

Chapter 5

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

By
Tanu Irau¹

1. Background

1.1 Background – Countercyclical Capital Buffer (CCCB)

Following the global financial crisis (GFC) in 2008/2009, the problem of procyclicality² 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).

-
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 objectives⁴. 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 Kina⁶ (US\$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

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.

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 *on-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 (CAMELS⁹); 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

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 Warning 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 been 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 policy 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

currency¹⁰. 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 data¹¹.

4.2 Key Indicator

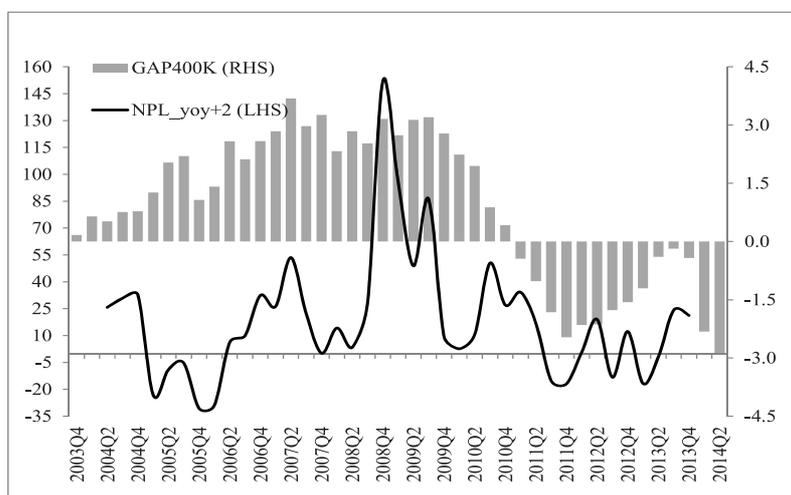
A number of key indicators are suggested by the Basel Committee and amongst these include the credit-to-GDP gap, credit growth and GDP growth. Correlation analysis was undertaken to determine the relationships the proposed key variables have with the growth in non-performing loans. It was established 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 $\tau_t = y_t$, $t = 1, \dots, t$. If $\lambda = \infty$, the τ_t is the linear trend obtained by fitting y_t to a linear trend modelled by ordinary 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.

$$NPL_{yoy_t} = \beta_0 + \beta_1 GAP_{t-1} + \varepsilon_t \quad (5.1)$$

Where $t = 1, 2, \dots, 8$

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:

$$NPL_{yoy_t} = 7.37 + 8.78GAP_{t-7}$$

(1.09) (2.66)**

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

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

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:

$$NPL_{yoy_t} = \beta_0 + \beta_1 GAP_7 + \beta_2 X_i + \varepsilon_t \quad (5.2)$$

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.

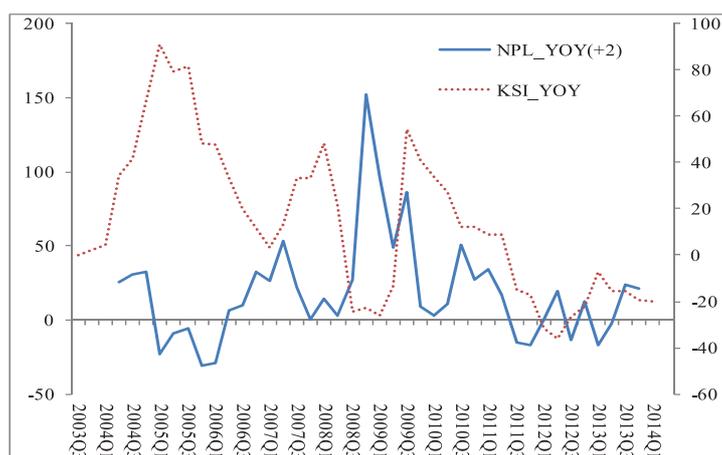
5.3 Buffer Level and Progression

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

References

- Aipi, B., (2008), “The Development of E-Payments and Challenges in Papua New Guinea,” Chapter 7 in the Development of E-payments and Challenges for Central Banks in the SEACEN Countries, The SEACEN Centre, pp. 169-190.
- Australian Prudential Regulatory Authority (APRA), (2013), Implementing Basel III Liquidity Reforms in Australia, May.
- Australian Bankers’ Association, (2010), Submission on BCBS Consultative Document Countercyclical Capital Buffer Proposal, September.
- Avel, S., (2008), “Problem Bank Identification, Intervention and Resolution in Papua New Guinea,” The SEACEN Centre.
- Bakani, L., (2014), Public Notice, Available at: <http://www.bankpng.gov.pg/images/stories/mediarelease/2014/20140310_KATS_PRESS_RELEASE_as_in_Post_Courier_10_March_2014.pdf>
- Bank for International Settlements, (BIS), “Comprehensive Response to the Global Banking Crisis,” Available at: <<http://www.bis.org/press/p100111.htm>>
- Bank for International Settlements, (2009), Strengthening the Resilience of the Banking Sector.
- Bank for International Settlements, (2010), Countercyclical Capital Buffer Proposal.
- Bank for International Settlements, (2010), Guidance for National Authorities Operating the Countercyclical Capital Buffer.
- Bank for International Settlements, (2014), Regulatory Consistency Assessment Programme (RCAP): Assessment of Basel III Regulations – Australia.
- Biggs, P.,(2007), “The Financial Sector in Papua New Guinea — A Good Case of Reform,” Australian Treasury.
- Borio, C. and H. Zhu, (2008), “Capital Regulation, Risk-taking and Monetary Policy: A Missing Link in the Transmission Mechanism?” *BIS Working Papers*, No. 268.

- Bank of Papua New Guinea, (2008), *Money and Banking in Papua New Guinea*, 2nd Edition Melbourne University Publishing.
- Bank of Papua New Guinea, Quarterly Economic Bulletin, Various Issues. de Jong, R.M. and Sakarya, (2013), “The Economics of the Hodrick-Prescott Filter,” Ohio State University, USA.
- Drehmann, M., et al., (2010), “Countercyclical Capital Buffers: Exploring Options,” *BIS Working Paper*, No. 317, Bank for International Settlements.
- Ernest & Young, (2011), *Basel III Implementation – What You Need to Know About APRA’s Consultation Packages*, 7 September.
- International Monetary Fund, *Financial System Stability Assessment*. Available at: <<http://www.imf.org/external/pubs/ft/scr/2011/cr11163.pdf>>
- Irau, T., (2009), “Capital Flows and their Implications for Central Bank Policies,” Chapter 8 - Capital Flows and Implication for Central Bank Policies in the SEACEN Countries, The SEACEN Centre, pp. 223-247.
- KPMG, *Basel III: Issues and Implications*. Available at: <<http://www.kpmg.com/global/en/issuesandinsights/articlespublications/documents/basel-iii-issues-implications.pdf>>
- Jonathan, E. W., (2014), “Analytical Framework in Assessing Systemic Financial Market Infrastructure of Papua New Guinea,” Chapter 6 - Analytical Framework In Assessing Systemic Financial Market Infrastructure: Interdependence Of Financial Market Infrastructure And The Need For A Broader Risk Perspective, The SEACEN Centre, pp. 173-197.
- Office of Best Practice Regulation, (2012), *Implementing Basel III Capital Reforms in Australia*.
- PricewaterhouseCoopers, (2011), “Basel III Capital Reforms: Managing New Regulatory Burdens,” *Banking Insight*, September.
- Ravn, M. O. and H. Uhlig, (2002), “On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations,” *Review of Economics and Statistics*, 84(2), pp. 371-376.

- Reserve Bank of Australia, (2013), “Box B: The Basel III Capital Reforms in Australia,” *RBA Bulletin*, September.
- Repullo, R. and J. Saurina, (2011), “The Countercyclical Capital Buffer of Basel III: A Critical Assessment,” *CEMFI*, Madrid.
- Rupa, R., (2011), “Relative Effectiveness of Policy Choices during Financial Crisis,” The SEACEN Centre.
- Sarel M., (1996), “Non-linear Effects of Inflation on Economic Growth,” *IMF Staff Paper*, Vol. 43. No. 1
- Shrestha B. Min, (2008), *Macroeconomic Surveillance for Monetary Policy Management in SEACEN Countries*, The SEACEN Centre.

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

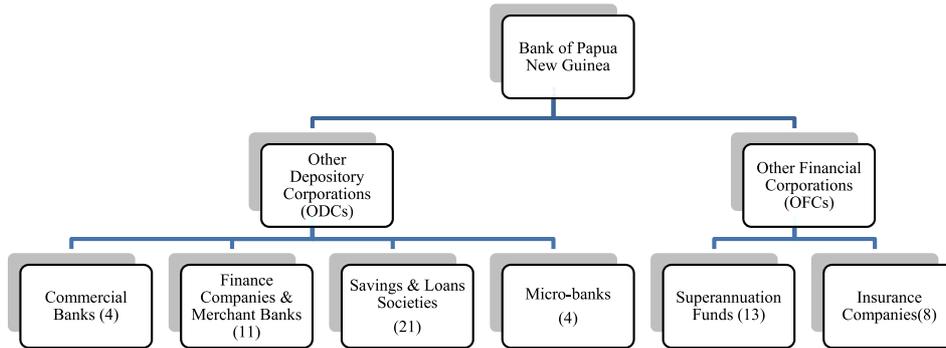


Figure A1.2
Other Financial Corporations

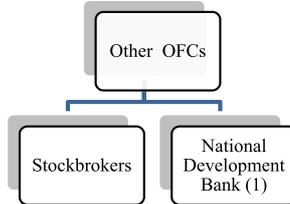
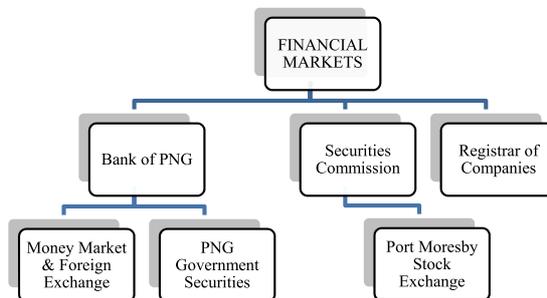
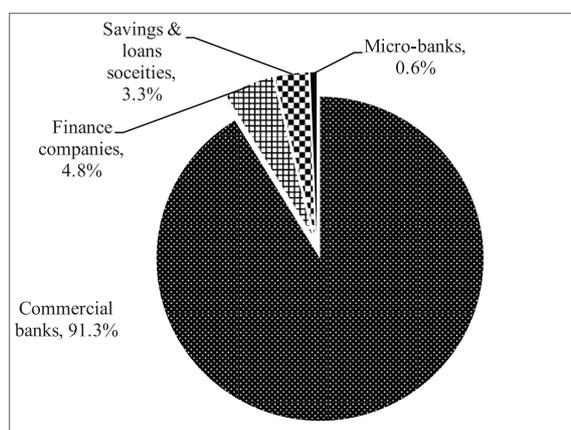


Figure A1.3
PNG Financial Market



**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://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)

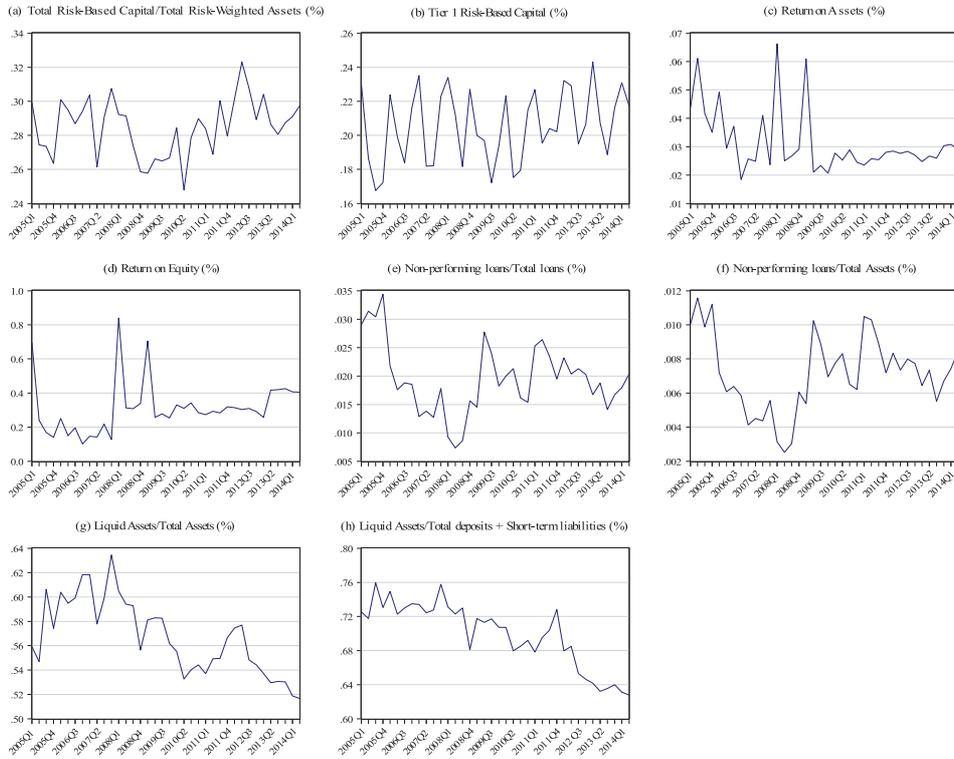


Chart A4.2 (b)
NPL and Credit Growth

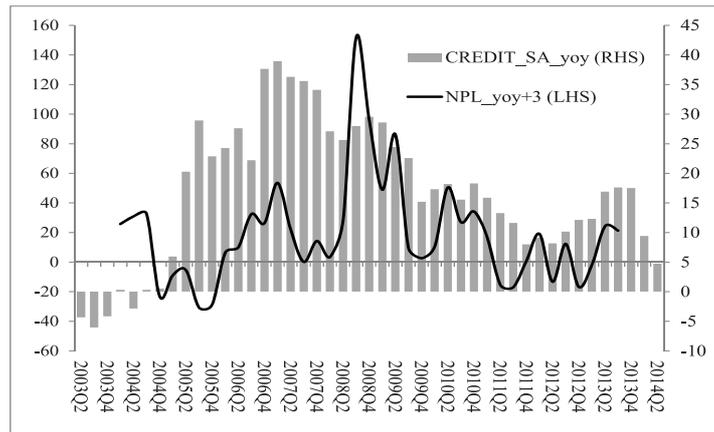


Chart A4.2 (c)
NPL and GDP Growth

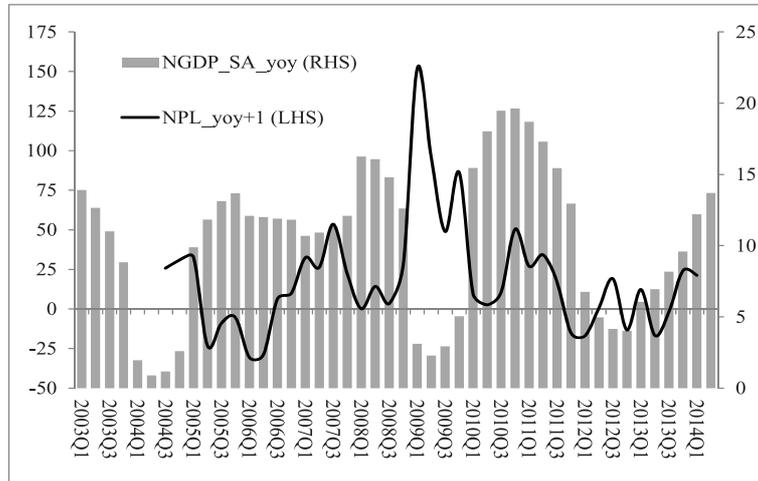


Table A5.1
Regression Results

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 $t = 1, 2, \dots, 8$

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 $t = 1, 2, \dots, 8$

Chart 5.2A

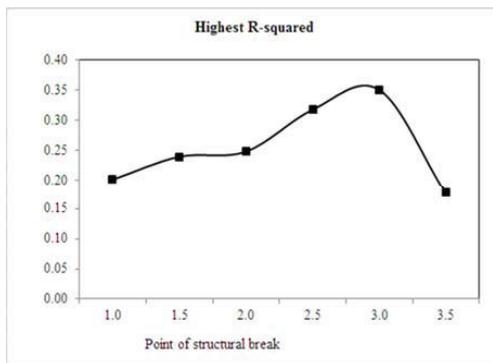


Chart 5.2B

