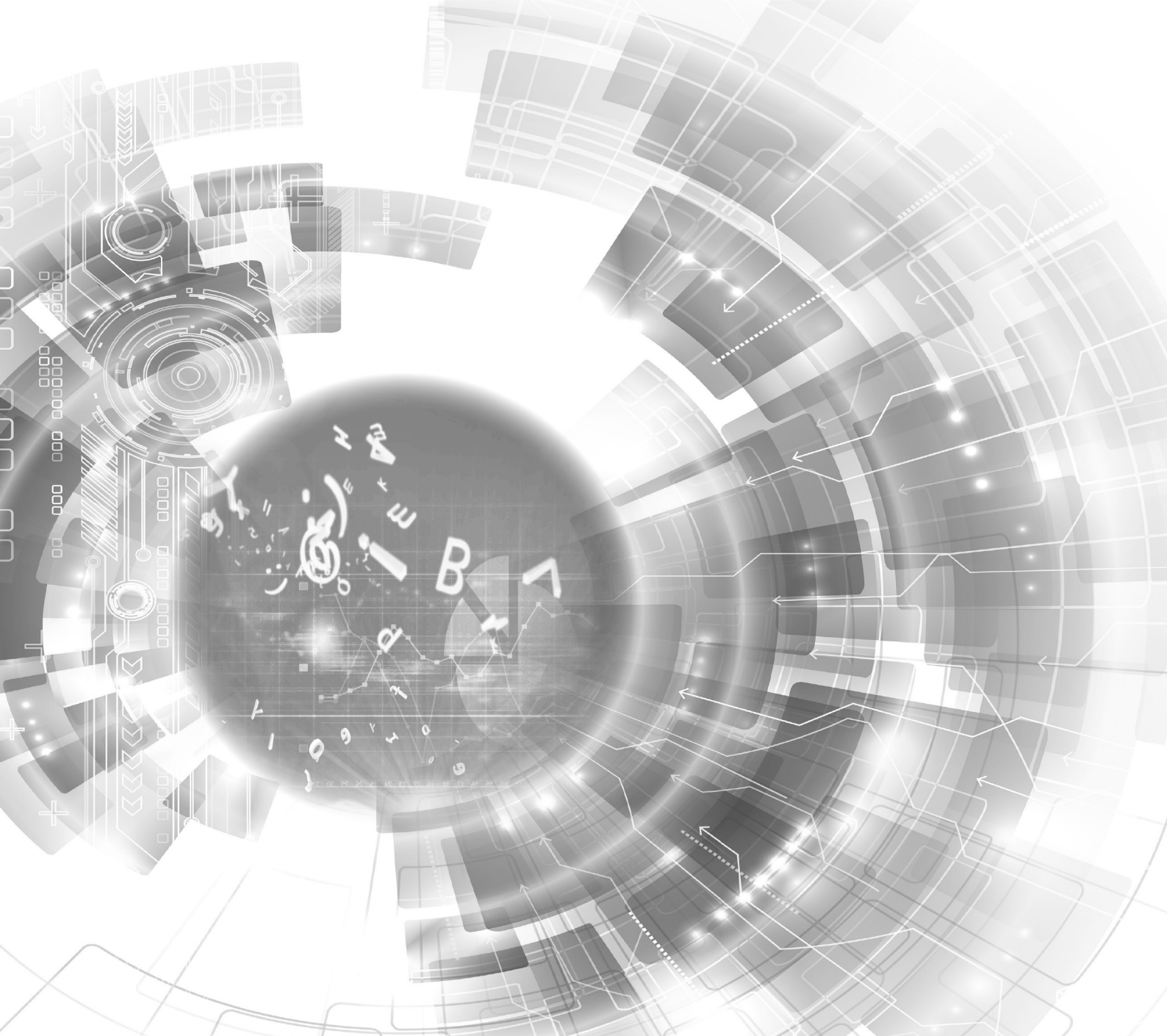
December 2018 SPA/18/01

SEACEN STAFF POLICY ANALYSIS

CREDIT CYCLES AND THE COUNTERCYCLICAL CAPITAL BUFFER

The South East Asian Central Banks (SEACEN)
Research and Training Centre

The SEACEN Centre



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The **SEACEN Staff Policy Analysis: Credit Cycles and the Countercyclical Capital Buffer** reflects the analysis and views of SEACEN staff and do not represent the views of its member central banks and monetary authorities.

Notes:

The SEACEN Centre recognizes "China" as People's Republic of China; "Hong Kong, SAR" as Hong Kong, China; and Korea as "Republic of Korea".

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FOREWORD

It is my pleasure to introduce the inaugural issue of **SEACEN Staff Policy Analysis,** a new publication of the SEACEN Centre intended to provide in-depth analysis of topical policy issues in macroeconomics, monetary policy, financial stability, and payment systems with a particular emphasis on contextualising these issues to the SEACEN economies. It is our hope that this publication will contribute to discussions that are ongoing in the international financial arena by providing a regional perspective on these issues. The publications is thus a natural component of the Centre's continuing efforts to provide SEACEN-wide perspectives on prominent issues that confront our member central banks and monetary authorities.

This inaugural issue takes a look at the relationship between the credit cycles and the countercyclical capital buffer (CCB) proposed under Basel III measures developed by the Basel Committee on Banking Supervision. Our experience of past episodes of financial crises has shown that credit booms frequently sow the seeds of subsequent credit crunches. It is no coincidence then that the growth in credit and asset prices has assumed an important role in discussions of the design of macroprudential policies in view of attenuating financial stability risks. Precise and timely policy actions on the part of the authorities, however, requires the correct identification of the current phase of the cycle in credit and asset prices. The academic literature though has not yet reached a consensus on how to precisely measure the credit cycle.

As part of Basel III's global regulatory standards on bank capital, the CCB is expected to dampen and counteract the inherent procyclicality in credit by 'leaning against' or 'building up a buffer' during times of excessive credit exuberance, whereas the buffer is immediately released once the cycle turns. This issue of the SEACEN Staff Policy Analysis is being published at a timely and opportune moment in view that the CCB's agreed phase-in arrangement would end at year-end 2018, becoming fully effective on 1 January 2019.

This issue has been prepared by staff of SEACEN's Macroeconomic and Monetary Policy Management (MMPM) pillar. Dr. Victor Pontines (Senior Economist, MMPM) authored and supervised the production of this issue. Dr. Rogelio Mercado (Senior Economist, MMPM) provided comments on an earlier draft. Dr. Ole Rummel (Director, MMPM) and SEACEN's Executive Director reviewed and approved the issue.

Finally, I wish to emphasise that the views expressed in this inaugural issue of the SEACEN Staff Policy Analysis are those of the author and do not represent the views of the SEACEN's member central banks and monetary authorities.

Hans Genberg
Executive Director
The SEACEN Centre

December 2018

ABSTRACT

This report examines across eight SEACEN economies, the sensitivity of the Countercyclical Capital Buffer (CCB) to alternative measures of credit on the one hand and alternative methods of obtaining the credit gap on the other. It finds that the determination in the level of the historical buffers is sensitive to these two sets of alternatives. This result arises because national authorities can obtain a different estimate of the credit cycle depending on the measure of credit they use as well as on the choice of the filtering method used. The report concludes with a brief discussion of the implications to policy of these findings.

NON-TECHNICAL SUMMARY

The Basel III framework proposed the countercyclical capital buffer (CCB) as one broad-based tool for national authorities. The idea of the CCB is that during the upturn of the credit cycle when financial imbalances are growing, banks are required to build-up extra capital. This is expected to mitigate the excessive credit condition in the economy. Conversely, during the downturn phase in the cycle, the buffer built-up during the boom are immediately released. This helps banks to cushion their losses by avoiding a credit crunch and the deleveraging that follows. An accurate measurement of the credit cycle is then needed to maximize the benefits from the implementation of this macroprudential policy instrument.

The Basel Committee on Banking Supervision (BCBS) accords a prominent role to the credit-to-GDP ratio, in particular, the total private, non-financial sector credit-to-GDP ratio. Furthermore, it suggests that the CCB is activated once the country's total private, non-financial credit-to-GDP ratio exceeds its long-run trend (i.e., credit gap)[1] by two percentage points. The CCB should then reach its maximum level of 2.5 percentage points once the same country's credit gap is at least ten percentage points. To obtain the country's long-run trend, the BCBS suggests the use of the one-sided Hodrick-Prescott (HP) filter.

This report examines across eight SEACEN economies, the sensitivity of the CCB to alternative measures of credit, on the one hand, and alternative methods of obtaining the credit gap, on the other.[2] The main findings from the analysis conducted in this report are the following:

First, both credit ratio series (i.e., credit series derived from total credit and a measure of credit that takes only bank credit into account) are trending upward in each of the economies, with the exception of Indonesia.

Second, with the exception of Malaysia and Thailand, total credit has usually been higher than bank credit. For some of these economies, not only is this difference higher, but in recent years, it is widening. This suggests the increasingly important role of non-bank financing for this set of economies.

Third, for the majority of the economies, credit to non-financial corporations as a percentage of GDP as well as the lending that goes to the household sector as a percentage of GDP are both gradually rising over time.

Fourth, for most of the economies, the calculated buffers are sensitive to the credit series used in the calculation of the credit-to-GDP ratio. For instance, in some of the economies, the buffer calculated using the credit gap obtained from total credit-to-GDP is suggestive of setting the level of the buffer at the maximum level for the most recent period. In contrast, the buffer calculated using the credit gap obtained from bank credit-to-GDP either imply non-activation or the buffer set at the maximum level but reduced much earlier.

Fifth, different filtering methods give rise to different estimates of the cycles and as such, suggest different levels of the historical buffer. For instance, credit cycles obtained from a one-sided HP filter are suggestive of buffers that can be set at the maximum level in most of the historical periods. On the other hand, the historical buffers calculated using other filtering methods reach the maximum level in most of the periods less frequently.

1. This report uses the terminologies credit cycle and credit gap, interchangeably.

2. The eight economies are as follows: China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Singapore and Thailand.

1. Introduction

The events of the last decade have demonstrated that a pure micro-based approach to financial regulation and supervision is not sufficient to ensure the stability of the financial system as a whole. A broader set of policy tools that complement existing micro-prudential regulations and traditional macroeconomic management tools (i.e., monetary and fiscal policies) are needed to mitigate system-wide risk. For instance, time-varying macroprudential policy has become one of the focal points of interest not just among national monetary and prudential regulatory authorities, but has also received emphasis from the primary international standard-setter for prudential regulation of banks, i.e., the Basel Committee on Banking Supervision (BCBS). The Basel III framework proposed the countercyclical capital buffer as one broad-based tool-applied at the aggregate level to influence the credit exposures of domestic banking systems. As a macroprudential policy that vary over the credit cycle[1], the countercyclical capital buffer's main aim is to enhance the resilience of the financial system to shocks in good times and to cushion the losses of the financial sector in bad times (IMF, 2014). Box A elaborates on the nexus between the credit cycle and the countercyclical capital buffer.

In its guidance to national authorities on the operation of the countercyclical capital buffer, the BCBS accords a prominent role to the credit-to-GDP ratio, in particular, the total private, non-financial countercyclical buffer is activated once the country's total private, non-financial credit-to-GDP ratio exceeds its long-run trend (i.e., credit gap) by two percentage points. The countercyclical buffer should then reach its maximum level of 2.5 percentage points once the same country's total private, non-financial credit-to-GDP ratio exceeds its long-run trend by at least ten percentage points. To obtain the country's long-run trend, it suggests the use of the one-sided Hodrick-Prescott (HP) filter. Box B offers a brief discussion on the operation of the countercyclical capital buffer based on the guidance provided by the BCBS on the procedure for the implementation of the buffer.

This report examines the sensitivity of the proposed countercyclical buffer to alternative measures of credit, on the one hand, and alternative methods of obtaining the credit gap, on the other. Specifically, the sensitivity in the determination of the buffer across eight SEACEN economies[2] is assessed in two ways. First, we compare estimates of the buffer using bank credit as a measure of the credit series as opposed to using total credit in the calculation of the credit-to-GDP ratio. The motivation in conducting this sensitivity exercise is that some of the economies we consider in the analysis use a measure of domestic banking system credit to assess the credit-to-GDP gap in their policy decisions.[3] Second, we compare estimates of the buffer in which we employ three methods, including the one-sided Hodrick-Prescott (HP) filter, to extract the country's credit gap. It should be noted that there is a strand of literature that identifies the credit-to-GDP gap compared to other variables as the best single early-warning indicator of systemic banking crises.[4] We recognize that studies conducted along these lines are important to inform policymakers in their operation of broad-based, time-varying macroprudential policies. The work carried out in this report, however, is more closely related to the analysis conducted in Annex I of the BCBS guidance document (BCBS, 2010) which laid out the calculation of the countercyclical buffer by utilizing as an example, UK data on total credit-to-GDP and the corresponding estimates of the same country's credit gap obtained via a one-sided Hodrick-Prescott (HP) filter (see Graph A1.1, p. 16 of BCBS, 2010).[5] This report serves to complement the analysis conducted in this guidance document by extending its application to the eight SEACEN economies, most especially, to examine the sensitivity of the historical estimates of the buffer according to the two dimensions of assessment mentioned above.

This report is structured as follows. The following sub-section presents some trends in the credit data used for the eight SEACEN economies. The third section serves as the main section of this report in which the historical estimates and sensitivity of the buffer are assessed. The last section presents some brief conclusions and suggestions for further analysis.

1. This report uses the terminologies credit cycle and credit gap, interchangeably.

2. The eight respective economies are as follows: China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Singapore and Thailand.

3. See, for instance, BIS (2017).

4. See, for instance, Borio and Drehmann (2009), Drehmann et al. (2010), Behn et al. (2013), Drehmann and Juselius (2014).

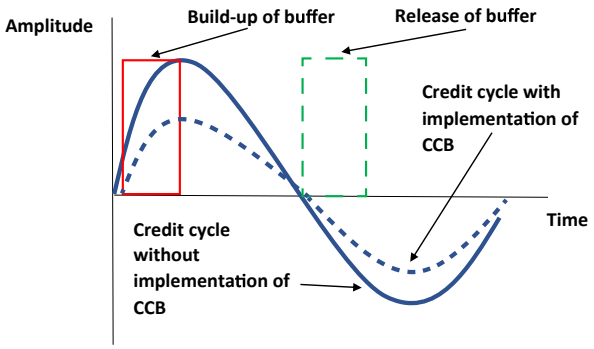
5. A recent and more related study is by Drehmann and Yetman (2018) which compares four methods of obtaining the credit gap as well as two methods of normalizing nominal credit. Again, however, this study assesses the early-warning properties of these different proxies for excessive credit.

Box A. **Credit Cycle and Countercyclical Capital Buffer**

Based on historical episodes of financial crises, it is well recognized that credit booms driven by excessive leverage are often succeeded by substantial busts in credit, with the global financial crisis as the most notable example in recent memory (e.g., Gourinchas and Obstfeld, 2012; Jorda, Schularick and Taylor, 2011; Schularick and Taylor, 2012). Specifically, in 'good times' the incentive by various lenders to expand credit and reduce their lending standards become the source of the build-up of system-wide vulnerabilities. Once the cycle turns, the decision by lenders to cut losses and the contraction in the supply of credit imposes serious consequences to the economy in terms of lower growth in output and persistent higher unemployment rates (e.g., Reinhart and Reinhart, 2010; Jorda, Schularick and Taylor, 2013). Macro-prudential policies, particularly, instruments that vary over the credit cycle which can dampen the upturn and downturn of the credit cycle are meant to counter this inherent procyclicality in credit.

For instance, under the Basel III framework, higher capital requirements in the form of time-varying buffers were introduced. One such buffer advanced under this framework is the countercyclical capital buffer (CCB). The figure below illustrates the basic idea underlying the CCB:

The Operation of the CCB over the Credit Cycle



Source: ESRB (2014, Fig. 4, p. 12)

In 'good times' when financial imbalances are growing, banks are required to hold or build-up additional capital (buffer). In doing so, the build-up of the CCB during the upturn of the credit cycle mitigates the excessive leverage in the economy. Conversely, when financial conditions tighten, the additional capital or buffer built-up in good times are then released. By releasing the buffer once the cycle turns, it avoids a credit crunch by helping banks to absorb losses and reduce the pressure on these banks to deleverage that would have otherwise been harmful to the economy. It follows that an accurate measurement of the credit cycle is needed to maximize the benefits from the implementation of the CCB.

Box B. **Operation of the Countercyclical Capital Buffer**

This box presents the salient points of the CCB described in section IV of the BCBS document on Basel III (BCBS, 2011) and in the BCBS guidance document (BCBS, 2010) which lay out for national authorities the procedures in the operation of the CCB. Basel III requires the authorities to 'monitor credit growth and assess whether such growth is excessive leading to the build-up of system-wide risk'. Based on this assessment, a CCB can be implemented that serves as an extension of the capital conservation buffer.[1]

The CCB varies from zero to 2.5 percentage points of risk weighted assets. In case that there is a need to raise the CCB, national authorities will pre-announce the decision by up to 12 months to give banks time to adjust, whereas the decision to lower the CCB takes effect immediately. The guidance document specifies five principles in the operation of the CCB: (i) its objectives; (ii) the common reference guide or variable to use when decisions on the CCB are taken; (iii) to consider the possibility that this variable can provide misleading signals; (iv) the prompt release of the CCB in times of stress; and, (v) a note to national authorities to consider other macroprudential tools, in addition to the CCB.

Under principle (ii), the total private sector credit-to-GDP takes a prominent role in the operation of the CCB as it is suggested as the common reference guide or variable. Annex I of the guidance document provides a step-by-step guide to calculate the so-called CCB add-on (from here on, we refer to this simply as the buffer). The three-step process involves the following:

1. Calculate the total private sector credit-to-GDP ratio
2. Calculate the credit-to-GDP gap (the gap between the ratio and the long-run trend)
3. Transform the credit-to-GDP gap into the buffer

In Step (1), the guidance document suggests a broad measure of credit to the private, non-financial sector together with GDP (both in nominal terms) to calculate the credit-to-GDP ratio. In Step (2), to establish the trend, it suggests the use of the one-sided Hodrick-Prescott (HP) filter with a high smoothing[2] parameter of 400,000.[3] Once the credit-to-GDP gap is calculated, in Step 3, it suggests for the buffer to be zero when the credit-to-GDP gap is below a lower threshold level (L). In other words, for values of the credit-to-GDP gap below this lower threshold, the buffer is not activated. The buffer rises above zero (or the buffer is then activated) as the credit-to-GDP gap increases above the lower threshold level, until the buffer reaches its maximum level of 2.5 percentage points when the credit-to-GDP gap exceeds the upper threshold level (H). When the credit-to-GDP gap is between the lower (L) and upper threshold (H) level, the buffer is set according to the formula: (credit-to-GDP gap $- L$)x($2.5/H - L$) percent. The guidance document suggests the thresholds to be at $L = 2$ percentage point and $H = 10$ percentage point.

1. The capital conservation buffer is discussed in section III of the BCBS (2011) document on Basel III.
2. Also referred to in the literature as λ (lambda).
3. More discussion on this HP filter is provided in Box C below.

2. Trends in the Credit Data

This section presents some basic trends in the credit data used for this report. This report utilized available quarterly credit data for eight SEACEN economies (viz., China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Singapore and Thailand)[6] from the Bank for International Settlements (BIS) database on total credit to the private, non-financial sector.[7] As defined by this database, the credit series capture total borrowing by the private, non-financial sector (i.e., households and non-financial corporations) from all domestic and foreign sources, covering both bank and non-bank financing (BIS, 2016). Given that the earliest available data for the economies that we examine in this report vary, we do not define a common historical period for all economies in order to maximize the available data in our analysis.

2.1 Trends in the total credit-to-GDP and bank credit-to-GDP ratio

The first set of trends that we look at is to compare the credit-to-GDP ratio when the credit series is derived from total credit as against a measure of credit that takes only bank credit into account. Figure 1 provides this comparison. It should be clear from the above definition of the credit series that any observed difference between total and bank credit comes from lending by non-bank entities to the private, non-financial sector. One obvious observation that can be gathered from Figure 1 is that both credit ratio series are trending upward in each economy with the exception of Indonesia for which despite the recent increase in both ratios, these are only slightly higher than the levels observed at the start of the period for this economy. In two of the eight economies, i.e., Malaysia and Thailand, there is little difference in both credit ratios. For the rest of the economies, however, total credit has usually been higher than bank credit. This observation appropriately describes the cases of Hong Kong SAR, Korea, Singapore as well as Indonesia to a certain extent due to the noted exception of a narrowing of the differences in both credit ratios around the time of the Global Financial Crisis. China and India, each present as interesting cases with their respective credit ratios coinciding at most times, but, in recent years, total credit-to-GDP had outpaced bank credit-to-GDP. A similar observation can also be ascribed to the cases of Hong Kong SAR, Korea, Singapore and, again to a lesser extent, Indonesia. For these set of economies, not only is total credit-to-GDP higher than bank credit-to-GDP, but, in recent years, this difference is also widening. This suggests the increasingly important role of non-bank financing for these economies.

2.2 Private, non-financial sector borrowers: households and non-financial corporations

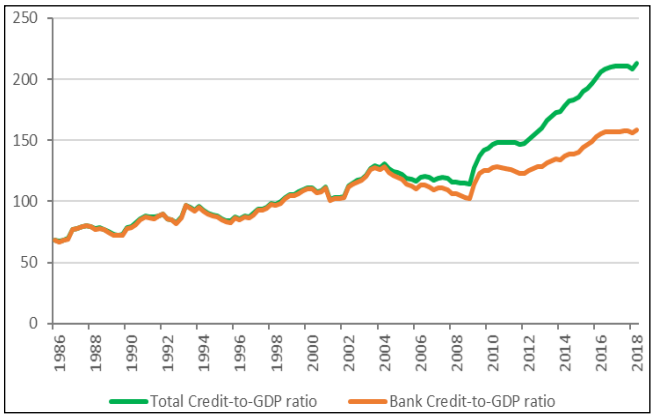
The next set of comparison that we consider is to depict the trends emanating from the private, non-financial sector borrowers, i.e., households and non-financial corporations. Figure 2 shows this comparison. One important observation from this figure is that for the majority of cases, not only that credit to the non-financial corporations as a percentage of GDP takes on a relatively bigger portion of total lending compared to lending that goes to the household sector, this share is also gradually rising over time (e.g., China, Hong Kong SAR, Korea, Singapore). In the case of India, total credit to the non-financial corporations appears to be settling at a level slightly higher than 40 percent of GDP compared to its total lending to the household sector which has remained stable at around 10 percent of GDP. In the case of Indonesia, after a gradual drop in total credit to the non-financial corporations as a proportion of GDP from the early 2000s until around the time of the eurozone crisis, this has increased in recent years, to about a quarter of the economy's GDP. Malaysia's total credit to the non-financial corporations has remained steady averaging at around 65 percent of GDP. In the case of Thailand, after a steep rise in its total credit to the non-financial corporations which reached a level close to 120 percent of GDP around the time of the Asian financial crisis, this had gradually come down in subsequent years. According to the latest available data, this is now around a little more than 40 percent of GDP. While total lending to the household sector for most economies have taken on a backseat role compared to the lending that goes to the non-financial corporations, one other important observation from Figure 2 is that for almost all economies, with the exception of India, total lending to the household sector has also been gradually rising over time.

6. Six (i.e., China, Hong Kong SAR, India, Indonesia, Korea, Singapore) of these eight economies are also members of the BCBS (https://www.bis.org/bcbs/membership.htm).

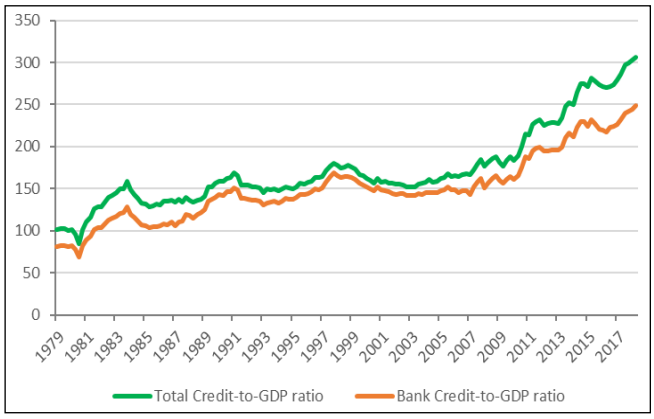
7. The choice of inclusion of these eight economies in this report was dictated by the available data in the BIS database on credit. Among SEACEN member economies, credit data were only available for these same eight economies in the database.

Figure 1: **Total Credit and Bank Credit-to-GDP Ratio (in %)**

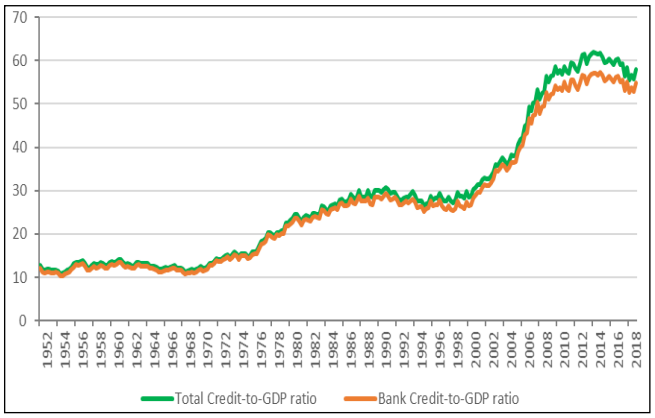
China



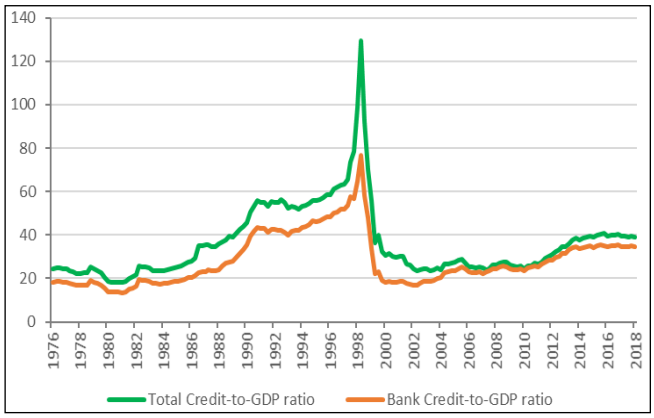
Hong Kong



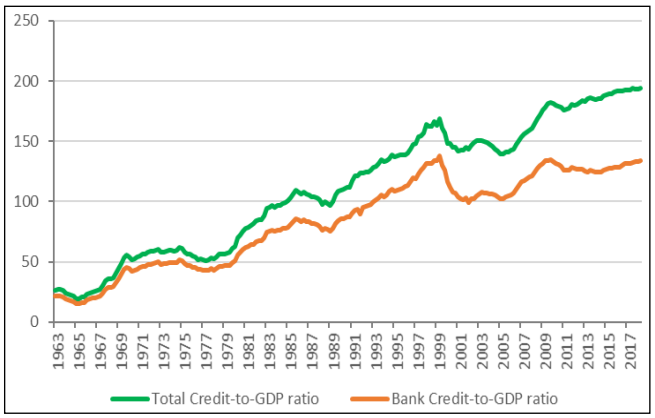
India



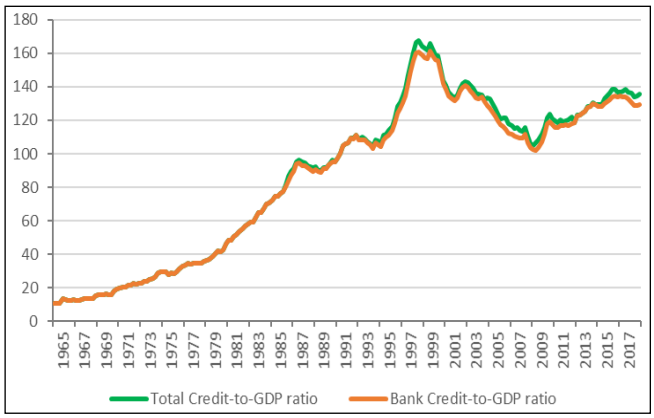
Indonesia



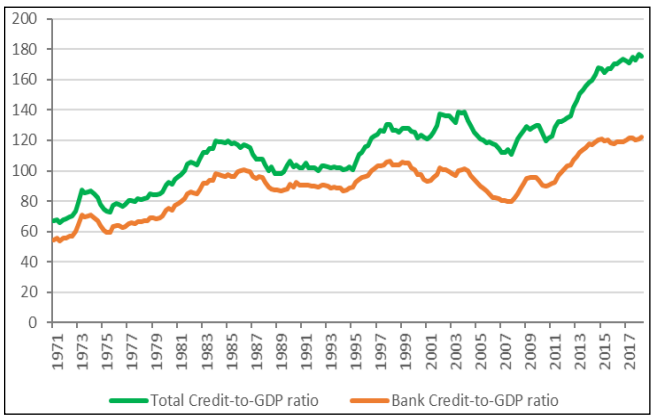
Korea



Malaysia



Singapore



Thailand

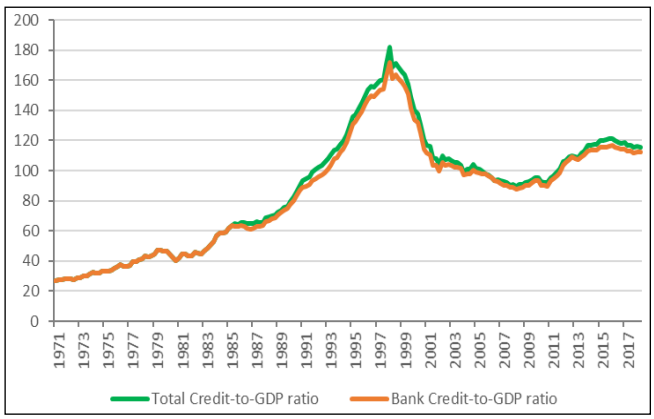
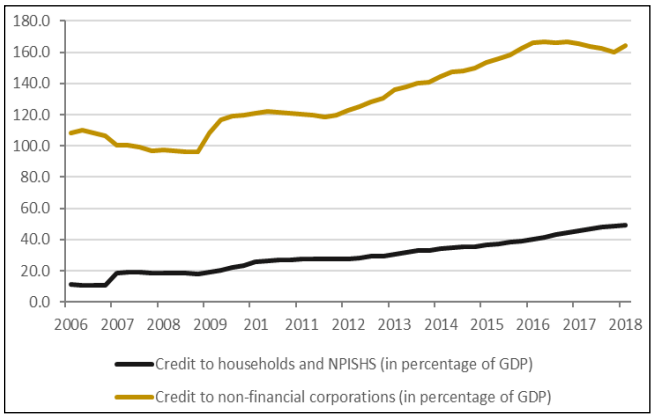
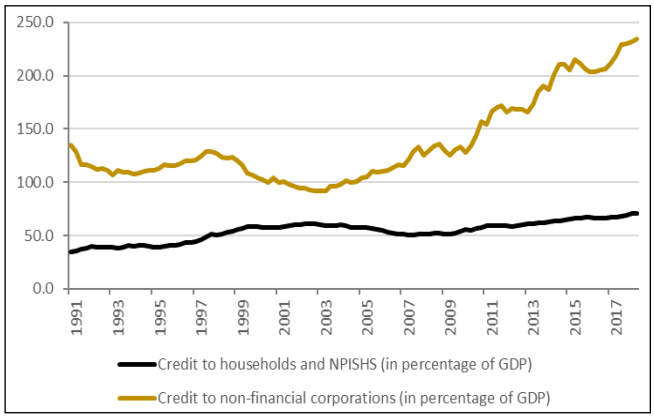


Figure 2: **Private non-financial Sector Borrowers (in %)**

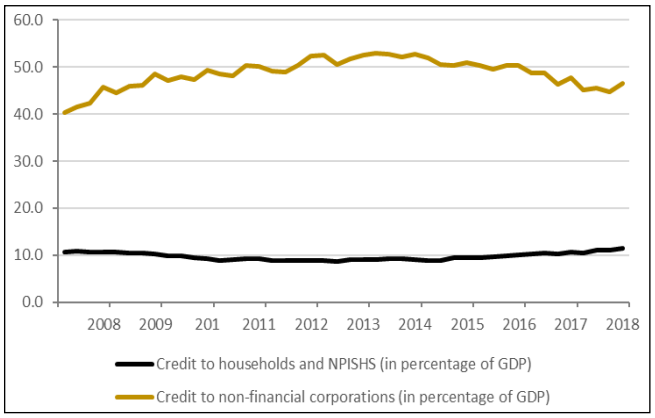
China



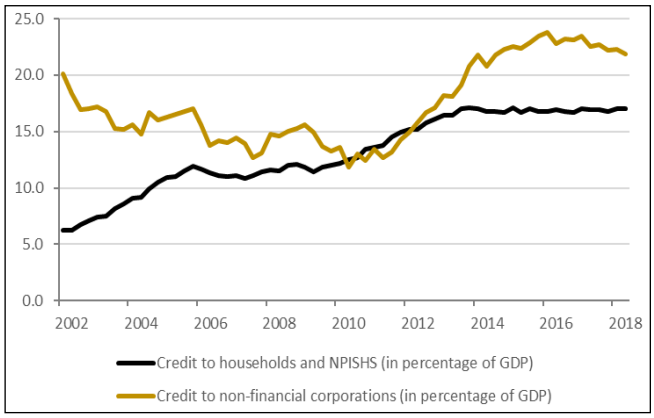
Hong Kong



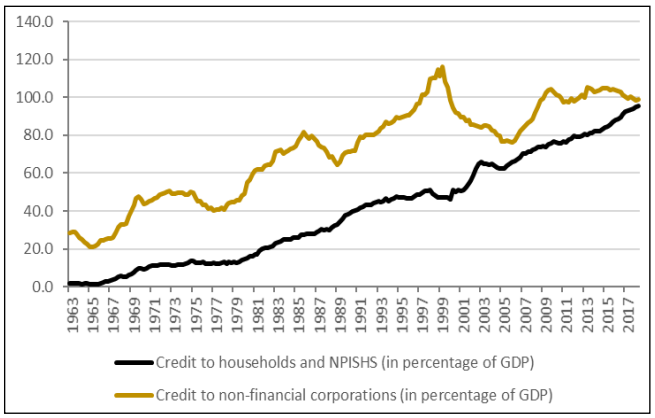
India



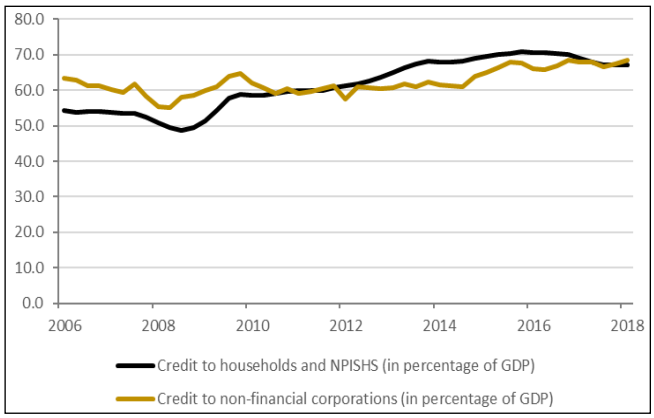
Indonesia



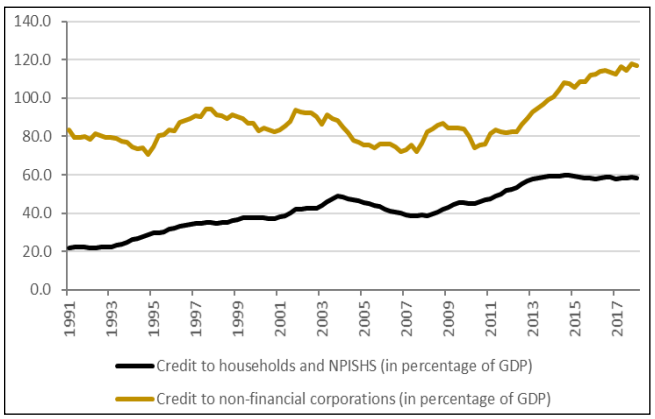
Korea



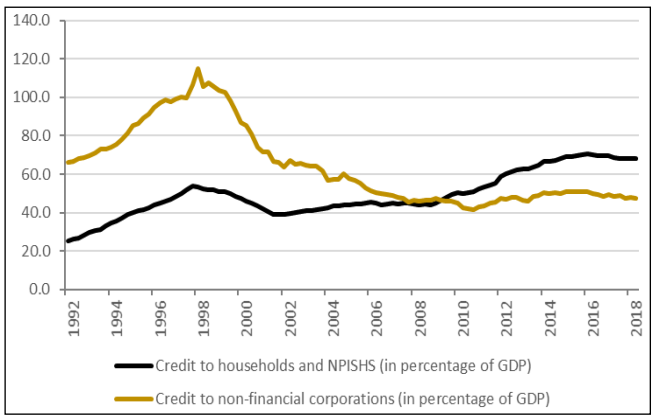
Malaysia



Singapore



Thailand



3. Assessing the Sensitivity in the Calculation of the Buffer

3.1 Sensitivity in terms of the distinction between total credit and bank credit in the calculation of the credit-to-GDP ratio

In this sub-section we compare estimates and ascertain the sensitivity of the buffer using a measure of credit that takes only bank credit into account as opposed to using the BCBS suggested total credit in the calculation of the credit-to-GDP ratio. We do this by first establishing the long-run trend and obtaining the credit gap from the total credit-to-GDP data as well as from the data on bank credit-to-GDP. We carried this out by following the BCBS suggestion of applying the one-sided HP filter with a smoothing parameter of 400,000. After this, each of the extracted credit gaps are then transformed into the buffer following the discussion presented in Box B. One final note concerns how the BIS computes and publishes their statistics for the credit-to-GDP gaps. In their case, they require at least 10 years of available data for the credit-to-GDP ratio before they publish the credit gaps (BIS, 2016).[8] In this report, we follow this strategy by not presenting the first ten years of the estimates of the credit gaps, and, hence, also the first ten years of the historical buffers which uses as inputs the information from these credit gaps (see Box B). Figure 3 presents the respective estimates of the credit gaps from our two credit ratios, while Figure 4 presents the historical transformation of the respective estimates of the credit gaps into the buffer.

The first obvious observation we can make out of the two extracted credit gaps in Figure 3 is that they exemplify varying amplitudes and fluctuations in each of the economy. Furthermore, in three of the eight economies, i.e., Malaysia, Thailand and India, both credit gaps closely resemble or coincide with each other. Apart from these three economies, however, Figure 3 distinctly shows that credit gaps extracted from bank credit-to-GDP data compared to credit gaps obtained from total credit-to-GDP have diverged at most times for the rest of the economies. For instance, in the case of China and Hong Kong SAR, one can clearly see that the observed divergence in the two credit gaps occurred sometime in the mid-2000s in the case of China, while it occurred a bit earlier for Hong Kong SAR. In the case of Korea and Singapore, the start of the observed divergence between the two credit gaps is not so clear-cut. Finally, in the case of Indonesia, it appears that the divergence occurred sometime during the Asian financial crisis, although there was noted narrowing of the divergence sometime in the aftermath of the Asian crisis as well as briefly during the time of the eurozone crisis.

Once the credit gaps are extracted from the respective credit-to-GDP data, these can then be transformed into the buffer. Our earlier observations that the credit gaps exemplify varying amplitudes as well as the divergence in most of the economies of the two extracted credit gaps are both important as these imply in retrospect that not only can it affect decisions on the activation of the buffer, but also the extent of the setting in the levels of the buffer. Based on Figure 4 below, this is illustrated by mainly looking in, no particular order, at the cases of China, Indonesia, Hong Kong SAR, Singapore and Korea. In the case of China, starting in the middle of 2010 until the end of the historical period, both credit gaps mainly turned positive, which suggests in hindsight that the buffer can be activated. Furthermore, in terms of the credit gap obtained from the total credit-to-GDP, the buffer can be set at the maximum level of 2.5 percentage points at most times during the same historical period. In contrast, this result does not hold for the buffer calculated using the credit gap obtained from the bank credit-to-GDP. Here, the buffer can be suggestively set at the maximum level only for a brief period (between mid-2015 to mid-2017).

In the case of Hong Kong, from a retrospective analysis, the setting in the level of the two calculated buffers differ substantially during the height of the GFC. For Indonesia, the two calculated buffers are observed to differ from end-2010 until the end of the historical period. During this same period, the buffer calculated using the credit gap obtained from bank credit-to-GDP initially suggests that the buffer can rise but reduced quite quickly. In contrast, the buffer calculated using the credit gap obtained from total credit-to-GDP suggests that it can be set at the maximum level and be reduced closer to the end of the historical period. In the case of Korea and Singapore, the two calculated buffers indicate substantial difference. For Korea, the period from 2011 until the end of the historical period, the buffer calculated using the credit gap obtained from bank credit-to-GDP imply non-activation, whereas it is the opposite result for the buffer calculated using the credit gap obtained from the total credit-to-GDP. In the case of Singapore, the buffer calculated using the credit gap obtained from the total credit-to-GDP is suggestive that the buffer can be set at its maximum level until the end of the historical period, whereas the buffer calculated using the credit gap obtained from bank credit-to-GDP suggests that it can already be reduced by mid-2016. Finally, there is little difference in the calculated buffers from both extracted credit gaps in the case of India, Malaysia and Thailand.

8. This has to do with the so called beginning-point problem.

Figure 3: **Credit cycles**

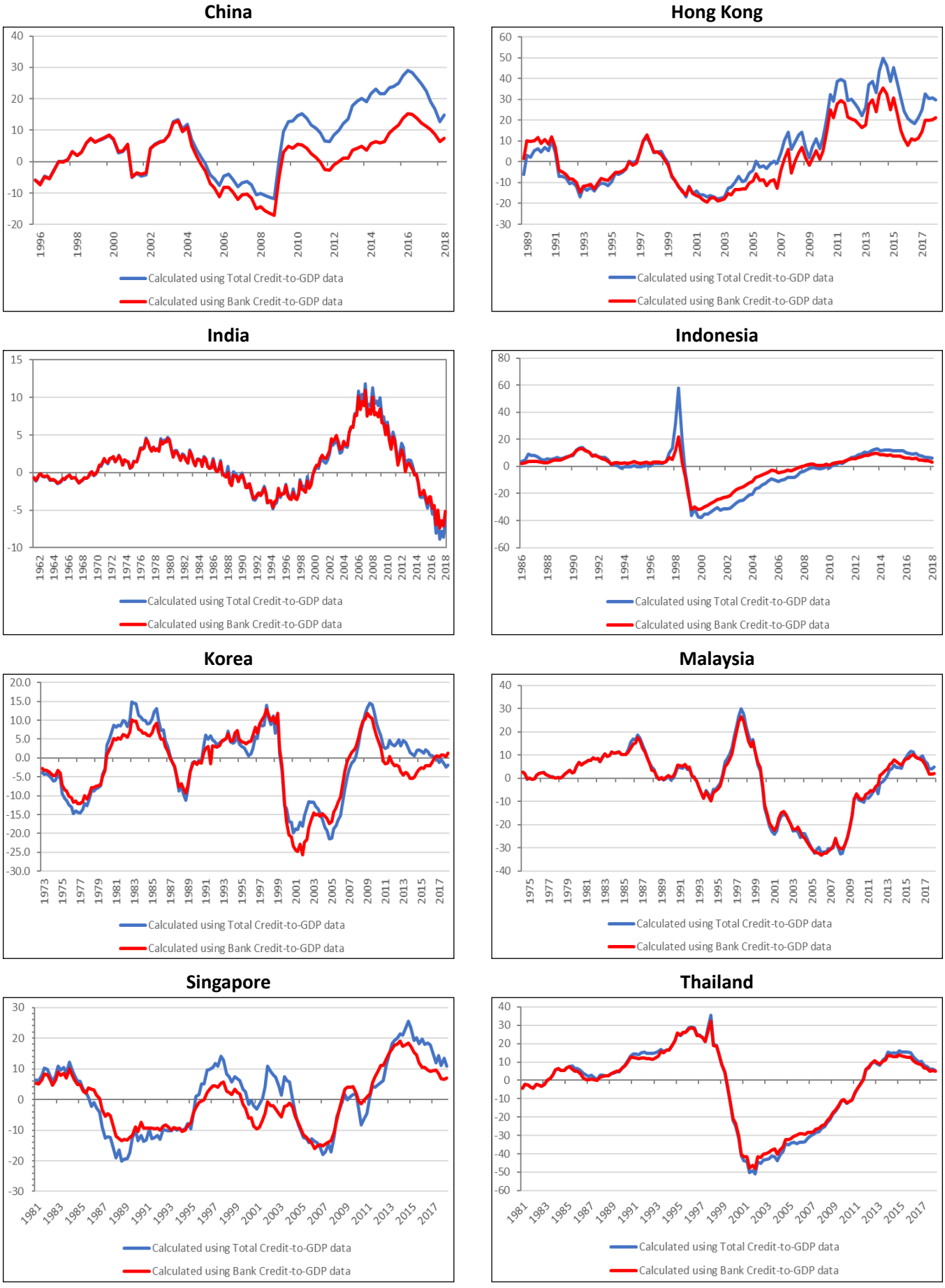
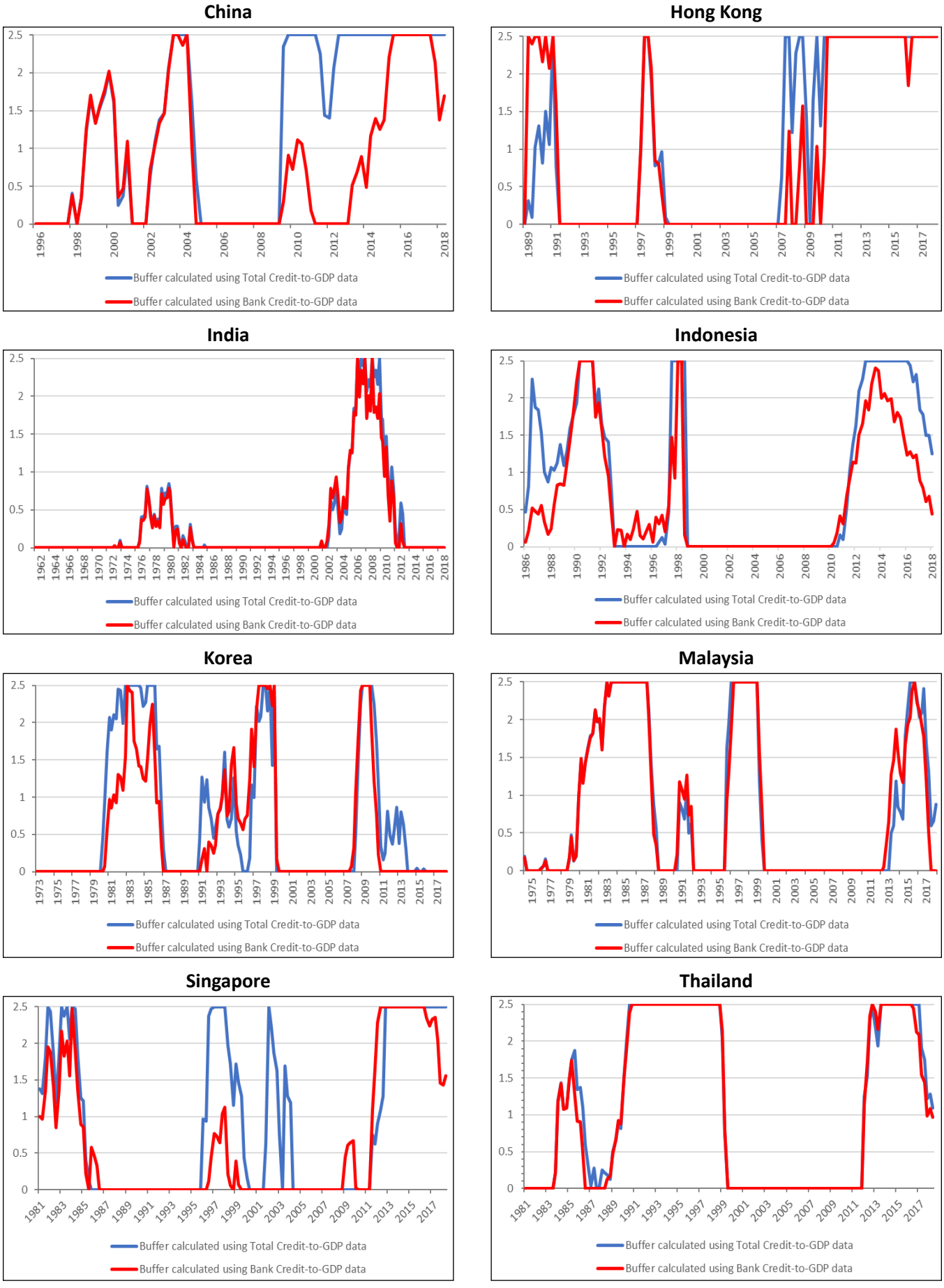


Figure 4: **Estimates of the Countercyclical Capital Buffer: Sensitivity Test 1**



3.2 Sensitivity in terms of the method employed to extract the credit cycle

Similar to the previous sub-section, this portion of the report presents the results into two main parts. The first part presents the credit cycles of the eight SEACEN economies extracted from the data on total credit-to-GDP ratio of these economies. Estimates of the credit cycles were obtained from the use of two other statistical filtering and detrending techniques, namely, the asymmetric Christiano-Fitzgerald (CF) band-pass filter and an unobserved component model following the work of Harvey (1989). It should be mentioned that in our estimates of the cycles using the asymmetric CF filter, two choices of the filter bands were assumed. One assumes a high-frequent cycle or with business cycle frequency, i.e., filter band of 6 and 32 quarters. The other assumes a low-frequent cycle with a filter band of 32 and 128 quarters. The associated estimates of the credit cycles from these two statistical methods are depicted in Figure 5. For purposes of comparison, the earlier presented one-sided HP filter (with a smoothing parameter of 400,000) estimates of the credit cycle using the data on total credit-to-GDP from Figure 3 are again displayed. Box C gives a brief discussion of these cycle extraction methods used, including the HP filter. After obtaining the respective credit cycles, the second part of this sub-section presents and analyses the corresponding historical estimates of the buffer, which are then presented in Figure 6. Also in this figure, for purposes of comparison, the earlier presented historical estimates of the buffer calculated using the credit gap (via the one-sided HP filter with lambda equal to 400,000) obtained from total credit-to-GDP in Figure 4 are displayed.

Figure 5 makes it clear that different methods can give rise to different estimates of the cycle. However, we can distinguish some general patterns in the estimates of the cycles in each of the eight economies. For one, cycles extracted from a one-sided HP filter display greater amplitude compared to the CF filter (with filter band of 6 and 32 quarters) and the UC model. Specifically, cycles extracted from a one-sided HP filter show larger peaks or deeper troughs or both in various times across each economy. On the other hand, cycles obtained using the CF filter (with filter band of 6 and 32 quarters) and UC model generally display more agreement in each of the economy, with the exception of Korea. In the case of China, for instance, cycles estimated by the three methods, i.e., one-sided HP filter, CF filter (with filter band of 6 and 32 quarters) and UC model show broad agreement from the start of the period until 2012. From here on, the cycle obtained via the one-sided HP filter 'veered away' by showing a greater positive amplitude. For Hong Kong, the cycle obtained via the one-sided HP filter displays a relatively deeper trough in the early part of 2000 and like China in the latter part of the period, shows a large, positive amplitude beginning sometime in 2007. In the case of India, cycles obtained using the one-sided HP filter display two large peaks (sometime in the late 70s and during the height of the GFC) and a lone, noticeable trough sometime during the mid-1990s. In the case of Indonesia, the same three methods consistently capture the single, large peak prior to the Asian financial crisis and the subsequent downturn that immediately followed.

In the case of Korea, it is the lone case among the rest of the economies considered in which each of the cycles obtained by the one-sided HP filter and UC model are in broad agreement. Specifically, the upturns and downturns captured by both methods generally coincide. For Malaysia, the same three methods capture the large peak prior to the Asian financial crisis. Although, the cycle obtained using the one-sided HP filter displays another noticeable peak sometime during the mid to late 80s and a deep downturn for the most part of the 2000s. In the case of Singapore, again the cycle obtained by the one-sided HP filter displays greater amplitude with two noticeable peaks (prior to the Asian financial crisis and sometime in 2015) and two troughs (late 80s and during the GFC). In the case of Thailand, to varying extent, the three methods capture the large peak prior to the Asian financial crisis, although the cycle obtained by the one-sided HP filter shows a deeper trough during the early part of 2000s. Finally, the cycle obtained using the CF filter and with a filter band of 32 and 128 quarters as expected, shows longer duration of cycles in each of the economy. Furthermore, it is able to capture the large peaks that occurred in most of the economies considered prior to the Asian financial crisis, e.g., Hong Kong, Indonesia, Korea, Malaysia and Thailand. More interestingly, towards the end of the historical period for each economy, the cycles obtained using this method is broadly in agreement with the direction of the cycles obtained from a one-sided HP filter.

Box C. **Three Cycle Extraction Methods.**

The Hodrick-Prescott (HP) Filter

The HP filter extracts from the credit-to-GDP (y_t) data the trend component τ_t and cyclical component c_t. The extraction of these two components is done through the minimization of the sum of squares of the cyclical component subject to a penalty for the curvature (or variation in the second differences) of the trend component. That is, the trend component is the solution to the following minimization problem:

$y_t = \tau_t + c_t$

$$\min_{\tau_t} \sum_t (y_t - \tau_t)^2 + \lambda \sum_t (\tau_{t+1} - 2\tau_t + \tau_{t-1})^2$$

where λ is the penalty parameter which is closely related to the smoothness of the estimated trend. The larger is λ, the smoother is the result. Because of this, the penalty parameter λ plays a crucial role in estimates of the trend and cyclical components and one that is subject to lengthy debate in the literature. Hodrick and Prescott recommended a value of 1,600 for quarterly data, while values of λ of 100 and 14,400 were considered appropriate for annual and monthly data, respectively. It should be noted that these recommended values were obtained using U.S. data.

The Christiano-Fitzgerald (CF) Filter

The CF filter is a band-pass filter that works by approximately eliminating from y_t all unwanted frequencies while the complement frequency is kept unchanged. In doing so, the credit-to-GDP data is decomposed into a trend and cycle. It is an approximation as it allows for fluctuations in the data with length between some arbitrary choice of cut-offs or filter bands. Two choices of cut-offs or filter bands were employed to produce the results from the CF filter presented in the main text. One filter band uses 6 quarters and 32 quarters such that between 1.5 and 8 years is cycle and over 8 years is trend. The other filter band uses 32 quarters and 128 quarters so that the filtered series with a frequency between 8 and 32 years is cycle and over 32 years is trend. The CF filter used is asymmetric such that the weights on the leads and lags of the minimization of the mean squared error between $\tau_{1,t}$ and $y_{1',t}$ are allowed to differ.

The Unobserved Component (UC) Model

The main idea of unobserved component model is that y_t is composed of a trend, cycle and an irregular component, which are not directly observable and estimated with the Kalman filter technique:

$y_t = \tau_t + c_t + \varepsilon_t$

where ε_t is the irregular or idiosyncratic component. The results presented in the main text follows the work of Harvey (1989) which is based on the hypothesis that the trend and cycle have the following separate dynamic structure:

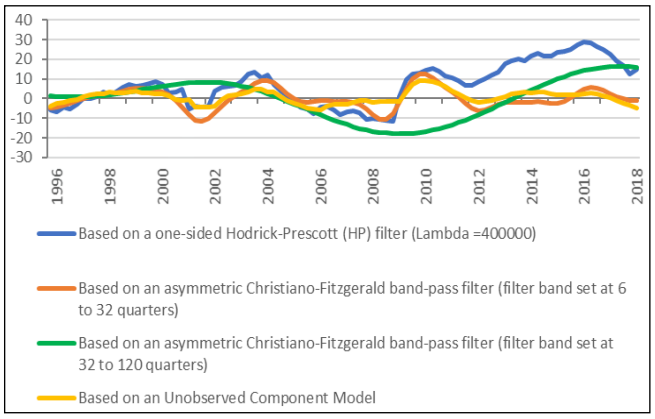
$\tau_t = \tau_{t-1} + \beta_{t-1} + \eta_t$

$\beta_t = \beta_{t-1} + \zeta_t$

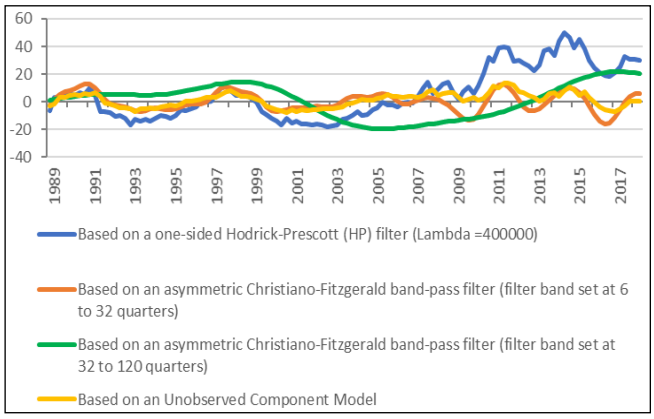
In this formulation, τ_t is usually referred to as the level of the trend, while β_t is interpreted as the slope. By placing restrictions on the variance parameters σ_ε^2, σ_η^2, σ_ζ^2, Harvey (1989) derived a series of models for the trend and irregular component.

Figure 5: **Credit Cycles**

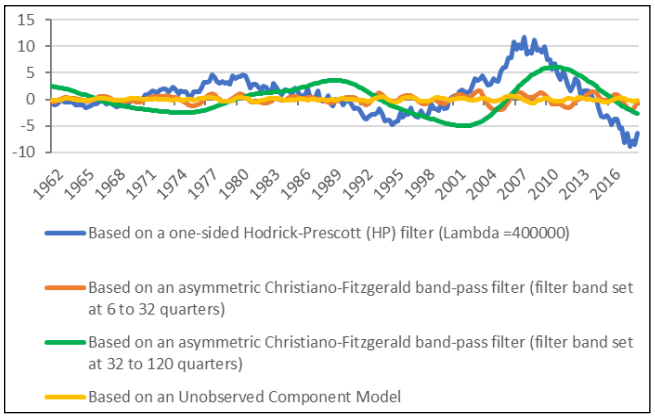
China



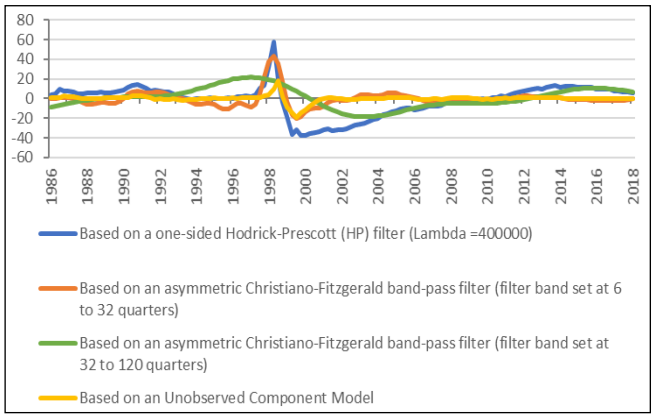
Hong Kong



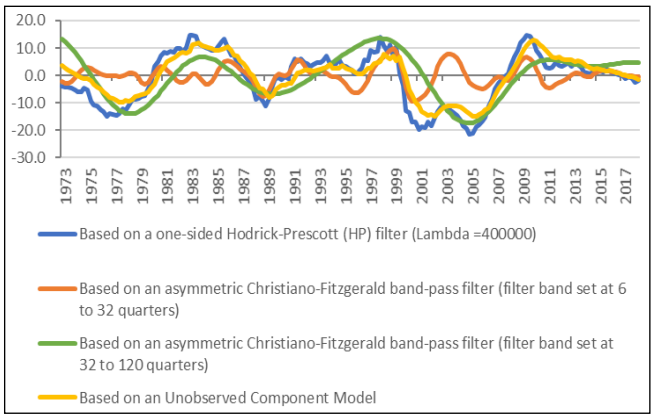
India



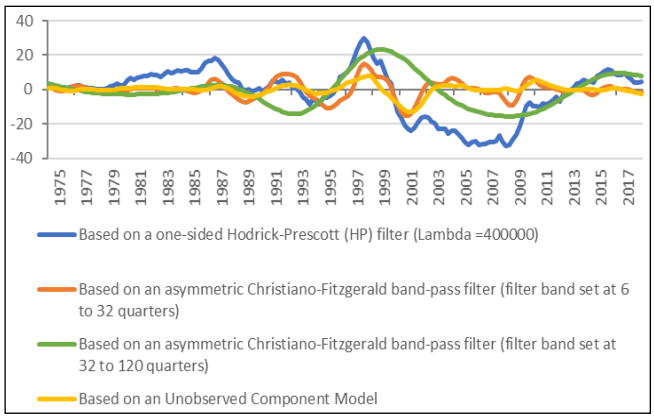
Indonesia



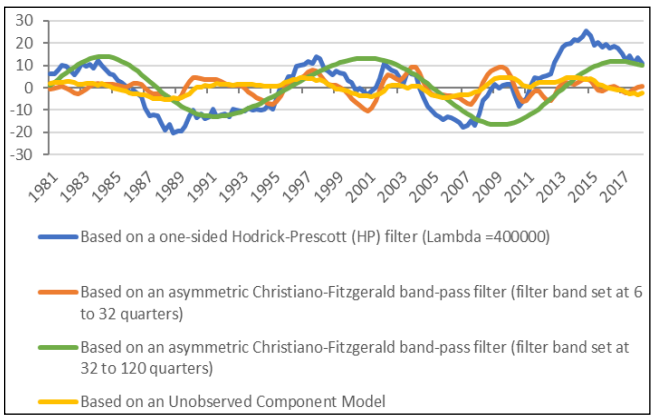
Korea



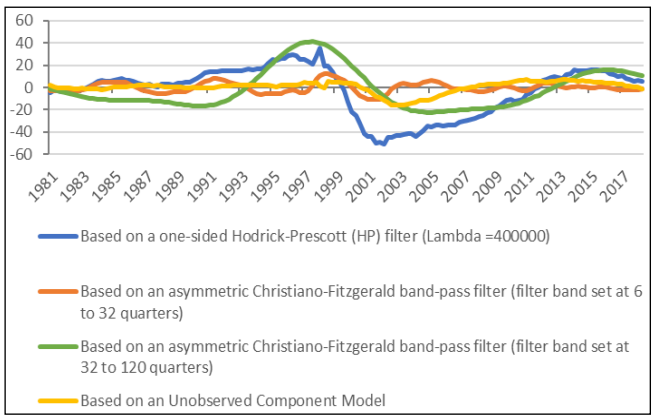
Malaysia



Singapore

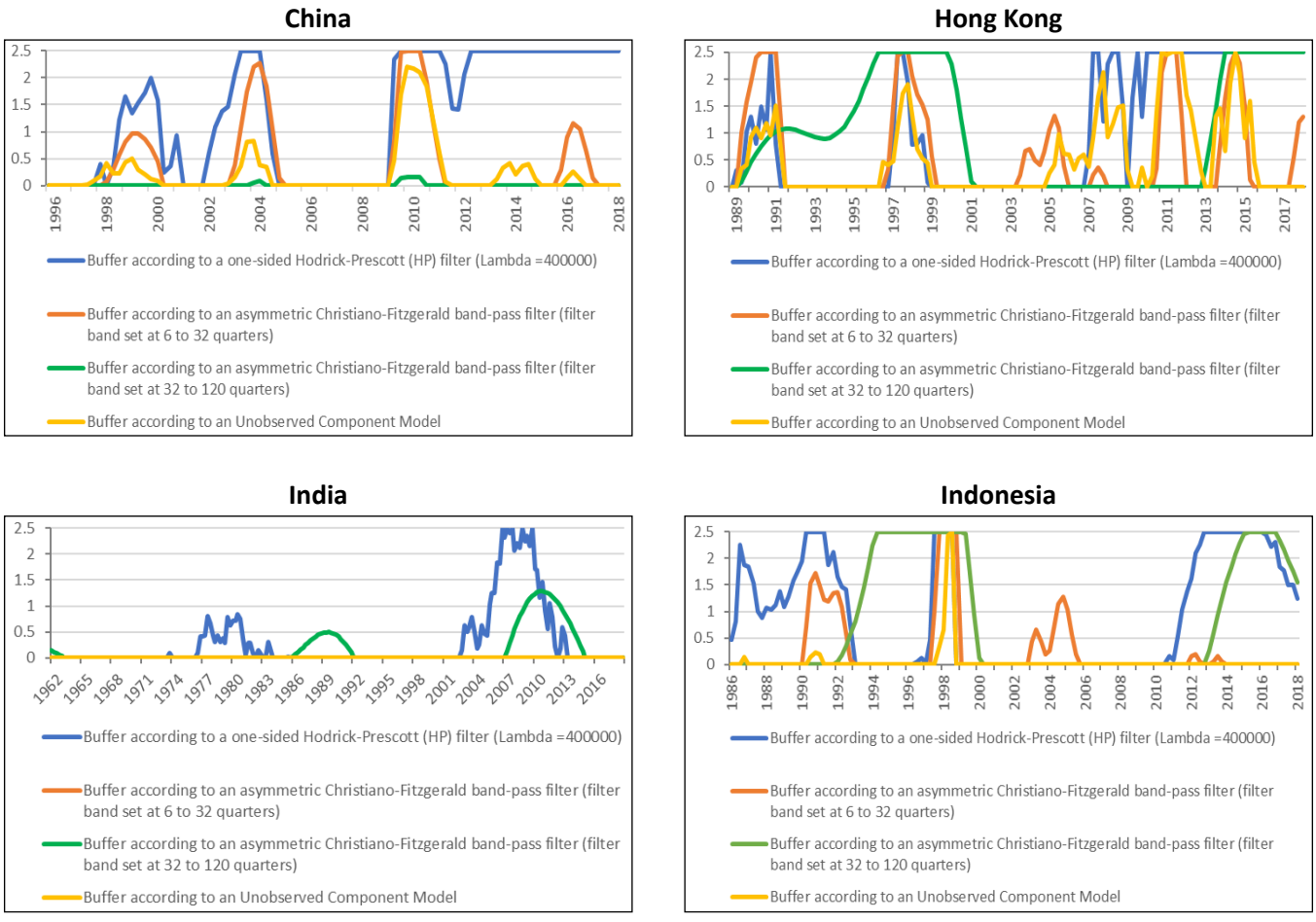


Thailand

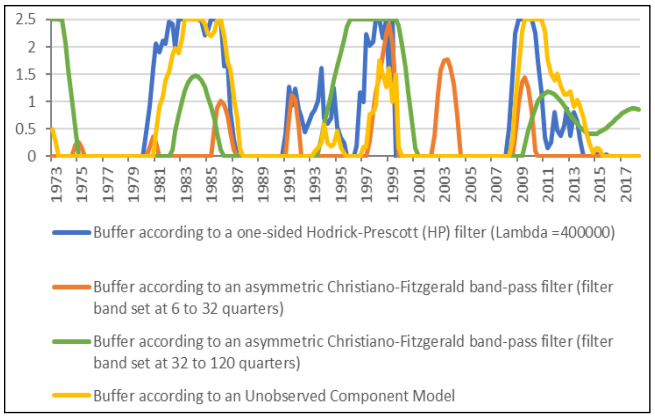


As we saw earlier, because different methods can give rise to different estimates of the cycle, it then follows that each method will suggest different levels of the historical buffer. For instance, given that we found the cycles extracted from a one-sided HP filter show larger peaks or deeper troughs or both in various times across each economy, we can then expect that the suggested course of actions will be at most times either to set the buffer at a relatively higher level or to not activate the buffer. This observation can be seen from Figure 6. In all the economies examined, the historical buffers that reach the maximum level in most periods are those using the credit cycles obtained from a one-sided HP filter. At the other extreme is the historical buffers calculated using the credit cycles obtained from a CF filter with a filter band of 32 and 128 quarters. In view of the much longer duration of cycles in this instance, the historical buffers reach the maximum level less frequently and in most periods, the buffer is suggested to be almost not activated at all (e.g., China and India). With the exception of India, in between these two outcomes are the historical buffers calculated using the credit cycles obtained from a CF filter with a filter band of 6 and 32 quarters and the UC model. Here, the historical buffers calculated using the credit cycles obtained from these two methods are broadly in agreement.

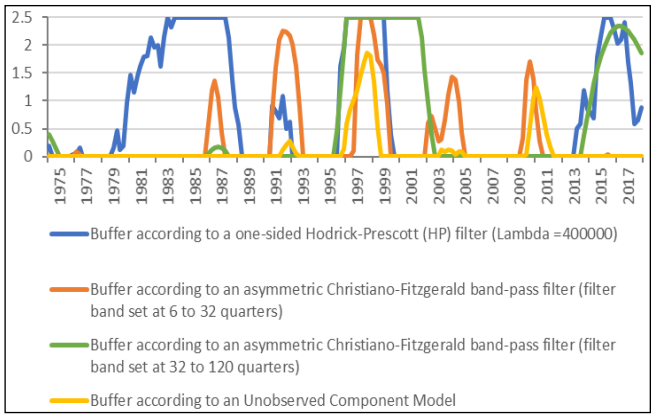
Figure 6: **Estimates of the Countercyclical Capital Buffer: Sensitivity Test 2**



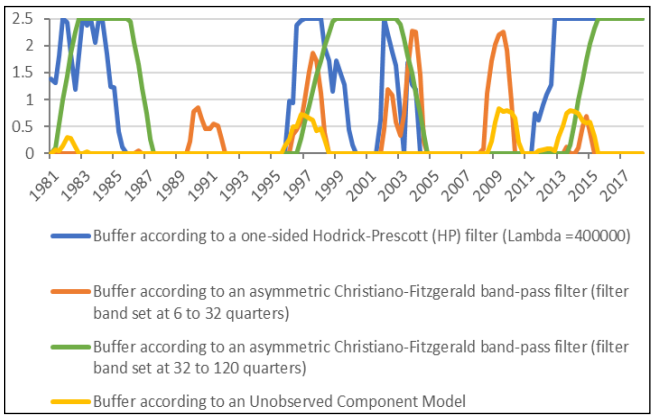
Korea



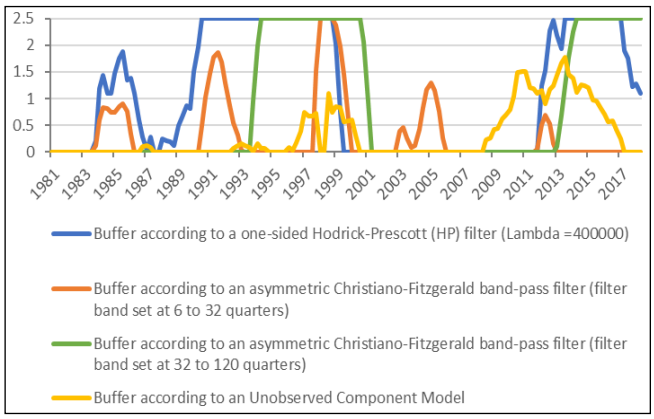
Malaysia



Singapore



Thailand



4. Conclusion

This report shows in retrospect that setting the level of the CCB can be quite sensitive to: (i) the credit series used in the calculation of the credit-to-GDP ratio, and (ii) the statistical method used to establish the long-run trend and to obtain the credit cycle. One caveat that we should make at this juncture is that this report does not make a stand on which statistical method is the most superior, for instance, in terms of having better early warning properties. Instead, this report has highlighted that national authorities can obtain a different estimate of the credit cycle depending on what measure of credit they use to calculate the credit-to-GDP ratio as well as the choice of the statistical method to use. These can have crucial implications on their CCB decisions.

This sensitivity stems from the fact that the actual credit cycle is far from exactly known. This means that estimates of the credit cycle are beset with a certain amount of uncertainty, a familiar challenge that also confronts estimates of the output gap. One key policy takeaway from this is that when setting the level of the buffer, national authorities should tone down their responses to movements in the credit cycle in light of this uncertainty. This then turns on one argument made by the BIS (2014) that apart from avoiding a mechanical interpretation of the buffer, judgment is required in the setting of the buffer. In this regard, however, determining when does a rule-based approach to policymaking ends, and a discretion-based approach to policy begins will always be a challenge in implementing the various instruments of macroprudential policy.

We can also learn from our experience in the modelling of the output gap in terms of how we can address the inherent uncertainty in estimates of the credit cycle. One way to go is to calculate cycles as a range rather than as a point estimate. Another way is to consider the probability distribution of the likely future values of the credit cycles. The suggestion by the BIS (2014), on the other hand, is to consider combinations of indicators to estimate the cycles. As they also acknowledged that the problem of the availability in the data can limit the feasibility of such an exercise.

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