean peninsula that rely on ship construction are in their early stage of development while in other regions, there are companies such as Samsung Electronics which are already booming).

3. Related Literature

The implementation of the new capital requirements under the Basel III regime is expected to benefit the economy by reducing the probability of a severe financial crisis from occurring. The reforms aim to enhance the resilience of banks and financial institutions, reduce economic volatility, and increase transparency. Even before the proposal for a CCCB by the BCBS was finalised in 2010, many banks in Asia have been practicing the principles behind the CCCB framework. Packer and Zhu (2012) noted that many economies in Asia adopted stricter provisioning requirements following the Asian financial crisis. Evidence from the 240 banks surveyed in 12 Asian economies suggests that countercyclical loan-loss provisioning has dominated throughout emerging Asia which made them resilient from the global financial crisis that started in 2007.

However, the benefits from these reforms come with a cost. It is expected to cause greater regulatory burdens, higher transaction costs, slower credit growth, and reduced innovations in the financial sector.[21] KPMG (2011) highlighted that weaker banks will find it difficult to raise the required capital which can result in intense competition and to more mergers and acquisitions among banking institutions. Pressure on banks' profitability will rise as the cost of funding increases with the higher capital requirement. Return to investors will likely drop in a time when firms need investors the most to build and restore the required buffers. Banks will have difficulty raising funds as debt and equity issuances will become less attractive to investors given that dividends are expected to be reduced to allow firms to build a stronger capital base. Finally, the higher provisioning requirement may curtail growth of lending and economic output.[22]

21. Morgan, P. and V. Pontines (2013), "An Asian Perspective on Global Financial Reforms," *Asian Development Bank Institute Working Paper,* No. 433.
22. KPMG, (2011), Basel III: Issues and Implications.

A number of studies already quantified the impact of the higher capital requirement to gross domestic product (GDP). The BSBS and Financial Stability Board (FSB) in February 2010 showed that bringing the global common equity capital ratio to the set minimum plus the capital conservation buffer will cause GDP to decline by a maximum of 0.22% from the forecast baseline that will occur after 35 quarters. In a subsequent study where banks are assumed to complete the transition to new levels of capital and liquidity requirements, results reflected that a percentage point increase in the capital ratio results to a 0.09% drop in output while meeting the liquidity requirement will cause GDP to contract by 0.08%. Empirical studies on a country-specific basis also reflected similar results. Parcon-Santos and Bernabe (2012) estimated that an accumulated 1% change in capital requirement leads to a 0.01% drop in real GDP per annum in the Philippines. These studies imply that the impact of higher capitalisation on growth could be marginal.

On a granular perspective, the implementation of a CCCB, which uses the credit-to-GDP gap in determining the timing of the implementation of the buffer, has attracted numerous criticisms. Doubts on the use of the credit-to-GDP gap in identifying periods of excessive credit growth were raised by Edge and Meisenzahl (2011) and by Buncic and Melecky (2013) while Shin (2013) proposed the use of other macroeconomic variables as early warning indicators or anchors for the CCCB. Repullo and Saurina (2011) suggested the use of credit growth or the deviation of the growth of credit with its long-run average as a leading indicator of systemic banking crisis.

Repullo and Saurina (2011) further stressed that the credit-to-GDP gap may trigger procyclical changes in the buffer that can prompt an increase in capital when GDP growth is high and a decline in period when GDP growth is low. Results showed that the minimum capital required is highly negatively correlated with the business cycle. Drehmann and Tsatsaronis (2014) counter-argued that the negative correlation between the credit gap and real GDP growth could only be partly correct and occurs during period “when credit gap was low and the capital buffer would not have been activated, or periods following crises when the buffer would have been released.” However, Drehmann and Tsatsaronis (2014) acknowledged the inconsistencies between financial and business cycles and should warrant further studies.[23] Drehmann, et al. (2012) showed that the boom and bust periods in the financial cycle are more aligned with periods of banking crisis than fluctuations in the business cycle.

23. BIS Quarterly Review, March 2014.

In the Philippines, the credit-to-GDP gap and business cycle models have been used as anchors in bank provisioning behaviour, which has been observed to be highly procyclical. Leitner (2005) noted that despite the call of a countercyclical approach during the boom and bust cycle, the Philippines applied a procyclical stabilisation policy with the highly positive and strong correlation of government expenditures and money supply with output. The findings from Floro (2010) support further the procyclical behaviour of provisioning of banks in the Philippines, in particular, for low-capitalised banks.

The procyclical nature of provisioning in the country is evidenced by the rise in financial crisis assistance by the central bank to banks confronted with temporary liquidity problem during the Philippine banking crisis 1981-1987 as identified by Gochoco-Bautista (2000). Outstanding emergency loans reached ₱32.9 billion in April 1985 from a low of ₱2.5 billion in 1980. Outstanding bank overdrafts also increased significantly to ₱152.2 billion in March 1986 from ₱31.7 billion in December 1983. In addition, the central bank attempted to stabilise the system by infusing additional liquidity through the Industrial Rehabilitation Fund and Stock Financing Programme. During the Asian financial crisis in 1997, the BSP released ₱5.2 billion in emergency loans to banks with liquidity problems. Moreover, the BSP's financial assistance to the Philippine Deposit Insurance Corporation (PDIC), which was primarily intended to rehabilitate ailing banks, grew dramatically to ₱177.0 billion in 1999 from ₱2.1 billion in February 1985. Meanwhile, the political crisis in 2000, led to a rise in emergency loans that reached ₱21.6 billion, attributed largely to the assistance extended to a bank faced with heavy withdrawals due to its involvement in the impeachment trial of former President Joseph E. Estrada. A year later, emergency loans increased further to ₱31.359 billion as the banking system suffered dwindling investors' confidence.[24]

4. Empirical Analysis

This study aims to arrive at a consensus in terms of finding the appropriate indicator to be used in the establishment of a CCCB in SEACEN member economies, in the Philippines, in particular. While the BIS recommends the use of the credit-to-GDP gap (or the "GAP") as the choice variable in taking buffer decisions, the guidelines suggest the need to assess a broad set of information

24. Gochoco-Bautista, M.S., (1999), The Past Performance of the Philippine Banking Sector and Challenges in the Post-crisis Period.

which include the use of macroeconomic, banking, and financial variables that can guide authorities in the buffer-decision making process in both the build-up and release phase of a CCCB.

This section begins with the selection of indicator variables that show properties of an early warning indicator (EWI). The assessment of the credit-to-GDP gap as the conditioning buffer guide for the Philippines follows by comparing the performance of the GAP series in signaling banking crises against other variables such as credit growth, GDP growth, stock market returns, and changes in residential capital values.

Using the credit-to-GDP gap as a choice variable, the gap series is calculated in accordance with the BIS framework of a rule-based CCCB guide. Further, the study extends the analysis by conducting a series of filter iterations in establishing the trend which can best fit the credit cycle in the Philippines. While the BIS suggests a one-sided Hodrick-Prescott (HP) filter analysis, the study explores the results from conducting alternative specifications from a two-sided HP filter with different smoothing parameters.

A series of robustness tests are employed in examining the strength of the variable as an EWI beginning with the conduct of a stepwise regression analysis between the credit gap series and the growth of non-performing assets (NPA) as well as its lag values. The selection of the threshold levels that can trigger the build-up and release of the buffer follows and is assessed on the basis of its noise-to-signal ratio and Sarel's method of total fit combined with the BIS rule of an "L+8" band methodology.

Finally, for the release phase, a number of supplementary variables are likewise examined on how they impact the banking and macroecnomic variables and on their ability to timely signal a crisis. This is done through correlations analysis between the supplementary indicators and bank NPAs.

4.1 Data Description

The conditioning variables that can guide the accumulation and release phase of the CCCB are divided into three groups: macroeconomic indicators, banking data, and financial variables (see Appendix Table 4). The macroeconomic variables include: nominal and real GDP, real credit growth, and deviations of the credit-to-GDP ratio from its long-term trend. The measures of banking sector performance include the loss indicator or NPA of the banking system. In the financial indicator group, variables include growth in the Philippine Stock Exchange index (PSEi) and residential capital values which serve as supplemental variables relevant in the release phase of the CCCB exercise.

The frequency and data coverage of the identified variables vary. The macro, banking indicators, and stock market data are on a quarterly basis from 4Q 1988 to 2Q 2014 with 103 observations. For financial indicators, the residential capital values cover data from 3Q 1995 to 3Q 2014 with 77 observations. The GDP and credit variables are both annualised and deseasonalised using the Census X12 methodology. The macro, banking and asset price variables are denominated in peso while the stock market data are in index points. Most of the macroeconomic and banking indicators are sourced from the Department of Economic Statistics of the BSP while the other financial variables are extracted from the Bloomberg while real capital values are from Colliers International.[25]

The descriptions of the major variables used are as follows:

In measuring aggregate macroeconomic condition and the country's business cycle, the nominal GDP growth is used in this study. The nominal GDP forms part of the Basel-proposed conditioning variable, the credit-to-GDP ratio.

Credit is defined as the private domestic credit that includes all sources of private sector debt, even those debts funded or sourced abroad. Empirical works by Borio and Lowe (2002) and Kaminsky and Reinhart (1999) suggest that developments in the credit market may provide an early warning indicator of vulnerability in the financial system. As boom periods are characterised by rapid credit expansion and declines in overall credit are typically considered as symptomatic of a credit crunch, deviations of credit growth from a trend can be informative of an impending financial crisis.

Non-performing assets refer to the sum of non-performing loans (NPL) and real and other properties acquired (ROPA). Meanwhile, NPL refers to past due loan accounts whose principal and/or interest is unpaid for 30 days or more after due date while ROPA refers to real and other properties, other than those used for banking purposes or held for investment, acquired by the bank in settlement of loans through foreclosure or dacion in payment and/or for other reasons. In this paper, NPA is used as indicator of financial stress given the rise in loans that are likely to default which can impact the ability of a financial

25. See Annex Table 1 for the basic statistics of the sample data.

institution to intermediate effectively, causing credit channels to function inefficiently.

Financial data includes stock market returns which is measured by taking the growth of the PSEi which is a weighted aggregate index of 30 stocks representative of the six sector indices of the country's stock market. These indices include the financial, industrial, holding firms, property, services, and mining and oil indices. Studies suggest that changes in the stress level in the global banking system became highly correlated with stock market returns.

Finally, in the absence of housing prices, residential capital values published by Colliers International are used as proxy for property price growth. The deviation of property prices from the trend can help identify crisis period which can be used in the activation phase of a buffer.

4.2 Identifying the Key Indicator

The BIS guidance framework posted a caveat on the use of credit-to-GDP gap as the common reference in operating a CCCB, noting that "the guide does not always work well in all jurisdictions." Many authors have proposed the use of indicators other than the credit-to-GDP gap as anchor variable that can be used in designing a CCCB guide.

Drehmann and Tsatsaronis (2014) compared the performance of six indicators, which include the credit-to-GDP gap, credit growth, GDP growth, residential property price growth, debt service ratio, and non-core liability ratio. The indicators were assessed in terms of their strength as an EWI for banking crisis. The results showed that the credit-to-GDP gap is statistically the best single EWI indicator for forecast horizon between five and two years.

Meanwhile, Repullo and Saurina (2011) proposed the use of real credit growth, or the deviations of credit growth with respect to its long-run average, as the common reference variable for taking buffer decisions. The study showed that real credit growth appears to be a good signaling variable in the build-up of systemic risk and does not exacerbate the underlying procyclicality of Basel's minimum capital requirements.

In this section the performance of different conditioning variables are analysed by visually inspecting the movement of these variables against the country's historical banking crises. As discussed in Section 3, severe banking crisis in the Philippines occurred in 1980s which led to the contraction of the economy in 1984-85. Another crisis followed in 1997 when a significant number of banks closed in the aftermath of the Asian financial crisis. Financial stress continued in the next five years with the BSP primarily supporting the banking system through emergency loans. During this period, non-performing loans reached its peak, reflecting the rapid decline in operational efficiency of the banking system which has been the main concern during the Asian crisis. The system was subject to more pressures arising from defaults of payments of banks' corporate clients and rise in total expenditures were not translated into higher returns as their income generating activities were tempered by the slowdown in economic activity.

In this study, the crisis period captured by the available data includes only the 1997 Asian financial crisis. Charts 1.A to 1.C show the evolution of the selected variables around historical banking crisis. The charts reflect the ability of credit-to-GDP gap and credit growth variables in anticipating stress period as they rise strongly before a crisis worsens. On the other hand, developments of the property price gap indicator may not be conclusive in identifying a crisis period which can be due to the lack of long data series. For the stock market return, given its volatile behaviour, the indicator fails to appropriately signal a crisis period in advance as it rises rapidly in a stress event and subsequently falls after its peak. Given the above observations, the credit-to-GDP gap appears the best indicator in identifying banking stress.

Chart 1
Performance of Conditioning Variables and Banking Crisis
(in percent)

A. Credit/GDP & Property Prices | **B. Real GDP & Credit Growth** | **C. Growth in Stock Returns & NPA**

Note: Shaded area represents crisis period. Credit-to-GDP ratio and property prices are deviations from its long- term trend using the highest smoothing parameter, while GDP and credit growth are in real terms. NPA is in billion pesos.

4.3 Using the BIS Framework[26]

The BCBS has identified a common starting reference point to guide regulators in setting their appropriate CCCBs. The standard BIS framework, which was based on empirical evidence drawn from periods of more than 40 systemic banking crises in 36 countries, relies on the use of the credit-to-GDP gap as the key indicator in the accumulation phase of the CCCB. The empirics from the BIS framework showed that the credit-to-GDP gap has the most suitable signaling properties among the indicators.

Applying the BIS framework, the credit-to-GDP gap for the Philippines is calculated as follows:

$$RATIO_t = CREDIT_t / GDP_t \ x \ 100\% \qquad (1)$$

GDP_t is domestic GDP and $CREDIT_t$ is private domestic credit which includes loans granted to the private sector and securities issued by private entities in period *t*. Both *GDP* and *CREDIT* are in nominal terms and on a quarterly basis. The BIS recommends the use of such broad definition of credit which captures all sources of debt funds for the private sector in calculating the buffer guide.

The credit-to-GDP ratio is compared to its long-term trend. If the credit-to-GDP ratio is significantly above its trend (i.e., there is a large positive gap), this is an indication that credit may have grown to excessive levels relative to GDP. The gap (*GAP*) in period t is calculated as the actual credit-to-GDP ratio minus its long-term trend (*TREND*):

$$GAP_t = RATIO_t - TREND_t \qquad (2)$$

The *TREND* is a way of approximating a sustainable average ratio of credit-to-GDP based on the historical experience of the economy. The BIS framework

26. Guidance for National Authorities, p. 12.-14.

recommends a one-sided Hodrick-Prescott (HP) filter[27] with a high smoothing parameter in establishing the trend (*TREND*$_t$). The smoothing parameter, referred to as the lambda, is set at 400,000 to capture the long-term trend in the behaviour of the credit-to-GDP ratio in each jurisdiction.

The credit-to-GDP gap is transformed into the guide buffer add-on. The size of the buffer add-on (*VB*$_t$), expressed as a percentage of risk-weighted assets, is zero when *GAP*$_t$ is below a certain threshold (*L*). It then increases with the *GAP*$_t$ until the buffer reaches its maximum level (*VBmax*) when the *GAP* exceeds an upper threshold *H*. The BCBS work has found that an adjustment factor based on L = 2 and H= 10 may provide reasonable and robust specification based on historical banking crises.

Setting L = 2 means that when:

$((CREDIT_t/GDP_t) \text{ X } 100\%) - (TREND_t)) < 2\%$, the buffer add-on is zero (3)

Setting H = 10 means that when:

$((CREDIT_t/GDP_t) \text{ X } 100\%) - (TREND_t)) > 10\%$, the buffer add-on is at its maximum (4)

Operationally, the maximum buffer add-on (*VBmax*) is 2.5% of risk-weighted assets. When the credit-to-GDP ratio is two-percentage points or less its long-term trend, the buffer add-on (*VB*$_t$) will be 0%. When the credit-to-GDP ratio exceeds its long-term trend by 10 percentage points or more, the buffer add-on will be 2.5% of risk-weighted assets. When the credit-to-GDP ratio is between

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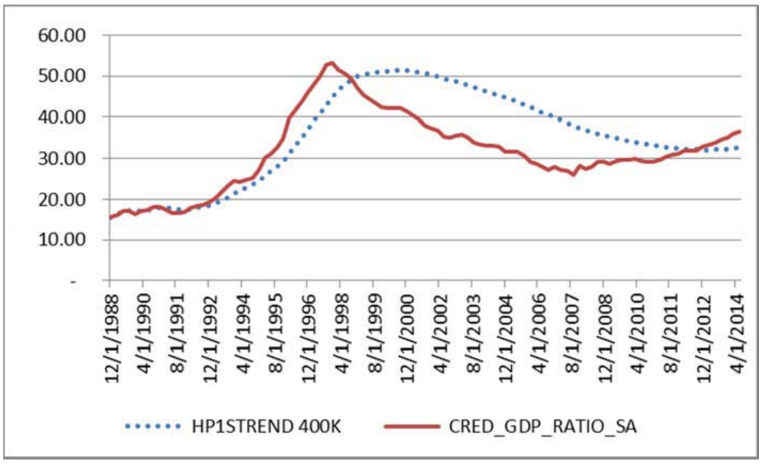
27. A one-sided HP filter has the advantage of giving higher weights to more recent observations and deals more effectively with structural breaks. Technically, the HP filter is a two-sided linear filter that computes the smoothed series of s of y by minimising the variance of y around s, subject to a penalty that constrains the second difference of s. That is, the HP filter chooses s to minimise: $\Sigma_{(14.49)t=1}^{T}(y_t - s_t)^2 + \gamma\,\Sigma_{t=2}^{T-1}\left((s_{t+1} - s_{t)}) - (s_t - s_{t-1})\right)^2$.

    The penalty parameter controls the smoothness of the series *s*. The larger the γ, the smoother the *s*. As γ = ∞ ", s approaches a linear trend. The original Hodrick and Prescott values for γ using a power rule of 2 for quarterly data is 1,600, but the BCBS has set a larger lambda or γ to smoothen a long-term series. Source: "Balance Sheet Approach in Determining the Countercyclical Buffer for Philippine Banks," *Bangko Sentral ng Pilipinas Financial Stability Report,* 2012.

two and 10 percentage points of its trend, the buffer add-on will vary linearly between 0 and 2.5%. This will imply, for example, a buffer of 1.25% when the credit-to-GDP gap is 6 (i.e., halfway between 2 and 10).

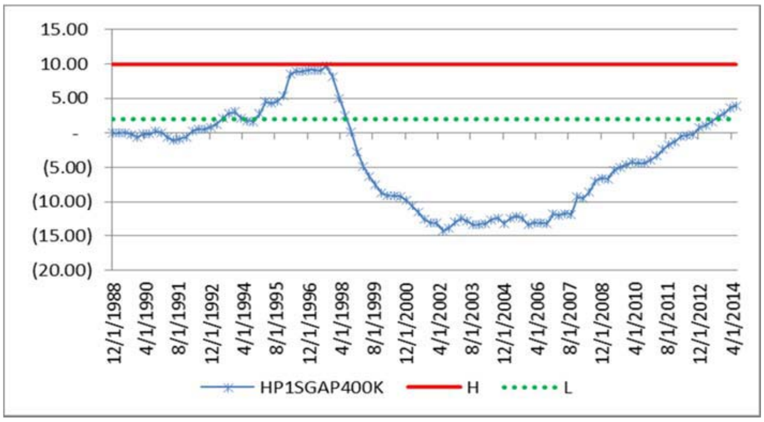
The results of the implementation of the BIS standard framework for the Philippines are presented in Charts 2 and 3. Chart 2 shows the development of the country's credit-to-GDP ratio and its long-term trend during the period 3Q 1988 to 2Q 2014. The ratio is above the trend beginning 3Q 1990 and reached its peak at 50.6% in 2Q 1998. Since then, the ratio dropped to 26.1% in 3Q 2007 and trended below its long-term average. Following the decline, the ratio started to climb up in 4Q 2012 and has been above the trend in the last seven quarters, settling at 36.6% in 2Q 2014.

Chart 2
Credit-to-GDP Ratio and Trend
(in percent)



Note: HP1STREND 400K refers to the trend of the credit-to-GDP ratio derived from using a 1-sided HP filter with a smoothing parameter or λ=400,000.

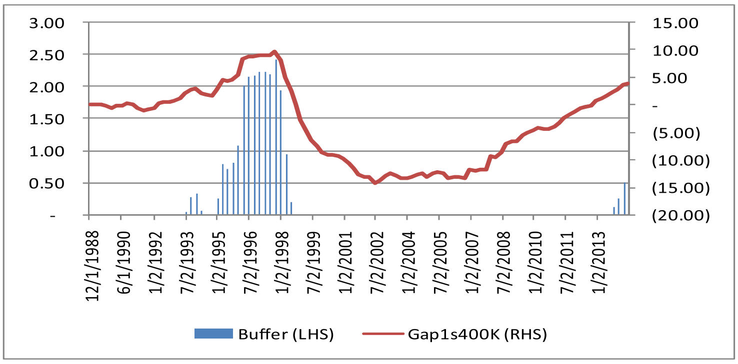
Chart 3
Credit-to-GDP Gap and BIS L&H Threshold
(in percent)



Note: HP1GAP400K refers to the trend of the credit-to-GDP gap derived from using a 1-sided HP filter with a smoothing parameter or λ=400,000.

Chart 3 shows the credit-to-GDP gap or the deviation of the ratio from its long-term trend along with the lower (L) and the upper (H) thresholds of 2% and 10%, respectively. Prior to the 1997 Asian financial crisis, the gap was positive as credit grew faster than the country's GDP. Real credit grew at an average of 37.3% in the last 8 quarters since its peak in 4Q 1996 at 44.2%. After the gap reached its widest at 9.7% in 3Q 1997, the gap fell rapidly, dropping significantly to a low of minus 14.2% in 2Q 2002 and has remained negative for 56 quarters until 3Q 2012 which turned positive since then. Given the gap trend, the chart also shows periods when the gap is within the 2% and 10% thresholds as suggested by the BIS, capturing the 1997 crisis and recent quarters following the 2008 global financial crisis.

Chart 4
Credit to GDP Gap and the Buffer add-on
(in percent)



Note: Gap1S400K refers to the credit-to-GDP gap derived from using a 1-sided HP filter with a smoothing parameter or λ=400,000.

Chart 4 shows the time series calculation of the credit-to-GDP gap and the historical performance of the buffer guide following the BIS guidance. The chart references a buffer build-up 12 quarters prior to 3Q 1997 when the buffer reached its high of 2.4%. A subsequent accumulation of capital buffer started in 3Q 2013, running 4 quarters to 2Q 2014, which may signal an impending banking crisis driven by the volatilities arising from adjustments in the interest rate environment in the external market.

Alternatively, Table 4 presents the development of the credit-to-GDP gap for 12 quarters prior to a crisis (i.e., Q-1 is the first quarter preceding the crisis). It is worth noting that the buffer guide was 'off' for the 12 consecutive quarters prior to September 2008 given that the Philippines did not experience a credit boom during this period.

Table 4
Credit-to-GDP Gap Before the Crises
(in percent, L=2 H=10)

Gap	Q-1	Q-2	Q-3	Q-4	Q-5	Q-6	Q-7	Q-8	Q-9	Q-10	Q-11	Q-12
Asian Financial Crisis: 1997Q3	9.7	9.0	9.1	9.1	8.9	8.9	8.5	5.4	4.6	4.2	4.5	2.8
Buffer	2.4	2.2	2.2	2.2	2.2	2.2	2.0	1.1	0.8	0.7	0.8	0.3
Global Financial Crisis: 2008Q3	(4.6)	(5.8)	(6.3)	(5.6)	(7.8)	(7.0)	(6.7)	(5.9)	(6.8)	(6.0)	(5.4)	(5.1)
Buffer	0	0	0	0	0	0	0	0	0	0	0	0
Impending Crisis: 2013Q3									3.9	3.6	2.8	2.4
Buffer									0.6	0.5	0.2	0.1

On the other hand, the double digit growth in real credit beginning 2Q 2013 to 1Q 2014, which averaged 10% (y-o-y), triggered a buffer accumulation in response to potential risks that may arise from such growth in private sector borrowings. During this period, borrowers were seen taking advantage of the relatively low interest rate environment prior to the adjustments in the monetary policy in the US, in particular. The rise in the credit-to-GDP gap triggered a build-up of capital buffer given the ensuing rise in volatility in interest and exchange rates and the expected increase in borrowing costs as monetary policy condition tightens. If such is the case, the buffer model is signaling an impending crisis in the next 9 quarters by building up buffer throughout this period.

4.4 Filter Selection Iteration for Credit-to-GDP Gap

The use of a credit-to-GDP gap as the anchor variable may be successful in predicting or identifying the 1997 Asian financial crisis as the gap peaks during the height of the crisis and fell rapidly after. The period of negative gaps coincide with the full effects of the Asian financial crisis as evidenced by the rise in the non-performing loans and decline in operational efficiency of banks. The political crisis in 2000 that affected the confidence of the public in the banking system may have exacerbated the impact of the financial crisis to the local financial market.

With the gap staying negative for 56 quarters, this may imply that the Philippine banking system experienced a severe financial crisis that lasted for about 14 years. However, it was not the case for the country. Evidence shows that some recovery has taken place when the level of NPA fell significantly from its peak in 1997 and has consistently remained low since then. It is worth noting that the regulatory reforms implemented by the BSP after the crisis contributed largely to the improvement in banks' asset quality which tempered the emergence of another banking crisis.

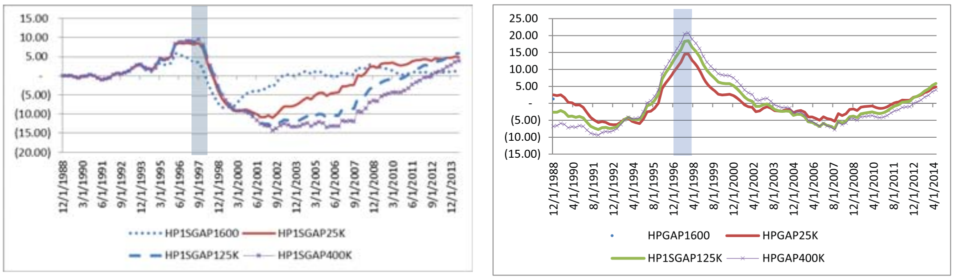
Hence, the use of a 1-sided HP filter with a smoothing parameter or a lambda of 400,000, which the BIS guidance recommends, may not be the appropriate framework for the Philippines. The wider gaps exhibited by the model distinctively before and after the identified crisis may not coincide with the actual credit and business cycles in the Philippines which can impact the signaling ability of the choice variable as a buffer guide.

A number of literatures noted that the performance of the credit-to-GDP gap can be affected by measurement problems related to the calculation of the long-term trend of the ratio. Literature suggests that the lambda is set according to the expected duration of the average business or credit cycle and the frequency of observations. For instance, Hodrick and Prescott proposed the use of lambda=1,600 as the standard for business cycle analysis when using quarterly data and a business cycle frequency of around 7.5 years. Ravn and Uhlig (2002) noted that an optimal lambda is set to 1,600 multiplied by the fourth power of the observation frequency ratio.[28] Meanwhile, Borio and Lowe (2002) suggested the use of a one-sided, backward-looking HP filter with lambda set at 400,000. The BIS also specified the use of a much larger smoothing parameter given that credit cycles are, on average, four times longer than standard business cycles and crises tend to occur once every 20-25 years.[29]

In this study, the use of other smoothing parameters that would fit the business cycle of the Philippines was explored. Following the assessment of Drehmann, et al. (2010) on the implications of the different lambdas in the performance of the credit to GDP gap, a comparison of the different choices of lambdas was calculated using one-sided and two-sided HP filters.

Chart 5
Impact of Different Smoothing Parameters on the Credit-to-GDP Gap
(in percent)

A. One-Sided HP filter **B. Two-Sided HP filter**



Note: (1) Vertical shaded areas indicate banking crisis period as discussed in the previous section.
(2) HP1SGAP refers to the credit-to-GDP gap derived from using a 1-sided HP filter while HPGAP using a 2-sided HP filter with a smoothing parameter or λ=1,600, λ=25,000, λ=125,000, and λ=400,000.

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28. The implication of different lambdas for the performance of the credit-to-GDP gap with:
λ= 1,600 = 14*1,600, assuming that credit cycles have the same length as business cycles.
λ= 25,000 H" 24*1,600, assuming that credit cycles are two times as long as business cycles.
λ= 125,000 H" 34*1,600, assuming that credit cycles are three times as long as business cycles.
λ= 400,000 H" 44*1,600, assuming that credit cycles are four times as long as business cycles.
Source: Drehmann, et al., (2010).

29. Drehmann and Tsatsaronis (2014).

Chart 5 shows the time series of Philippine credit-to-GDP gap using lambda of 1,600, 25,000, 125,000 and 400,000 under one- and two-sided HP filters. By visually inspecting gap movements around historical banking crisis, gaps with higher lambdas of 400,000 and 125,000, in both one-sided and two-sided HP filters, appear to have wider positive and negative gaps before and after a crisis. Eliminating the wider gaps, Chart 6 shows the less volatile credit-to-GDP gap time series, in particular, using lambda of 25,000 both in one- and two-sided HP filters.

5. Lag Length Determination

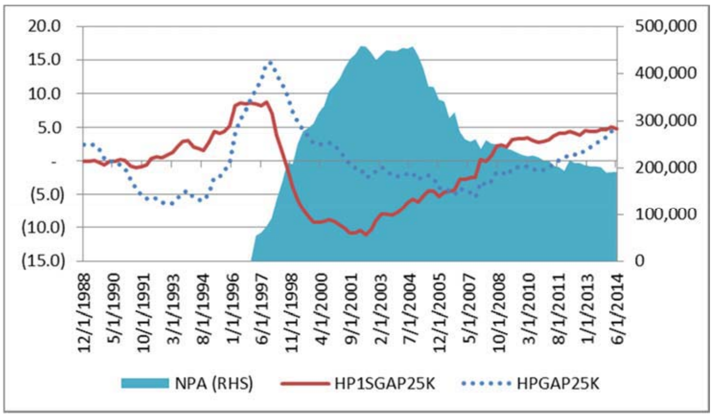
5.1 Credit-to-GDP Gap as an EWI for Banking Crises

Several empirical studies have already documented the ability of the credit-to-GDP gap to act as an EWI for banking crises. Drehmann and Tsatsaronis (2014), for instance, documented evidences when credit-to-GDP gap performs best as EWI based on certain criteria proposed by Drehman and Juselius (2014). The study suggests that an EWI must be able to provide signals in advance for policy measures to take effect. In the BIS guidance, "the indicator should breach the minimum critical threshold at least two to three years prior to a crisis." Further, an EWI should be a stable indicator and should not signal periods without crisis to reduce uncertainty in the variable which serves as basis for policymakers in their decision making. Finally, an EWI should be easy to interpret and understand for both the regulators and the financial institution.

In this study, the EWI property of the credit-to-GDP gap was examined by comparing the gap series with the Philippine banking system's indicator of financial distress or the NPA. Chart 6 shows the ability of the gap as an EWI given the lead time of the indicator to turn positive several quarters before a run-up in banks' NPAs. In particular, the gap series, calculated by means of a one-sided HP filter with a lambda of 25,000, shows a lead lag of 40 quarters or gap turning positive before NPA reached its peak in 1Q 2002. After the crisis, the gap fell rapidly and turned negative for 39 quarters from 3Q 1998 to 1Q 2008 and turned positive again in 2Q 2008 and has consistently increased up to 2Q 2014.

Relative to a two-sided HP filter using a similar smoothing parameter, the lead lag is 25 quarters or the period when gap turned positive and rose consistently until the gap reached its widest in 4Q 1997. The gap fell after the crisis and reached the negative territory after 15 quarters, in contrast to the series using one-sided HP where the gap turned negative only in 6 quarters from its widest in 4Q 1996. This may imply that using a one-sided HP filter, rather than the 2-sided HP, can give policymakers more time in announcing and implementing capital buffer add-ons especially during the accumulation phase.[30]

Chart 6
Comparison of 1- and 2-Sided HP Filter with l=25,000 and Banks' Non-Performing Assets (NPA)
(Gap in percent, NPA in million pesos)



Note: HP1SGAP25K refers to the credit-to-GDP gap derived from using a 1-sided HP filter while HPGAP25K using a 2-sided HP filter, both with a smoothing parameter or λ=25000.

To statistically assess if the key variable has the property of an EWI, a lead-lag relationship between a banking indicator of stress and the gap series was conducted. The regression analysis between the growth in the banking system's NPA (dependent variable) and lagged values of the credit-to-GDP gap (independent variable) was estimated as described in equation 5.

$$NPA\ Growth = f(credit - to - GDP\ gap\ (-1\ to - 20)) \qquad (5)$$

The results indicate a credit-to-GDP gap series with lag values of 8-10 quarters register statistically significant relationship with NPA growth (see Annex Table 5). A lag of 9 quarters has the highest coefficient and is statistically significant at 99% probability and can explain about 25% of the changes in NPA

30. On this note, Drehmann and Tsatsaronis (2014) stressed that applying a 2-sided HP filter may not be practical for policymakers since future values of the credit-to-GDP ratio is unobservable, reducing the signaling ability of the credit-to-GDP gap.

growth. This means that NPA is expected to reach its peak level in about 9 quarters after the credit-to-GDP gap hit its highest point level, giving enough time for the policymakers to announce a potential accumulation of CCCB.

To further test the signaling ability of the choice variable, this study employed a signal extraction methodology in the assessment of the appropriate lambda values of the credit-to-GDP gap as the conditioning variable for CCCB. Kaminsky and Reinhart (1999) and Drehmann, et al. (2010) noted that an ideal indicator is generally chosen by their ability to signal all impending crises and not the crises that did not happen. The best indicator is chosen on the basis of the lowest noise-to-signal ratio (NTSR), or the fraction of Type II errors (a signal is issued but no crisis occurs) over 1 minus the fraction of Type I errors (no signal is issued but a crisis occurs).This is represented by equation 6.

$$NTSR = \frac{Type\ II\ error}{1-Type\ I\ error} = \frac{\beta\ risk}{1-\alpha\ risk} = \frac{\frac{B}{B+D}}{1-\frac{C}{A+C}} = \frac{B*(A+C)}{A*(B+D)} \tag{6}$$

Where:

Table 5
True and False Crisis Signals

	Crisis (within 8 quarters)	**No Crisis (within 8 quarters)**
Signal	A	B
No signal	C	D

The equation also implies that the smaller the NTSR, the lower the noise. Using the same equation, the probability of an indicator correctly signaling a crisis is computed using equation 7.

$$P\ (crisis|signal) = \frac{A}{A+B} \tag{7}$$

The model assumes that a signal of 1 (0) is judged to be correct if a crisis (no crisis) occurs any time within a two-year horizon. A range of threshold for the gap series using different lambda values 1,600, 25,000, 125,000, and 400,000 are assessed. Annex Table 6 summarises the result of the NTSR test. The analysis shows that a gap series based on lambda of 25,000 has the smallest NTSR and satisfies the condition that at least two-thirds of crises are predicted when setting the threshold at 5.

Further, using the same signaling extraction methodology employed in the credit-to- GDP gap, Annex Table 7 shows the NTSR results for other macroeconomic conditioning variables that are often used by literatures as EWI of financial crises. The results indicate that the credit-to-GDP gap still has the lowest NTSR and higher crisis predicted than other variables.

On the other hand, it is important to note that the conditioning variables identified should already signal a build-up in vulnerabilities 8 quarters or 2 years prior to the peak of a crisis. As stressed in the Drehman, et al. (2010) study, such signal will be counted as "false" despite the indicator providing a signal only in advance. This increases the likelihood of a Type II error and a higher NSTR results, implying that no single variable can provide the perfect signal for a banking crisis. Hence, there is a need for constant discretion from the regulators in managing the timing and degree of a CCCB.

The empirical results from the analysis in Sections 4 and 5 propose the use of a credit-to-GDP gap as a conditioning variable in the adoption of a CCCB metric in the Philippines. The choice of a 25,000 lambda in a one-sided HP filter appears to be the best smoothing parameter among the filter iterations performed as compared to the 400,000 specification suggested by the BIS.

As EWI for banking sector crises, the credit-to-GDP gap likewise shows significant statistical performance given its low noise-to-signal ratio and the ability to predict at least two-thirds of crises at a threshold of 5. Similarly, the variable exhibits a significant lag relationship with growth in NPA of the banking system at a lag of 8-10 quarters. The credit-to-GDP gap as the choice variable gives policymakers ample time in preparing banks especially for the accumulation phase of the CCCB.

5.2 Sarel's Methodology

The mechanical use of the credit-to-GDP gap as a common reference point for taking buffer decisions is constantly challenged in terms of its ability to act as a leading indicator of systemic banking crisis. In this section, the strength of the credit-to-GDP gap is tested further with regard to how it may relate to the banking sector's NPA at a particular threshold. The threshold level of the trigger variable was evaluated by using the model of Sarel (1996) which identifies the relationship of the growth in banking sector's NPA (dependent variable) with the credit-to-GDP gap and a threshold variable Xi. Equation 8 estimates the regression:

$$GrowthNPA = f(Gap,\ X_i) \tag{8}$$

Where:

Variable (Xi) = Credit-to-GDP gap * Dummy
Dummy Variable = Credit-to-GDP gap > Threshold
Threshold = 0-9

Annex Table 8 summarises the results of the regression. It showed that the credit-to-GDP gap and the Xi variables are positively and significantly related with the growth in NPA given p-values at 0 and t-statistics of above 3. The best threshold that can explain the growth in NPA is at level 5 with the highest coefficient of 12.5 and lowest AIC of 8.1.

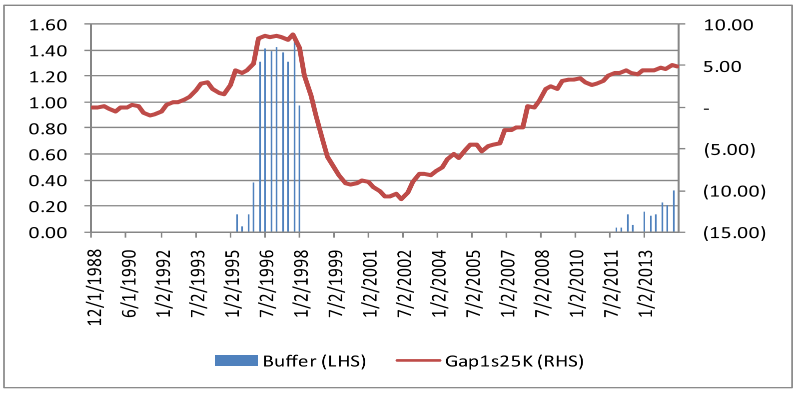
5.3 Calibration of Thresholds

The BIS guidelines set the thresholds, i.e., gap level L and gap level H, that determine when the buffer is turned "on" and "off." The gap level L is the threshold which indicates that banks should start building up their capital buffers. The gap level H is when the buffer is at its maximum, i.e., the point that should be reached before the onset of a crisis. At this level, no additional capital will be required even if the gap will continue to increase.

As such, L should be low enough so that the banks are able to build up capital in gradual fashion before the potential crisis. Banks are given one year to raise additional capital which means that the indicator should breach the minimum at least 2-3 years prior to a crisis. In addition, L should be high enough so that it will not be breached during normal times when no additional capital is required. On the other hand, H should be low enough so that the capital buffer will be fully complied with before a major banking crisis.

In the case of the Philippines, the NTSR robustness test showed a threshold significant at level 5 while results of the Sarel's methodology suggest a threshold of 5 to 6. If L should be low enough to give banks ample time to build up buffers and high enough so that the capital buffer may not be triggered in the absence of a crisis, an L equal to 4 or 5 can be considered. Meanwhile, in determining the upper bound threshold H, the BIS guidelines recommend an "L+8" rule. With L set at 4-5, the H can be set at around 12-13.

Chart 7
Credit to GDP Gap and Buffer
(in percent, L=4 H=12)



Note: Gap1s25K refers to the credit-to-GDP gap derived from using a 1-sided HP filter with a smoothing parameter or λ=25000.

Given the above results, the lower threshold L, or the period when the buffer guide will start to indicate the need to build up capital can be set at 4 while the maximum H, at which the point where no additional capital is required even if the gap will continue to increase, can be set at 12. With L=4 and H=12, the buffer guide is turned "on" 12 quarters or 3 years prior to 4Q 1997, just enough time for authorities to announce and implement the accumulation phase of a CCCB. The buffer hit its highest level of 1.5% in 3Q 1997 when the gap is at its maximum. Further, the buffer declined immediately after the peak level, signaling the release phase which requires the reduction in the buffer to take effect at once to help reduce the risk of a contraction in the supply of credit as previously constrained by the buffer measure. In contrast with the results using the BIS framework, the buffer was turned "on" 18 quarters prior to the peak of the crisis which indicate that L=2 may be too low and translates to an earlier-than-recommended trigger when banks are supposed to start building up buffers.

Moreover, the calibrated threshold points to a build-up in buffer beginning 3Q 2011 and is set "on" in the next 12 quarters up to 2Q 2014. The buffer build-up is triggered by the increase in the credit-to-GDP gap brought about by higher growth in private domestic credit which started to register at a double digit rate of 15.4%. It is noted that during this period, the Philippines did not experience a banking crisis, although was not totally immune from the external headwinds of the global financial crisis. The impact was largely through higher volatility in the financial markets, causing large fluctuations in domestic asset prices.

5.4 Buffer Level and Progression

The previous sections focused on the timing of the build-up and release of capital buffers in a CCCB model. However, the indicators do not necessarily indicate the optimal level of a countercyclical buffer. The above results were based on a maximum buffer add-on set at 2.5% of bank's risk weighted assets. When the credit-to-GDP ratio exceeds its long-term trend by 12 percentage points or more, the buffer add-on will be 2.5% of risk weighted assets. When the credit-to-GDP ratio is four-percentage points or less its long-term trend, the buffer add-on will be 0%. When the credit-to-GDP ratio is between four and 12 percentage points of its trend, the buffer add-on will vary linearly between 0 and 2.5%.

It maybe recalled that the aim of a CCCB is to ensure that banks have sufficient capital in such a way that they can operate efficiently during periods of stress without limiting the supply of credit in the economy. Hence, it is important to identify the period where required capital is expected to fall in a stressed situation and the corresponding impact of the additional capital requirment on economic activity during normal times. The size of the buffer may depend on the amount of expected losses that banks may incur in periods of financial stress. In identifying the optimal level of the buffer guide, the use of stress testing tools can be employed or by directly examining the losses incurred by banks in past crises periods.[31]

In the case of the Philippines, the results from the previous exercise show that the maximum buffer reached was only at 1.5%. There may be a need to re-assess the application of a 2.5% buffer add-on for a CCCB. A lower buffer amount can be examined in terms of its applicability in the local banking system. There may be country-specific factors that warrant an optimal capital buffer amount which can efficiently balance the cost of higher capital requirements on economic growth in non-crisis times as well as the benefit of easing the required capital in periods of financial stress.

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31. ibid., Riksbank, p.31.

6. Release Phase

The BIS was clear about the need to assess a broad range of indicators in taking decisions on buffer. The authorities should be mindful of how the choice variable moves with other factors especially in taking buffer decision both in the build-up and release phase.

For instance, Drehman, et al. (2010) noted that the credit-to-GDP ratio and credit growth indicators may perform well in anticipating crises as both variables increase consistently well above the trend before a crisis period but fall too late and too slow especially during the onset of a crisis. If used in the release phase of a CCCB, the timing can be late and the timing of the release may not be as immediate as what is required. Moreover, deviations of the property price indicators were also found to be helpful in the build-up phase but not in the release phase as difference from its long-term trend tends to narrow before a crisis emerge which can prompt an early release of the buffer. This can run counter to what a CCCB aims to achieve, in particular, in reducing the risk of contracting the supply of credit in crisis time by promptly reducing the amount of buffer during this period.

In the same paper, high-frequency financial variables such as credit spreads indicated strength in their usefulness as indicators for the release phase of a CCCB. These variables tend to perform well in a crisis period, rising faster as strains emerge after staying below their long-term average in normal times. They are good in capturing the current level of stress in the financial sector but less useful in signaling an impending crisis since they reflect the materialisation of risks rather than its build-up.[32]

Countercyclical buffer decisions should not only depend on the choice indicators such as the GAP ratio or credit growth variables. As reflected in the previous section, the credit-to-GDP gap alone was unable to fully anticipate a crisis from happening. The low R-squared values of around 20-25% reflect that the credit gap series can explain only a portion of the changes in banks' NPA. In addition, the gaps remained high even after the crisis which could affect the timing of the release of the buffer.

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32. ibid., Riksbank, p.21.

6.1 Supplementary Indicators

In this section, a number of supplementary indicators are examined in terms of their ability to signal in the release phase of the buffer. A simple correlation between the NPA growth and the lag of selected macroeconomic and financial market indicators was conducted. Annex Table 9 presents the correlation coefficients, t-statistics, and p-values between the main variables in our model. The results show that NPA growth and changes in residential capital values has the highest correlation coefficient and is significant at a lag of 1. Meanwhile, significant correlation between growth in NPA and growth in stock market returns is highest at lag 2. The negative and significant correlation between NPA growth and growth in capital land values and stock market return may imply a wealth effect that negatively impacts the collateral channel such that when growth in capital values and stock market returns decline, growth of banks' NPA increases.

As an indicator of financial stress, the results show that the identified variables can be useful indicators in the release phase of the buffer as these variables tend to signal one or two quarters ahead of NPA. On the other hand, the correlation between NPA growth and real credit growth is significant at lag 8 which reflects the strength of the variable as an early warning indicator and not as indicator in the release phase.

With the indicators identified, the next step will be to look at the modalities in the release of the buffer, i.e., immediate or gradual drawdowns. A buffer should be released if various stress indicators are signaling a high level of stress on the financial sector. The BIS noted that the release should be in periods when banks are already incurring losses such that the buffer is depleted first before banks begin tapping their normal capital conservation buffer. If a buffer is released before losses have been incurred, there is a risk that the extra capital can be used to pay out dividends instead of lending it out. The release should be timely to allow banks to use the capital and thereby lessen the potential risk of a credit crunch. It is therefore important for regulators to be clear about the purpose of the buffer release in order to identify the appropriate modalities in easing buffer restrictions, which can be a choice between absorbing losses or in maintaining credit flow in the system. This study recommends a further analysis on this matter.

6.2 Communication

The need to pre-announce buffer requirements with a lead time of two to three years to give banks ample time to adjust their capital position warrants the development of an appropriate communication strategy from the regulators. The BIS stressed the necessity of communicating buffer decisions in a timely manner to promote accountability from the regulators and sound decision making from financial institutions. In the build-up phase, planning the timing of the announcement can help reduce the risk of the buffer not being in place before the credit cycle turns. In the release phase, communicating the immediate deactivation of the buffer is essential so as not to contract the supply of credit in periods when banks needed the reprieve the most.

Since there are limited number of central banks that have already adopted the measure and with most of these banks from advanced economies, there is a need to design a communication plan that can work for economies like the Philippines. This should be aligned with the appropriate analytical tools that allow for an efficient announcement of an entry and exit decision by regulators. The communication strategy should form part of regulator's periodic assessment of macroeconomic and financial condition to determine whether the CCCB should be activated, adjusted or turned off. Pronouncements should be reviewed and updated on a regular basis so that any changes in the authorities' outlook can be publicly announced in a timely manner. This can help smoothen out the expectations and give banks enough time to adjust and plan their capital positions. The BIS suggests that the authorities should revisit and comment on potential changes and updates in the model at least once a year using the various communication tools available.

Should the Philippines implement a CCCB, the assessment as well as the announcement can form part of the BSP's Financial Stability Report (FSR).[33] With the FSR providing a comprehensive assessment of the robustness as well as vulnerabilities of the domestic financial system against the emerging economic and financial developments both in the global and domestic environment, the assessment for the build-up and release of a CCCB can leverage from the results of the FSR report.

The semi-annual frequency of the publication of the FSR by the BSP will keep the market well informed with regard to the developments of financial risks and exposures that can potentially impact the overall stability and efficiency of the economy which can subsequently trigger the activation of additional capital buffer. Overall, communicating CCCB decisions through the FSR will help: 1)

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33. As of writing, the FSR is published by the BSP internally since 2007.

improve the understanding of risks to financial intermediaries in the economy; 2) alert financial institutions and market participants on the possible collective impact of their individual actions/decisions; and 3) build a consensus for financial stability and the improvement of the financial and regulatory infrastructure.[34]

7. Consensus, Recommendations and Conclusions

The study aims to arrive at a consensus in terms of finding the appropriate indicator to be used in the establishment of a CCCB in SEACEN member economies. For the Philippines, the empirical results suggest the use of the credit-to-GDP gap as a choice variable in taking buffer decisions especially in the build-up phase of a CCCB. The study highlights the ability of the GAP series to signal a financial stress event compared with other variables such as credit growth, GDP growth, stock market returns, and changes in residential capital values.

With the credit-to-GDP gap as a choice variable, the calculation of a rule-based CCCB guide using the BIS framework showed the need to recalibrate some assumptions that will best fit the Philippine credit cycle. The results of the filter iteration exercises in establishing the trend of the GAP series showed that a lower smoothing parameter or a lambda equal to 25,000 using a one-sided HP filter can best capture stress events in the domestic financial system. In examining the strength of the variable as an EWI, the results of the stepwise regression indicate a credit-to-GDP gap series with lag values of 8-10 quarters register statistically significant relationship with NPA growth. This means that NPA is expected to reach its peak level in about 2.5 years after the credit-to-GDP gap hit its highest level, giving enough time for the policymakers to announce a potential accumulation of the CCCB. In selecting threshold levels that should trigger the build-up phase of the buffer, the results of the robustness tests on the basis of the lowest noise-to-signal ratio and from Sarel's method of total fit suggest the use of a lower and upper bound thresholds of 4 and 12, respectively, different from the L=2 and H=10 thresholds proposed by the BIS.

The study also highlights that countercyclical buffer decisions should not only depend on a single choice indicator such as the GAP ratio or credit growth variables. In this study, the correlation analysis of supplementary indicators and banks' NPA suggest that high frequency financial variables such as growth in

34. 2013 BSP Financial Stability Report.

stock market returns and changes in capital land values can be useful indicators in the release phase of the buffer as these variables peak one or two quarters ahead of NPA. On the other hand, since these are just two of the financial market data available, there may be a need to examine further other quantitative and qualitative indicators of banks' risk taking behaviour such as banks' credit default swaps and financial stability index as supplementary indicators in the release phase of the buffer.

On the other hand, the study raises some issues in the conduct of a CCCB measure in the Philippines. First, the guide may be successful in "predicting" the Asian financial crisis and in signaling the appropriate buffers amount but this is only one event. There may be a need to lengthen the series of the choice variables to capture other banking crisis and the development of the choice variables during these events. Second, while the study focused on identifying the timing of the build up and release of capital buffers in a CCCB model, the indicators do not necessarily reflect the optimal level of a countercyclical buffer. There may be a need to re-assess the 2.5% maximum buffer add-on as suggested by the BIS. There can be country-specific factors that warrant an optimal capital buffer amount which can efficiently balance the cost of higher capital requirements on economic growth in non-crisis times as well as the benefit of lower capital in periods of financial stress. Finally, there is a need to develop an appropriate communication strategy should regulators start to implement a CCCB. Since there are limited number of central banks that have already adopted the measure and with most of these banks coming from advanced economies, there is a need to design a communication plan that can work for economies like the Philippines. This should be aligned with the appropriate analytical tools that allow for an efficient announcement of the entry and exit decisions by regulators.

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Annex Table 1
Characteristics of the Banking Sector in the Philippines

	Credit*				Ownership Group*			Targeted Credit*			Crisis	Banking	Major Reforms
	Bank	Non-Bank	Market	External	Public	Private	Foreign	Agri	Manu	SME	Year	Supervisor	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13
Philippines	79.6	1.3	7.5	11.6	4.9	93.4	1.7	7.6	13.0	n.a.	1997, 2001, 2008	BSP	1993, 1994, 2000

*In percent, last five year average

Annex Table 2
CCCB Policy Progress in the Philippines

	CCCB Guideline Published	Policy Measures Taken	Policy Gap	Policy Hurdles	Proposed Implementation	Remarks
Philippines	none	none	-	-	no target timeline	1 - Banks are highly capitalized at the moment
						2 - Further study is needed on the appropriate tools needed to implement the countercyclical buffer

Annex Table 3
Descriptive Statistics

Sample: 12/01/1988 6/01/2014

	CREDIT_SA	GDP_ANNUAL_SA	NPA_SA	RLAND_VAL	STOCKS
Mean	1521383.	4688797.	285061.1	74906.92	2476.563
Median	1458870.	3810077.	254200.3	66996.13	2036.970
Maximum	4404517.	12049830	456663.6	127114.8	6850.210
Minimum	138062.7	884237.4	52771.53	54808.63	610.5200
Std. Dev.	1035722.	3176227.	108516.7	20950.71	1461.630
Skewness	0.706665	0.703530	0.122861	1.429753	1.306414
Kurtosis	3.142360	2.320064	2.202348	3.843632	4.263939
Jarque-Bera	8.659594	10.48081	2.031832	28.51724	36.15476
Probability	0.013170	0.005298	0.362071	0.000001	0.000000
Sum	1.57E+08	4.83E+08	19954276	5767833.	255086.0
Sum Sq. Dev.	1.09E+14	1.03E+15	8.13E+11	3.34E+10	2.18E+08
Observations	103	103	70	77	103

Annex Table 4
Summary Findings for the Philippines

Key Variable	Filter	Supplementary Indicators	Lead-lag	L	H	Level 0-2.5%	Accum.	Release	Purpose	Comm	Review
Credit-to-GDP gap	1-sided HP with lambda-25,000	Growth of stock market returns & Growth in residential capital values	8-10 qtr	4	12	0-2.5%	Linear	Supplementary indicators and judgment	Sustain supply of credit	FSR	Annual

Annex Table 5
Regression Results of Credit-to-GDP gap and NPA growth (Gap using 1-Sided HP Filter with l=25,000)

Lag	Coef	T-stat	R-Sq	Ad R-Sq	AIC	SBC	Prob
4	2.178	2.652	0.100	0.086	10.133	10.200	0.010
5	2.556	3.239	0.143	0.129	10.085	10.152	0.002
6	2.818	3.711	0.179	0.166	10.041	10.108	0.000
7	2.997	4.081	0.209	0.197	10.004	10.071	0.000
8	3.135	4.416	0.236	0.224	9.969	10.036	0.000
9	3.243	4.704	0.260	0.248	9.938	10.005	0.000
10	3.211	4.655	0.256	0.244	9.943	10.010	0.000
11	3.139	4.522	0.245	0.233	9.958	10.025	0.000

Note: NPA growth is the dependent variable and credit to GDP gap as independent variable

Annex Table 6
Comparison of Different Choices of the Credit-to-GDP Gap Lambda Values

Lambda Values	Threshold	Type I error	Type II error	Predicted	Noise-to-signal ratio
1-Sided HP					
λ-=1,600	3	0.27	0.01	0.89	0.02
λ=25,000	5	0.18	0.01	0.90	0.01
λ=125,000	5	0.18	0.02	0.82	0.03
λ=400,000	4	-	0.02	0.85	0.02

Annex Table 7
Comparison of Macroeconomic Conditioning Variables

Indicator	Threshold	Type 1 error	Type 2 error	Predicted	Noise-to-signal ratio
Credit-to-GDP gap using λ=25,000					
	5	0.18	0.01	0.90	0.01
Real Credit Growth					
	25	0.09	0.03	0.77	0.04
Real GDP Growth					
	3.5	0.31	0.65	0.37	0.95
Residential Capital Values Growth Gap using λ=25,000					
	4	0.57	0.60	0.07	1.40

Annex Table 8
Summary of Regression Results

Threshold	Coeficient Xi	P-values	T-stat	R-sq	AR-sq	AIC	SBC
X2	11.84	0.00	5.07	0.74	0.73	8.91	9.01
X3	9.26	0.00	5.03	0.74	0.73	8.92	9.02
X4	10.36	0.00	6.81	0.79	0.79	8.70	8.80
X5	12.53	0.00	11.87	0.89	0.89	8.07	8.17
X6	11.72	0.00	9.76	0.86	0.85	8.33	8.43
X7	11.72	0.00	9.76	0.86	0.85	8.33	8.43
X8	10.30	0.00	6.92	0.79	0.79	8.69	8.79
X9	10.30	0.00	6.92	0.79	0.79	8.69	8.79

Note: X5 is the interactive dummy variable with thresold level equals 5.

Annex Table 9
Correlation Coefficient of Selected Variables

Lag	Growth in Residential Capital Land Values		Growth in Stock Market Returns		Credit Growth	
1	-0.74	***	-0.45	***	-0.22	**
2	-0.64	***	-0.50	***	0.02	
8	0.24	**	-0.07		0.73	***

*** Significant at the threshold of 1%, ** at 5%, * at 10%.
Growth in residential capital land values and credit are in real terms.

Annex 10
Using Other Conditioning Variables

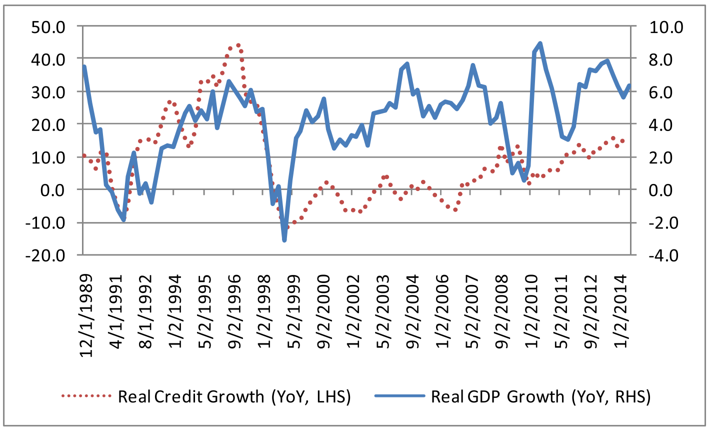
The BIS guidance framework posted a caveat on the use of credit-to-GDP gap as the common reference in operating a CCCB, noting that "the guide does not always work well in all jurisdictions." Many authors have proposed the use of indicators other than the credit-to-GDP gap as anchor variable.

Drehmann and Tsatsaronis (2014) compared the performance of six indicators, which include the credit-to-GDP gap, credit growth, GDP growth, residential property price growth, debt service ratio, and non-core liability ratio. The indicators were assessed in terms of their strength as an early warning indicator (EWI) for banking crisis. The results showed that the credit-to-GDP gap is statistically the best single EWI indicator for forecast horizon between five and two years.

Meanwhile, Repullo and Saurina (2011) proposed the use of real credit growth, or the deviations of credit growth with respect to its long-run average, as the common reference variable for taking buffer decisions. The study showed that real credit growth appears to be a good signaling variable in the build-up of systemic risk and does not exacerbate the underlying procyclicality of Basel's minimum capital requirements.

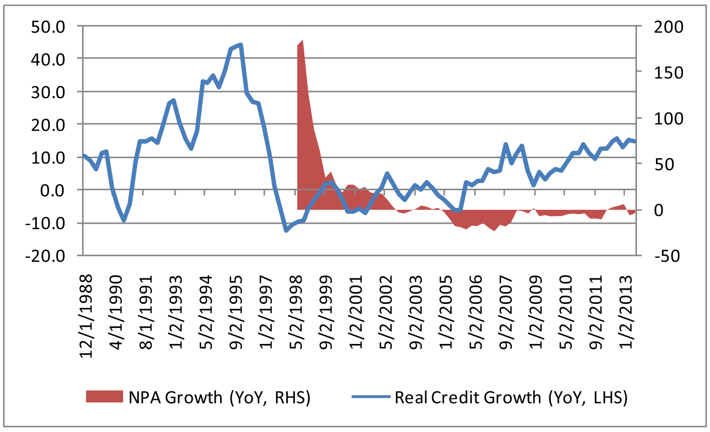
In this study, the use of real credit growth as an alternative conditioning variable for the CCCB was also examined. The GDP deflator was used to get the real credit from the existing nominal values. Chart 6 shows the series of real private sector credit with respect to the country's GDP growth. The dotted line shows credit for the period 4Q 1989 to 1Q 2014 and exhibits peak levels in 4Q 1996, 3Q 2008, and 3Q 2013 while showing negative values in 3Q 1991, 4Q 1998, 2Q 2002, and 2Q 2006. The solid line represents real GDP growth. The chart reflects the positive correlation between the two variables with real credit growth lagging behind GDP growth in two periods, in 3Q 2008 and in 2Q 2010.

Chart 8
Real Private Sector Credit versus GDP growth
(in percent)



When compared against a banking sector variable or the NPA, Chart 7 shows that the real credit growth peaked in 4Q 1996 which represents a lag of 8 quarters prior to 3Q 1998 when NPA reached its highest growth. However, the relationship weakened after the crisis as the growth in NPA decelerated while the growth in real credit exhibited a rising trend. The weakening ability of the indicator to act as a signaling variable for a banking sector crisis could be a result of the series of regulatory and prudential measures implemented by the BSP after the crisis that resulted in improvements in the banking system's asset quality (i.e., lower NPAs amid rising growth in credit).

Chart 9
Real Private Sector Credit versus NPA growth
(in percent)



Chapter 7

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL ANALYSIS IN CHINESE TAIPEI

By
Shu-Chun Huang and Hsi-Pin Wei[1]

1. Introduction

In 2008, the world experienced an unprecedented economic and financial crisis after the Great Depression. The global economy shrank by about 0.7% in 2009. The US subprime crisis not only caused the failure of several large international banks, but also endangered the real sector. Meanwhile, some governments, such as Ireland and Greece, were trapped by debt problems and bailing out their troublesome banks.

Financial regulators thus are paying increasing attention to the banking sector's ability to absorb shocks arising from financial and economic stress. The new international banking regulation system, Basel b!, enhances the soundness of the banking industry by imposing new rules of capital and liquidity on banks, and the countercyclical capital buffer (CCCB) plays a critical role in the reforms.

The Basel Committee on Banking Supervision (BCBS, 2010) explained, "the primary aim of the countercyclical capital buffer regime is to use a buffer of capital to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk." It clearly shows the reasons

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for introducing this measure. However, it’s not easy to perceive the risk in advance and to implement the CCCB putting it in place in due course.

Although the Basel committee suggested the credit-to-GDP gap as a common reference point for implementing the CCCB, some empirical results show that the ratio is not a trustworthy indicator. For example, during the recession period, the ratio may get higher owing to the decrease of GDP (Repullo and Saurina, 2011). However, others[2] support the recommendation made by the BCBS.

In fact, the Basel committee understands the limit of the single indicator. “Rather than rely mechanistically on the credit/GDP guide, authorities are expected to apply judgment in the setting of the buffer in their jurisdiction after using the best information available to gauge the build-up of system-wide risk” (BCBS, 2010). Therefore, most of the competent authorities around the world are eager to find complementary indicators.

In Chinese Taipei, the relevant regulation is stipulated in Article 5 of the *Regulations Governing the Capital Adequacy and Capital Category of Banks*. It is suggested that the competent authority has to consult with the Central Bank, Chinese Taipei (hereafter CBC) and other relevant organisations to raise the minimum requirement stated in the previous paragraph if necessary in order to minimise systemic risks. However, the ratio shall not be higher than 2.5%. Currently, the guideline of the measure is under formulation.

This paper, therefore, mainly focuses on the evaluation of the effectiveness of the credit/GDP ratio gap and finding complementary indicators for implementing the CCCB. In Section 2, comparative evidences provide the outline of the BCBS recommendations regarding the CCCB. Section 3 demonstrates the relevant studies. Section 4 shows the results of empirical analysis. Section 5 reveals possible policy recommendations for the implementation of the CCCB in Asian countries, and Section 6 concludes.

2. Cross-country Evidences

2.1 Definition and Implementation of the CCCB: View of BCBS

The purpose of building up the CCCB is “to ensure the banking system has a buffer of capital to protect it against future potential losses” and “it will be

2. BCBS (2010).

deployed by national jurisdictions when excess aggregate credit growth is judged to be associated with a build-up of system-wide risk (BCBS, 2011)." Therefore, system-wide risk must be perceived and sound monitoring is the first step for this policy to be successful.

The BCBS (2010) offered the guidelines for the CCCB implementation and asked the authorities to apply judgments to determine whether the buffer should increase or decrease over time (within the range of zero to 2.5% of risk-weighted assets (RWAs) depending on whether the system-wide risks they observed increase or decrease.

According to the report by the BCBS (2011), the CCCB is one type of extension of the capital conservation buffer. The minimum capital conservation ratios of banks depend on their common equity tier 1 (CET1) ratios.[3] Given that a bank is subject to a 2.5% countercyclical requirement, its minimum capital conservation ratio is required as shown in the Table 2.1.

Table 2.1
Individual Bank Minimum Capital Conservation Standards[1]

Common Equity Tier 1 Ratios (including other fully loss absorbing capital)	Minimum Capital Conservation Ratios (expressed as a percentage of earnings)
4.5% - 5.75%	100%
>5.75% - 7.0%	80%
>7.0% - 8.25%	60%
>8.25% - 9.5%	40%
> 9.5%	0%

Notes: 1. When a bank is subject to a 2.5% countercyclical requirement.
2. Common Equity Tier 1 ratio = Common Equity Tier 1 Capital / Risk-weighted Assets.
Source: BCBS (2011).

3. A measurement of a bank's core equity capital compared with its total risk-weighted assets.

Although the meaning and process of employing the CCCB seems clear, the implementation is difficult. The critical problem is the finding of reference points. There are no trustworthy indicators that can be used to activate the CCCB.

The BCBS also recommends the frequency of calculation and disclosure and transitional arrangements (BCBS, 2011). Banks must ensure that their countercyclical buffer requirements are calculated and publicly disclosed with at least the same frequency as their minimum capital requirements. The countercyclical buffer regime will be phased-in in parallel with the capital conservation buffer between 1 January 2016 and the end of 2018, and it will be fully effective on 1 January 2019. This means that the maximum countercyclical buffer requirement will begin at 0.625% of RWAs on 1 January 2016 and increase each subsequent year by an additional 0.625 percentage points to reach its final maximum of 2.5% of RWAs on 1 January 2019.

To relieve concerns about the introduction of the credit-to-GDP gap, the BCBS[4] uses a panel of 26 countries over the period of 1980–2012 to compare the performance of six indicators, including the credit-to-GDP gap, credit growth, GDP growth, residential property price growth, the debt service ratio (DSR) and the non-core liability ratio. The result shows that the credit-to-GDP gap, among others, performs best.

2.2 The CCCB in Japan

Japan is characterised as having an integrated regulatory structure with the Japanese Financial Services Agency (JFSA) in charge of supervising banking, securities and insurance companies. The JFSA is also responsible for monitoring the compliance of the Basel regulation. It promulgated the Basel III rules in March 2012 and offered the timetable for the Basel standards implementation as depicted in Table 2.2.

4. BCBS (2014).

Table 2.2
Timetable of Basel Standards Implementation in Japan

	Publication Date of Proposed Rules	Publication Date of Final Rules	Rules Effective as of
Basel II	October 2004, March, September and December 2005	March 2006	March 2007
Basel 2.5	February 2011	May 2011	December 2011
Basel III	February 2012	March 2012	March 2013

Note: The fiscal year in Japan begins in April (BCBS, 2012).
Source: JFSA.

The BCBS assessed the final capital regulations of Japan in 2012 and found that it has amended the domestic regulation in compliance with the Basel regulation. The total assessment grade is "compliant" with Basel II and Basel 2.5, which means "all minimum provisions of the international framework have been satisfied and if no material differences have been identified" (BCBS, 2012).

However, the *Report to G20 Leaders on Monitoring Implementation of Basel III Regulatory Reforms*, points out that Japan has not completed the job for implementing the CCCB and comments that the rules covering the capital conservation buffer and the countercyclical buffer have not yet been issued. The draft regulations are expected in 2014/15 (BIS, 2013).

2.3 The Progress in Chinese Taipei

Chinese Taipei has not experienced any financial distress over the past decades when the global economy went through several crises. The banking industry in Chinese Taipei even operated soundly and performed well during the Asian financial crisis in 1997 and 1998. However, the economy was affected by some local financial disorders. In 1998 and 1999, some listed companies went bankrupt, which damaged both the economy and the asset quality of banks. Reflecting this, the average NPL ratio increased from 4.18% in 1997 to 4.93% in 1998. After that, the domestic banks experienced a "card crisis" in the wake of a dramatic rise in the debt of credit cards and cash cards which peaked at US$268 billion in 2006. More than half a million debtors were not able to repay their loans. As a result, it was suggested that appropriate capital buffer is necessary.

Although Chinese Taipei was not forced to revamp its financial regulatory system by any financial crisis, it has made some financial reforms. The authority regularly overhauls the regulations to comply with the Basel principles. For example, the modified *Regulations Governing the Capital Adequacy and*

Capital Category of Banks of 2014 offers some capital requirements standard for banks (Table 2.3).

Table 2.3
The Required Minimum Capital Ratio for Banks in Chinese Taipei

	2013	2014	2015	2016	2017	2018	After 2018
Total Capital Adequacy Ratio (%)	8.0	8.0	8.0	8.625	9.25	9.875	10.5
Tier 1 Capital Ratio (%)	4.5	5.5	6.0	6.625	7.25	7.875	8.5
Common Equity Tier 1 Ratio (%)	3.5	4.0	4.5	5.125	5.75	6.375	7.0

Source: FSC.

As for the CCCB, Article 5 of the *Regulations Governing the Capital Adequacy and Capital Category of Banks* stated that "to minimise systemic risks, the competent authority has to consult with the CBC, and other relevant organisations to raise the minimum requirement stated in the previous paragraph if necessary. However, the minimum ratio shall not be higher than 2.5%." In this regard, the authority has the power to implement the CCCB. Nevertheless, the relevant guidelines are under formulation. Presently, the competent authority is deliberating the feasibility of the credit-to-GDP gap and seeking to develop other trustworthy indicators. Some candidates are on the list, for example, the Business Composition Index, the Financial Composition Index, point-in-time (PIT) and through-the-cycle (TTC) approaches.

3. Literature Review

3.1 The Motive

The financial crisis has focused policymakers' attention on establishing frameworks and tools to address the procyclicality of the financial system. Aiming to guide the national authorities to construct a broader macroprudential tool, Basel III introduced a CCCB in order to enhance banks' resilience against the build-up of systemic vulnerabilities mainly stemming from periods of excess aggregate credit growth.[5] Moreover, given that financial crises tend to be led by private sector credit boom,[6] the early warning indicator (EWI) for systemic

5. See BCBS (2010).
6. See, for example, Borio and Lowe (2002); Borio and Drehman (2009); and Gourinchas and Obstfeld (2012).

banking crises can be selected.[7] To this end, Basel III assigns the credit-to-GDP gap, which is regarded as a useful EWI that successfully captures the credit boom,[8] as a guide for setting CCCBs.

Nevertheless, the link between the credit-to-GDP gap and the capital buffers is not mechanical. Instead, the framework of Basel III allows for policymakers' judgment on how buffers are built up and released (Drehmann and Tsatsaronis, 2013). To wit, it is felt that judgment can complement quantitative analysis, where appropriate. This may allow financial agencies to flexibly manage the regulatory instrument by using indicators other than the credit-to-GDP gap. It can further help to reduce the risk of the supply of credit being constrained by regulatory capital requirements that can undermine the performance of the real economy and bring about additional credit losses in the banking system.

3.2 Design of Countercyclical Capital Buffers

3.2.1 Selection of Indicator Variables

The primary step in designing the CCCB is to identify an appropriate indicator which is endowed with the early warning property. In addition, conditioning variables which can guide the build-up or release of capital are an integral part of this analysis. In addition to the credit-to-GDP ratio which seems best for the build-up phase,[9] the alternative indicator variables (e.g., the Financial Stress Index (FSI)[10] the growth of credit and the aggregate debt service ratio[11]) have also been explored in a wide range of papers. By means of event study of the risk build-up, the IMF identified 76 occurrences of financial distress across 40 countries

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7. See, for example, Wang (2014) for the establishment of a new early warning system to predict currency crises which is applicable to any exchange rate system.

8. See, for example, Borio and Lowe (2002) and Borio and Drehman (2009).

9. See Drehmann, Borio, Gambacorta, Jiménez and Carlos Trucharte (2010).

10. The FSI is a monthly indicator of national financial system strain. For advanced economies, the index is the sum of seven variables, each of which is normalised to have a zero mean and a standard deviation of one, including; (i) the banking-sector beta; (ii) the difference between the three-month Treasury bill rate and the Eurodollar rate, namely the TED spread; (iii) the difference between short- and long-term government bonds (i.e., term spreads); (iv) stock market returns; (v) stock market volatility; (vi) sovereign debt spreads; and (vii) exchange market volatility. For emerging economies, the FSI consists of five variables, excluding the TED and term spreads but using an index of exchange market pressure instead of exchange market volatility. See Cardarelli, Elekdag, and Lall (2011) and Balakrishnan, Danninger, Elekdag and Tytell (2009).

11. See Drehmann and Juseliu (2013).

on the basis of the definition of the FSI and observed the changes in the selected indicators (e.g., credit growth, credit-to-GDP, credit-to-GDP gap, leverage) prior to and following the events (IMF, 2011). The result demonstrates that changes in the credit-to-GDP ratio accelerate sharply alongside a positive credit-to-GDP gap before a crisis event occurs. In contrast, changes in the credit-to-GDP ratio dramatically decline together with a negative credit-to-GDP gap in the wake of the crises.

The BCBS (2010) presents an extensive analysis of the properties of a broad range of indicator variables by categorising them into three groups.[12] The credit-to-GDP gap, among others, is viewed as the best performance of the range of variables considered. The main findings of the guidance include the following: (1) the credit-to-GDP ratio tends to rise smoothly well above the trend before the most serious events; (2) deviations of property and equity prices tend to narrow way ahead of the emergence of financial strains, suggesting that the timing they start releasing the buffer is too early; and (3) the performance of bank profits as a signal for the build-up in good times appears to be somewhat uneven.

Drehmann, Borio and Tsatsaronis (2011) support previous research that the gap between the ratio of credit-to-GDP and its long-term backward-looking trend performs best as an indicator for the accumulation of capital, capturing in the build-up of system-wide vulnerabilities. Drehmann and Juseliu (2013) apply the criteria to a set of potential EWIs, which consist of the credit-to-GDP gap, the debt service ratio (DSR) and the non-core liability ratio. They find that all these three indicators satisfy the policy requirements but the first two variables consistently outperform the third. In particular, the credit-to-GDP gap is the best indicator at longer horizons, whereas the DSR dominates at shorter horizons.

3.2.2 Identifying Good and Bad Times

An essential component of the macroprudential approach is to address the procyclicality of the financial system by requiring the accumulation of buffers in "good times" so that these can be drawn down in "bad times". In this regard, related tools such as CCCBs or dynamic provisioning are already considered or

12. The first group includes aggregate macroeconomic variables such as deviations of the credit-to-GDP ratio from a long-term trend; the second group consists of measures of banking sector performance; and third group includes proxies for the cost of funding, in the form of credit spreads.

are used by national authorities. One key challenge for policymakers is to identify the different states in real time, with particular emphasis on detecting unsustainable booms that may eventually lead to a financial crisis. In this respect, we could reexamine the objectives of the exercise by FSB (2009) which demonstrate that banks should build up buffers so that they can absorb losses in bad times. Due to the asymmetry in the financial cycle, the transition from good to bad times tends to be very abrupt, whereas the transition from bad to good times is much more gradual. Drehmann, Borio, Gambacorta, Jiménez and Trucharte (2010) suggest that the transition from good to bad times can be identified by a mix of two factors—one is the measure of aggregate gross losses at banks,[13] the other is an indicator of whether the banking sector is a source of credit contractions (Table 3.1).

Table 3.1
Criteria to Identify Bad Times

		Banking Sector Source of Credit Contraction	
		Yes	**No**
Bank losses	**High**	Bad times	Bad times[1]
	Low	Bad times?[2]	Good times

Notes: 1. Even if the banks experience sizeable losses, the credit supply may not be constrained because the banks may wish to protect customer relationships. Buffers should still be released to help forestall a credit crunch.
2. It will be appropriate to release the buffer if the credit supply constrains reflect a prospective erosion of the capital cushion, owing to expected losses not yet recorded in the accounts (e.g., as a result of backward-looking accounting practices).

Source: Drehmann, Borio, Gambacorta, Jiménez and Trucharte (2010).

3.3 Calculation of the Credit-to-GDP Gap

3.3.1 Business Cycle vs. Credit Cycle

Over the past decades, different statistical techniques to determine the business cycle have been discussed at length in the statistical literature. Among others, Hodrick and Prescott (HP) filters,[14] mainly with respect to de-trending

13. It probably can be best normalised by the size of balance sheets.
14. See Hodrick and Prescott (1981).

GDP growth, are viewed as a good method in mimicking NBER business cycles (e.g., Canova, 1998). To find an optimal solution for the following equation by Hodrick and Prescott (1981), a smooth parameter of ë, which equals 1,600, was suggested and has become the standard for business cycle analysis on the basis of quarterly data. That is,

$$\min_{\{g_t\}_{t=1}^{T}} \sum_{t=1}^{T}(y_t - g_t)^2 + \lambda \sum_{t=1}^{T}(g_{t+1} - 2g_t + g_{t-1})^2$$

Where y_t consists of two components by the trend (g_t) and the cycle (c_t).

This implicitly assumes a business cycle frequency of around 7.5 years by using frequency analysis. Ravn and Uhlig (2002) further analyse the adjustment of λ with other frequencies (daily, annual, etc.) and suggest that it is optimal to set λ equal to 1,600 multiplied by the fourth power of the observation frequency ratio. They also find that the credit cycle is between three and four times longer than the business cycle, given that the duration of financial cycles ranges from five to 20 years with a mean of around 15 years.

Following the work of Borio and Lowe (2002),[15] Drehmann, Borio, Gambacorta, Jiménez and Trucharte (2010) shed light on the assessment of the performance of the credit-to-GDP gap with different choices for smoothing parameters λ (i.e., 1,600, 2,500, 125,000, and 400,000).[16] In terms of the four thresholds of λ, "Type I error"[17] and "Type II error"[18] as well as "predicted"[19] value of crisis and "noise-to-signal ratio" (NTSR)[20] are calculated in the analysis for a cross-border comparison of six countries. The results show that gaps based on λ=1,600 or λ=25,000 perform very poorly, whereas λ=125,000 and 400,000 both perform well. Later, Drehmann, Borio and Tsatsaronis (2011) use a one-sided HP filter with a smoothing factor λ=400,000 to assess the signaling properties of different credit-to-GDP gaps as anchors for setting the level of the countercyclical regulatory capital buffer requirements for banks.

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15. They suggest to set λ equal to 400,000 to the credit-to-GDP gap.

16. Following the Drehmann, et al. (2010) study, it is assumed that credit cycles have the same length as business cycles when λ=1,600 (= 14*1,600). Meanwhile, it assumes that credit cycles are two times, three times and four times, as long as business cycles when λ=2,500 (≈ 4^2*1,600), 125,000 (≈ 4^3*1,600) and 400,000 (≈ 4^4*1,600)., respectively.

17. No signal is issued and a crisis occurs.

18. A signal is issued but no crisis occurs.

19. Fraction of crises predicted by correct signals.

20. Fraction of Type II error over one minus Type I error.

3.3.2 Total Credit vs. Bank Credit

In line with Basel III recommendations for the CCCB, it is suggested that the credit-to-GDP gaps can be further developed by considering all sources of credit to the private non-bank financial sector and cross-border lending, rather than just bank credit (Dembiermont, Drehmann and Muksakunratana, 2013). In the same vein, a BIS report which compares the performance of various credit-to-GDP gaps as EWIs shows a supportive result that the total credit developments predict the risk of systemic crises better than indicators based solely on bank credit.[21] Drehmann (2013) claims that both types of indicators can help identify vulnerabilities or guide the arrangement of macroprudential tools such as CCCBs. However, given the suggestion of the Basel III guidelines, credit-to-GDP gaps based on all sources of credit are likely to provide a more accurate signal of imminent systemic crises.

3.4 Caveats about the Measurement of Credit-to-GDP Gap

As regards the practical and conceptual criticisms of the credit-to-GDP gaps, Drehmann and Tsatsaronis (2013) indicate that a proper adjustment of data is vital to structural breaks. In addition, they suggest using a valid rule of thumb which calculates the credit gap only for credit-to-GDP series with at least 10 years of available data.

As far as the measurement of capital buffer is concerned, the lower and upper thresholds L and H are key in determining the timing and the speed to adjust the guide buffer add-on to underlying conditions. Given that the maximum buffer add-on is 2.5% of risk-weighted assets (RWAs), the BCBS (2010) suggests that an adjustment factor based on L=2 and H=10 provides a reasonable and robust specification based on historical banking crises. Nevertheless, it depends to some extent on the choice of the smoothing parameter λ, the length of the relevant credit and GDP.

In this context, it is noted that while historically the credit-to-GDP gap can be a useful guide in making buffer decisions, it does not always perform well in all jurisdictions. National authorities are expected to apply judgment by flexibly calibrating the buffer by means of measuring the build-up of system-wide risk rather than rely mechanistically on the credit-to-GDP guide.

4. Empirical Analysis

The design of a rule-based countercyclical mechanism aims to find a formulaic expression that allows for the creation of a capital buffer during the

21. Drehmann (2013).

growth period and the subsequent decline of business cycle to keep pace with the unanticipated losses during the downturn. To this end, our design of a countercyclical mechanism will focus on finding anchor variables (i.e., macro or financial indicators) which are robust enough to be viewed as proxies of EWIs over time for adding onto banks' capital buffer.

In addition to pursuing the 3-step process for calculating the countercyclical buffer add-on suggested by the BCBS (2010), robustness tests (e.g., stability variable), the thresholds are then set by running stepwise regression and the NTSR analysis.

4.1 Data

In light of the previous papers and *the Guidance for National Authorities Operating the Countercyclical Capital Buffer* of BCBS (2010) (hereafter "BCBS Guidance"), a bank's NPL ratio and its profitability are constructed as dependent variables, while selected macro and financial variables are treated as explanatory variables in our regression models (Table 4.1). All the data for the financial variables (i.e., aggregate credit to private sector, banks' NPL ratio and profitability) are obtained from *the CBC Financial Statistics* that contain 72 firm-quarterly observations during Q1 1996 to Q4 2013. Meanwhile, the data on macro variables and supplementary indicators (i.e., GDP, stock price and housing price) are collected from several databases over the same period.

The major variables are further described as follows:

NPL Ratio: The figures trend downward after reaching a peak at 8.04% in Q1 2002 and kept touching new lows up to the end of 2013, reflecting satisfactory asset quality.

Profit: The net income before tax is viewed as bank's profit. Over the past 15 years, the aggregate profit of domestic banks temporarily dropped to a trough in Q4 2002 and Q4 2006, respectively. However, the figures subsequently turned around and trended upward before reaching a record high at NT$258.2 billion in 2013.

Credit: Implied from a tractable approach in our model, the credit series are data from the *Financial Statistics Monthly*, *Republic of China (Taiwan)* based on the definition of IFS-IMF (32d)[22] which has been broadly used by

22. Domestic credit is the sum of net claims on the private sector. It includes (1) all credit extended to households and other non-financial private entities; (2) credit extended to non-financial public sector which is excluded in the domestic credit; and (3) the credit extended by the other non-financial institutions.

national central banks for empirical analysis. Moreover, in order to avoid overlapping with other workstreams and diluting the cyclical properties, a wider definition of credit that includes gross credit flows between financial institutions as well as public exposures is not applied in the analysis.

GDP/GDP growth rate: The GDP series, which can be seen as a factor cost at market prices, is shown in normal terms and of quarterly frequency. In view of statistical bias, the GDP series is constructed by two types of specification; one is seasonally adjusted, and the other is non-seasonally adjusted. In the former series, seasonal variations are removed or discounted from quarterly data by means of census X12.

Credit-to-GDP: The Credit-to-GDP ratio refers to annualised credit-to-GDP ratio. Following the BIS study, each quarterly credit is divided by rolling GDP sum of past four quarters.

Credit-to-GDP gap: The credit-to-GDP gap, which can be seen as a reasonable starting point in deciding the thresholds of a buffer requirement, is also split into non-seasonally adjusted and seasonally adjusted series. Furthermore, for obtaining the most statistically powerful variables, both two-sided and one-sided HP filter in terms of three different parameters of λ value (i.e., λ = 1,600; 14,400; 400,000) are considered when conducting regression analysis.

Table 4.1
Data Definition and Source

Data Span	**From Q1 1996 to Q1 2014**			
Variables	**Definition**	**Frequency**	**Dependent or Explanatory var.**	**Source**
NPLr	NPL ratio	Quarterly	Dependent Var.	CBC
PROFIT_g	Profit growth (year on year)	Quarterly	Dependent Var.	CBC
GDPr	Real GDP	Quarterly	Explanatory Var.	DGBAS
GDPn_l_	Logarithm of nominal GDP	Quarterly	Explanatory Var.	DGBAS
CREDIT_l	Logarithm of credit (IMF-IFS 32d, nsa)	Quarterly	Explanatory Var.	CBC
GDPsa_l	Logarithm of seasonally-adjusted nominal GDP	Quarterly	Explanatory Var.	DGBAS
U	Unemployment rate	Monthly	Explanatory Var.	DGBAS
U_d	Difference of unemployment rate	Monthly	Explanatory Var.	DGBAS
HOUSE_g	Growth of Cathay house price index (year on year)	Quarterly	Explanatory Var.	Cathay Real Estate
CPI	Consumer price index	Monthly	Explanatory Var.	DGBAS
STOCK_d_l	Difference of logarithm of TAIEX stock index	Monthly	Explanatory Var.	TWSE
STOCK_l	Logarithm of TAIEX stock index	Monthly	Explanatory Var.	TWSE
STOCK_g	Growth of TAIEX stock index (year on year)	Monthly	Explanatory Var.	TWSE
GAP1_1600	Credit-to-GDP gap (λ=1,600) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS

GAP1_14400	Credit-to-GDP gap (λ=14,400) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP1_400000	Credit-to-GDP gap (λ=400,000) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP1sa_1600	Seasonally-adjusted Credit-to-GDP gap (λ=1,600) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP1sa_14400	Seasonally-adjusted Credit-to-GDP gap (λ=14400) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP1sa_400000	Seasonally-adjusted Credit-to-GDP gap (λ=440000) by one-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2_1600	Credit-to-GDP gap (λ=1,600) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2_14400	Credit-to-GDP gap (λ=14,400) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2_400000	Credit-to-GDP gap (λ=400,000) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2sa_1600	Seasonally-adjusted Credit-to-GDP gap (λ=1,600) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2sa_14400	Seasonally-adjusted Credit-to-GDP gap (λ=14400) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS
GAP2sa_400000	Seasonally-adjusted Credit-to-GDP gap (λ=440000) by two-sided HP filter	Quarterly	Explanatory Var.	DGBAS

Sources: CBC Financial Statistics, DGBAS, TWSE, and Cathay Real Estate.

4.2 Methodology and Empirical Result

Following the BCBS guidance, this study employs a 3-step process for calculating the countercyclical buffer add-on as follows:

- Step 1: Calculate the credit-to-GDP gap (the gap between the ratio and its trend) based on the resulting credit-to-GDP ratio.

- Step 2: Conduct a stepwise regression analysis based on the macroprudential variables to determine better specifications which have economically and statistically significant relationships with the growth of NPL ratio and the growth of banks' profit.

- Step 3: Determine the upper and lower threshold after conducting regression analysis and some robustness tests on the basis of the indicator variable selected from the Step 2 exercise.

As far as the target factor—the credit-to-GDP gap—is concerned, it should be noted that the BCBS guidance uses a one-sided HP filter to establish the trend by assuming that only current and past states influence the current observation. Distinctively, this study, besides the one-sided HP filter analysis, adds a two-sided HP filter analysis that considers the entire sample period in the regression model, so as to make a comparison between different measures.

4.2.1 Calculating the Credit-to-GDP Ratio

- Calculation of the Credit-to-GDP Ratio and the Trend

Firstly, the credit-to-GDP ratio is given by the following equation:

$$CTG_t^{23} = Credit_t \ / \ GDP_t * 100\% \qquad (4\text{-}1)$$

Where CTG_t denotes the credit-to-GDP ratio. The numerator nominator is quarterly credit, while the denominator is rolling GDP sum of past four quarters.

The equation (4-1) states that the credit-to-GDP ratio equals "the total credit to the private sector" divided by domestic GDP. Both GDP and credit are in nominal terms and on a quarterly basis.

Secondly, we estimate the long-term trend of the actual credit-to-GDP ratio by means of HP filter on the basis of the objective equation (4-2) below, so as to compare the credit-to-GDP ratio (CTG_t) and its long-term trend (Trend).

$$\min \sum_{t=1}^{T} \{[CTG_t - Trend_t]^2 + \lambda[Trend_{t+1} - 2Trend_t + Trend_{t-1}]^2\} \qquad (4\text{-}2)$$

where λ denotes a smoothing parameter. The larger the value of λ the higher the penalty for the variations in the growth rate of the trend component.

In the BCBS guidance, two unconventional choices are made regarding the standard HP filter, that is, the choice of a one-sided HP filter to calculate trend and the setting of the smoothing parameter λ=400,000. In supplementing this claim, alternative specifications subject to the resulting estimate of one/two-sided HP filter with different smoothing factors (i.e., λ=1,600; 14,400) and the effects of seasonality are also considered in our empirical analysis.

- Calculation of the Credit-to-GDP Gap

The credit-to-GDP gap (GAP_t) in period *t* is calculated as the actual credit-to-GDP (CTG) ratio minus its long-term trend (Trend) accordingly.

$$GAP_t = CTG_t - Trend_t \qquad (4\text{-}3)$$

23. For example, credit to GDP for Q4 = {Q4 credit stock yr (i)/sum (GDP (Q1): GDP (q4))}*100.

Using EViews to apply the HP filter to (i) the above-mentioned three criterion values of λ; (ii) non-seasonally and seasonally adjusted series, and (iii) one-sided and two-sided method, we can get 12 different trend and cyclical components generated by the equation (4-1) and (4-2). If the credit-to-GDP ratio is significantly above its trend which implies there is a large positive gap, then this is an indication that credit may have grown to excessive levels relative to GDP_t and vice versa. Comparing the movement of the trend and cyclical components under different specifications, Chart A2.1 and Chart A2.2 of Annex 2 illustrate that the GAP_t generated by the equation (4-3) tend to have a greater amplitude of fluctuation when the value is calculated by a two-sided HP filter, in particular, without seasonal adjustment.[24]

4.2.2 Selecting Explanatory Variables

In this study, we focus on identifying micro or macro factors which not can only signal well the emergence of a crisis during a specific horizon but also coincide with the movement of the business cycle. In this view, we firstly set up a regression model as follows:

$$Y_{it} = f(GAP_{it}, X_{it}) \tag{4-4}$$

Where Y_{it} denotes a time series of dependent variable i in time t. GAP_{it} represents a time series of *credit-to-GDP gap* under i type of data properties, while X_{it} denote two financial variables (i.e., stock price and housing price) over the same period.

To avoid spurious regression, we firstly conduct three different unit root tests (i.e., the Augment Dickey-Fuller test, Phillips-Perron test and KPSS test) to investigate the unit root properties prior to the model test. Considering the consistency of data properties among variables, some series (i.e., stock price index and unemployment rate) with monthly data are transformed into quarterly basis. The results show that all the variables are stationary[25] and significant at 99.5% interval.

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24. Given the same smoothing factor (e.g., λ=1,600), the standard deviation of the credit-to-GDP gap by two-sided HP filter is 19.06 (with seasonal adjustment is 14.84), which is higher than the standard deviation (17.82) of the series treated by the one-sided HP filter (14.43, after seasonal adjustment).

25. Among others, the series of unemployment rate and stock price index are stationary after first order difference, while the series of GDP and credit are stationary after log transformation.

Subsequently, we conduct a stepwise regression analysis to identify the variables contributing most to the determinants of the profit growth rate and the NPL ratio[26] on the basis that the criterion t value=2. After that, we select the specification with the highest R-square value, which is also known as the coefficient of determination, for further analysis. The processes are as follows. First, to mitigate the tractability of multivariate problems, we adopt two sets of single-variate regressions, in which dependent variables are NPL ratio and profit, respectively. Next, we set out each independent variable (i.e., *GAP*, stock price and housing price) with lags up to 12 periods and confine both the stepwise stopping criteria for forwards and backwards to t value no more than 2. As a result, among the 28 equations,[27] only 4 equations subject to profit growth rate (*PROFIT_g*) as the dependent variable can pass the criteria. The resulting models are shown in Annex 1.

We select the variable "*GAP1_1600*" that represents the credit-to-GDP gaps, which are calculated by a one-sided HP filter using a smoothing factor λ=1,600 as a candidate variable due to higher R-square value, its early indicator property of being able to forecast decline in profit before ten quarters (Annex 1). Afterwards, we determine the threshold estimation from the above-mentioned resulting models on the basis of explanatory power.

4.3 Selection of Threshold

The BCBS (2010) suggests that thresholds of L=2 and H=10 provide a reasonable and robust specification based on historical banking crises. However, it depends on the factors such as the smoothing parameters (λ) and the data properties. Accordingly, in terms of country-specific data and financial circumstances, we intend to obtain the optimal threshold which can adequately reflect a buffer requirement by signaling the build-up in increase or decrease of systemic risks. In line with the approach provided by Sarel (1996), for dummy variable we use the credit-to-GDP gaps (GAP_i) greater than a certain level and set regression model for threshold estimation as follows:

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26. We ran the NPL growth rate against independent variables, but the result is insignificant. In addition, the regression results for correlation and lagged correlation of quarterly NPL growth (yoy), and bank profit growth (yoy) with stock return (yoy) and housing prices growth (yoy) are also statistically insignificant. Accordingly, these explanatory variables are not further used to be the indicator variables for judging the timing of buffer release.

27. That is 2 dependent variables multiplied by 14 independent variables (stock price, housing price and gaps with or without seasonal adjustment derived from one-sided and two-sided HP filters where λ=1,600, 14,400, and 400,000).

Dummy=1, if GAP_i > threshold value, otherwise zero
Variable $D_t = GAP_i$ *dummy
Profit growth $(Y_2) = f(GAP_i, D_i)$ i=1 to 30 (4-5)

Where GAP_i denotes the selected variable of credit-to-GDP gaps from Section 4.2.2, and i is the gap value.

An assessment of a range of thresholds for different specification of is conducted based on the resulting R-square value associated with regression model (4-5). The result shows that the highest R-square is derived from the specification that the credit-to-GDP gap is set at 23. It implies that the maximum (H) at GAP=23 without additional capital would be required, even if the gap would continue to increase. However, the BCBS's criteria for the maximum (H) also alerts the national agencies that the maximum value should be low enough, so that the buffer would be at its maximum prior to major banking crises. Consequently, on account that our resulting maximum value (H=23) is far beyond the maximum value (H=10) suggested by the BCBS, it seems that further statistical exercise is needed to prove the robustness of our model. To this end, we further conduct some robustness tests in the Section 4.4.

4.4 Robustness Test

4.4.1 Measuring the Performance of GAP

As the first step, we measure the performance of different specifications in credit-to-GDP gap by visually inspecting their evolution around four financial crises/distresses which had marked impact on domestic banks over the past two decades.[28] Chart A2.1 and Chart A2.2 of Annex 2 illustrate some implications as follows:

(1) The business cycle could somehow consistently capture the movement of the credit-to-GDP gap during specific periods.

(2) Deviations of the credit-to-GDP ratio perform well in signaling the emergence of some serious financial distress, in particular, with the specification that the gap is calculated by a one-sided HP filter using a smoothing factor λ=1,600.

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28. We selected four major financial events including (1) Asian crisis & local financial distress (Q3 1998); (2) dotcom bubble & historical-highs of NPL ratio (Q4 2001); (3) credit card/cash card distress (Q3 2005); and (4) the US subprime crisis (Q3 2008).

(3) Compare with the setting of the maximum value at H=10 which is expected to signal all financial stress, we suppose that the setting of H=23 is not only able to concretely signal the most serious episodes but also to mitigate the likelihood of false alarms.

4.4.2 Calculating the NTSR

Secondly, we detect whether the threshold of H=23 for *"GAP1_1600"* is robust to pass some statistical tests. Kaminsky and Reinhart (1999) point out that the best EWI is generally chosen on the basis of the lowest NTSR, which is the ratio of the fraction of Type II error (a signal is issued but no crisis occurs) over 1 minus the fraction of Type I error (no signal is issued and a crisis occurs). In this view, if *"GAP1_1600"* issue a signal and a crisis occurs in the following 8 quarters (counted in cell A), the signal is considered accurate. Conversely, if *"GAP1_1600"* issues a signal and no crisis occurs in that time frame (counted in cell B), the signal is viewed as a false alarm or noise (Table 4.2).

$$\text{NTSR}= \frac{Type\ II\ error}{1-Type\ I\ error} = \frac{\beta\ \ risk}{1-\alpha\ \ risks} = \frac{\frac{B}{B+D}}{1-\frac{C}{A+C}} = \frac{B*(A+C)}{A*(B+D)} \qquad (4\text{-}6)$$

From equation 4-6, it implies that the smaller NTSR the less noise. Accordingly, we could calculate the probability of an indicator variable correctly signaling a crisis with equation 4-7.

$$P\ \ crisis\ signal\ \ \ \frac{A}{A+B} \qquad (4\text{-}7)$$

Table 4.2
The Number of Crisis Signaled by the Credit-to-GDP Gap

	Crisis occurs in the following 8 quarters	No crisis occurs in the following 8 quarters
Signal is issued	A	B
No signal is issued	C	D

Note: When a positive (negative) Credit-to-GDP Gap higher (lower) than the threshold is viewed as a signal, and vice versa.
Source: Kaminsky and Reinhart (1999).

Given the model assumption (H_0: a crisis occurs any time within a two-year horizon; H_1: no crisis occurs any time within a two-year horizon), we assess a range of thresholds for the variable selected in the previous exercise (i.e., the credit-to-GDP gap) with the specification the gap is calculated by a one-sided HP filter using λ=1,600 and 400,000, respectively.[29] Table 4.3 alternatively provides valuable information about the determination of the optimal threshold for the buffer add-on. As to the performance of specification with λ=1,600, it shows that the credit-to-GDP gap achieves the lowest NTSR (36.9%) when the high level threshold is 13. We choose 13 as the high level threshold instead of 23 (derived from stepwise analysis) in a prudential view because there is no "actual" financial crisis in Chinese Taipei over the past two decades and set the low level threshold to be 2, which is similar to the suggestion from the BCBS as our data are so volatile. Moreover, the result of specification with λ=400,000 shows that the credit-to-GDP gap could not provide useful signaling about the build-up of a financial crisis since most of the NTSRs are higher than 1, which means that it is difficult to discern the information between right signals and wrong ones.

Looking across the analysis in Sections 4.4.1 and 4.4.2, we conclude that the credit-to-GDP gap seems to be a useful indicator which not only provides timely signals of the emergence of financial distress, but also shows a coincident movement with the business cycle. It helps the financial supervisory authorities to judge whether the amplified credit-to-GDP gap results from an abnormal expansion of credit.

29. The higher degree of smoothing, such as λ=400,000, is intended to better capture the gradual and cumulative build-up of "financial imbalances," which could be ineffective if the deviation of the actual data from the trend is too small.

Table 4.3
Performance of the Credit-to-GDP Gap to Signaling Crises

Threshold[1]	Type I error[2]	Type II error[2]	Predicted[3]	Noise-to-Signal Ratio	# Crises[4]
One-sided HP filter using λ =1,600					
0	34.38	55.00	65.63	83.81	4
1	34.38	50.00	65.63	76.19	4
2	40.63	47.50	59.38	80.00	4
3	40.63	47.50	59.38	80.00	4
4	43.75	47.50	56.25	84.44	4
5	46.88	42.50	53.13	80.00	4
6	50.00	40.00	50.00	80.00	4
7	53.13	37.50	46.88	80.00	4
8	56.25	32.50	43.75	74.29	4
9	59.38	27.50	40.63	67.69	4
10	59.38	27.50	40.63	67.69	4
11	59.38	25.00	40.63	61.54	4
12	59.38	20.00	40.63	49.23	4
13	59.38	15.00	40.63	36.92	4
14	65.63	15.00	34.38	43.64	4
15	71.88	15.00	28.13	53.33	4
16	78.13	15.00	21.88	68.57	4
17	78.13	15.00	21.88	68.57	4
18	81.25	15.00	18.75	80.00	4
19	84.38	12.50	15.63	80.00	4
20	84.38	12.50	15.63	80.00	4
21	84.38	12.50	15.63	80.00	4
22	87.50	12.50	12.50	100.00	4
23	90.63	10.00	9.38	106.67	4

Threshold[1]	Type I error[2]	Type II error[2]	Predicted[3]	Noise-to-Signal Ratio	# Crises[4]
Two-sided HP filter using λ = 400,000					
0	28.13	72.50	71.88	100.87	4
1	28.13	67.50	71.88	93.91	4
2	34.38	67.50	65.63	102.86	4
3	34.38	67.50	65.63	102.86	4
4	40.63	67.50	59.38	113.68	4
5	40.63	67.50	59.38	113.68	4
6	46.88	67.50	53.13	127.06	4
7	50.00	67.50	50.00	135.00	4
8	53.13	62.50	46.88	133.33	4
9	56.25	60.00	43.75	137.14	4
10	59.38	55.00	40.63	135.38	4
11	59.38	55.00	40.63	135.38	4
12	59.38	55.00	40.63	135.38	4
13	62.50	52.50	37.50	140.00	4
14	65.63	47.50	34.38	138.18	4
15	68.75	47.50	31.25	152.00	4
16	71.88	47.50	28.13	168.89	4
17	71.88	42.50	28.13	151.11	4
18	71.88	42.50	28.13	151.11	4
19	75.00	42.50	25.00	170.00	4
20	75.00	42.50	25.00	170.00	4
21	75.00	40.00	25.00	160.00	4
22	78.13	37.50	21.88	171.43	4
23	78.13	37.50	21.88	171.43	4

Notes: 1. A signal of 1 is issued if conditioning variable is larger than the threshold.
2. A signal of 1 (0) is judged to be correct if a crisis (no crisis) occurs any time within a three year horizon. Type I error: no signal is issued and a crisis occurs. Type 2 error: a signal is issued but no crisis occurs.
3. Predicted: fraction of crises predicted by correct signals. Green cells: more than two thirds of crises are captured. The NTSR: fraction of Type II error over one minus Type I error.
4. Number of crises in the analysed sample.

Sources: Drehmann, et al. (2010); authors' calculations.

4.5 Buffer Release

The choice of the appropriate timing to release the buffer is integral to the success of the implementation of the CCCB. This is because a crisis can be aggravated if the buffer is released too early, whereas a serious delay in releasing capital buffers can also undermine the economic recovery. The best timing is to release the buffer when the crisis materialises. Therefore, we need to identify some coincident indicators to serve as the trigger as they can appropriately signal the crisis.

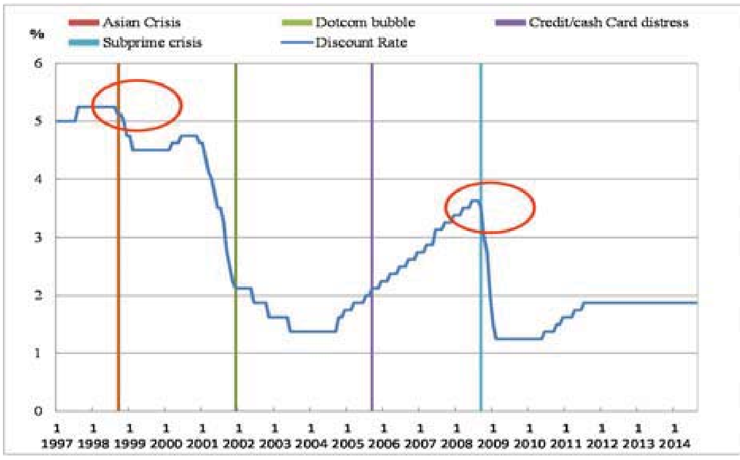
According to the suggestion of the BCBS (2010), macro variables, asset prices, interest rate spreads, and banking sector conditions are useful in helping the authorities to assess and explain the need to release the buffer after the financial system comes under stress. However, these variables cannot serve as reliable indicators for releasing the buffer due to mixed signals.

In such instance, we find that a change in monetary policy stance by the central bank can be a reasonable indicator for regulators judging the buffer release. A potential reason to support this finding is that central banks tend to adjust interest rates promptly to respond to abnormal economic conditions. For example, interest rate cuts were commonly used by central banks to revitalise the domestic economy in the wake of the recent global financial crisis. Hence, it is plausible to infer that the economy is under stress when the central bank decides to lower its policy rates.

In support of this claim, there is, to some extent, a linkage between accommodative monetary policy and banking crises over the last few decades. For example, our analysis shows that policy rate cuts were announced by the CBC around the time of the Asian crisis (Q3 1998) and the US subprime crisis (Q3 2008), which had dramatic impacts on the domestic financial industry. However, the CBC would not adopt accommodative monetary policy against the other financial distresses[30] (Chart 4.1), given that the financial sector remained stable alongside a relatively low level of policy rates over the same periods. While we cannot merely rely on the change in monetary policy stance to signal the release phase of capital buffers, we still believe that this indictor can be an alternative as it also highly interconnects with macroprudential regulation which is addressed by Basel III.

30. They are the dotcom bubble in Q4 2001 and the credit card/cash card distress in Q3 2005.

Chart 4.1
Changes in the Policy Rates of Chinese Taipei



Notes: 1. The discount rate denotes the policy rate announced by the CBC.
2. The four vertical (in parallel with the Y axis) lines paralleling to the Y axis represent, from left to right, the starting point of Asian crisis, dotcom bubble, credit/cash card distress and the US subprime crisis, respectively.

Source: CBC.

In sum, the selection of variables for signaling release of the buffer is still an open issue among policymakers. A recent U.K. study[31] echoes the major empirical challenge mainly from the fact that the uncertainty of stress materialising makes it difficult to test indicators for buffer release in practice, particularly on those time series when the macroprudential policy regime was not in place. Rather, we think that an indicator variable involving the change in monetary policy stance will be more intuitive and pragmatic. In addition, it can be regarded as an entry point taking into account a more practical perspective regarding the interactions of monetary policy, macroprudential supervision and financial stability.

5. Policy Recommendations

Based on the analysis in the previous section, the indicators and relevant thresholds are selected. However, it is another thing to put the CCCB measure in force. The authorities should understand the characteristics of the chosen indicators intensively in order to make timely and correct decisions. In addition,

31. See Giese, Andersen, Bush, Castro, Farag and Kapadia (2013).

the weakness and limit of the analysis which can be an obstacle to choosing proper thresholds should be tackled. This section focuses on the two topics to figure out the critical issues that policymakers should pay attention when implementing the CCCB measure.

5.1 The Characteristics of the Indicators

In this study, we merely focus on testing the specifications in one-sided HP filter with ë=1,600 and 400,000, respectively. The reason is that the former unfolds the best performance in our model, while the latter is the specification suggested by the BCBS guidance. The profile of the credit-to-GDP gaps is shown as follows.

(1) The figures of the gaps have changed dramatically. The data shows that both positive and negative gaps happening in the same year are common no matter what the economic condition is. From 1996 to 2013, only 5 years in the 18 years show consistent signs (i.e., gaps consecutively show positive or negative signs throughout a year) if we take the specification with ë=1,600 as an example. The volatility reveals the difficulty of decision making facing the policymakers since the signs for the build-up or release of capital normally appear in the same year.

(2) The gaps can capture the emergence of an incoming crisis, but they have inconsistent signs (Annex 3). We can find some gaps touch the thresholds before all the four crises during the periods we analysed. The phenomenon could be explained as a result of volatility of the gaps. It means the signal is suitable for deciding to implement the CCCB since it can always reveal a looming crisis. However, some of the gaps before a crisis show no extra capital is needed for the banks. For example, the gaps are negative for the fourth and fifth quarters before the crisis with NPL ratio over 10% in 2001.

(3) The gaps could be very high after a crisis, which does not verify the emergence of an imminent crisis. From the definition and the analysis, the gaps come from the differences of credit-to-GDP ratios and its trends, so they are affected by both credit and GDP. It means the gaps could be very high if the GDP dramatically decline after a crisis. However, the big gaps immediately after a crisis are not assured by the drop in GDP from the data. For example, the values of the gaps are greater than 20 in the first and the second quarters of 2006, but the economic growth rate registers at 5.8%.

In a nutshell, the indicator we choose is informative, but volatile. The implication for policymakers based on the characteristics of the indicator, therefore, can be described as follows.

(1) The authorities should implement the measure when the gaps touch the thresholds despite a negative gap in the next period. If no crisis happens and the authorities want to release the excess capital, it is better to take a wait-and-see approach and hold the decision for at least three quarters. The situation is different from that when a crisis materialises. Promptly releasing capital is convincing if a crisis actually happens.

(2) Large gaps lasting several quarters are not unusual after a crisis, so the authorities should be very careful in implementing the measure after a crisis. Since the GDP tend to decline and the governments are inclined to introduce stimulus policies during and after a crisis, the gaps will get higher. Unless the evidence of a "double dip" is verified, the authorities should keep their hands out of the building up of banks' capital during a downturn.

5.2 Policy Response

After exploring the profile of the indicators, it shows some other relevant issues should be further discussed before and after a crisis. Different methods are used in this paper to find suitable indicators, but they all have some limits and weaknesses. The implications are discussed below.

5.2.1 Before a Crisis

We should pay attention to the issues below in the capital build-up period.

(1) The credit-to-GDP gap, like other indicators, cannot be the only indicator for triggering the CCCB mechanism. As shown in the fourth section, the credit-to-GDP gap was not 100% correct in anticipating whether a crisis would happen or not. When we run the NTSR analysis, it is clear. If we seek to raise the probability of forecasting a crisis correctly, the ratio of false alarms gets higher. Therefore, complementary indicators are needed.

(2) In this paper we use the NTSR analysis to decide the thresholds for the CCCB add-on. The NTSR analysis can choose the proper indicator based on its ability to predict crises while making few false alarms. However, it does not provide the information of the lead time of the signal. It means that we cannot know the specific quarter when the looming crisis will materialise

after the threshold condition of the variable is satisfied. However, timing is a critical issue for the buffer regime. In addition, the BCBS suggests giving "banks a reasonable amount of time to adjust their capital plans," the authorities should "preannounce prospective buffer requirements with a lead time of up to 12 months."

(3) Stepwise regression analysis helps to find the proper variables for explaining the volatility of financial conditions. The method also can be used to find the proper lag period and to set the thresholds incorporated into dummy setting. However, it only offers the possibility of finding suitable variables for predicting the change in profits or NPL ratios. It does not assure the materialisation of a crisis.

As usual, all the methods we use in this paper have some weaknesses and limits. According to the discussion above, the results of stepwise regression analysis show that H=23 is the best upper threshold for the credit-to-GDP gap. However, we suggest that H=13 is suitable for newly industrialised economies, like Chinese Taipei, whose financial markets and GDP are characterised with higher volatility. In addition, we should not only identify supplementary variables but also consider complementary methods, so as to form a sound buffer regime.

As suggested by the BCBS guidance, policymakers are expected to exercise judgment in setting up the buffer after using the best information available to gauge the build-up of system-wide risk. There is significant room to improve the methods of choosing the indicators and thresholds. However, appropriate decisions by policymakers will always play a pivotal role.

5.2.2 After a Crisis

If a crisis materialises, the authorities should promptly release the buffer to reduce the risk of credit supply being constrained by the regulatory capital requirements. In some cases, the gaps remain high after the crisis and the situation could last for several quarters. Therefore, the decision-making before and after a crisis‘ is quite different. Although the damage of false alarms is not huge in normal times, the price will be high during a recession. The economy may need more credit to achieve a recovery.

To this end, monetary policy, which interacts with macroprudential policy, can play a crucial role to temper the conflict between different decisions, and, in turn, mitigate the unpredicted impacts on the real sector and financial sector.

6. Conclusion

The empirical result indicates that the credit-to-GDP gap, among other macro and financial variables, is the best indicator variable under the assessment of the effectiveness of crisis prediction. We then compare the resulting credit-to-GDP gap derived from the one-sided and two-sided HP filter with different λ values. Although the BCBS suggests using one-sided HP filter with λ=400,000, we find that the one-sided HP filter with λ=1,600 is the best candidate in the case of Chinese Taipei. The evaluation of the gaps is performed by comparing the revisions to the gaps on the basis of stepwise regression methods. Different from the thresholds (H=10 and L=2) suggested by the BCBS guidance (2010), we find that the upper threshold of 13 and the lower threshold of 2 are appropriate for Chinese Taipei based on the NTSR analysis and other practical considerations.

According to the analysis, a credit-to-GDP gap with greater fluctuation can reflect the excess credit conditions in Chinese Taipei. Nevertheless, given that the gap is extremely volatile, it is impossible to decide to implement CCCB measures solely based on this indicator. From the analysis, we find that there is no need to apply the same threshold to all countries. It seems too conservative for a newly industrialised economy like Chinese Taipei to impose the maximum buffer of 2.5% when the credit-to-GDP gap is just above 10%. Moreover, further research should be conducted, such as using the Bry Boschan (1971) smoothing variable method to moderate volatile credit-to-GDP gaps and to identify the financial cycle.

The last part of the paper discusses some basic issues. This paper uses the NTSR and the stepwise regression analysis to select indicators and thresholds. These two methods are complementary and address different aspects of the issues. However, from the analysis in the fourth section, we understand that the results of the research are not only "economy-specific" but also "time-specific." This leaves room for improvement in the future. Since the sample period of this paper may be too short to reveal the relationship between variables, the "limited time horizon of data" as well as the "complexity of defining a crisis" are additional concerns in this paper apart from those described in the previous sections.

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Annex 1: The Results of the Stepwise Regression for Four Selected Specifications

1. Dependent variable: PROFIT_g

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GAP2sa_400000 (-12)	**1.366085**	**0.669601**	**2.040148**	**0.0457**

R-squared	**0.060921**	Mean dependent var	-8.839717
Adjusted R-squared	0.060921	.D. dependent var	137.1602
S.E. of regression	132.9166	Akaike info criterion	12.63358
Sum squared resid	1060009.	Schwarz criterion	12.66818
Log likelihood	-384.3241	Hannan-Quinn criter.	12.64714
Durbin-Watson stat	1.972308		

2. Dependent variable: PROFIT_g

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GAP1_1600 (-7)	**-2.392683**	**0.829854**	**-2.883256**	**0.0053**

R-squared	**0.110719**	Mean dependent var	-7.207966
Adjusted R-squared	0.110719	S.D. dependent var	132.2553
S.E. of regression	124.7190	Akaike info criterion	12.50504
Sum squared resid	1011064.	Schwarz criterion	12.53822
Log likelihood	-411.6663	Hannan-Quinn criter.	12.51815
Durbin-Watson stat	2.002488		

3. Dependent variable: PROFIT_g

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GAP1_14400 (-7)	**-1.772591**	**0.709717**	**-2.497603**	**0.0150**

R-squared	**0.084814**	Mean dependent var	-7.207966
Adjusted R-squared	0.084814	S.D. dependent var	132.2553
S.E. of regression	126.5225	Akaike info criterion	12.53375
Sum squared resid	1040516.	Schwarz criterion	12.56693
Log likelihood	-412.6138	Hannan-Quinn criter.	12.54686
Durbin-Watson stat	1.942247		

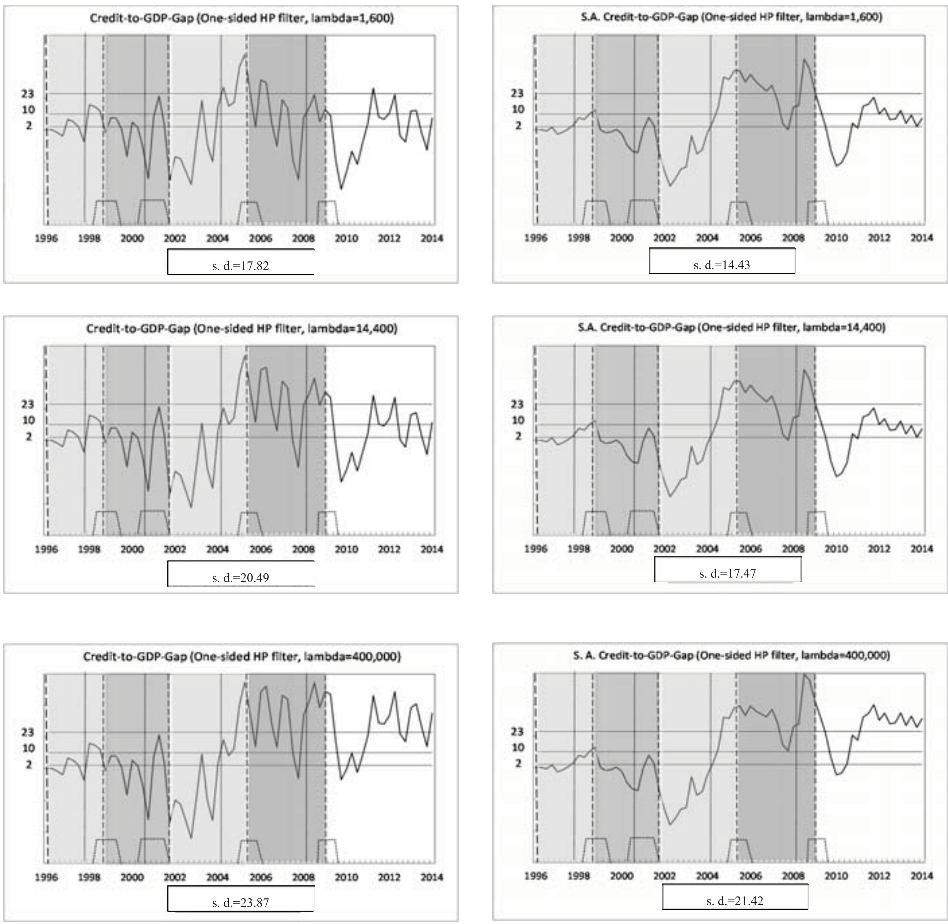
4. Dependent variable: PROFIT_g

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
GAP1sa_1600 (-10)	-2.770642	1.060010	-2.613788	0.0112

R-squared	**0.096070**	Mean dependent var	-7.966362
Adjusted R-squared	0.096070	S.D. dependent var	135.0458
S.E. of regression	128.3951	Akaike info criterion	12.56385
Sum squared resid	1022089.	Schwarz criterion	12.59787
Log likelihood	-394.7612	Hannan-Quinn criter.	12.57723
Durbin-Watson stat	1.959153		

Annex 2: Mapping the Credit-to-GDP Gaps to the Crises and Business Cycles

Chart A2.1 Calculated by a One-Sided HP Filter



Notes: 1. The solid line represents credit-to-GDP gaps.

2. The light grey blocks represent the duration of business cycles from peak to trough, while the dark grey blocks are the duration of business cycles from trough to peak.

3 The dashed lines denote the peak months of business cycles, while the dotted lines are the trough months.

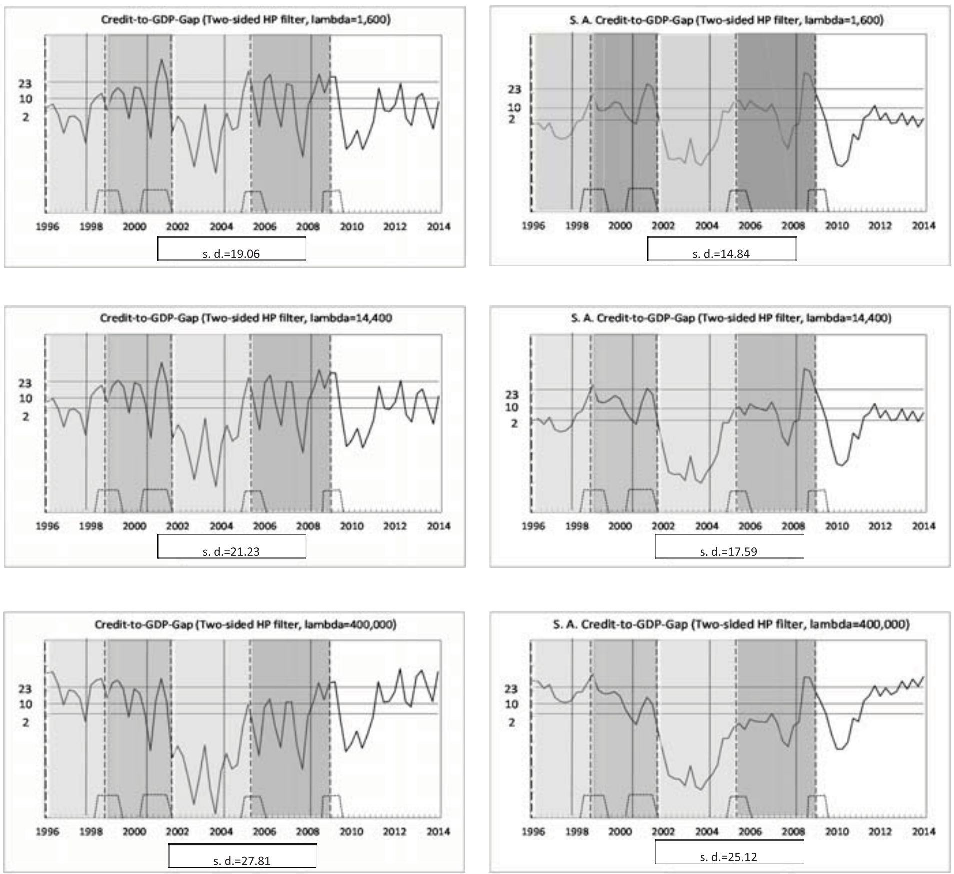
4. The black dash-framed areas represent the duration of the four major crises over the period from Q1 1996 to Q1 2014.

5. The three lines in parallel with the X axis represent the thresholds at 23%, 10% and 2%, respectively.

6. "s. d." refers to the standard deviation of the series of credit-to-GDP gap.

Sources: NDC; CBC; authors calculation.

Chart A2.2: Calculated by a Two-Sided HP Filter



Notes: 1. The solid line represents credit-to-GDP gaps.
2. The light grey blocks represent the duration of business cycles from peak to trough, while the dark grey blocks are the duration of business cycles from trough to peak.
3 The dashed lines denote the peak months of business cycles, while the dotted lines are the trough months.
4. The black dash-framed areas represent the duration of the four major crises over the period from Q1 1996 to Q1 2014.
5. The three lines in parallel with the X axis represent the thresholds at 23%, 10% and 2%, respectively.
6. “s. d.” refers to the standard deviation of the series of credit-to-GDP gap.

Sources: NDC; CBC; authors calculation.

Annex 3: Robustness Test Results by a Noise-to-Signal Ratio Analysis

Table A3.1: The Credit-to-GDP Gap Before Banking Crisis (by One-Sided HP Filter Without Seasonal Adjustment)

One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=1,600)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	15.84**	-7.6	6.16*	6.59*	-3.98	1.49									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	21.43**	-30.73	0.54	4.89*	-16.48	-5.36	7.59*	-1.84	3.41*	15.84**	-7.6	8.68*	6.59*	-3.98	2.37*
Credit card/cash card distress (2005q3)	47.92**	15.04**	30.12**	27.07**	-19.85	3.24*	18.63**	-34.31	-12.19	3.16*	-31.89	-15.84	21.43**	-30.73	-3.1
Subprime crisis (2008q3)	22.24**	-31.26	3.11*	18.99**	-19	0.77	31.65**	1.82	17.01**	47.92**	17.43**	32.18**	27.07**	-19.85	9.3*
One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=14,400)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	15.88**	-7.61	6.2*	6.6*	-3.98	1.49									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	21.32**	-31.93	-0.02	5.09*	-16.36	-5.26	7.91*	-1.64	3.74*	15.88**	-7.61	8.77*	6.6*	-3.98	2.38*
Credit card/cash card distress (2005q3)	53.91**	10.14*	29.89**	20.59**	-29.97	-5.25	10.92*	-42.49	-19.81	3.22*	-33.46	-17.81	21.32**	-31.93	-3.7
Subprime crisis (2008q3)	39.45**	-16.79	18.58**	37.45**	-1.15	18.93**	46.38**	11.4*	34.17**	53.91**	14.42**	35.38**	20.59**	-29.97	1.7
One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=400,000)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	15.89**	-7.61	6.21*	6.6*	-3.98	1.49									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	21.3**	-32.09	-0.1	5.11*	-16.34	-5.24	7.96*	-1.61	3.78*	15.89**	-7.61	8.78*	6.6*	-3.98	2.38*
Credit card/cash card distress (2005q3)	54.81**	8.06*	29**	18.29**	-32.71	-7.72	9.09*	-44.13	-21.42	3.23*	-33.72	-18.16	21.3**	-32.09	-3.79
Subprime crisis (2008q3)	54.55**	-6.52	31.03**	46.43**	9.64*	28.34**	52.22**	13.86**	35.91**	54.81**	12.68*	35.5**	18.29**	-32.71	-0.75

Note: ** refers to Gap e”13, * refers to 2d”Gap<13. Data are annual averages of quarterly credit-to-GDP. gaps. Averages credit-to-GDP gaps around crises times are based on 4 quarters. The gaps are deviations of the credit-to-GDP ratios from their long-term trends, calculated by a one-sided HP filter.

A3.2: The Credit-to-GDP Gap Before Banking Crisis (by One-Sided HP Filter With Seasonal Adjustment)

S.A. One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=1,600)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	7.66*	0.48	4.42*	1.65	-2.78	-0.85									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	7.78*	-14.11	-0.93	0.17	-13.17	-6.33	12.75*	-1.95	2.34*	10.13*	3.04*	5.73*	1.65	-2.78	-0.54
Credit card/cash card distress (2005q3)	37.78**	14.48**	29.42**	5.47*	-14.91	-5.87	44.95**	-30.65	-20.57	33.47**	-35.4	-18.38	7.78*	-14.11	-4.94
Subprime crisis (2008q3)	44.95**	0.01	18.72**	28.11**	4.06*	18.9**	35.15**	27.54**	30.93**	37.78**	31.93**	35.19**	14.48**	-12.34	1.47

S.A. One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=14,400)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	7.63*	0.49	4.4*												
Dotcom bubble & historical-highs of NPL ratio (2001q4)	8.52*	-13.1	-0.08	-0.04	-12.65	-6.27	12.51*	-2.19	2.1*	10*	3.04*	6.77*	1.65	-2.78	-0.54
Credit card/cash card distress (2005q3)	35.65**	20.17**	29.93**	13.15**	-5.63	2.98*	4.92*	-24.28	-12.62	3.45*	-30.79	-16.11	8.52*	-13.1	-4.11
Subprime crisis (2008q3)	28.21**	-15.42	3.32*	9.48*	-13.19	0.87	21.97**	10.93*	17.06**	35.65**	29.49**	32.26**	20.17**	-2.8	9.43*

S.A. One-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=400,000)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	7.66*	0.48	4.42*	1.65	-2.78	-0.85									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	7.67*	-14.26	-1.06	0.2	-13.24	-6.34	12.78*	-1.92	2.37*	10.15*	3.04*	6.84*	1.65	-2.78	-0.54
Credit card/cash card distress (2005q3)	38.21**	12.13*	28.38**	2.82*	-17.27	-8.47	-5.9	-31.86	-22.27	2.77*	-36.24	-18.78	7.67*	-14.26	-5.06
Subprime crisis (2008q3)	59.6**	10.57*	30.94**	37.05**	14.41**	28.11**	39.17**	33.08**	35.54**	39.18**	31.25**	35.14**	12.13*	-14.98	-1.12

Note: ** refers to Gap e”13, * refers to 2d”Gap<13. Data are annual averages of quarterly credit-to-GDP gaps. Averages around crises times are based on 4 quarters. The seasonally adjusted gaps are deviations of the credit-to-GDP ratios from their long-term trends, calculated by a one-sided HP filter.

A3.3: The Credit-to-GDP Gap Before Banking Crisis (by Two-Sided HP Filter Without Seasonal Adjustment)

Two-sided HP filter	Year-1			Year-2			Year-3			Year-4			Year-5		
(lambda=1,600)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	16.83**	-19.16	1.55	1.29	-13.07	-2.52									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	38.09**	-21.71	14.21**	22.05**	-1.85	11.46*	23.97**	6.54*	17.27**	19.94**	-19.16	7.21*	1.16	-13.07	-3.51
Credit card/cash card distress (2005q3)	26.19**	-23.84	-2.44	-11.63	-59.68	-34.3	-6.06	-54.14	-31.79	21.14**	-21.64	-7.47	38.09**	-21.71	10.26*
Subprime crisis (2008q3)	32.35**	-32.77	6.36*	23.1**	-13.58	4.98*	28.04**	-15.22	9.91*	26.19**	-20.75	5.1*	-11.63	-59.68	-30.28
Two-sided HP filter	Year-1			Year-2			Year-3			Year-4			Year-5		
(lambda=14,400)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	10.83*	-24.8	-4.17	-2.93	-17.57	-7.17									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	41.01**	-21.56	16.45**	18.76**	-6	8.76*	18.58**	0.56	11.77*	13.88**	-24.8	1.32	-3.93	-17.57	-8.45
Credit card/cash card distress (2005q3)	31.6**	-14.89	4.77*	-1.73	-48.5	-23.51	5.32*	-43.68	-21.16	25.54**	-15.78	-0.96	41.01**	-21.56	11.12*
Subprime crisis (2008q3)	29.13**	-35.65	3.25*	21.53**	-16.13	3.2*	28.86**	-12.24	13.49**	31.6**	-12.9	11.11*	-1.73	-48.5	-20.11
Two-sided HP filter	Year-1			Year-2			Year-3			Year-4			Year-5		
(lambda=400,000)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	28.43**	-4.1	15.75**	25.05**	8.94*	18.62**									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	29.8**	-26.99	6.69*	21.63**	-0.58	10.23*	28.66**	14.68**	22.82**	29.81**	-4.1	19.67**	20.82**	8.94*	15.89**
Credit card/cash card distress (2005q3)	9.42*	-41.49	-19.71	-29.35	-77.14	-51.79	-22.71	-69.42	-47.38	11.45*	-32.66	-19.05	29.8**	-26.99	4.24*
Subprime crisis (2008q3)	26.61**	-41.72	-1.01	11.37*	-24.63	-6.39	13.7**	-30.92	-4.76	9.42*	-38.22	-11.83	-29.35	-77.14	-47.9

Note: ** refers to Gap e”13, * refers to 2d”Gap<13. Data are annual averages of quarterly credit-to-GDP gaps.
Averages around the crises times are based on 4 quarters. The gaps are deviations from the credit-to-GDP ratios of their long-term trends, calculated by a two-sided HP filter.

Table A3.4 The Credit-to-GDP Gap Before Banking Crisis (by Two-Sided HP Filter With Seasonal Adjustment)

S.A. Two-sided HP filter		Year-1			Year-2			Year-3			Year-4			Year-5	
(lambda=1,600)	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean
Asian crisis & local financial distress(1998q3)	2.19*	-10.37	-3.83	-0.05	-10.79	-6.04									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	26.42**	-0.76	16.14**	14.22**	1.41	8.64*	19.72**	8.18*	11.76*	10.75*	-7.51	-1.64	-0.05	-10.79	-7.51
Credit card/cash card distress (2005q3)	14.13**	-11.2	4.56*	-18.08	-28.85	-23.86	33.89**	-27.29	-21.54	24.02**	-24.26	-1.1	26.42**	-0.76	10.49*
Subprime crisis (2008q3)	33.89**	-17.32	3.36*	12.86*	-11.66	3.28*	15.05**	8.74*	11.31*	15.3**	7.04*	11.19*	-11.2	-28.85	-20.05
S.A. Two-sided HP filter		**Year-1**			**Year-2**			**Year-3**			**Year-4**			**Year-5**	
(lambda=14,400)	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**
Asian crisis & local financial distress(1998q3)	8.39*	-5.01	1.99												
Dotcom bubble & historical-highs of NPL ratio (2001q4)	23.68**	-0.67	14.1**	18.67**	2.79*	11.62*	25.97**	13.87**	17.55**	17.04**	-1.8	7.51*	4.13*	-5.8	-2.73
Credit card/cash card distress (2005q3)	8.64*	-20.2	-2.71	-28.02	-40.03	-34.67	-21.89	-38.31	-32.11	19.79**	-32.68	-7.47	23.68**	-0.67	9.85*
Subprime crisis (2008q3)	36.99**	-14.57	6.35*	14.3**	-9.23	4.94*	13.1**	5.67*	9.81*	11.04*	0.33	5.1*	-20.2	-40.03	-30.25
S.A. Two-sided HP filter		**Year-1**			**Year-2**			**Year-3**			**Year-4**			**Year-5**	
(lambda=400,000)	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**
Asian crisis & local financial distress(1998q3)	19.23**	10.88*	15.35**	25.07**	11.77*	18.44**									
Dotcom bubble & historical-highs of NPL ratio (2001q4)	14.95**	-6.42	6.13*	19.38**	-1.4	9.87*	33.42**	17.95**	22.47**	26.19**	12.4*	19.18**	25.07**	10.88*	15.68**
Credit card/cash card distress (2005q3)	-8.5	-38.23	-20.36	-46.12	-57.88	-52.54	-38.93	-54.74	-48.1	9.67*	-46.47	-19.47	14.95**	-6.42	3.37*
Subprime crisis (2008q3)	30.99**	-23.83	-1.3	2.11*	-19.51	-6.76	-2.33	-10.4	-5.22	-5.61	-17.47	-12.2	-38.23	-57.88	-48.26

Note: ** refers to Gap e"13, * refers to 2d"Gap<13. Data are annual averages of quarterly credit-to-GDP gaps.
Averages around the crises times are based on 4 quarters. The seasonally adjusted gaps are deviations of the credit-to-GDP ratios of their long-term trends, calculated by a two-sided HP filter.

Chapter 8

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: AN EMPIRICAL TEST FOR THAILAND

By
Panita Piyaoui[1]

1. Introduction

The Basel Committee on Banking Supervision (BCBS) issued "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems" in 2010 and revised the document in 2011 in order to strengthen the regulatory standards, including the bank capital requirements, in response to the recent global financial crisis of 2008-2009. Besides other mandatory capital adequacy requirements in the Basel III package, the BCBS for the first time introduced a discretionary countercyclical capital buffer (CCCB) framework by which national regulators can require the banks to build up additional capital buffer up to 2.5% of total risk weighted assets (RWA), in order to reduce the risks of individual banks and also the system-wide risk of the banking sector against "procyclicality" during periods of economic boom and imbalances in excess credit growth. In addition, the BCBS also issued the "Guidance for National Authorities Operating the Countercyclical Buffer" document in 2010 to provide the guidelines and procedures for regulators to operate the CCCB regime, as well as to assist the banks to understand the concepts and prepare ahead for the CCCB implementation in their countries.

Since then, the implementation of the CCCB is in its early stages. It is challenging for many countries to implement the CCCB applying their national discretion with regard to the issues of setting the appropriate threshold and timing to activate or deactivate the buffer, as well as the size of the buffer and the incremental steps of between 0% and 2.5%, which should be preannounced in advance. The national authorities need to develop the CCCB mechanism using rational judgment and with the decision making process strongly supported by adequate in-depth analysis of both quantitative and qualitative indicators in the economic and financial areas. With the aforementioned implementation challenges, only a few countries have so far explicitly issued the CCCB

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guidelines. In fact, the CCCB framework is in the process of development and the issues are under consideration in many countries with regard to the choices of methodologies, anchor variables, supplementary indicators, and trigger points, and so forth.

In order to assist the SEACEN members in preparing for the CCCB implementation, the SEACEN Board of Governors approved the CCCB empirical study as one of the 2014 research projects undertaken to facilitate the conduct of collaborative empirical assessment and consensus among members, especially in the areas of selected micro and macro indicators and choices of anchor variables with lead-lag behaviours, as well as threshold estimation.

Like the majority of the SEACEN member economies, Thailand has not yet issued the detailed CCCB guideline although the country has implemented the Basel III capital requirements since 2013. By joining the SEACEN research project, the findings may be incorporated as inputs in decision making by the Thai national authorities for effective CCCB policy planning.

The structure of this paper is organised as follows. Following this introduction, Section 2 briefly highlights the BCBS' recommendation on the CCCB and the operational progress in Thailand and in other countries. Section 3 reviews the relevant literature concerning the CCCB. Section 4 presents the empirical evidences from the selected methodology and data. Section 5 provides the CCCB policy recommendation/s from the empirical results. Finally, Section 6 concludes the CCCB empirical findings.

2. Comparative Evidences

This section briefly highlights the CCCB recommendation in the BCBS proposal and the CCCB operational evidences from Thailand and from other economies.

2.1 Summary of BCBS' Recommendation[2]

The BCBS issued the guideline for CCCB in 2010 and revised it in 2011 as part of the Basel III package, together with the "Guidance for National Authorities Operating the Countercyclical Buffer" document, in order to assist the national authorities in implementing the CCCB regime. The main objective of the CCCB is to protect the banking sector from unexpected future losses occurring from "procyclicality" or credit cycle that leads to the build-up of risk of individual banks and system-wide risk during periods of economic boom and excess credit growth.

For the CCCB implementation, the BCBS allows national discretion in the setting up of the CCCB regime appropriate to each member economy. National authorities are required to monitor credit growth over time and to determine the appropriate time frames and trigger points to increase or decrease the buffer, within a proper 0% to 2.5% range. Pursuant to BCBS' guidance in the setting of the trigger points, several criteria should be taken into consideration. First, the lower threshold (L) should be low enough for banks to be able to build up additional capital in a gradual fashion before a potential crisis. Second, at the same time, L should be high enough to require no capital for banks during normal periods. Third, the upper threshold (H) should be low enough to reach its maximum level before a potential crisis. For buffer activation, it must be preannounced by up to 12 months in advance, in order to facilitate banks to have time for preparation; therefore, the build-up of capital can be 2 to 3 years ahead of a crisis. The CCCB level should be set as a linear function of the threshold related to the gap between credit-to-GDP ratio variable and its long-term trend, as shown in following Table 1. The suggested CCCB levels of BCBS are L = 2 and H = 10, respectively.

Table 1
CCCB Level and the Threshold

Credit to GDP Gap	CCCB Level
Gap < L	0%
L ≤ Gap ≤ H	0% < CCCB Level < 2.5%
H < Gap	2.5%

2. See "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems," BCBS, Revised Version: June 2011; "Guidance for National Authorities Operating the Countercyclical Buffer," BCBS, December 2010; and "Countercyclical Capital Buffers: Exploring Options," *BIS Working Paper*, No. 317, Monetary and Economic Department, July 2010.

On the other hand, the buffer removal must be taken immediately, in order to promptly reduce the risk of credit supply shortage in the financial market. According to the guideline in setting the buffer, there are some principles and issues to be studied, such as using common reference indicators and regular disclosure, risk of misleading signal from assessment, and use of other macroprudential tools in concert with the CCCB buffer. Additionally, for active international banks, the host supervisors are responsible for the buffer setting and for informing the home supervisors which have powers to set and exercise the CCCB regime directly and to enforce the banks to maintain the buffer requirements as stipulated by the host supervisors, or at a higher level, if found insufficient.

The guideline, moreover, provides further suggestions for the national authorities to comply, and some of the issues are as follows:

- Having buffer decision reviews at least on a quarterly basis, communicating to the stakeholders regularly to promote accountability and sound decision making, as well as submitting the report of the CCCB changes to the BIS on a timely basis;

- Planning discussion with banks regarding their treatment of capital surplus that should be used to absorb losses when the CCCB buffer is turned off, in order to prevent distribution of capital surplus if considered to be imprudent; and

- Not having double CCCB capital requirement for both Pillar 1 and Pillar 2 approaches under Basel III in relation to the same financial system-wide risks.

2.2 Thai Banking Sector and CCCB Implementation

In Thailand, the banking system played an important role in the financial system and economy, although after the financial crisis in 1997-1998, the role of the equity market and bond market have become more significant in financially supporting the large and medium corporations. About one-third of the total credits provided to the real sectors are funded by banks. Banking credits is the major source of funds for the private sector, especially SMEs and households, which in turn was the main factor for the banks' credit growth in the past few years originating from the government stimulus packages to the SMEs and households. More than 50% of the assets of the banking system are owned by locally incorporated private commercial banks. The rest are owned by the government banks, including special financial institutions[3] (SFI), and foreign banks[4] which accounted for about 34% and 10%, respectively.

Commercial banks in Thailand are regulated and supervised by the Bank of Thailand (BOT)[5]. Since the banking crisis, a number of bank regulatory and supervisory reforms have been conducted in order to strengthen the Thai banking system in several areas. The major banking reforms, for instance, are the new Financial Institution Act (2008), the new Bank of Thailand Act (2008), the Financial Sector Master Plan I (2004-2008) and II (2010-2014), and consolidated supervision. As a consequence, there was a dramatic improvement in the overall stability of the banking system. That is, until now the banking system has reported good performance with continued profit growth and low non-performing loans, below 3%. Overall the characteristic and landscape of the Thai banking sector are showed in Table 2 and Graph 1, respectively.

Table 2
Characteristic of the Banking Sector

Credit Provider *				
	Bank (excluded interbank)	Non-Bank	Market (equity + Corp bond)	External (foreign debt to private)
% to total credits	34.53	18.07	37.78	9.62

Ownership Group *			
	Public (Government owned + SFI)	Private (locally incorporated)	Foreign Bank
% to total assets	33.53	56.00	10.47

Target Credit (as of Dec. 2013)			
	Consumer	Manufacturing	Wholesale & Retails
% to total banks' credits	30.4	20.3	16.3

Crisis Yr.	Banking Supervisor	Major Reforms Yr.
1997 - 1998	BOT	2008 : new FI Law 2004 - 2008 : FSMP-I 2010 - 2014 : FSMP-II

* last 5 years average, except external debt data are 4 years average

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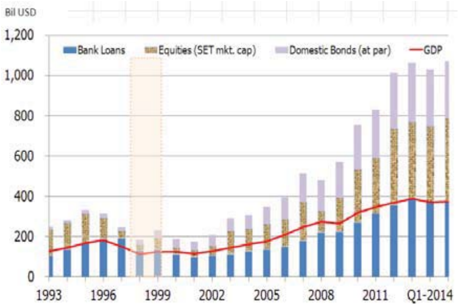
3. The government deposit-taking Special Financial Institutions (SFIs) are the Government Housing Bank, the Government Savings Bank, the Bank for Agriculture and Agricultural Cooperatives, the Export-Import Bank of Thailand, the Small and Medium Enterprise Development Bank of Thailand, and the Islamic Bank of Thailand.
4. Including the foreign branches and foreign subsidiaries.
5. The Bank of Thailand (BOT) has power to regulate and supervise commercial banks, retail banks, foreign bank branches, and subsidiaries of foreign banks under the Financial Institution Business Act B.E. 2551 (2008).

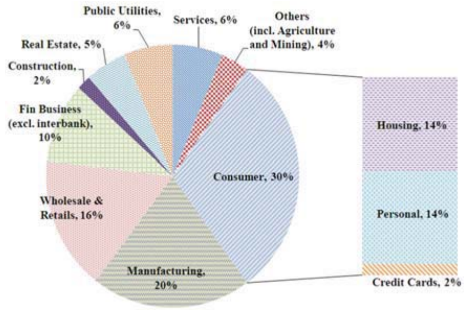
Graph 1
Financial Market Size

Financial Market Size
(as of March 2014)



Source: The data are from the Thai Bond Market Association (ThaiBMA)'s Website.

Bank Credits Classified by Industries
(as of December 2013)



Source: The data are from the BOT's Website, excluding interbank.

Like most other countries concerning the Basel III implementation, Thailand has adopted the minimum capital requirement under the Pillar. I since 2013 and although the CCCB timeline is set to be gradually phased-in during 2016 - 2019, the detail guideline for CCCB on the top of the 2.5% conservation buffer has not been issued yet. The CCCB framework, then, will be announced when the Bank of Thailand deems appropriate in the future. The timeframe of capital requirement under Basel III in Thailand is summarized in the following Table 3.

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Table 3
Basel III Implementation Timeframe in Thailand

Ratio	2012	2013	2014	2015	2016	2017	2018	2019
➢ Total Capital = I + II + III								
I. Minimum Capital Ratio (%)		1st			2nd			
• Common Equity Ratio (CE)	Fully implemented from 2013	4.5						
• Tier 1 Ratio (CE + Add.Tier 1)		6.0						
• Total Capital Ratio		8.5						
• Total Capital Ratio		8.5						
II. + Conservation Buffer (%)					0.625	1.25	1.875	2.5
• Common Equity Ratio (CE)					5.125	5.75	6.375	7.0
• Tier 1 Ratio (CE + Add.Tier 1)				Gradually implemented from 2016	6.625	7.25	7.875	8.5
• Total Capital Ratio					9.125	9.75	10.375	11.0
III. + Countercyclical Buffer (%)					0 – 2.5			

2.3 CCCB Implementation Progress in Non-SEACEN Economies

So far, a few non-SEACEN economies that are found to have the CCCB guidelines explicitly in place are Peru (2011), Switzerland (2013), and Norway (2013). All of them are in the early stage of implementation with less experience in operating the CCCB. Apart from the BCBS proposal, the CCCB operating mechanisms are found to be different in Peru and Switzerland. The BCBS recommends that the buffer be fixed between 0% and 2.5% by comparing the gap between the common credit-to-GDP ratio and its trend with a designed threshold. However, under a different mechanism, the policy buffer in Peru is estimated as a function of the difference between capital requirement under the stress RWA and capital requirement under the actual RWA which may be greater than 2.5%, as suggested by the BCBS. The CCCB rule in Peru has been activated since July 2012, and banks are expected to phase in capitals up to 75% of the CCCB requirement by July 2016 under special obligation of capitalising at least 50% of their net income in each year. Besides, Peru uses GDP growth as a reference indicator for activation, instead of credit-to-GPD indicator as suggested by the BCBS.[6] In Switzerland, the CCCB is deployed only for the mortgage and real estate credit segments, and the buffer level will

6. See Galindo, Rojas-Suarez, and Valle (2013).

be set proportionally to the degree of imbalances in the mortgage and real estate markets later at the time of activation. Following the BCBS guideline, the CCCB level in Norway is first set at only 1% of RWAs and will be effective in June 2015. The buffer may be increased up to 2.5% if there is signal of a further build-up of financial imbalance.

3. Related Literature

There are two main streams of related literatures and research in the countercyclical buffer area: one links to a dynamic provisioning tool while the other links to a CCCB tool because both of them are time-varying buffers and can be used as countercyclical macroprudential measures and regulations for banks to strengthen financial stability of the banking system. That is, they provide cushions for banks to absorb unexpected losses during bad times: one is in the form of provision while the other is in the form of capital. The dynamic provisioning rule has been used in many countries for a long time, such as Spain in 2000, Columbia in 2007, Bolivia 2008, Peru in 2008, and Ecuador in 2012[7], as compared to the CCCB regime which was recently introduced by the BCBS in 2010 and is presently in the early stage of operation in a few countries. Therefore, not many empirical works in the CCCB area have existed, and more works are needed to be done in this area. However, the main focus of this research study is on the CCCB related literatures which are briefly summarised as follows.

As mentioned previously, the CCCB regime is proposed to protect the banking system from imbalances in excess credit growth or procyclicality during economic boom. For the operating mechanism, the BCBS recommends that credit cycles and their characteristics be observed to identify "boom period" and "credit growth" by using the credit-to-GDP ratio as a common reference indicator. The common methodology suggested is the Hodrick-Prescott (HP) filter in order to find a trend (HP trend), and the "imbalance" period is identified as when actual credit grows above its trend by more than a certain threshold. In other words, the gap between the actual credit-to-GDP ratio and its HP trend is compared with the defined threshold in order to activate or deactivate the buffer, along with supervisory judgment.[8]

7. See Fernandez de Lis (2012).

8. See the Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems (2010) and (2011) and the Guidance for National Authorities Operating the Countercyclical Buffer (2010). Also see Galindo, Rojas-Suarez, and Valle (2013).

To determine the CCCB by using the credit-to-GDP gap as the reference indicator, as suggested by the BCBS, there are empirical evidences supported by the studies of Galindo, Rojas-Suarez and Valle (2013),[9] Bonfim and Monterio (2013),[10] Drehmann and Gambacorta (2011),[11] and Drehmann, Borio, and Tsatsaronis (2011).[12] However, an opposite argument is presented by the study of Repullo and Saurina (2011) that the credit-to-GDP gap and the GDP growth have generally negative correlation. That is, the credit-to-GDP gap tends to suggest releasing of capital during high GDP growth and increasing of capital during low GDP growth; as a consequence, the countercyclical buffer determined by the credit-to-GDP ratio may not fulfill the purpose of the CCCB as a counter-measure against the pro-cyclicality at the first place[13]. This negative correlation is also confirmed by the study of Giesbergen (2012) only with a few sample countries, such as Egypt, Indonesia, and Russia[14].

Nevertheless, the CCCB reference policy indicator for building up buffer during the boom period may not be the same as an effective policy indicator for releasing the buffer as pointed out by the study of Chen and Christensen (2010)[15]. Besides, other indicators, such as house price index, credit growth, equity price index, and government debt, are found useful for the CCCB decision; therefore, usage of a wide set of indicators and information is suggested to accompany the CCCB policymaking decision concerning the building-up and releasing of the buffer.[16]

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9. Galindo, Rojas-Suarez, and Valle (2013) studies and compares the macroprudential regulation tools used across countries of the Andean region (e.g., Bolivia, Columbia, Ecuador, Peru, and Venezuela) and shows a strong positive correlation between the real credit and real GDP cycles in this region, as well as in the rest of Latin America countries. Besides, many macroprudential tools used in those countries are observed, such as countercyclical buffer, dynamic provisioning, liquidity requirements, reserve requirements, loan-to-value ratio, and limits to currency mismatches. Peru is the only country in this region that implements the CCCB.

10. Bonfim and Monterio (2013) shows that the credit-to-GDP ratio gap is among the best indicators to be considered in setting the CCCB.

11. See Drehmann and Gambacorta (2011).

12. See details in Drehmann, Borio, and Tsatsaronis (2011) which examines the performance of various variables as anchors for setting the level of CCCB requirement for banks.

13. See details in Repullo and Saurina (2011).

14. Giesbergen (2012) finds positive correlation in the sample countries of Brazil, China, India, and Turkey.

15. Chen and Christensen (2010) mentions that some informative variable during the bad time, such as non-performing loans, may not perform effectively during the boom period.

16. See more details in Bonfim and Monterio (2013) and Chen and Christensen (2010).

4. Empirical Analysis

Following the BCBS guidance, this section aims to find a suitable CCCB level for the Thai banking system based on a selected set of Thai financial data. Detailed explanation of data and methodology used, as well as the main empirical findings are presented in the following sections.

4.1 Data

Selected common macroeconomic and financial data, such as credit, GDP, NPL, NPA, bank profit, bank spread, equity price index, and housing price index, is observed by quarter for the sample period of 1990 – Q1 2014, as shown in the following Table 4. However, due to availability, some of the data is collected for a shorter period.

Table 4
Data Definition and Sample Period

Indicators	Sample Period	Type	Definition
Credit	1990 – 2014 (Q1)	Q	claim on private sectors (32d)
GDP	1993 – 2014 (Q1)	Q	at current price
NPL	1998 (Q2) – 2002 (Q3) 2002 (Q4) – 2014 (Q2)	Q	- 3 months pass due - loan classification from substandards and lower classes
NPA	1991 – 1996 1997 – 2013	A Q	foreclosed assets
Bank Profit	1991 – 1998 1999 – 2014 (Q2)	A Q	net profit
Bank Spread	1990 – 2014 (Q2)	Q	difference bet prime rate and saving interest rate
Equity Prices Index	1990 – 2014 (Q2)	Q	SET index = 100 in 1975 yr
Housing Prices Index	1991 – 2007 2008 – 2014 (Q1)	Q	- from the Government Housing Bank portfolio, index = 100 in 1991 yr. - from commercial banking system portfolio, index = 100 in 2009 yr.

Note: "A" and "Q" are represented as annual data and quarter data, respectively.

The major sources of these selected data are from the Bank of Thailand's website and database, except for the information on equity prices index, which is obtained from the Stock Exchange of Thailand's website. The data collected is denominated in local Thai baht (THB) for the analysis of this paper.

In more details, following the BCBS, a broad definition of "credit" is used as "claim on private sectors" from 1990 to Q1 2014 by quarter and in line with the IMF International Financial Statistic (line 32d). The GDP data is collected quarterly at the current price from 1993 to Q1 2014. Unfortunately, the non-performing loans (NPL) data has been available on quarterly basis since Q2 1998 to Q2 2014, according to banks' required financial reporting, and the definition of NPL was changed in 2002. That is, for the period of Q2 1998 to Q3 2002, the NPL definition was three months pass due loans, and for the period of Q4 2002 to Q2 2014, the definition has been changed to loans classified as substandard and lower. The non-performing assets (NPA) data is collected as banks' foreclosed assets from 1991 to Q1 2014; however, the quarterly data is available from 1997. Although the banks' net profits are used as "bank profit" and are gathered from 1991 to Q2 2014, the quarterly data is available from 1999 onwards. The bank spread is calculated quarterly as the difference between the prime rate and saving interest rate for the period of 1990 to Q2 2014 because the saving deposit is the largest portion of total deposits, about 46%. The equity prices index is collected quarterly from the SET index with the 1975 base year from 1990 to Q2 2014. The housing prices index, however, is the process of revision. For the period of 1991 to 2007, the housing price index is calculated quarterly by using data from the government housing bank's portfolio and, for the period of 2008 to Q1 2014, by using the quarterly data from the commercial banks' portfolio. The data from the government housing bank is from housing loans for low income borrowers while the data from the commercial banks is from loans for high and middle income classes. Therefore, the data from these two sources is not comparable.

4.2 Methodology and Empirical Findings

In order to find suitable thresholds as trigger points for CCCB activation, the methodologies used in this paper are historical performance analysis of data and Noise-to-Signal Ratio (NTSR) method. Then, after the CCCB thresholds are estimated, the buffer levels can be determined as a linear function of thresholds as suggested by the BCBS. The supplementary indicators also are considered by using correlation analysis and regression analysis. The discussion of methodologies and empirical findings for the CCCB is as follows.

4.2.1 History Performance Analysis and HP Trend

Historical performance analysis for selected data is conducted in order to find an appropriate indicator to represent "procyclicality" or "imbalance in excess credit growth" condition, with an appropriate lead-time, especially before the crisis, and to be used to determine thresholds for the CCCB. From the historical data, when the actual financial crisis occurred in the country during 1997 to 1998, the credit-to-GDP ratio (%) and credit growth (% yoy) variables are found to have that special quality and are selected to compare with their long-term trends using the Hodrick-Prescott filter method (HP Trend). The graphs showing the historical performance of the selected data are shown in Annex 1, and in order to be compared with other SEACEN economies, the graphs are shown in USD currency term. The graphs of the HP trends for the credit-to-GDP ratio and credit growth variables are provided in Annex 2 and the statistical data are shown in the Annex 3.

In fact, some data has limitation, such as NPA, NPL, bank profit, equity price index, and housing prices index, and do not well respond to the aforesaid "procyclicality" or "imbalance" condition. The NPA data seems to be a lag indicator due to a long bankruptcy process, according to the Bankruptcy Law. The availability of the NPL data starts only from Q2 1998 onwards which does not cover the whole crisis period. The annual "bank profit" is used to avoid seasonal effect and accounting period differences of some foreign banks; however, it shows some outliner of extra-ordinary items, such as asset sell-off or reversed accounting reserve. The equity price index data is quite volatile and the calculation of the housing price index data is currently being revised because of two different public series from two different sources as previously explained in the Section 4.1. Thus, due to the limitations, these variables are not relevant to be used as key reference indicators.

Nevertheless, the findings confirm that both the credit-to-GPD ratio and the credit growth variables can capture the condition of "procyclicality" or "excess credit growth" in the economy quite well. Therefore, in this paper, the credit-to-GDP ratio and the credit growth variables are analysed to be used as reference indicators and they are defined in the following equations, (a) and (b) below. Again, as mentioned earlier, in order to avoid the exchange rate effect, the value in local THB currency of all variables is used in this analysis. The credit-to-GDP ratio variable is calculated quarterly by dividing the credit at time (t) by summation of GDP at time (t) and its 3 previous quarters (t-1, t-2, and t-3). In order to avoid the seasonal effect, the credit growth variable (% yoy) is also computed as the difference between credit at time (t) and its 4th previous quarter (t-4) divided by the credit at 4th previous quarter (t-4).

(a) Credit to GDP (t) $= \frac{Credit\ (t)}{\sum_{t}^{t-3} \text{GDP(t)}} * 100\%$

(b) Credit growth (t) $= \frac{Credit\ (t) - Credit\ (t-4)}{Credit\ (t-4)} * 100\%$

As suggested by the BCBS and other studies mentioned in Section 3, the gap between the actual value and its HP trend of the reference indicator is used to identify the “imbalance” condition and to compare with corresponding thresholds in order to activate or deactivate the buffer. Then, the GAP (t) is defined as the difference between the actual credit-to-GDP ratio at time (t) and its long-term trends, using the one-sided Hodrick-Prescott filter method (HP Trend) with λ = 400,000, in order to smooth the trend, in line with the BCBS's suggestion. Similarly, the GAP (t) of credit growth is also found.

(c) GAP (t) of credit to GDP = Credit to GDP (t) - HP Trend (t)

(d) GAP (t) of credit growth = Credit growth (t) - HP Trend (t)

4.2.2 Noise to Signal Ratio

The NTSR method[17] is used to determine suitable thresholds to activate or deactivate the CCCB and to compute the buffer level accordingly. The selection of optimal thresholds is based on the lowest NTSR and the highest probability of prediction (PROB). The NTSR and PROB are calculated as in the following equations, (e) and (f), and in the Table 5.

(e) NTSR $= \dfrac{Type\ II\ error}{1 - Type\ I\ error} = \dfrac{\frac{B}{B+D}}{1 - \frac{C}{A+C}} = \dfrac{B * (A+C)}{A * (B+D)}$

(f) PROB (crisis | signal) $= \dfrac{A}{A + B}$

Where,

A = signal and crisis occurs within the timeframe
B = signal but no crisis outside the timeframe
C = no signal but crisis occurs within the timeframe
D = no signal and no crisis occurs outside the timeframe

17. It is commonly used as model for economic and financial crisis prediction, as well as in the early warning system studies.

Table 5
Indicator Variables for NTSR

Prediction	Crisis Occur	No Crisis
Showing Signal	A	B
No Signal	C	D

In order to compute the NTSR and PROB, the next step is to define the crisis period as financial crises which actually occurred in Thailand during the period of 1997 to 1998. According to the BCBS's guidance, the CCCB activation should be pre-announced in advance as banks should be given at least 4 quarters to raise additional "CCCB add-on" capital before the crisis, the observation timeframes of 4, 8 and 12 quarters before crisis, are identified to detect whether there are any signals or no signal and within or outside the timeframe, as illustrated in Tables 5 and 6.

Table 6
Observation Timeframe for NTSR
(Observation Timeframe = X quarters before crisis + Crisis period)

	12 quarters before the crisis	8 quarters before the crisis	4 quarters before the crisis	Crisis Period	
Timeframe Interval (quarters)					
year	1994	1995	1996	1997	1998

Then, "having a signal" or "no signal" is assigned as a dummy variable (Dummy) that takes a value of 1 or 0 as set in the equation (g). That is, the Dummy value equals to 1 when the GAP (t) is greater than designed thresholds; otherwise, it equals to 0. In this paper, the GAP (t) for both the credit-to-GDP variable and the credit growth variable is taken into account for consideration.

(g) Dummy = 1 where GAP (t) > threshold (i); i = 1, 2, 3, …, n
= 0 otherwise

Although the results from the NTSR method show that the credit growth (% yoy) indicator has lower NTSR and higher prediction probability than the credit-to-GDP indicator as shown in the following Tables 7 and 9, the credit-to-GDP indicator seems to be a better key reference indicator due to having a wider range between the lower and upper thresholds which is more practical by considering the BCBS's suggestion[18].

Table 7
NTSR of GAP (t) of Credit to GDP

NTSR of Credit to GDP (Lamda = 400,000)												
Threshold	4 quarters before Crisis				8 quarters before Crisis				12 quarters before Crisis			
	NTSR	PROB	TYPE I error	TYPE II error	NTSR	PROB	TYPE I error	TYPE II error	NTSR	PROB	TYPE I error	TYPE II error
1	25.714	40.00	0.00	0.26	27.706	46.67	0.13	0.24	36.866	46.67	0.30	0.26
2	24.286	41.38	0.00	0.24	29.837	44.83	0.19	0.24	39.702	44.83	0.35	0.26
3	22.857	42.86	0.00	0.23	27.972	46.43	0.19	0.23	37.221	46.43	0.35	0.24
4	22.857	42.86	0.00	0.23	27.972	46.43	0.19	0.23	37.221	46.43	0.35	0.24
5	22.857	42.86	0.00	0.23	27.972	46.43	0.19	0.23	37.221	46.43	0.35	0.24
6	22.857	42.86	0.00	0.23	27.972	46.43	0.19	0.23	37.221	46.43	0.35	0.24
7	20.000	46.15	0.00	0.20	28.283	46.15	0.25	0.21	37.634	46.15	0.40	0.23
8	20.000	46.15	0.00	0.20	28.283	46.15	0.25	0.21	37.634	46.15	0.40	0.23
9	18.571	48.00	0.00	0.19	26.263	48.00	0.25	0.20	34.946	48.00	0.40	0.21
10	17.143	50.00	0.00	0.17	24.242	50.00	0.25	0.18	32.258	50.00	0.40	0.19
11	18.701	47.83	0.08	0.17	26.446	47.83	0.31	0.18	35.191	47.83	0.45	0.19
12	18.701	47.83	0.08	0.17	26.446	47.83	0.31	0.18	35.191	47.83	0.45	0.19
13	18.857	47.62	0.17	0.16	26.667	47.62	0.38	0.17	35.484	47.62	0.50	0.18
14	20.952	45.00	0.25	0.16	29.630	45.00	0.44	0.17	39.427	45.00	0.55	0.18
15	20.952	45.00	0.25	0.16	29.630	45.00	0.44	0.17	39.427	45.00	0.55	0.18
16	17.143	50.00	0.25	0.13	24.242	50.00	0.44	0.14	32.258	50.00	0.55	0.15
17	19.286	47.06	0.33	0.13	27.273	47.06	0.50	0.14	36.290	47.06	0.60	0.15

For the credit-to-GDP indicator as shown in Table 7, even though the optimal thresholds obtained from all 4, 8 and 12 quarters timeframes are at the same level, the thresholds from the 4 quarters timeframe have the lowest NTSR. In this case, the lower threshold (L) = 10 and the upper threshold (H) = 16 are selected with the same NTSR (17.143) and prediction probability (50%). That is, it can be interpreted that a lead time of 4 quarters is the best trigger point for the pre-announcement time and the CCCB activation should be started when the gap of credit-to-GDP indicator is greater than 10. Then, when the gap reaches

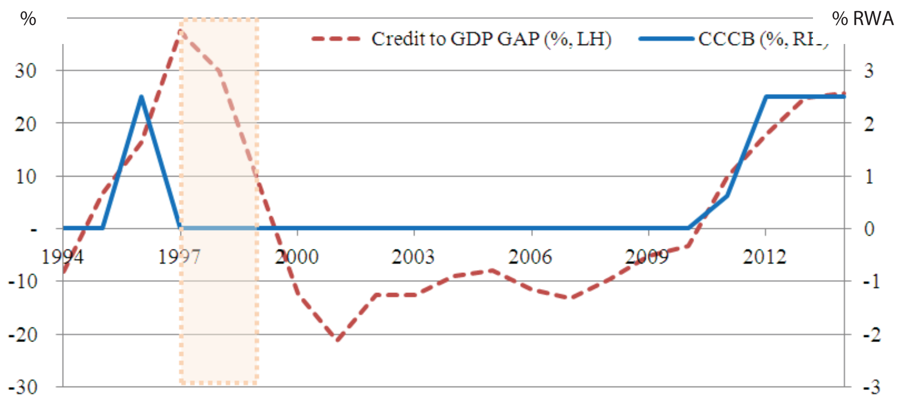
18. As previously mentioned in Section 2.1, page 3.

16, the capital buffer should be at the maximum of 2.5%. However, in order to provide enough time for banks to accumulate the CCCB, the L is considered to be lowered from 10 to 8, making the difference between the H (16) and L (8) equals 8, the same as BCBS's guidance[19].

Table 8
Thresholds and Buffer Levels
(Gap of Credit-to-GDP)

Thresholds **Gap of Credit to GDP (%)**	**Buffer Levels** **(% of risk weighted assets)**
< 8	0
8 to < 10	0.625
10 to < 12	1.25
12 to < 16	1.875
16 and above	2.5

Graph 2
Actual Credit-to-GDP Gap and Determined Buffer Level



In addition, to assign the CCCB levels, according to the BCBS's recommendation, it should be set as a linear function of the thresholds. Therefore, together with judgment, the buffer levels for countercyclical capital add-on can be assigned linearly between 0% and 2.5% of RWAs as in Table 8 and Graph 2 shows the actual credit-to-GDP gap and its corresponding determined capital buffer level. However, as shown in Graph 2, although the maximum buffer

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19. The difference between BCBS's thresholds, H (10) and L (2), equals 8.

level can be reached before the 1997 crisis, the timing period for buffer accumulation is very short, only about one year after activation in 1996. Thus, this result does not quite support the BCBS's guidance for the building up of capital buffers several years ahead of a crisis. [20]

On the other hand, for the credit growth (% yoy) indicator as shown in Table 9, the lower threshold (L) = 10 and the upper threshold (H) = 11 are selected with the NTSR of 11.13 and 5.19 and the prediction probability at 70% and 83%, respectively. Although it receives lower NTRS and higher prediction probability compared to the credit-to-GDP indicator, the estimated thresholds display very narrow interval between the lower (L = 10) and the upper (H = 11) levels. It is too limited for banks to gradually raise capital buffer up to 2.5% within this small interval and they cannot fulfill the criteria of the BCBS as pointed out in Section 2.1. Nonetheless, the 12 quarters time frame shows the best thresholds with the lowest NTSR and the highest prediction probability than the other two time frames. That is, the best lead-time to preannounce the CCCB decision is 12 quarters when the gap of credit growth indicator is greater than 10.

Table 9
NTSR of GAP (t) of Credit Growth

NTSR of Credit Growth (Lamda = 400,000)												
Threshold	4 quarters before Crisis				8 quarters before Crisis				12 quarters before Crisis			
	NTSR	PROB	TYPE I error	TYPE II error	NTSR	PROB	TYPE I error	TYPE II error	NTSR	PROB	TYPE I error	TYPE II error
1	135.53	9.43	0.58	0.56	96.57	16.98	0.44	0.54	79.92	24.53	0.35	0.52
2	158.82	8.16	0.67	0.53	101.23	16.33	0.50	0.51	80.09	24.49	0.40	0.48
3	178.82	7.32	0.75	0.45	95.94	17.07	0.56	0.42	70.84	26.83	0.45	0.39
4	240.00	5.56	0.83	0.40	98.77	16.67	0.63	0.37	67.53	27.78	0.50	0.34
5	169.41	7.69	0.83	0.28	65.84	23.08	0.63	0.25	41.56	38.46	0.50	0.21
6	148.24	8.70	0.83	0.25	55.97	26.09	0.63	0.21	33.77	43.48	0.50	0.17
7	268.24	5.00	0.92	0.22	59.26	25.00	0.69	0.19	31.75	45.00	0.55	0.14
8	240.00	5.56	0.92	0.20	64.20	23.53	0.75	0.16	29.22	47.06	0.60	0.12
9	225.88	5.88	0.92	0.19	47.41	29.41	0.69	0.15	23.09	52.94	0.55	0.10
10	n/a	n/a	n/a	n/a	29.63	40.00	0.75	0.07	11.13	70.00	0.65	0.04
11	n/a	n/a	n/a	n/a	19.75	50.00	0.81	0.04	5.19	83.33	0.75	0.01
12	n/a	n/a	n/a	n/a	13.17	60.00	0.81	0.02	0.00	100.00	0.75	0.00
13	n/a	n/a	n/a	n/a	13.17	60.00	0.81	0.02	0.00	100.00	0.75	0.00
14	n/a	n/a	n/a	n/a	9.88	66.67	0.88	0.01	0.00	100.00	0.85	0.00

20. According to the BCBS's guidance (2010), the rule is to build up capital buffer ahead of a crisis, starting several years earlier.

Besides, the NTSR method calculated from the different gap with different HP trend of λ = 1,600 is also conducted with different time frames. The estimation results do not improve the above findings of λ = 400,000. That is, they confirm the results from the BCBS' guidance that the higher λ provides the better findings. Therefore, to summarise, given the above empirical evidence, together with judgment, the credit-to-GDP ratio is proposed to be used as the key common reference indicator for CCCB activation when the credit-to-GDP gap hits the determined thresholds (L = 8 and H = 16), with a lead-time of policy preannouncement of at least 4 quarters.

Moreover, in case of deactivation, it should be considered to release the buffer when the credit-to-GDP gap falls below the lower threshold (8) and the buffer should be removed immediately when the crisis occurs to prevent further damage to the financial condition as recommended by the BCBS.

4.2.3 Supplementary Indicator

This section tries to identify the supplementary indicators to be used in conjunction with the key reference indicator, credit-to-GDP ratio, found in the previous section for the CCCB activation by considering correlation and regression analysis with the stock market and banking sector variables. Two indicators, stock return and NPL variables, are selected and are computed in the following equations, (h), (i), and (j), respectively, and the results are shown in the Annex 4 and Annex 5. That is, at time (t), the stock return indicator is calculated as changes of stock price index from its previous 4 quarters (% yoy) and the NPL indicators are computed as NPL-to-total credit ratio (%) and NPL growth from previous 4 quarters (% yoy).

(h) Stock return (t) $= \frac{Stock\ price\ index\ (t) -\ Stock\ price\ index\ (t-4)}{Stock\ price\ index\ (t-4)} \ast\ 100\%$

(i) NPL ratio (t) $= \frac{NPL\ (t)}{Credit\ (t)} \ast\ 100\%$

(j) NPL growth (t) $= \frac{NPL\ (t) - NPL\ (t-4)}{NPL\ (t-4)} \ast\ 100\%$

In the Annex 4, the results from correlation analysis between the credit-to-GDP gap and stock return, as well as two definitions of NPL indicator, are displayed with different lag periods. For the stock return indicator, it shows negative relationship with credit-to-GDP gap of different lag periods from 1 to 4 quarters. However, the t-statistical significance level at 5% is found only for the stock return at the same period as the credit-to-GDP gap. That is, it can be interpreted that the stock return indicator has no relationship with the credit-to-GDP gap indicator in previous quarters, perhaps, due to its high volatility.

For the NPL indicators, although a positive relationship with the credit-to-GDP gap for different lag periods is found for both the NPL ratio and the NPL growth, the NPL ratio indicator has shown more significant results than the NPL growth. The results of the NPL ratio illustrate t-statistical significance level at 5% for relationship with the credit-to-GDP gap up to 7 lag periods, compared to only 4 lag periods of the NPL growth.

To further explore the relationships between these indicators, the ordinary least square regression is performed for different lag periods of stock returns and NPL ratio as defined in the equations (k) and (l) as follows. In this case, the NPL ratio is chosen to represent the NPL indicator due to its outstanding performance over the NPL growth. The number of lag periods in the regression analysis is assigned in correspondence with the significant results found in the Annex 4. That is, the regression is conducted for 4 lag periods of the stock return indicator and for 8 lag periods of the NPL ratio indicator, accordingly.

(k) *Stock return* (t) = *f*((Credit to GDP Gap (*t* - *i*))

Where i = 0 to 4 lag periods from time (t)

(l) *NPL ratio* (t) = *f*((Credit to GDP Gap (*t* - *i*))

Where i = 0 to 8lag periods from time (t)

From the estimation results, as shown in the Tables 10 and 11 below, the NPL ratio indicator performs outstandingly with higher t-statistic and R-square compared to the stock return indicator. Although the credit-to-GDP gap indicator with different lag periods shows significant positive impact on the NPL ratio, the highest t-statistic and R-square is found for the 5^{th} lag period of credit-to-GDP gap. Therefore, it can be interpreted that the credit-to-GDP gap can be used as a key reference indicator in conjunction with the NPL ratio indicator of the 5^{th} following quarter, as a supplementary indicator.

Table 10
Summarised Regression Results of Stock Return and Credit-to-GDP Gap

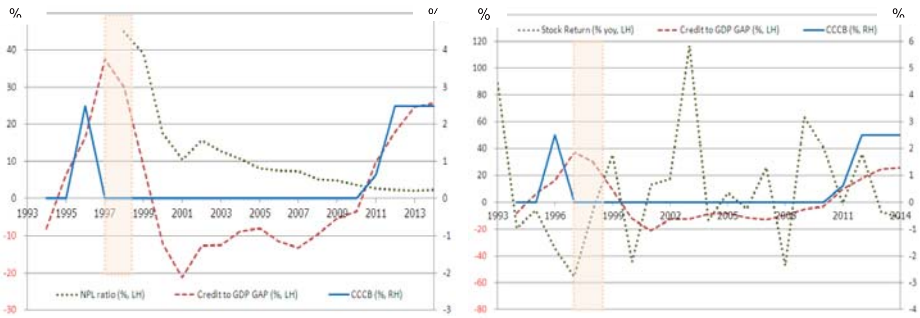
Y = Stock Return	Coefficient	Std. Error	t-Statisitic	Prob.	R-Square
Credit-to-GDP Gap	-0.607	0.254	-2.391	0.019	0.070
Lag 1	-0.509	0.260	-1.961	0.053	0.048
Lag 2	-0.459	0.262	-1.752	0.084	0.039
Lag 3	-0.456	0.261	-1.745	0.085	0.039
Lag 4	-0.429	0.260	-1.653	0.103	0.035

Table 11
Summarised Regression Results of NPL Ratio and Credit-to-GDP Gap

Y = NPL ratio	Coefficient	Std. Error	t-Statisitic	Prob.	R-Square
Credit-to-GDP Gap	0.322	0.099	3.250	0.002	0.146
Lag 1	0.413	0.093	4.433	0.000	0.241
Lag 2	0.475	0.085	5.614	0.000	0.337
Lag 3	0.525	0.078	6.738	0.000	0.423
Lag 4	0.559	0.074	7.529	0.000	0.478
Lag 5	0.571	0.073	7.858	0.000	0.499
Lag 6	0.571	0.073	7.818	0.000	0.496
Lag 7	0.564	0.075	7.564	0.000	0.480
Lag 8	0.544	0.774	7.026	0.000	0.443

Furthermore, the actual performance of the key reference indicator, the credit-to-GDP gap, is plotted against both stock return and NPL indicators, along with the determined countercyclical buffers, as displayed below in Graph 3. The stock return indicator seems to be too volatile to be used as a supplementary indicator due to the high volatility of the stock price index as mentioned previously in Section 4.2.1. Therefore, for conclusion in this paper, it is proposed to use the NPL ratio of the 5th quarter lag period as a supplementary indicator, along with the credit-to-GDP ratio as a key reference indicator, in the process of decision making for CCCB activation.

Graph 3
Actual Performance of the Key Reference and Supplementary Indicators



5. CCCB Policy Recommendation

In this empirical study, besides the estimation results, judgment has been taken into consideration in the process of data selection, threshold estimation, and capital buffer level decision, as well as the key reference indicator and supplementary indicator selection. A list of the recommendations and issues with regard to the CCCB policy framework are noted as follows.

1. The credit-to-GDP indicator is proposed to be used as a key reference indicator, together with the NPL indicator as a supplementary indicator, in the CCCB regime. However, to improve the results, because the credit data collected for this paper is subsumed under a broad term as “private credit”, other definitions of “credit” may be considered. Other potential banking indicators, such as bank credit growth, bank liquidity ratio, or bank gross profit before extraordinary items, for example, may be further explored for their better abilities to capture “procyclicality” condition or imbalances in excess credit growth. Also, given that the gap of credit growth (% yoy) variable does not provide a good threshold from the NTSR method, the analysis may be extended to use credit growth level directly.

2. The thresholds (L = 8 and H = 16) of the credit-to-GDP gap are recommended to activate the CCCB although they are higher than the BCBS guidance (L = 2 and H = 10).

3. The countercyclical buffer for capital add-on, 0.625% to 2.5% of RWA, along with its corresponding the thresholds (L = 8 and H = 16) of credit-to-GDP gap, is proposed as in Table 8. However, in addition to prevent the banking sector

from future losses during an economic downturn, the recommended capital amount should be further examined to determine if it is appropriate to perform as a countercyclical tool effectively because the banking sector activities account for only one-third of the Thai financial market, as shown in Graph 1.

4. The policy decision may be preannounced with a lead-time of at least 4 quarters, consistent with the BCBS guidance.

5. For policy de-activation, the buffer releasing is proposed when the credit-to-GDP gap falls below the lower threshold (L = 8) and the buffer should be removed immediately when the crisis occurs to prevent further damage to the financial condition as recommended by the BCBS. However, other proper triggers and different indicators to support decision making for buffer releasing may be further investigated.

6. This study has limitation in that the data sample (from 1990 to Q1 2014) covers only one crisis which actually occurred in Thailand during 1997 to 1998. In order to perhaps improve the empirical estimation, some other definitions of crisis may be assumed or the data sample may be expanded to cover the other previous crisis that occurred during 1981 to 1985.

7. To enhance the empirical results, different HP trends with different λ**,** besides 1,600 and 400,000, may be conducted for comparison and also other methodologies, such as Sarel's method (1996),[21] for example, may be considered.

8. The thresholds, the key reference indicator, and the supplementary indicator found from the empirical study are based on historical data of which conditions and relationships may not hold in the future. Therefore, changes in economic and financial conditions, as well as structural changes, should be taken into consideration for policy decision and implementation, accordingly.

9. Finally, following the BCBS guidance, the estimation results are expected to be used in conjunction with discretion and appropriate judgment for policymaking.

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21. Sarel, M., (1996), "Nonlinear Effects of Inflation on Economic Growth," *IMF Staff Papers*, 43(1), pp. 199-215.

6. Conclusion

This paper is a part of the 2014 SEACEN research projects undertaken to conduct the CCCB empirical study and to find consensus among the members about CCCB-related issues in order to assist the members in preparing for the CCCB implementation.

To support the CCCB decision making, this empirical study presents a process for the buffer estimation by using Thai data sample for the period of 1990 to the first quarter of 2014. The NTSR method with HP trend (one-sided filter, $\lambda = 400,000$) is conducted to find the thresholds for the buffer activation. As a result, the credit-to-GDP ratio variable is proposed to be used as a key reference indicator for threshold selection, together with the NPL variable as a supplementary indicator. The thresholds of L = 8 and H = 16 are also suggested as trigger points for the capital buffer activation and minimum of 4 quarters lead-time is recommended for the CCCB policy preannouncement. As a consequence, the capital buffer amount at 0.625%, 1.25%, 1.875%, and 2.5% of RWA is provided for the threshold levels of 8%, 10%, 12%, and 16%, respectively. The buffer deactivation may be used with the same lower threshold (L = 8); that is, when the credit-to-GDP gap falls below 8%, and it should be removed immediately when the crisis occurs. Besides, although further analysis is needed regarding the CCCB issues as mentioned in the previous section, it is a good starting point for SEACEN's member economies.

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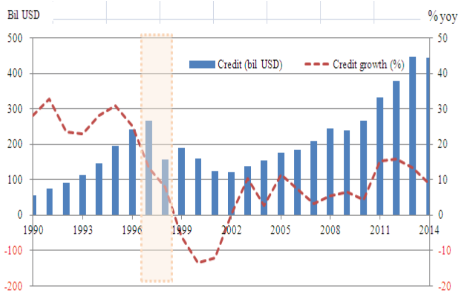
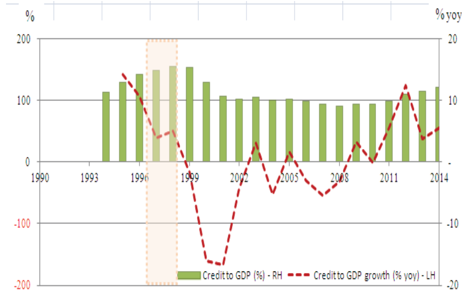
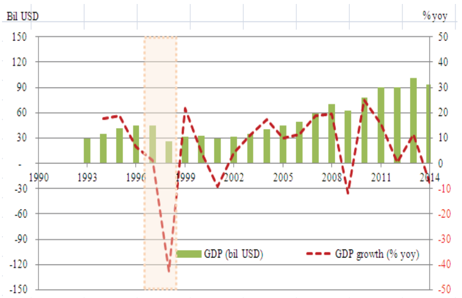
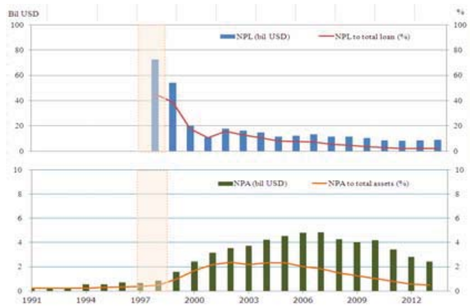
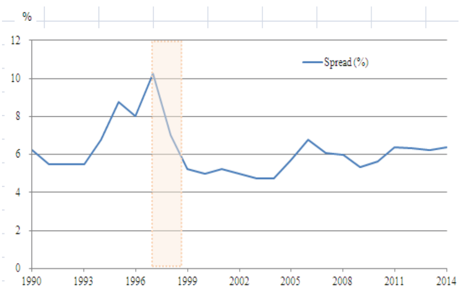
Annex 1: Historical Performance of Selected Data

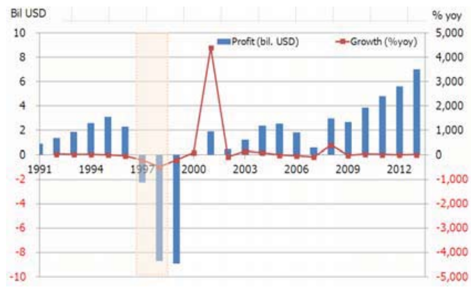


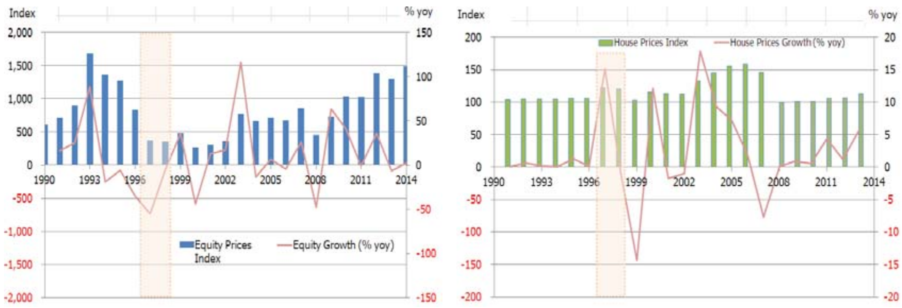




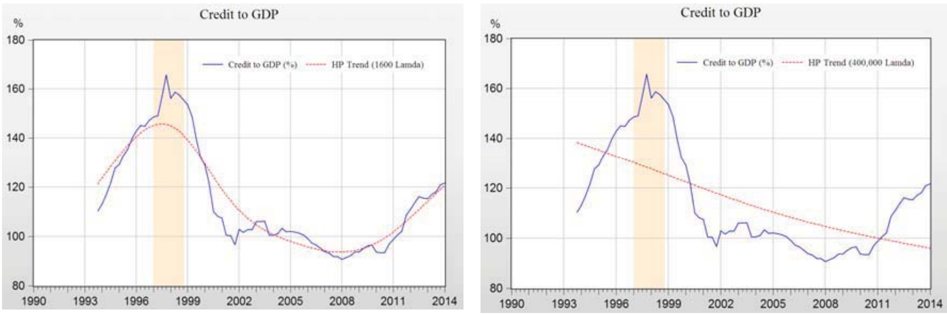








Annex 2: HP Trend



Annex 3: Statistical Data

	Credit (Bil. USD)	Credit Growth (%)	GDP (Bil. USD)	GDP Growth (%)	Credit to GDP (%)	Gross NPA (Bil. USD)	Gross NPL (Bil. USD)
Mean	205	10	51	3	446	3	19
Median	185	10	43	5	429	3	13
Maximum	459	33	101	17	577	5	73
Minimum	56	-17	26	-15	365	0	8
Std. Dev.	99	12	22	6	71	1.5	17
Skewness	1.0	-0.2	0.8	-0.9	0.6	-0.6	2
Kurtosis	3	3	2	4	2	2	6
Jarque-Bera	15	1.4	11	18	8	7	77
Probability	0	0.5	0	0	0	0	0
Sum	19,908	970	4,357	280	37,924	221	1,258
Sum Sq. Dev.	937,868	13,693	42,143	2,537	418,157	162	19,259
Observations	97	93	85	81	85	74	65

	Profit (Bil. USD)	Profit Growth (%)	Spread (%)	Equity Price Index	Equity Price Index Growth (%)	House Price Index	House Price Index Growth (%)
Mean	0.5	109	4	795	8	115	3
Median	0.7	21	5	734	6	109	3
Maximum	3	5,208	7	1,683	117	161	18
Minimum	-10	-401	2	254	-58	92	-14
Std. Dev.	2	658	0.9	362	34	18	6
Skewness	-4	7	-0	0	0	1.3	-0
Kurtosis	27	58	4	2	4	3	3
Jarque-Bera	1,778	8,678	8	5	5	25	0
Probability	0	0	0	0	0	0	1
Sum	36	6,962	439	77,917	766	10,734	249
Sum Sq. Dev.	165	27,294,623	72	12,677,751	109,959	29,319	3,123
Observations	67	64	98	98	94	93	85

Annex 4: Correlation Analysis

Stock Returns (% yoy) and Credit-to-GDP (%) (with Different Lags)

Covariance Correlation t-Statistic	Credit to GDP GAP (%)	Credit to GDP GAP – Lag1 (%)	Credit to GDP GAP – Lag2 (%)	Credit to GDP GAP – Lag3 (%)	Credit to GDP GAP – Lag4 (%)	Stock return (% yoy)
Credit to GDP GAP (%)	233.43 1.00 -----					
Credit to GDP GAP – Lag1 (%)	224.75 0.97 36.54 *	228.71 1.00 -----				
Credit to GDP GAP - LAG2 (%)	212.60 0.92 21.18 *	221.11 0.97 35.81 *	226.43 1.00 -----			
Credit to GDP GAP - LAG3 (%)	197.42 0.86 14.42 *	210.60 0.92 20.80 *	220.69 0.97 35.63*	227.97 1.00 -----		
Credit to GDP GAP - LAG4 (%)	178.06 0.77 10.37 *	196.22 0.85 14.20 *	211.13 0.92 20.71*	223.30 0.97 35.73*	231.74 1.00 -----	
Stock return (% yoy)	-141.78 -0.26 -2.39 *	-116.50 -0.22 -1.96	-104.02 -0.20 -1.75	-103.99 -0.20 -1.75	-99.50 -0.19 -1.65	1,231.20 1.00 -----

Note: * with t- statistical significance level at 5%.

NPL Indicators (%) and Credit-to-GDP gap (%) with Different Lags

Covariance Correlation t-Statistic	CREDIT_TO_GDP (%)	CREDIT_TO_GDP Lag 1 (%)	CREDIT_TO_GDP Lag 2 (%)	CREDIT_TO_GDP Lag 3 (%)	CREDIT_TO_GDP Lag 4 (%)	CREDIT_TO_GDP Lag 5 (%)	CREDIT_TO_GDP Lag 6 (%)	CREDIT_TO_GDP Lag 7 (%)	CREDIT_TO_GDP Lag 8 (%)	NPL_RATIO (%)	NPL_GROWTH (% yoy)
CREDIT_TO_GDP	154.46 1.00 -----										
CREDIT_TO_GDP Lag 1 (%)	150.84 0.97 29.14	157.37 1.00 -----									
CREDIT_TO_GDP Lag 2 (%)	143.87 0.91 16.46	154.95 0.97 29.56	162.69 1.00 -----								
CREDIT_TO_GDP Lag 3 (%)	134.74 0.83 11.15	150.27 0.91 16.98	162.53 0.97 30.70	172.37 1.00 -----							
CREDIT_TO_GDP Lag 4 (%)	122.98 0.73 8.14	142.06 0.84 11.59	158.76 0.92 17.68	173.03 0.97 31.82	183.65 1.00 -----						
CREDIT_TO_GDP Lag 5 (%)	106.07 0.61 5.93	129.59 0.74 8.48	149.72 0.85 12.05	168.23 0.92 18.23	183.21 0.97 32.46	192.84 1.00 -----					
CREDIT_TO_GDP Lag 6 (%)	91.68 0.51 4.47	117.47 0.64 6.38	142.23 0.76 9.04	164.33 0.86 12.75	183.58 0.93 19.13	197.05 0.97 32.25	212.59 1.00 -----				
CREDIT_TO_GDP Lag 7 (%)	70.52 0.38 3.14	97.95 0.53 4.70	124.77 0.66 6.65	151.30 0.78 9.34	174.09 0.86 13.07	192.39 0.93 19.56	210.39 0.97 30.68	221.04 1.00 -----			
CREDIT_TO_GDP Lag 8 (%)	47.29 0.25 2.00	73.53 0.39 3.24	101.74 0.53 4.80	129.99 0.66 6.73	157.10 0.78 9.34	179.33 0.86 13.03	200.87 0.92 18.02	215.38 0.97 29.65	223.71 1.00 -----		
NPL_RATIO (%)	9.18 0.07 0.56	30.08 0.24 1.86	48.33 0.37 3.07*	64.55 0.49 4.23*	77.16 0.56 5.18*	84.79 0.60 5.76*	95.95 0.65 6.51*	100.59 0.67 6.84*	98.21 0.65 6.48*	102.58 1.00 -----	
NPL_GROWTH (% yoy)	74.41 0.23 1.82	54.18 0.17 1.30	22.54 0.07 0.52	-9.93 -0.03 -0.22	-53.03 -0.15 -1.17	-91.98 -0.26 -2.03*	-123.22 -0.33 -2.64*	-155.13 -0.41 -3.37*	-178.99 -0.46 -3.99*	1.27 0.00 0.04	663.67 1.00 -----

Note: * with t- statistical significance level at 5%.

Annex 5: Regression Analysis

Stock Return (% yoy) and Credit-to-GDP gap (%) (with 1 to 4 lags)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.548102	3.892147	1.682388	0.0966
C_GDP_GAP400000	-0.607358	0.254060	-2.390610	0.0193

R-squared	0.069938	Mean dependent var	5.864557
Adjusted R-squared	0.057701	S.D. dependent var	35.31563
S.E. of regression	34.28163	Akaike info criterion	9.932403
Sum squared resid	89317.48	Schwarz criterion	9.992831
Log likelihood	-385.3637	Hannan-Quinn criter.	9.956593
F-statistic	5.715017	Durbin-Watson stat	0.553059
Prob(F-statistic)	0.019297		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.172357	3.929869	1.570627	0.1204
C_GDP_GAP_LAG1	-0.509374	0.259651	-1.961761	0.0535

R-squared	0.048198	Mean dependent var	5.864557
Adjusted R-squared	0.035674	S.D. dependent var	35.31563
S.E. of regression	34.67999	Akaike info criterion	9.955509
Sum squared resid	91405.33	Schwarz criterion	10.01594
Log likelihood	-386.2649	Hannan-Quinn criter.	9.979700
F-statistic	3.848506	Durbin-Watson stat	0.557979
Prob(F-statistic)	0.053452		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.877345	3.946048	1.489426	0.1405
C_GDP_GAP_LAG2	-0.459414	0.262240	-1.751886	0.0838

R-squared	0.038815	Mean dependent var	5.864557
Adjusted R-squared	0.026168	S.D. dependent var	35.31563
S.E. of regression	34.85050	Akaike info criterion	9.965318
Sum squared resid	92306.33	Schwarz criterion	10.02575
Log likelihood	-386.6474	Hannan-Quinn criter.	9.989509
F-statistic	3.069106	Durbin-Watson stat	0.549946
Prob(F-statistic)	0.083827		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.607421	3.949389	1.419820	0.1597
C_GDP_GAP_LAG3	-0.456131	0.261388	-1.745037	0.0850

R-squared	0.038524	Mean dependent var	5.864557
Adjusted R-squared	0.025873	S.D. dependent var	35.31563
S.E. of regression	34.85578	Akaike info criterion	9.965621
Sum squared resid	92334.31	Schwarz criterion	10.02605
Log likelihood	-386.6592	Hannan-Quinn criter.	9.989812
F-statistic	3.045153	Durbin-Watson stat	0.536773
Prob(F-statistic)	0.085021		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.357247	3.966380	1.350664	0.1808
C_GDP_GAP_LAG4	-0.429346	0.259768	-1.652808	0.1025

R-squared	0.034697	Mean dependent var	5.864557
Adjusted R-squared	0.021996	S.D. dependent var	35.31563
S.E. of regression	34.92508	Akaike info criterion	9.969594
Sum squared resid	92701.83	Schwarz criterion	10.03002
Log likelihood	-386.8142	Hannan-Quinn criter.	9.993784
F-statistic	2.731773	Durbin-Watson stat	0.545963
Prob(F-statistic)	0.102496		

NPL Ratio (%) and Credit-to-GDP gap (%) (with 1 to 8 lags)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.06854	1.454621	8.984153	0.0000
C_GDP_GAP400000	0.322991	0.099379	3.250096	0.0019

R-squared	0.145571	Mean dependent var	12.61844
Adjusted R-squared	0.131790	S.D. dependent var	12.43227
S.E. of regression	11.58411	Akaike info criterion	7.767897
Sum squared resid	8319.880	Schwarz criterion	7.835362
Log likelihood	-246.5727	Hannan-Quinn criter.	7.794475
F-statistic	10.56312	Durbin-Watson stat	0.030155
Prob(F-statistic)	0.001866		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.17577	1.370836	9.611488	0.0000
C_GDP_GAP_LAG1	0.412884	0.093141	4.432889	0.0000

R-squared	0.240666	Mean dependent var	12.61844
Adjusted R-squared	0.228419	S.D. dependent var	12.43227
S.E. of regression	10.92047	Akaike info criterion	7.649906
Sum squared resid	7393.909	Schwarz criterion	7.717371
Log likelihood	-242.7970	Hannan-Quinn criter.	7.676484
F-statistic	19.65051	Durbin-Watson stat	0.036173
Prob(F-statistic)	0.000039		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.16507	1.279235	10.29136	0.0000
C_GDP_GAP_LAG2	0.474621	0.084544	5.613874	0.0000

R-squared	0.337009	Mean dependent var	12.61844
Adjusted R-squared	0.326315	S.D. dependent var	12.43227
S.E. of regression	10.20419	Akaike info criterion	7.514226
Sum squared resid	6455.784	Schwarz criterion	7.581691
Log likelihood	-238.4552	Hannan-Quinn criter.	7.540804
F-statistic	31.51558	Durbin-Watson stat	0.062917
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.16926	1.193001	11.03876	0.0000
C_GDP_GAP_LAG3	0.525429	0.077976	6.738300	0.0000

R-squared	0.422744	Mean dependent var	12.61844
Adjusted R-squared	0.413433	S.D. dependent var	12.43227
S.E. of regression	9.521580	Akaike info criterion	7.375750
Sum squared resid	5620.950	Schwarz criterion	7.443215
Log likelihood	-234.0240	Hannan-Quinn criter.	7.402328
F-statistic	45.40469	Durbin-Watson stat	0.052600
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.21064	1.134928	11.64007	0.0000
C_GDP_GAP_LAG4	0.559049	0.074250	7.529305	0.0000

R-squared	0.477633	Mean dependent var	12.61844
Adjusted R-squared	0.469207	S.D. dependent var	12.43227
S.E. of regression	9.057593	Akaike info criterion	7.275835
Sum squared resid	5086.480	Schwarz criterion	7.343300
Log likelihood	-230.8267	Hannan-Quinn criter.	7.302413
F-statistic	56.69043	Durbin-Watson stat	0.063572
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.21888	1.111443	11.89343	0.0000
C_GDP_GAP_LAG5	0.571039	0.072669	7.858099	0.0000

R-squared	0.498989	Mean dependent var	12.61844
Adjusted R-squared	0.490908	S.D. dependent var	12.43227
S.E. of regression	8.870509	Akaike info criterion	7.234093
Sum squared resid	4878.528	Schwarz criterion	7.301558
Log likelihood	-229.4910	Hannan-Quinn criter.	7.260671
F-statistic	61.74972	Durbin-Watson stat	0.083632
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.23282	1.114405	11.87434	0.0000
C_GDP_GAP_LAG6	0.570699	0.072997	7.818141	0.0000

R-squared	0.496440	Mean dependent var	12.61844
Adjusted R-squared	0.488318	S.D. dependent var	12.43227
S.E. of regression	8.893045	Akaike info criterion	7.239167
Sum squared resid	4903.347	Schwarz criterion	7.306632
Log likelihood	-229.6534	Hannan-Quinn criter.	7.265745
F-statistic	61.12333	Durbin-Watson stat	0.105149
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.26936	1.132944	11.71228	0.0000
C_GDP_GAP_LAG7	0.564314	0.074600	7.564533	0.0000

R-squared	0.479962	Mean dependent var	12.61844
Adjusted R-squared	0.471575	S.D. dependent var	12.43227
S.E. of regression	9.037372	Akaike info criterion	7.271365
Sum squared resid	5063.794	Schwarz criterion	7.338830
Log likelihood	-230.6837	Hannan-Quinn criter.	7.297943
F-statistic	57.22216	Durbin-Watson stat	0.094723
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.26677	1.172498	11.31496	0.0000
C_GDP_GAP_LAG8	0.543723	0.077390	7.025780	0.0000

R-squared	0.443255	Mean dependent var	12.61844
Adjusted R-squared	0.434275	S.D. dependent var	12.43227
S.E. of regression	9.350890	Akaike info criterion	7.339571
Sum squared resid	5421.227	Schwarz criterion	7.407037
Log likelihood	-232.8663	Hannan-Quinn criter.	7.366149
F-statistic	49.36158	Durbin-Watson stat	0.110965
Prob(F-statistic)	0.000000		

Chapter 9

BUILDING ON THE COUNTERCYCLICAL BUFFER CONSENSUS: ASIAN EMPIRICAL TEST

By
Luyen Nguyen, Dung Tran, Ngan Nguyen and Nhan Nguyen[1]

1. Introduction

Recent years have shown record highs with regard to the number of defaulted companies and the amounts of defaulted debt. This has emphasised the need for pro-active and prudent credit risk management, and underlined the importance of credit risk models that can provide timely insight into the build-up of credit risk. As a result, several interesting lines of research have emerged. Both professional and academic papers appear in the areas of predicting bankruptcies, pricing credit risky instruments, measuring credit risk of portfolios, managing credit risk, and regulatory aspects of credit risk, including the issue of procyclicality. In theory, procyclicality will not emerge if banks hold sufficient capital buffers through the cycle, improving their capital position in upturns in order to withstand losses in downturns. Analyses of this issue should therefore recognise the trade-off between the effects of procyclicality of banks' balance sheets on the one hand and the cost of holding capital on the other.

The countercyclical capital buffer (CCCB) aims to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk. In addressing this primary aim, the CCCB regime may also help to lean against the build-up phase of the cycle in the first place, by raising the cost of credit, and thus dampening its demand. Jurisdictions will be required to monitor the credit growth in relation to the measures such as GDP and assess whether the growth is excessive and leading to the build-up of system-wide risk. Based on this assessment, a CCCB requirement, ranging from 0 to 2.5% of risk-weighted assets (RWAs) may be put in place. The following are some of the reasons why the CCCB matters:

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First, procyclicality (amplification of the effects of the business cycle) in banking was said to have exacerbated the impact of banking crisis, and whilst it is inherent and cannot be eliminated, the CCCB aims to reduce its amplification through the banking sector, caused in particular by excessive credit growth.

Second, the Basel Committee on Banking Supervision (BCBS) sees the CCCB as resulting in the following benefits:

i) Protecting the banking sector from losses resulting from periods of excess credit growth followed by periods of stress;

ii) Helping ensure credit remains available during periods of stress; and

iii) It may cause the cost of credit to increase during the build-up phase, and if credit is being granted at a rapid pace, this may act as a brake on bank lending.

Third, the common reference point put forward by the BCBS for taking CCCB decisions is the credit-to-GDP guide. It is important to note that the BCBS has caveats with respect to its use, not least that the common reference point can give misleading signals if used as a standalone measure. As a result, the BCBS propose that supervisory judgment is also exercised when the CCCB decisions are made. The key role given to judgment by the relevant national authorities, the designation of which to be left to each jurisdiction, can, however, result in an unlevel playing field.

Finally, it is also important that the CCCB is seen and used not in isolation, but with regard to the full potential suite of macroprudential tools.

Since the beginning of the financial crisis, procyclicality was regarded by the G-20 as a key issue to be addressed. The financial crisis has illustrated its disruptive effects and there was broad consensus that there is a role for prudential instruments to smooth the effects of the credit cycle. The BCBS's rationale for the introduction of a CCCB as part of the Basel III package focused on the need for the banking sector to build up its capital defences in periods when credit has grown to excessive levels.

In reality, though the 2007-2008 global financial crisis seemingly did not have much significant impact on the Vietnamese banking system, the Vietnamese economy has witnessed from 2010 up to now a high number of defaulted companies and large sums of defaulted debt . Why this is happening, how to solve the problem, and how to control the banking system to maintain the growth rate, are issues of concern. The research may help to answer these questions and suggest suitable regulations for the Vietnamese banking system.

2. Cross-country Evidences

2.1 Brief Outline of BIS Recommendation Regarding CCCB

The CCCB requires banks to build up capital when the aggregate growth in credit is judged to be associated with a build-up of system-wide risk. The buffer can then be drawn down to absorb losses during stressed periods. An increase in the CCCB provides a cushion to absorb losses that are larger than anticipated under the normal microprudential regime, as well as providing incentives for firms to avoid excessive or under-priced exposures. A release of the CCCB when threats to stability are judged to have receded can help mitigate a contraction in the supply of lending.

If effective, the CCCB may also result in smoothing the credit cycle and avoiding troughs similar to those experienced by a number of economies during the crisis. As it is a new tool, there is an element of uncertainty around its success.

A CCCB varying between 0 and 2.5% of common equity or other fully loss-absorbing capital will be implemented according to national circumstances. The countercyclical buffer can be introduced by the national regulator in times of excessive credit growth.

Table 1
Capital Requirement and Buffers Suggested by Basel III

Calibration of the Capital Framework
Capital requirements and buffers (all numbers in percent)

	Common Equity (after deductions)	Tier 1 Capital	Total Capital
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5
Countercyclical buffer range*	0 – 2.5		

* Common equity or other fully loss absorbing capital

Source: BIS.

In Vietnam, Basel II has been applied in steps but not Basel III, though some banks have enough capital to comply with the CCCB requirements (Annex Table 2).

To gauge the progress of implementation of the countercyclical buffer or dynamic provisioning and the effects of applying the CCCB, we make a brief survey of some economies, notably Switzerland and United Kingdom.

2.2 Evidences in Switzerland

Switzerland is one of the few countries that have already implemented the CCCB since July 2012 through the Article 44 of the Ordinance on Capital Adequacy and Risk Diversification for Banks and Securities Traders [Capital Adequacy Ordinance (CAO)]. It has also become in early 2013 the first big financial centre to require banks holding this additional capital to calm the economy after a long housing market boom (more than 10 years). A description of the decision enabling this buffer is outlined below.

According to Article 44 of the CAO, the Central Bank of Switzerland (SNB) will regularly analyse the condition of the real estate and mortgage markets in order to determine whether or not to activate or deactivate the buffer. The key indicators of systematic analysis chosen are domestic mortgage volume indicators and domestic residential real estate price indicators. Indeed, the banking crisis of the 1990s in Switzerland followed a long phrase of excessive credit growth – particularly compared with economic activity (GDP). Drawing on this experience, the Swiss regulators have chosen the domestic mortgage-market-related indicators as key indicators. Moreover, Switzerland has experienced the real estate crisis on the late of 1980s, during which real estate prices increased strongly exceeding the historical standards. More recently, in the context of the global financial crisis, the United States and some other countries witnessed housing credit boom that negatively affected the economy. That is the reason why the SNB included property prices in the set of key indicators. Related to the recent activation of the buffer, according to a SNB report, Swiss house prices have risen 77% in the past 10 years and mortgage volumes have swelled to about 135% of national output. Besides these two indicators, the SNB uses also other indicators as a complement, such as interest-rate risk, interest-rate margins, credit condition indicators and leverage.

In the case of activation, the SNB will determine the level of the buffer needed (the maximum level is 2.5% according the BIS guidance). Nevertheless, the SNB should consult the Swiss Financial Market Authority (FINMA) to make decisions concerning the buffer. The final decision will be released after the Federal Council consultation. The period of implementation will vary between 3 to 12 months. As the goal of the CCCB is to absorb losses, it will be deactivated under normal circumstances. The decision to deactivate the buffer will follow a similar approach to that adopted for activation.

2.3 Evidences in United Kingdom

In June 2013, the European Union (EU) published legislation to implement within the EU Basel III, the international regulatory framework for banks developed by the BCBS. The legislation replaces the current capital requirements directives with two new instruments: the Capital Requirements Directive (CRD) and the Captial Requirements Regulation (CRR). And so, the Bank of England (BoE) issued the Consultation Paper (CP) which sets out the proposed changes to the Prudential Regulation Authority (PRA)'s rules in order to implement the package of the EU legislation known as the CRD IV, consisting of the CRR and the CRD. This CP is relevant to the banks, building societies and PRA-designated investment firms, henceforth 'firms.'

The CRR is the 'single rulebook' that gives effect to the majority of the provisions relating to Basel III: quality of capital, credit risk, counterparty credit risk, market risk and operational risk. The CRD contains, in particular, provisions concerning remuneration, enhanced governance and transparency arrangements, supervisory powers, supervisory review and evaluation processes and the introduction of new capital buffers. The different legal nature of these two instruments has implications for how the PRA will implement them in the United Kingdom.

Unlike the CRR, the CRD is not directly applicable and must be transposed into UK law, including through the PRA rules. A brief explanation of the PRA's proposed approach to this transposition, and the relevant draft rules text, are included in this consultation.

2.3.1 Directive of Capital Buffer

The CRD requires each member state to designate an authority, which will be responsible for setting the CCCB rate for credit exposures in that member

2. See "HM Treasury's Financial Services Bill: The Financial Policy Committee's Macroprudential Tools," Available at: www.gov.uk/government/uploads/system/ uploads/attachment_data/file/191584/condoc_fpc_tools_180912.pdf.

state on a quarterly basis. HM Treasury has proposed that the BoE be the designated the UK authority for the CCCB, with the responsibility for policy decisions on the CCCB delegated to the Financial Policy Committee (FPC)[2]. As set out in the draft rules in Appendix 1, firms will be required to calculate their firm-specific CCCB rate as a weighted average of the buffer rates that are being applied in jurisdictions to which they have a relevant credit exposure.

Parts of the regime for the CCCB in the United Kingdom will be determined by HM Treasury, including the authority responsible for setting the level of the CCCB for the United Kingdom, the timetable for implementation and transitional arrangements. HM Treasury will consult separately on these arrangements. Therefore, the draft rules included in this CP may be subject to change.

The CCCB regime must be introduced by 2016, though member states can begin to use it sooner. The draft PRA rules are included in this CP for the operation of the CCCB before 2016, though these may be subject to change depending on the precise powers given to the FPC by HM Treasury over the CCBB rates (including powers to reciprocate rates set by overseas authorities) before 2016. These draft rules will require firms to apply the CCCB rate (if any) set by the FPC for exposures in the United Kingdom and the CCCB rates reciprocated by the FPC for exposures located overseas. From 2016, within the European Economic Area (EEA), each firm will be required to apply the buffer rate set by the designated EEA or third-country authority to exposures located in the respective EEA state or third country, where the buffer rate does not exceed 2.5% of RWAs.

For EEA or third-country buffer rates above 2.5%, the FPC must choose whether to recognise such rates for UK authorised institutions' exposures to those jurisdictions. The FPC has stated that it expects to reciprocate with overseas authorities when such CCCB rates are judged appropriate. For exposures outside the EEA, the FPC can set buffer rates where none has been set by the relevant overseas authority and set buffer rates that are higher than those chosen by the relevant overseas authorities.

The CRD IV sets out the transitional provisions, which permit member states to cap the firm-specific CCCB at 0.625% of RWAs in 2016, rising to 1.25% in 2017, and 1.875% in 2018 irrespective of the buffer rates set by individual jurisdictions. The extent to which this affects a firm will depend on the geographical distribution of its exposures, as well as the FPC's decisions on whether and when to activate the CCCB in the United Kingdom and the rate set.

The draft PRA rules included in this CP do not set a cap, though this may be subject to change depending on the approach taken by HM Treasury to implementing the CCCB in the United Kingdom. HM Treasury will consult separately on this approach.

3. Literature Review

3.1 Literature for Vietnam on CCCB

In Vietnam, regulations on bank capital always involve the attention of regulators. Regulators, such as the Bank Supervision Department of State Bank of Vietnam (SBV), National Financial Supervision Commission (NFSC) or Deposits Insurance of Vietnam (DIV) who have promulgated policies to assess banks' financial health, for which they emphasise the increase of capital in order to decrease systemic risk in banking. The first capital regulation was the decision 297/1999 issued by the SBV, which determined 8% as the minimum capital requirement. However, the method of calculation was simple and did not reflect exactly the spirit of Basel I. In 2005, the SBV introduced the Decision 457/2005 with the same proportion of capital requirement, but the method of calculation was improved and closer to Basel I. For 2010, the SBV enacted the Circular 13/2010 to replace the Decision 457/2005, in which the minimum capital requirement was increased to 9% and the calculation used is in line with Basel II. Nonetheless, the CCCB has not been addressed in any legal documents.

The need of addressing the countercyclical problem in economic development amongst developing countries should warrant more attention. The reason is that for the developing countries, the range of issues may block the policy design and implementation of the CCCB. They include the conflicting objectives of financial stability and economic development, limited policy instruments with undeveloped underlying markets and assets, dearth of data, supervisory independence needing improvement, and banking system consensus to implement supervisors' regulations (Ren, H., 2011). Given these limitations with countercyclical prudential measures, the developing countries may have to appropriately modify some measures in the framework suggested by Basel III, experimenting with suitable instruments while carefully monitoring and evaluating their effectiveness over time.

Ren, H. (2011) also emphasises in his study that the developing countries will need to take into account their stage of financial development, the structure of their financial system and the exposure to external shocks when choosing the indicators for making buffer decisions. In addition to that, according to the

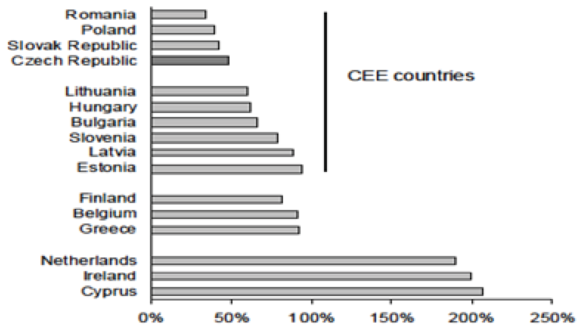
Principle 3 in the BIS Guidance for national authorities operating CCCB (2010), the authorities should not use any single indicator. Moreover, they should look for evidence with regard to the link between the credit-to-GDP guide, the indicator that plays a dominant role in studies on the CCCB, and other variables. These variables are: asset prices; real GDP growth; data on the ability of the non-financial entities to meet their debt obligations on a timely basis, which is often represented by gross non-performing asset (GNPA) or gross non-performing loan (GNPL); and bank profits. The need for other indicators besides the credit-to-GDP gap is also mentioned in research of Gersl, A. and Seidler, J. (2011) for the Eastern European countries.

The question is which are the suitable early warning indicators that can signal vulnerability and imminent economic crisis in the developing countries? The project of Sussangkarn, C. and Tinakorn, P. (2002) reviews financial vulnerability in China, Indonesia, Philippines, South Korea, Thailand and Vietnam, and concludes that the method of looking for the early warning indicators in Vietnam should differ from the others. This can be explained by differences in the growth rate and crisis symptom, for example, the bad debt caused the China crisis. whereas it was the balance of payment that caused the Vietnamese crisis during the Asian crisis period from 1997. However, the financial market and banking system characteristics have been changing rapidly, so the indicators may need to vary overtime.

3.2 Literature on Credit-to-GDP Indicator

Although the credit-to-GDP gap seems to work reasonably well in the Basel Committee countries, Drehmann, M., et al. (2010) indicate the failure of this indicator to identify the build-up of cyclicality in some developing countries, while striking a false alarm in others. Among the developing countries with low level of financial depth, systemic risk, which is induced by cyclicality problem, may not be easily identified by simply looking at the deviation of the credit-to-GDP ratio from the trend. In such cases, it may be more appropriate to use nominal credit growth as the indicator.

Figure 1
Credit-to-GDP Ratio Across Countries as at End-2007



Source: IMF.

The credit boom was witnessed during the period from 2003 to 2007 in the Central and Eastern European (CEE) group of developing economies, yet the credit-to-GDP ratios were comparatively low, it implies that the ratios were not effective in signaling the credit cycle in these jurisdictions.

3.3 Literature on Other Indicators

According to the research of IMF (2004), 75% of the banking or financial turmoil was rooted in credit booms, then credit growth should be engaged as the first crucial indicator for forecasting the business cycle. This conclusion is also impressed in the researches of Borio, C. and Lowe, P. (2002); and Jimenez, G. and Saurina, J. (2006). In addition to that, Vietnam is a bank-based economy, so considering credit growth as an important signal of credit cycle is appropriate. The notable point here in the case of excess credit growth, is concentrating on a specific sector in the loan portfolio. In this circumstance, the authorities should focus on credit-related data for that sector rather than on the aggregate credit.

The purpose of the CCCB, however, is not to restrain credit growth but to set the capital buffer reserve in banks to face sudden changes in the credit cycle and/or business cycle. Therefore, the BIS recommends the authorities to use macro-indicators as the complementary tools of banking indicators, such as asset prices, and GDP growth (BIS Guidance for National Authorities Operating CCCB, 2010). The use of those indicators is reliable as they both have significant nexus with the credit cycle and changes in the macroeconomic factors.

First, real GDP growth, typically for any economy, is the most natural indicator of the aggregate business cycle. However, the business and the financial cycle, although indicate causality relationship, are not be fully synchronised at all times. That means, financial strains do not arise with every recession, and vice versa. This conclusion is verified by charts in the study of Drehmann, M., et al. (2010) on the relationship between credit growth and GDP growth for Norway, Spain, United Kingdom and United States. For Vietnam, as stated in Section 1, the credit cycle, in general, runs parallel with the business cycle for the past 20 years. Nevertheless, the credit cycle fluctuated more compared to the other, and the growth rates were much higher than the growth rates of GDP over the years. For this reason, GDP growth as a data series should be reviewed for its reliability.

The next indicator that requires understanding are asset prices. They include stock prices, equity prices, housing prices, and commodities prices. Borio, C. and Lowe, P. (2002) studied some selected economies and showed that a boom and bust in asset prices was the most common threat that underlies financial crises. It is plausible that large swings in asset prices figure prominently in many accounts of financial instability. This was evidenced in both the industrial and emerging markets alike. The Latin America crisis in the late 1970s to early 1980s and the financial crisis happened to East Asia in the mid-to-late 1990s are some examples. More specifically, Hutchison, M. and McDill, K. (1999) found that the decreases in stock prices are useful one-year-ahead indicator of future banking problems. Alternatively, Kaminsky, G. and Reinhart, C. (1999) discovered that equity prices generally fall in the 9 months preceding a crisis and rise strongly in the 9 months before that. Kaminsky, G. and Reinhart, C. did not, however, make clear from their researches whether the fall or the increase in equity prices contributes to the crisis, or simply reflects the market's expectation about the likely crisis.

In the research of the BIS in 2010, the bank profit indicator is also studied. The variable has worked significantly for the United States and United Kingdom in the 2007 financial crisis and for Spain in the early 1990s. However, the performance of banks' pre-tax profits as a signal for the build-up period in the credit cycle seemed to be unlikely for the others in the Basel Committee group. Since there is no template for the effectiveness of this indicator, then a question needs solving so far is whether it works well in the case of Vietnam. This research also considers the appropriateness of GNPA or banks' losses as the proxy for the credit cycle. The empirical study showed that the absence of GNPA during good times need not imply the expansion or stagnation of good times.

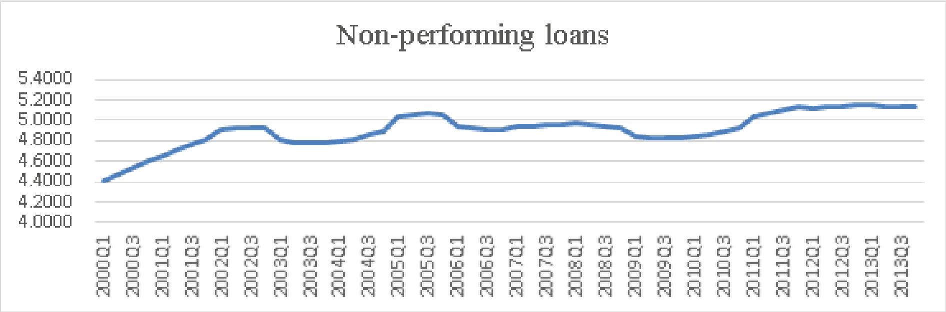
4. Empirical Analysis

The analysis of some potential indicators in this section will provide useful information for the SBV to decide whether or not it is necessary and how to activate the CCCB. In considering the credit-to-GDP GAP as one of the target indicators, the empirical evidence shown in this research is that any single indicator such as credit-to-GDP GAP, non-performing loan (NPL), credit growth, GDP growth and VNINDEX may not be the best choice to manage countercyclicality in the economy. The decision-making in respect of the CCCB may follow the monetary and fiscal policymaking and should use other tools in combination with the CCCB. Due to the unavailability and/or dearth of data for some sectors, like gold, real estate, and derivatives, to date, the indicators relating to these sectors may not be a part of the CCCB decision, but may likely to be useful in the future.

4.1 Data

Following the guidance of the BIS for operating the CCCB, banks' NPLs are set as the dependent variable. All other selected factors play roles as the independent variables in the regressions. For the macro data, namely GDP and GDP growth, the authors collected from the Vietnamese General Statistics Office (http://www.gso.gov.vn). Besides, the banking data like credit growth and NPL are obtained from regular official reports of the SBV (http://www.sbv.gov.vn). With the VNINDEX data, the authors referred to the data base of the State Securities Commission of Vietnam (http://www.ssc.gov.vn). The quarterly data is chosen to ensure the significance of the analysis, which includes 54 observations from Q3 2000 to Q1 2014. With a newly established stock market, available observations for VNINDEX are limited and the longer-time data is unavailable. The major variables are defined as follows:

Figure 2
NPL Ratios Overtime in Vietnamese Banking System



Unit: %.

- **NPL Ratio**: the loan-loss provisions over total loans are delegated for the NPLs in banks. This variable indicates the quality of loans and can be considered as the signal for the credit cycle.

  The NPL ratios followed the upward trend; it increased rapidly from the beginning of 2000 and reached a constantly high level at around 5.1% in recent quarters. Generally, over the period under study, the NPL level remains relatively high.

- **Credit** and **Credit Growth Rate**: Quarterly data on total credit from banks to the rest of the economy, including both to domestic and foreign subjects, is collected from the statistics published by the SBV. However, the data excludes the credit transactions made within financial institutions, including inter-bank lending. The gross credit in VND are extended in following areas: industry, commercial, construction, agriculture, transportation, communications and the others. Given the data for credit, credit growth levels are calculated from Q2 2000 to Q1 2014.

- **GDP** and **GDP Growth Rate**: The nominal GDP on quarterly basis is collected. In Vietnam, the data on GDP is released annually or quarterly by the General Statistics Office and follows the Income Approach. The GDP growth rates are derived from the data for GDP for the period from Q2 2000 to Q1 2014.

- **Credit-to-GDP Gap:** As the first step, the credit-to-GDP ratio for the quarter i^{th} of year T is calculated with the equation below:

Credit-to-GDP for Qith = Qith credit stock/ sum (GDP_{i-4}, GDP_i)

Secondly, the long-term trend of the credit-to-GDP ratio is estimated by the Hodrick-Prescott (HP) filter function.

Finally, the credit-to-GDP Gap at time t is calculated by subtracting the credit-to-GDP ratio at time t by its long-term trend:

$$GAP_t = \text{Credit-to-GDP}_t - Trend_t$$

In the BIS's guidance on applying the CCCB, it chose the one-sided trend with the smoothing parameter of $\lambda = 400{,}000$. In addition to that, our paper considers adjustment with the one-sided and two-sided HP filter with smoothing parameters of $\lambda = 400{,}000$, $\lambda = 25{,}000$ and $\lambda = 1{,}600$.

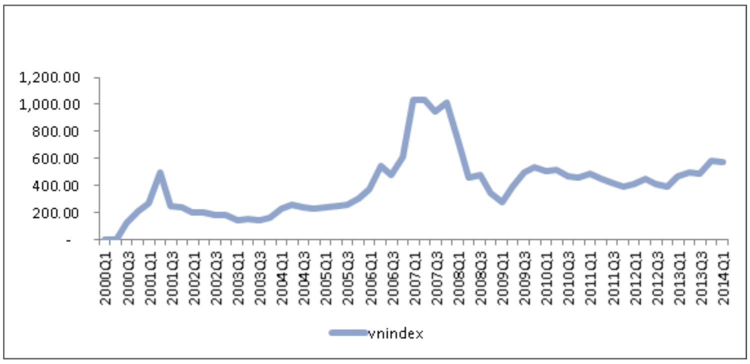
- **VNINDEX:** VNINDEX or the Vietnamese stock index is a capitalisation-weighted index of all the companies listed on the Ho Chi Minh City Stock exchange. The index was operated from July 28, 2000 and released by the State Securities Commission of Vietnam by the Passcher Method. The equation to calculate VNINDEX is given below:

$$\text{VNIndex} = \frac{100 * \sum_{i=1}^{N} P_{1i}Q_{1i}}{\sum_{i=1}^{N} P_{0i}Q_{0i}}$$

Where:

- P_{1i}: Current market price of stock i
- Q_{1i}: Volume in circulation of Volume as listed of stock i
- P_{0i}: Price of stock i at time t_o
- Q_{0i}: Volume of stock i at time t_o

Figure 3
VNINDEX Over Time



There was a wild fluctuation in the index from 2000 to 2014. The index peaked at a remarkable high level of 1,034.99 points in Q1 2007 and remained at around 1,000 points for the whole year. Right after that, there was a dramatic drop in the index and, from 2009 up to present time, the index oscillates in range of between 400-600 points. VNINDEX is the index which denotes the stock market's strength and reflects the situation of the economy. It may be a potential indicator for the business cycle.

5. Empirical Analysis

5.1 Filter Selection Integration

We plotted NPL3 with different measures of the gap using both the one-sided and two-sided HP filter, and found the results seemingly to be not quite different. We checked and selected the one-sided HP filter with Lamda =1,600 as most suitable. During the 2008 crisis, its performance is quite close to the real situation, so it may be selected as a credible signal.

Figure 6
Credit-to-GDP Gap with One-sided Hotdrick- Presscott Filter
(Lamda = 1,600, 25,000 & 400,000)

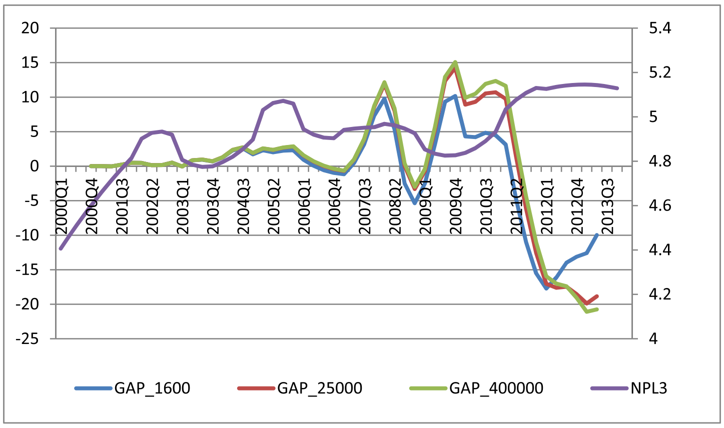
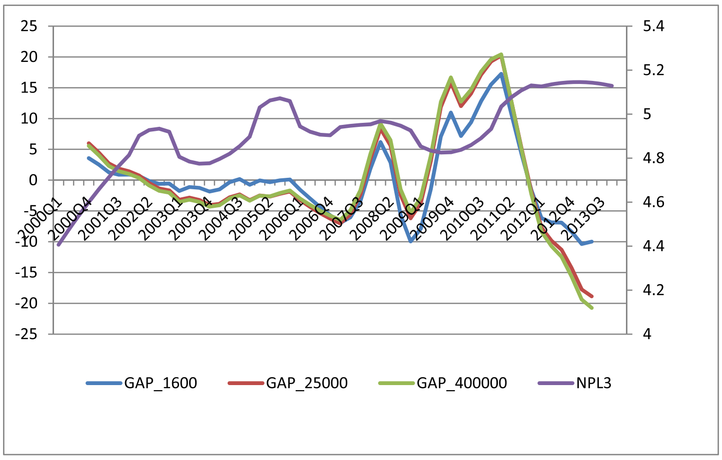


Figure 7
Credit-to-GDP Gap with Two-sided Hotdrick- Presscott Filter
(Lamda = 1,600; 25,000 & 400,000)



As can be seen from the graph, the numbers fluctuated from Q3 2007 to Q4 2009 then increased significantly. After the period, there is a sharp decrease in the gap up to now. This is because the Vietnamese economy was impacted by the financial crisis. However, as the NPL in the banking system increased significantly consequently, the banks were hesitant to give out loans. The failure and closing down of many firms also led to a decrease in credit growth. Up until Q3 2014, credit growth appeared to show some recovery.

5.2 Lag Length Determination

Vietnam is a bank-based economy. The equity market is quite small. Most of the capital to economy is provided by the banking system, so credit-to-GDP can be selected as the EWI variable. The lead-lag relation between the change in NPL3 to the lagged value of the credit-to-GDP gap is described in the Table 3 below:

$NPL3\ (t) = f(Credit\ to\ GDP\ Gap(-t))$, where t = 1,2,3, ...

Table 3
Results of Lag Length Determination

	T-stat	R-square	AIC	SBC
0	-3.627749	0.201971	-0.914208	-0.840542
1	-3.836888	0.220643	-1.083693	-1.010027
2	-3.88672	0.225113	-1.22122	-1.147554
3	-3.702612	0.21186	-1.332776	-1.258426
4	-3.27023	0.176201	-1.39455	-1.319502
5	-2.471598	0.11085	-1.398676	-1.322918
6	-1.748914	0.059906	-1.397008	-1.320527
7	-1.014528	0.02143	-1.386164	-1.308947
8	-0.273551	0.001624	-1.374396	-1.29643

As can be seen from the Table, the R-square is highest at (-2). This means that the change in credit-to-GDP will affect the NPL after 2 quarters. However, the lag length remained statistically significant up to four quarters; this indicates that the credit-to-GDP gap possesses early indicator property and can be used for the CCCB for Vietnam.

5.3 Low and High Threshold Identification

As a buffer to protect banks from the financial distress, it is important to determine the level for which the CCCB should be activated (the low level, L) and the level at which the maximum buffer should be reached. The BCBS (2010) has recommended L should be low enough so that banks are able to build up capital gradually before a potential crisis and it should be high enough so that banks do not need to raise additional capital during normal times. Regarding the high level (H), it should be low enough so that the maximum buffer would be reached before a crisis. In other words, banks should build up buffers so that they can absorb losses in bad times, and should not be a source of credit contraction induced by financial tensions on their balance sheets. Rather, they should act as far as possible more as shock absorbers than amplifiers.

Based on these conditions, the BCBC (2010) suggests that L should be at 2 and H should at 10. However, these levels depend on other factors such as the smoothing parameters, the available data and the characteristics of each economy. In the context of Vietnam, we try to define the low and high levels. As such, we denote the dummy variable Di as the credit-to-GDP gap (GAPi) is greater than a certain level '*i*', and propose the following regression model to estimate the adequate threshold:

NPLt = *f [GAPi, GAPi*Di]* with i=1 to 20

In line with the approach of Sarel (1995), we look for the threshold that conducts on the highest R-square. As results, we find that the H level is set at 18, i.e., as the credit-to-GDP gap reaches through 18, the maximum capital buffer should be released (2.5%). However, as recommend by the BCBS, the H level should be low enough so that the maximum buffer will be reached before a crisis. Our result is so far beyond the suggested high level of the BCBS, and should be re-tested in the following part.

As an alternative, in line with Kaminsky and Reinhart (1999), we use a signal extraction method to compare the performance of the different variables, and decide the time interval between the signal and the crisis is 8 quarters (i.e., 2 years), as recommended by Drehmann, et al. (2010) and the BCBS (2010) However, a crisis is imminent with the prediction of its exact timing, and the dynamics of banking crises differ considerably across episodes and their exact timing is however unpredictable. Thus, in line with Kaminsky (1999), we use a window during which a crisis may occur rather than a specific interval of time between signal and event. Hence, any signal given within the 8 quarters before the beginning of the crisis is considered as a good signal, whereas other signal outside that 8 quarters window is labeled a false alarm or a noise.

The literature has shown that the crises were preceded by credit boom, but not every credit boom presages a crisis. Hence, we need to select an appropriate threshold that separates when a credit boom is considered a signal of crisis. Specifically, let,

- y_t the credit-to-GDP gap with λ = 1,600 (also repeat our analysis with λ = 25,000 and 400,000),

- and $S(y_t)$ a signal that can be 0 (i.e,, "off") or 1 (i.e,, "on") depending on whether y is below or above a threshold value. The signal is "on" if y_t exceeds the threshold level. It is correct if a crisis occurs any time within 2 years, and similarly with the "off" signal. We also test the horizon of 1 and 3 years later.

We will select a threshold value, then compute the noise-to-signal (NTSR) ratio. According to Kaminsky and Reinhart (1999), the definition of NTSR is best illustrated by considering the following matrix:

	Crisis occurs in the following 24 months	No crisis occurs in the following 24 months
Indicator issues a signal	A	B
Indicator does not issue a signal	C	D

A perfect indicator will only have entries in cells A and D. The NTSR for any indicator is given by the following formula:

$$NTSR = \frac{Type2error}{1 - Type1error} = \frac{B/(B+D)}{A/(A+C)}$$

In which Type 1 error corresponds to "no signal is issued and a crisis occurs", and Type 2 error when "a signal is issued but no crisis occurs."

We then select the threshold value that minimises the NTSR. Choosing the optimal threshold involves a trade-off between these two types of error especially when a variable indicates a lot of crises, i.e., signals in the two years after the beginning of a crisis. The two-year window is at the low end of the estimates of the average length of crises. It is very hard to determine a crisis period in Vietnam as, according to regulators, Vietnam has not experienced a crisis since the year 2000. We try to detect some period of "distress" by determining the quarter which has the highest credit-to-GDP gap (i.e., Q1 2008 and Q4 2010) Q3 2009 is not considered as two-year window Cell A and then low Type 1 error) it tends to over-predict their number (i.e., issue false signals and exhibit a high Type 2 error).

It should be emphasised that once in a crisis, it makes no sense to predict another crisis: The indicator has already done its job, and it should be not counted again. We therefore do not consider any signals in the two years after the beginning of a crisis. The two-year window is at the low end of the estimates of the average length of crises.

Table 4
Performance of the Credit-to-GDP Gap (one-sided) to Signal Crisis (λ=1,600)

Threshold	Type2	Type1	NTSR	Predicted
0	62.50	0.00	62.50	100.00
1	45.83	0.00	45.83	100.00
2	45.83	0.00	45.83	100.00
3	45.83	0.00	45.83	100.00
4	33.33	12.50	38.10	87.50
5	33.33	18.75	41.03	81.25
6	29.17	31.25	42.42	68.75
7	25.00	31.25	36.36	68.75
8	20.83	31.25	30.30	68.75
9	20.83	37.50	33.33	62.50
10	12.50	37.50	20.00	62.50
11	4.17	37.50	6.67	62.50
12	0.00	37.50	0.00	62.50
13	0.00	37.50	0.00	62.50
14	0.00	37.50	0.00	62.50
15	0.00	37.50	0.00	62.50
16	0.00	37.50	0.00	62.50
17	0.00	37.50	0.00	62.50
18	0.00	43.75	0.00	56.25
19	0.00	50.00	0.00	50.00
20	0.00	50.00	0.00	50.00

Note: A signal equals to 1 is issued when the conditioning variable exceeds the threshold. Otherwise the signal is equals to 0. A signal of 1 (0) is judged to be correct if a crisis (no crisis) occurs any time within a two-year horizon. Type 1 error: no signal is issued and a crisis occurs. Type 2 error: a signal is issued and no crisis occurs. The column labeled "Predicted" refers to the percentage of crises predicted correctly. Bold figures for this column indicate that at least 66% of crises are captured. The NTSR is defined as the fraction of Type 2 errors divided by one minus the fraction of Type 1 errors. Bold figures for the NTSR identify the lowest NTSR among the threshold values that lead to a correct prediction rate of at least 66%.
Sources: Drehmann (2010); Authors' calculations.

By measuring the performance of the credit-to-GDP gap with λ =1,600, we show that the adequate low level is 3 (L=3) whereas the high one is 8 (H=8). By testing the λ = 25,000 and 400,000, we obtain the low and high threshold, respectively, L = 8 and H = 15.

We also test for the window of 1 and 3 years instead of 2 years, and finding are summarised in Table 5.[3]

Table 5
Comparison of Different Choices for λ and Window Interval

	One-year window		Two-year window		Three-year window	
	Low level	High level	Low level	High level	Low level	High level
λ = 1,600	5	17	3	8	3	10
λ = 25,000	11	26	8	15	8	14
λ = 400,000	10	25	8	15	8	14

Sources: Authors' calculations.

The above table once again shows the relevance of the smoothing value λ of 1,600, the levels found are more suitable to BCBS's recommendations (i.e., L=2, H=10) than other smoothing values. Considering that the lower bound should satisfy both criteria that: (1) it is low enough, so that banks are able to build up capital in a gradual fashion before a potential crisis; and (2) it is high enough, so that no additional capital is required during normal times, we decide to choose the low level at 3. Moreover, in view of the fact that the lower and upper thresholds should not be too narrow, so that banks have reasonably enough time to reserve their capital in a gradual manner, we consider the high level H at 13, as shown in the two last columns of Table 5, as the NTSR is lowest.

5.4 Buffer Level and Progression

In Vietnam, Basel II has been applied for some main banks on experimental basis from 2014. Therefore, after full application of Basel II, the CCCB may be interpreted to apply.

3. See Appendix 3.

5.4.1 Supplementary Indicator

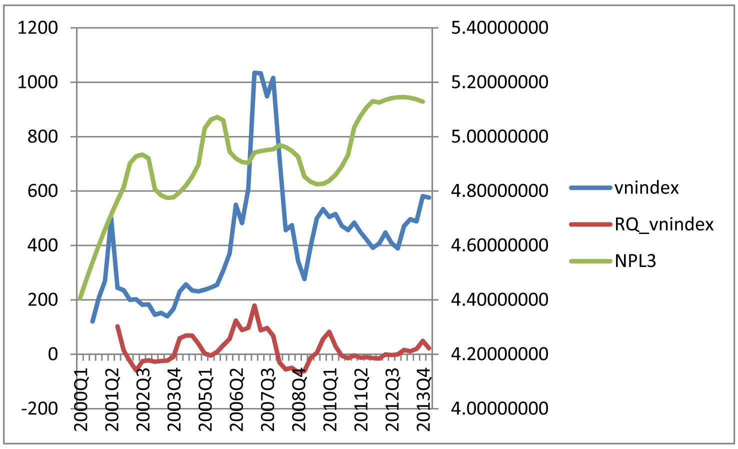
There are some supplementary indicators to be considered such as: equity return, change in housing price, gold price, or oil price. However, in Vietnam, the housing market and gold market are recent developments. The gold market has just been established in 2013 and the housing market has been operating only the past several years, so their data are not sufficient to run regression analysis. Since oil price is subsidised by the government, there need to be more analysis made before it can be used as an indicator. Therefore, the only variable, equity return, may be considered to be a supplementary indicator.

Although the Vietnamese stock market is quite small, with market capitalisation/GDP accounting for 31% up to 2013, the stock market represents the economy to some extent. Taking correlation analysis (T-Start), VNIDEX and NPL3 correlation is significant around 4 quarters. The result shows that VNINDEX can be an early warning indicator. This means the increase or decrease of VNINDEX will be parallel with the change in NPL3 after 1 year. It is appropriate with the real situation in Vietnam, especially during the crisis period.

Table 6
Covariance Analysis: Ordinary

Covariance Analysis: Ordinary							
Sample (adjusted): Q3 2002 Q2 2013							
Included observations: 44 after adjustments							
Balanced sample (list-wise missing value deletion)							
	Return VN	Return VN(-1)	Return VN(-2)	Return VN(-3)	Return VN(-4)	Return VN(-5)	
Correlation							
NPL3	-0.143756	-0.059068	0.049692	0.192735	0.283381	1	
	-0.941422	-0.383475	0.322436	1.272932	1.915022	-----	
GAP_400,000	0.105924	0.173206	0.227411	0.229706	0.197101	-0.63102	1
	0.690348	1.139733	1.513443	1.529566	1.302922	-5.27146	-----

Figure 8
Vnindex and NPL3



The gap shows the change in VINDEX and NPL3. It can be seen clearly that VNINDEX increases significantly in 2006, peaked in 2007, then plummeted in 2008; and with NPL3 following the same pattern but lags approximately one year. Therefore, VNINDEX may be an early indicator with one-year duration.

6. Recommendations and Conclusions

6.1 Recommendations

1. To deal with the effects of economic cyclicality after the successful implementation of Basel II, SBV shall be the authority to operate and communicate the CCCB decision.

2. The credit-to-GDP gap may be used in conjunction with other indicators, like NPL growth, VNINDEX for CCCB decisions in Vietnam.

3. The CCCB decision may be pre-announced with a lead time of 2 quarters.

4. The L of CCCB: 3 % of gap.

5. The H of CCCB: 13% of gap.

6. The CCCB increase 0 - 2.5 % RWA of the bank based on the position of gap (3-13).

Gap > 13 %, CCCB remain at 2.5 % RWA.

Gap < 3 %, no CCCB requirement

7. The SBV may apply discretion in the use of indicators while activating or adjusting the buffer.

8. SBV should activate the countercyclical policies at a sectoral level

9. Instead of hard rules-based approach, flexibility in terms of the use of judgement and discretion may be provided to the SBV for operating the release phase of the CCCB. Further, the entire CCCB may be released promptly at a single point in time.

10. The SBV will provide necessary guidance to the banks as regards the treatment of the surplus at times when the CCCB returns to zero.

11. Maintain capital under the CCCB framework based on banks. All foreign incorporated or domestic banks in Vietnam should maintain capital under the CCCB framework based on exposure in Vietnam. However, the SBV may ask the Vietnamese banks to keep excess capital buffer in case of CCCB in host country seems to be inadequate.

12. The CCCB requirement based on annual monetary policy and information. The CCCB decision may form a part of the annual monetary policy statement of the SBV. However, more frequent communication can be made by the SBV, if there are sudden and significant changes in economic condition that have impact on the CCCB decision.

13. The CCCB and Pillar 2 to be kept independent.

14. The CCCB shall be maintained on solo basis as well as on consolidated basis in Vietnam. The CCCB has been untested in Vietnam so it is likely that it may not be imposed. Moreover, some indicators such as house price index, gold price, and credit condition survey are not tested in relation with the CCCB in the research. Therefore, further study on the CCCB is required before applying the result to all banks in Vietnam.

15. The finding can be used in creating policy for the implementation of the CCCB as well as Basel III in Vietnam.

6.2 Conclusion

The results show that to address procyclicality, Vietnam should apply the CCCB requirements. The credit-to-GDP gap may be used to identify the situation in which banks collect and release the CCCB. The low of the CCCB in Vietnam is 3 and the high is 13, and the CCCB should be released at least 2 quarters based on the credit-to-GDP gap, or 4 quarters based on VNINDEX indicator. The release should imply a step-by–step approach due to the conditions of the Vietnamese banks. The communication to be at least once a year, but once every six months is better due to the results due to the results of the finding on the lead-lag relation. These results have some limitations because of data availability and high level of credit to GDP has not been tested for Vietnam. However, the results of the research may be useful as early suggestions for CCCB policy planning in the SBV, and for maintenance of stability of the banking system and of the Vietnamese economy.

List of Abbreviations

BCBS	Basel Committee on Banking Supervision
CAO	Capital Adequacy Ordinance
CBR	Central Bank of Russia
CCCB	Countercyclical Capital Buffer
CEE	Central and Eastern Europe
CP	Consultation Paper
CRD	Capital Requirements Directives
CRR	Capital Requirements Regulation
EEA	European Economic Area
PRA	Prudential Regulation Authority
RWA	Risk-weighted asset
SBV	State Bank of Vietnam
SNB	Central Bank of Switzerland

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Annex Table 1
Characteristics of Vietnamese Banking Sector

Credit				
	Credit Institutions (Banks and the Others)	**Non-credit Institutions ("Black" Credit Market)**	**Equity Market and Bond Market**	**Foreign Debt**
% of total credit	72.6	20	6.2	1.2
Ownership Group				
	Public	**Private**	**Foreign**	
% of Total Assets	40.35	43.19	16.46	

Targeted Credit						
	Industry	**Transportation and Communication**	**Agriculture**	**Construction**	**Commercial**	**Others**
% of Total Banks' Credit	31	5	9	10	21	24

Crisis Year	Banking Supervisor	Major Reform Year
1997-1999: Asian financial crisis	State Bank of Vietnam	1989 to 2008: Reformation

Source: SBV.

Annex Table 2
CCCB Policy Progress in Vietnam

Guideline Published	Policy Measurement Taken	Policy Gap	Policy Hurdles	Proposed Implementation
N/a	N/a	N/a	N/a	N/a

Annex Table 3
CCCB Progress in Russia

	2013					As of 1 January 2019
	01.04	01.10	2016	2017	2018	
Basel III						
Minimum Common Equity Tier 1 Ratio (Core Capital)	Recommendation to start the application	Mandatory requirement to maintain				
Total own capital	Recommendation to start the application	Mandatory requirement to maintain				
Minimum Tier 1 capital (Main capital)	Recommendation to start the application	Mandatory requirement to maintain				
Capital conservation buffer			0.625%*	1.25%*	1.875%*	2.5%*

* Details are not confirmed by the CBR
Source: CBR.