

Bank Stability and Macro Stress Testing of the Top 24 Universal and Commercial Banks in the Philippines



Merino, Michaela Nicole¹, Dacanay, Jovi²

¹ Graduate Staffmember, School of Economics, University of Asia and the Pacific

² Assistant Professor and Doctoral Program Director, School of Economics, University of Asia and the Pacific

新型コロナウイルスの感染爆発による経済の混乱で出稼ぎ・移民労働者からの送金が減ったことはフィリピンの銀行にどのような影響を与えたか。国内の主要24行についてストレス検査を施した。

Abstract

Stress testing on banks is an exercise that helps bank managers and regulators to understand the financial rigidity of banks. In the context of the Philippines, stress testing will serve as a guide for the financial institutions on survivability in times of recessions or financial crises. Banks are still not invincible to economic shocks. Hence, this paper aims to discover which banks will be affected the most given the changes in macroeconomic, such as external shocks, and bank specific variables. The study seeks to answer the question: Does better credit quality result from an improvement in the macroeconomic environment and bank performance? The study aims to answer the following objectives: First, to determine the presence of long-run relationships between the macroeconomic and bank specific variables, Second, to examine the effect of the macroeconomic and bank specific variables on the credit quality of the entire Top 20 UKBs, Third, to quantify the impact of macroeconomic and bank specific variables on the credit quality for each individual bank under the Top 20 Philippine UKBs, under a Covid19 Pandemic situation. With the use of a vector-autoregressive (VAR) estimation procedure, the study will be able to determine how banks interact during periods of financial volatility, as well as how they perform during financial crises. The effects of the decrease in remittances, especially during the Covid19 pandemic, to bank performance and lending, shall be incorporated in the study. Banks have provided enough liquidity in spite of the decrease in bank performance, due to their stability.

Keywords

Bank stability, Financial stability, performance, volatility, macro-stress testing, trust

Introduction

The world was plunged into global financial crisis in 2008 when Lehman Brothers, then America's fourth largest bank, incurred huge subprime mortgages that were backed by securities.¹ This caused a contagion that affected, not only the USA, but also Europe and parts of Asia. The experience of the world economy in the post-global financial crisis shows the impact of the financial

sector on a country's economy as well that of other nations.² No matter how big or how much money a bank makes, it can fail due to rising vulnerabilities, such as economic slowdown in developing countries and emerging markets.³ A misstep by one major bank can trigger

1 Denning, S. (2011, December 05). Lest We Forget: Why We Had A Financial Crisis. Retrieved May 11, 2019, from <https://www.forbes.com/sites/stevedenning/2011/11/22/5086/#75f21049f92f>

2 Dua, P. & Kapur, H., 2018. Macro Stress Testing and Resilience Assessment of Indian Banking. *Journal of Policy Modeling*. Available at: <https://ideas.repec.org/a/eee/jpolmo/v40y2018i2p452-475.html>.

3 Chow, J. (2015). *Stress Testing Corporate Balance Sheets in Emerging Economies*. [Working Paper] International Monetary Fund, IMF Working Papers.

the collapse of the entire banking system, especially of public and commercial banks that are vulnerable to shocks in interest rates, exchange rates, and earnings.

Stress testing can help managers and regulators understand the financial rigidity of banks.⁴ It presents scenarios that call for strategic survival measures in the case of an economic downturn. Such scenarios present the consequences of loss due to different macroeconomic variables.⁵ Major lessons can be drawn from the Global Financial Crisis (GFC) of 2007-2008 that saw an average increase of 30% in borrowing costs, 20% decline in earnings before income taxes (EBIT), and currency depreciation averaging 30% against the USD. This was the case of the 1990 financial crisis, proving that banks are not invincible to economic shocks.⁶

This paper aims to discover which banks will be most affected by changes in macroeconomic and bank-specific variables. *Does better credit quality result from an improvement in the macroeconomic environment and bank performance?* Specifically, this study aims to (1) determine the relationship between macroeconomic and bank specific variables; (2) examine their effect on the credit quality of the Top 24 universal and commercial banks (UKBs); and (3) quantify their impact on the credit quality of each bank under the Top 24 Philippine UKBs.

Banks are not just for saving money; more importantly, they are critical to stimulating the economy by lending to firms for the sustenance of business and to households for the purchase of big-ticket items, like houses and automobiles.⁷ It is important that government

workers know the effects of policies and projects on macroeconomic variables because these affect the credit quality of banks. The failure of major banks affects businesses as the former will not be able to disburse funds to those who need it. If firms and people cannot borrow money, then there will be less spending.⁸ Banks today are vulnerable to economic shocks but if they are able to anticipate potential problems, then they will be in a better position to apply the appropriate stabilizing measures. This study should serve as a guide for researchers and students to understand the impact of macroeconomic variables on the banking industry.

Focus will be on the relationship of macroeconomic and bank-specific variables of the Philippines' top 25 UKBs. Their quarter balance sheets from 2005 to the 4th quarter of 2018 will be examined for credit quality. This research is limited to UKBs because they hold the bulk (91.2% or about P15,421.2 billion) of the banking system's assets. As of 2018, their combined assets total 97.9% of all the UKBs.⁹ Data comes from the *Banko Sentral ng Pilipinas* (BSP).

Theoretical Framework and Empirical Methodology

The standard macroeconomic model does not account for credit frictions because the money supply curve, which indicates monetary liquidity, assumes that all debt instruments can be lumped together in a bond market. This approach makes bank liabilities central to the monetary transmission mechanism, while giving no role to bank assets.¹⁰ Credit frictions have been introduced in the standard Keynesian macroeconomic model, which indicated demand for credit. It relies on the bank

4 Baudino, P., Goetschmann, R., Henry, J., Taniguchi, K., & Zhu, W. (2018). Stress-testing banks - a comparative analysis (Financial Stability Institute)

5 Pesaran, M., Schuermann, T., Treutler, B. and Weiner, S. (2006). Macroeconomic Dynamics and Credit Risk: A Global Perspective. *Journal of Money, Credit, and Banking*, 38(5), pp.1211-1261.

6 Chow, J. (2015). *Stress Testing Corporate Balance Sheets in Emerging Economies*. [Working Paper] International Monetary Fund, IMF Working Papers.

7 Alemayehu, F. and Teklemehhin, M. (2012). *Economic Significance of Banks*. [online] abyssinialaw.com. Available at: <https://www.abysinialaw.com/component/k2/item/394-economic-significance-of-banks> [Accessed 12 May 2019].

8 Pritchard, J. (2018). *Closer Look at Bank Failure and What Happens to Your Money*. [online] The Balance. Available at: <https://www.thebalance.com/bank-failures-315791> [Accessed 14 May 2019].

9 Bangko Sentral ng Pilipinas. *Bangko Sentral ng Pilipinas - Publications & Research*. Available at: http://www.bsp.gov.ph/publications/regular_annual.asp [Accessed July 15, 2019].

10 Bernanke, B. and Blinder, A. (1988). Credit, Money, and Aggregate Demand. NBER Working Paper Series. Cambridge: National Bureau of Economic Research. Available at: <https://www.nber.org/papers/w2534.pdf>.

lending rate and interest rate.¹¹ For the bank balance sheet, another asset is added in the form of loans. Since a new asset is added, the real side of the economy will now depend upon the interest rate on deposits and the lending rate.¹² Thus, the loan supply of banks increases with the interest rate on loans and decreases with interest rate on bonds. On the other hand, banks demand for loans rises with the interest rate on bonds and falls with the interest rate on loans.

Monetary expansion or an increase in bank reserves would bring about an increase in the quantity of money and in the volume of credit, which stimulates investment demand. The central bank reserves are a shift parameter of the credit frictions curve as reserves influence the effectiveness of monetary policy. An increase in the reserves available to banks will boost the supply of loans and the demand for bonds. Monetary policy may also affect the external finance premium by shifting the supply of intermediate credit, particularly loans by commercial banks. If the supply of bank loans is disrupted, then bank-dependent borrowers will incur the costs of finding a new lender and establishing a credit relationship. Therefore, a reduction in the supply of bank credit, relative to other forms of credit, is likely to increase the external finance premium and reduce real activity.¹³

The framework of the study links credit quality, or default rate. It is a measure that reflects the credit risk and quality of the aggregate bank portfolio and key macroeconomic variables and bank-specific factors.¹⁴ Following is the equation for the model:

Probability of Default_{*i*} = *f* (output growth, inflation rate, interest rate, exchange rate, profit, size indicator) where the Probability of Default (PD, or credit quality indicator) of an individual bank group is specified as a

function of key macroeconomic variables that represent macroeconomic conditions and a set of bank-specific factors that refer to the behavior of a specific group.

The study uses NPL ratio as an empirical measure of the probability of default. Furthermore, the model indicates that sounder economic conditions, which are determined by specific metrics on macroeconomic development, implies lower default rate and better credit quality (PD). Table 1 lists the explanatory indicators of credit quality, what these indicators mean, data used, and the expected signs.

Table 1. Credit Quality Determinants, What They Indicate, Data Used, and Expected Signs

MODEL: $N = f(y, i, \pi, e, R, a)$			
Variables	Indicator	Empirical Variable	Expected Sign
Dependent	N_i	NPA ratio of the <i>i</i> th bank group at time <i>t</i>	
Explanatory variables			
Macroeconomic	Cyclical/growth	Growth rate	-
	Price	Inflation rate	-
	Financial	Interest rate	+
	External	Exchange rate	+/-
Idiosyncratic (bank specific)	Size	Assets	-
	Profitability	Return on assets	-

Source: Dua Pami and Hema Kapur (2017)¹⁵

The macroeconomic variables used in the model would take into consideration the cycles of the variables as well as their growth rates, the inflation, interest and exchange rates. The bank-specific factors would be measured by profitability and asset size. The economy's growth rate is expected to have a negative impact on credit risk. This is because an economic recession, as reflected by a declining GDP, is likely to discourage investment which, in turn, causes a drop in a bank's ability to create credit. The impact of inflation on credit risk may be negative due to the effects on borrowing and lending. Price directly reduces real interest rate and promotes investment and economic growth. On the other hand, an increase in the volume of loans causes a decline in the real value of the borrowed amounts of debtors. This phenomenon usually comes about during periods of inflation.

11 Chinn, M. (2009). The Financial and Economic Crisis Interpreted in a CC-LM Model. Ssc.wisc.edu. Available at: https://www.ssc.wisc.edu/~mchinn/e302_crediterisis_f09.pdf.

12 Ibid

13 Bernanke, B. and Gertler, M. (1995). Inside the Black Box: The Credit Channel of Monetary Policy Transmission. Journal of Economic Perspectives, 9(4), pp.27-48.

14 Dua, P. and Kapur, H. (2017). Macro Stress Testing of Indian Bank Groups. Ph.D. University of Delhi.

15 Dua, P. and Kapur, H. (2017). Macro Stress Testing of Indian Bank Groups. Ph.D. University of Delhi.

Interest rate is expected to have a direct positive association with credit risk by increasing the cost of borrowed funds. However, interest rates also have an indirect effect on credit risk through increased profitability of the corporate sector. The impact of the exchange rate on credit risk can be mixed and indirect. Lowered nominal exchange rates are expected to boost the competitiveness of exports while an increase in export earnings would favorably affect the banks' capacity to service their debt and promote export-oriented sectors and economic growth. On the contrary, the impact of lower exchange rates on imports is expected to work in the opposite direction. Regarding bank-specific factors, the assets of a bank indicate its size and strength while its return on assets measures profitability.

Non-Performing Loans (NPLs) are expected to proxy the credit risk itself. According to Reinhart and Rogoff (2010), Nkusu (2011), and Louzis et al (2012), NPLs can signal the beginning of a banking crisis.¹⁶ Taking into consideration the aggregate level of NPLs, most studies on the determinants of NPLs assume that macroeconomic or bank-specific factors should serve as explanatory determinants. However, in their attempt to explain aggregate NPLs of Spanish Commercial and Savings Banks in 1985–1997, Salas and Saurina (2002), Mabvure et al (2012) and Louzis et al (2012) took into account macro and microeconomic variables, demonstrating that bank-specific determinants are early warning indicators for future NPLs.¹⁷

The non-performing loans (NPL) ratio of the total banking industry is on a downward trend. Asset quality has been improving considerably with commercial banks' NPL ratio settling at single digits at the start of 2005.¹⁸ The BSP's efforts to strengthen the foundations of the financial system through the Special Purpose

Vehicle (SPV) Law in 2015 and the adoption of the Basel III capital adequacy standards for UKBs reflects that the banking system is in a position to undertake far-reaching reforms. The promotion of Philippine Financial Reporting Standards (PFRS) 9 Financial Instruments in 2018 in which banks will be recognizing allowance for probable losses at an earlier stage, providing buffers to potential credit losses. In addition, the BSP Financial Supervision Sector (FSS) continues to improve its financial surveillance tools. The FSS is also vigilantly monitoring actions taken by banks to effectively manage exposures to specific sectors for which NPLs may rise, such as real estate lending and consumer loans, to mitigate signs of overheating that could lead to the deterioration of loan quality. Furthermore, the BSP imposed a single 20 percent overall limit on the exposure of the U/KBs to the real estate industry. The new limit, which primarily serves as a prudential safeguard against the overconcentration of credits of U/KBs to commercial lending. These measures together with the rise in the deposit base, capital and total resources, along with lending activity led to a significant improvement in the banking industry's asset quality with NPA and NPL ratios falling to single-digit levels. (See Figure 1).

Moreover, during the pre-crisis level in 2007, the banking industry remained stable as it was anchored on good asset quality and enhanced capital base. This proved the resilience of the banking industry as growth indicators such as asset levels, loans and deposits continued to post robust increases despite the negative developments emanating from the continuing global financial crisis and episodes of rising inflation during the first eight months in 2008. The banking sector's asset quality also exhibited a notable improvement as shown by the continued decline in NPL ratio while the capital adequacy ratio (CAR) remained above global standards and the BSP's regulatory requirement. At the same time, BSP implemented additional liquidity-enhancing measures to provide additional liquidity that will help ensure the orderly functioning of financial markets should global financial conditions worsen.

16 Abid, L., Ouertani, M., & Zouari-Ghorbel, S. (2014). Macroeconomic and Bank-specific Determinants of Household's Non-performing Loans in Tunisia: A Dynamic Panel Data. *Procedia Economics And Finance*, 13, 58-68. doi: 10.1016/s2212-5671(14)00430-4

17 Ibid

18 Bangko Sentral ng Pilipinas. *Bangko Sentral ng Pilipinas - Publications & Research*. Available at: http://www.bsp.gov.ph/publications/regular_annual.asp

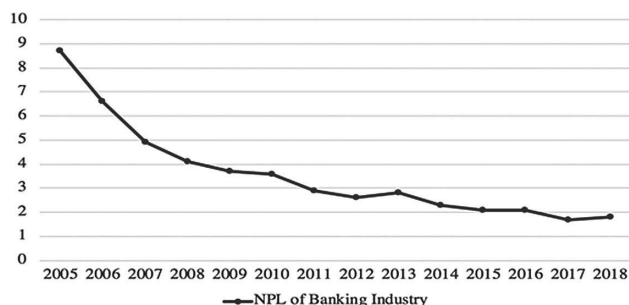


Figure 1. Historical Non-Performing Loans Ratio of the Banking Industry (2005 to 2018)

Source: Bangko Sentral ng Pilipinas

Notes: (1) BSP amended the banks' reporting standard for NPLs in 2013. Banks have been required to report their "gross" NPLs and their "net" NPLs.

(2) Data used for 2013 onwards is the "gross" NPLs.

Moving on, this paper is based on the paper of Dua and Kapur which examined how various bank groups operating in India have fared macro stress events and conduct macro stress testing to trace the impact of certain macroeconomic stress scenarios on the credit quality using panel data from 1997 to 2014 of five Indian bank groups: the State Bank of India and its associates, nationalized banks, private sector banks, new private sector banks, and foreign banks.¹⁹ For the empirical estimation of the macro stress testing analysis, Panel Unit Root and Panel Cointegration Test were used to determine a relationship between the NPL ratio and its potential determinants. Then, FMOLS was conducted in order to examine the effect of the macroeconomic and bank specific variables on the credit quality as predicted by economic theory in respect of their signs, estimates, and significance of the relevant coefficients.

The study used the Panel Cointegration Technique by Dua Pami and Hema Kapur in their paper, Macro Stress Testing of Indian Bank Groups.²⁰ The objective of panel cointegration estimation is to examine the existence and nature of long-run relations among variables on a single cross-sectional unit, as predicted by economic theory in

respect of their signs, estimates and significance of the relevant coefficients.

For empirical estimation, a panel cointegration methodology is used and three familiar steps are followed: examining the stochastic properties of the variables involved by means of panel unit root tests; testing for panel cointegration in order to assess for the presence of a long-run relationship; and applying the fully modified OLS (FMOLS) estimates to the cointegration vector in the empirical model.

Panel Unit Root Tests. These tests are generally preferred over various other available panel unit root tests because they allow for heterogeneity of the autoregressive (AR) roots under the alternative hypothesis and combine individual unit root tests to derive a panel-specific result. In order to conduct a Panel Cointegration Test, one must conduct a Panel Unit Root Test to check if the variables are non-stationary at level and stationary at first difference assuming individual intercept. Researchers will use two panel unit root tests: Im, Pesaran, Shin (IPS) Test and the Augmented Dickey-Fuller - Fisher (ADF) Test. These tests are used to determine whether the time-series variables considered are non-stationary. In the macro stress test model, non-stationarity is favorable for the variables because the variables we consider are macroeconomic and bank-specific variables that exhibit seasonality over time. The optimal lag length is chosen based on the Schwarz Information Criterion (SIC) for the variables such as: growth rate, interest rate, exchange rate, and assets. If other variables will not perform non-stationary properties at lag length of 2, then the researchers will change the lag length according to the minimum lag needed for it to become non-stationary.

Panel Cointegration Tests. The next step is to carry out tests for panel cointegration to find the existence of a statistically acceptable cointegration relationship between the NPL ratio and its potential determinants as specified in our empirical model which is:

$$N_{it} = \beta_{0i} + \beta_{1y_t} + \beta_{2i_t} + \beta_{3\pi_t} + \beta_{4e_t} + \beta_{5R_{it}} + \beta_{6a_{it}} + \varepsilon_{it}$$

Where:

$$N_{it} = \text{NPL ratio of the } i\text{th bank group at time } t$$

¹⁹ Dua, P. and Kapur, H. (2017). *Macro Stress Testing of Indian Bank Groups*. Ph.D. University of Delhi.

²⁰ Ibid.

y_t = economy's growth rate in time t
 i_t = nominal interest rate in time t
 π_t = inflation rate in time t
 e_t = nominal exchange rate in time t
 R_{it} = return on assets (ROA) of the i th bank group at time t
 a_{it} = assets of the i th bank group at time t
 β_{0i} = an intercept term

The end objective is to estimate the long-run relationships between the said variables and employ them to conduct MST (Macro Stress Testing) for the Top 24 Philippine UKBs.

Similar to panel unit root tests, panel cointegration tests provide more reliable results in testing of cointegration presence relative to those obtained by individual tests. To carry out tests for panel cointegration between the NPL ratio and its potential determinants specified in our empirical model, the optimal lag length is chosen based on the Schwarz Information Criterion (SIC). The panel cointegration test used was proposed by Pedroni (2004) on seven statistics for testing the null hypothesis of no cointegration against two alternative hypotheses—with a common AR root (within-dimension or panel statistics) and taking into account the heterogeneity of the AR roots (between-dimension or group statistics).

Pedroni Panel Estimation Technique (FMOLS). This technique uses a test of the OLS estimator with a bias-corrected t-statistic in finite sample size, but that is not an improvement over the OLS estimator in general. Furthermore, the FMOLS estimator is used in this study for estimation of panel cointegration. In addition, this estimator employs a semi-parametric correction to eliminate the problems caused by the long run correlation between the cointegrating equation and stochastic regressors innovations.

Conceptual Framework

The researchers constructed a reduced macroeconomic model based on Dua and Kapur's paper on Macro Stress Testing of Indian Bank Groups in order to estimate the impact of macroeconomic variables and bank specific factors to the credit quality of the Top 24 UKBs

as seen in Figure 2. Macroeconomic variables include macroeconomic (GDP) growth rate, interest rate, inflation rate, and exchange rate while bank specific factors include total assets to explain the bank's size and return on assets to account for its profitability. Furthermore, these determinants explain the credit quality of the banks which is captured by the probability of default using the NPL ratio.

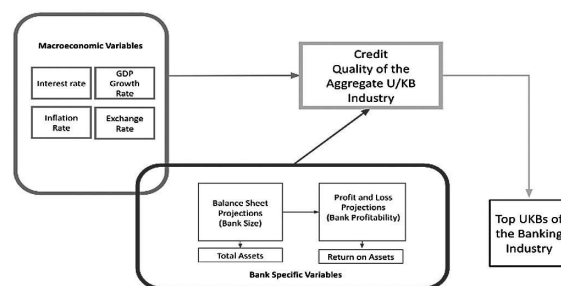


Figure 2. Reduced Macroeconomic Modelling Framework

Sources: Author's Theoretical Framework

Depicted in the model, cointegration between macroeconomic variables and the bank-specific variables is represented by the intersection of the orange and red boxes. Cointegration between the bank-specific variables and the macroeconomic variables is crucial since it determines the presence of long-run relationships which is the first objective of the study. The integration will be tested through the panel unit root test and the panel cointegration test as explained in the methodology. Given the existence of the long-run relationships of the variables, the effect of the credit quality can be estimated per individual bank in the top 24 UKBs using FMOLS estimation.

Multiple studies cite that there is a strong association between the macroeconomic variables and banks but the issue of the direction of causality is yet to be resolved.²¹ In addition, there is a positive relationship between financial development and economic growth has been

²¹ Degryse, H. (2011). *Microeconometrics of banking: methods, applications, and results*. [Erscheinungsort nicht ermittelbar]: Cram101, pp.135-163.

proven. The causality relationship between bank credit and economic growth suggests that economic development is a key economic engine to boost credit quality. The Time Series data done by Rousseau and Wachtel back in 1998 shows that an increase in credit quality does not affect the growth in the economy.²²

The risk considered is credit risk, which is represented by credit quality and is affected by the cointegration between the bank-specific factors and macroeconomic factors. This is represented in the model through the orange and red arrows pointing towards the yellow credit quality box. The shocks stem from problems at specific banks which are idiosyncratic or bank specific shocks, or from macroeconomic imbalances that affect the financial system, which are called systemic shocks. Much more can be explained in the next chapter in the results of Objective 1.²³

The impact from credit risk is observed in the individual banks as vulnerabilities in the respective factors that have sourced the credit risk. This is depicted by the credit quality's yellow arrow pointing towards the UKBs of the banking industry. The results of Objective 3 in the next can help further your understanding about the effect of said variables to the credit quality. An increase in the credit risk is a decrease in the credit quality of the banks since a bank's credit quality is represented by their NPL ratio.

Results of the Study

The results are obtained based on the following hypotheses:

Hypothesis 1: *Both macroeconomic factors and bank-specific features affect credit quality.*

Hypothesis 2: *Improved macroeconomic environment and specific bank performance result in better credit quality.*

²² Ibid.,

²³ Abid, L., Ouertani, M., & Zouari-Ghorbel, S. (2014). Macroeconomic and Bank-specific Determinants of Household's Non-performing Loans in Tunisia: A Dynamic Panel Data. *Procedia Economics and Finance*, 13, 58-68. doi: 10.1016/s2212-5671(14)00430-4

Results of Objective 1

Objective 1: To determine the presence of long-run relationships between the macroeconomic and bank specific variables. To determine the presence of long-run relationships between the variables, the stochastic properties of the variables must be tested using the Panel Unit Root test. Table 2 shows that the variables have non-stationary properties at level and stationary at first difference, thus the conclusion I (1). Since the variables present non-stationary properties, it is possible to apply the panel co-integration method to verify if there exists a stable long-run relation among the variables.

The results of the Pedroni Co-integration Test indicate that the majority of the tests reject the hypothesis of no co-integration at significant levels (see Table 3).²⁴ This provides evidence of a long-run relationship between NPL ratios of the top 25 UKBs and the explanatory variables. Hence, the impact of these macroeconomic and bank specific factors can be estimated in the event of an adverse short-term shock.

Table 2. Panel Unit Root Tests (Assuming Individual Intercept)

Variable	IPS		ADF-FISHER		Conclusion
	Levels	1st Difference	Levels	1st Difference	
Non-Performing Loans	-0.90286 (0.1833) [14]	-31.9063*** (0.0000) [SIC]	48.4256 (0.2296) [14]	658.182*** (0.0000) [SIC]	I (1)
GDP Growth Rate	-1.02220 (0.1533) [4]	-183.856*** (0.0000) [SIC]	52.0440 (0.3943) [SIC]	460.517*** (0.0000) [SIC]	I (1)
Nominal Interest Rate	-0.75510 (0.2251) [20]	-19.5715*** (0.0000) [SIC]	14.0905 (1.0000) [SIC]	399.232*** (0.0000) [SIC]	I (1)
Headline Inflation Rate	-0.60102 (0.2739) [8]	-15.616*** (0.0000) [SIC]	66.9330 (0.0550) [7]	343.045*** (0.0000) [SIC]	I (1)
Nominal Exchange Rate	-0.41019 (0.3408) [SIC]	-26.3147*** (0.0000) [SIC]	36.8328 (0.9171) [SIC]	637.102*** (0.0000) [SIC]	I (1)
Return on Assets	1.52470 (0.0637) [11]	-43.4197*** (0.0000) [SIC]	63.9776 (0.0884) [5]	969.374*** (0.0000) [SIC]	I (1)
Total Assets	12.7871 (1.0000) [SIC]	-31.3802*** (0.0000) [SIC]	17.2902 (1.0000) [SIC]	777.947*** (0.0000) [SIC]	I (1)

Source: Authors' calculations.

Notes: (1) p-values are indicated in parentheses

(2) lag length used is indicated in brackets

(3) Asterisks: the null hypothesis of the unit root is rejected at 1%.

²⁴ Five out of 10 tests prove the co-integration of said variables.

Table 3. Pedroni Co-integration Test Results

Model: $N = f(y, i, r, e, R)$		
Dependent variable: NPL ratio (N)		
Pedroni Co-integration Tests	Statistic	p-value
Alternative Hypothesis: Common AR Coefficients (within dimension)		
Panel v-Statistic	-74.37305	1.0000
Panel rho-Statistic	-9.942781***	0.0000
Panel PP-Statistic	-25.33938***	0.0000
Panel ADF-Statistic	-24.01009***	0.0000
Alternative Hypothesis: Individual AR Coefficients (between dimension)		
Group rho-Statistic	0.312251	0.6626
Group PP-Statistic	-10.02973***	0.0000
Group ADF-Statistic	-7.153871***	0.0000

Source: Authors' calculations

- Notes: (1) Asterisks indicate that the hypothesis of no co-integration is rejected at 1 % level of confidence
 (2) Total number of observations, NT= 1400
 (3) Deterministic trend specification includes individual intercept
 (4) The lag length selection is based on automatic SIC with a maximum lag of 2
 (5) For semiparametric corrections, Newey–West automatic bandwidth selection and Barlett kernel are used
 (6) Bank 23, The Bank of Tokyo-Mitsubishi UFJ LTD, was dropped from the test.

Degryse pointed out the strong cooperative link between financial intermediation and growth, proving that these variables have a long run relationship.²⁵ Banks are vital to economic growth because they have control over the circulation and spending of money in an economy. Take the Financial Crisis of 2008: the failure of one bank led to the collapse of the entire American economy—proof to the strong connection between growth and intermediation.

Results of Objective 2

Objective 2: To examine the effect of the macroeconomic and bank-specific variables on the credit quality of all the Top 24 UKBs. Table 4 presents the results of the Pooled Weighted FMOLS which indicate the signs of all variables and their statistical significance. Macroeconomic growth, exchange rate, and return on

²⁵ Degryse, H. (2011). *Microeconometrics of banking: methods, applications, and results*. [Erscheinungsort nicht ermittelbar]: Cram101, pp.135-163.

assets are inversely and significantly related to credit quality while interest rate is positively and significantly related to credit quality. In addition, the remaining variables, inflation rate, and assets, were insignificantly related to credit quality where the former is negatively related while the latter is positively related which is the only variable that is inconsistent with economic theory. The results also indicate the statistical significance of the coefficients through the specified p-values. The variables with the most statistically significant coefficient at the 1% level of confidence are the exchange rate and the return on assets variables. The coefficients of interest rate and GDP growth rate variables are also statistically significant but to a lower degree.

This implies that adverse changes in exchange rate and the return on assets of banks will significantly affect the overall non-performing loans of the top 24 UKBs. A shock in the form of a drop in profitability or the strengthening of the peso relative to the US dollar will increase the non-performing loans of the UKBs. Adversely, increased profitability and a weak peso will cause a decrease in the non-performing loans of UKBs.

The statistically insignificant variables are inflation rate and bank assets. The effects of inflation on NPL are minimal because both lender and borrower benefit from the price increase. On the other hand, a bank's expansion does not automatically translate to revenue and could contribute to a decrease in NPL.

Table 4. FMOLS Pooled Weighted Estimation Results (Assuming Constant Level)

Independent Variable	Expected Sign (+/-)	Actual Sign (+/-)	Constant	P-value
GDP Growth Rate	-	-	-0.059152*	0.095
Interest Rate	+	+	0.018143**	0.042
Inflation Rate	-	-	-0.007318	0.6839
Exchange Rate	+/-	-	-0.029901***	0.0099
Return on Assets	-	-	-0.621238***	0.0000
Assets	-	+	0.002964	0.4648

Source: Author's calculations

- Notes: 1) Asterisks indicate statistical significance of the coefficients at 10, 5, and 1 percent levels of confidence, respectively.

Results of Objective 3

Objective 3: To quantify the impact of macroeconomic and bank-specific variables on the credit quality for each bank under the Top 24 UKBs. The results of the estimated equations for each bank are presented in the Appendix. Comparing the coefficients and significance of the factors that determine the credit quality of the top 24 UKBs yields six important findings. First, the impact of macroeconomic growth significantly affects BDO Private Bank, Inc., which is the most benchmarked among the country's financial institutions. On the other hand, the credit quality of Mizuho Bank LTD - Manila Branch, Citibank, N.A., and Maybank Philippines Incorporated are the least likely to be affected by the growth in GDP. Consistent with economic theory, the majority, or 13 out of the 24 banks studied, showed negative correlation between credit quality and macroeconomic growth. This implies that it is most likely that economic recession, as reflected by a declining GDP, will not depress investment optimism and the subsequent creation of bank credit.²⁶

Second, the direct impact of monetary policy may be gauged by the coefficient of the nominal interest rate. It is important to examine this variable because it has implications in the rise of policy rate in a tightened monetary policy and its transmission to the bank default rate via pass-through effects to other rates in the economy, including lending rates. The interest rate is expected to have positive association with the bank's credit quality due to the direct impact of the increased cost of borrowed funds and the indirect effect of the rise in the corporate sector's profitability. Thirteen banks were consistent with economic theory, while only four, Bank of Commerce, BDO Private Bank, Inc., China Bank Corp., and Philippine Bank of Communications, are significantly affected by increased interest rates.

Third, it is highly probable that inflation would affect half of the banks' respective NPL ratios. Increased inflation particularly affects Philippine Bank of Communications, BDO Private Bank, Inc., and

Philippine Veterans Bank, while Mizuho Bank LTD - Manila Branch, Bank of Commerce, Metropolitan Bank & TCO, and Deutsche Bank AG are the least affected. Furthermore, 13 out of 24 banks scored negative, which is consistent with economic theory. The impact of inflation on credit quality may be negative due to the direct and indirect impact on borrowing and lending.²⁷ The direct, or price effect, reduces the real interest rate through the Fishers' effect, promotes investment and economic growth. On the other hand, the indirect, or volume effect during periods of inflation, favors debtors because the real value of loans declines.

Fourth, the variable exchange rate has the greatest impact particularly on the NPL ratio of Asia United Bank because it is a joint venture with Taiwanese investment banks, such as China United Trust & Investment Corporation and China Development Industrial Bank. The AUB portfolio consists of foreign investors, which suggests that foreign currencies make up a substantial portion of their assets. Thus, when the nominal exchange rate depreciates, that is, a stronger Philippine peso against the US dollar, exports become more competitive and the consequent increase in export earnings boosts the banks' capacity to service debts, stimulate export-oriented sectors, and promote economic growth.²⁸ On the other hand, a depreciated peso would mean higher import and fuel prices and reduced debt-servicing capacity of those who borrow in foreign currency. Moreover, the capacity of importers and borrowers to settle their debts is expected to decline and, consequently, hike up NPL ratios. This goes to show that the net impact of the exchange rate on NPL ratios can be positive or negative.

Fifth, assets, which are specific to banks, significantly affect Bank of Commerce and Land Bank of the Philippines. Meanwhile, based on the coefficients, the idiosyncratic variable of return on assets (ROA) notably affects BDO Private Bank and Philippine Bank of Communications. The impact of ROA on the majority of

26 Dua, P. and Kapur, H. (2017). Macro Stress Testing of Indian Bank Groups. Ph.D. University of Delhi.

27 *Ibid*

28 *Ibid*

banks means that it is most likely to affect the entire industry.

Finally, the constant term is estimated by the omission of predictors from a regression analysis. It captures the positive impact of various unobservable characteristics that are specific to banks and can affect the majority of the banks in this study.

Table 5. Summary Table of Objectives and Findings

Hypothesis	Objectives	Method and Indicators	Results
<p><i>Hypothesis 1:</i> Both macroeconomic factors and bank-specific features affect credit quality.</p>	<p><i>Objective 1:</i> To determine the presence of long-run relationships between the macroeconomic and bank specific variables</p>	<p>Panel Unit Root test and Panel Co-integration test. The dependent variable is credit quality which is measured by the probability of default and represented by the bank's non-performing loans ratio. Meanwhile, the macroeconomic explanatory variables are GDP growth rate, inflation rate, interest rate, and exchange rate. The bank-specific explanatory variables are assets and return on assets.</p>	<p>Panel Unit Root test: Variables exhibit non-stationary properties at level and stationary at first difference, thus arriving at the conclusion I (1).</p>
			<p>Panel Co-integration test: Majority of the tests (five out of seven) reject the hypothesis of no co-integration between the explanatory variables and credit quality.</p> <p>These results support the hypothesis that macroeconomic and bank-specific factors affect credit quality due to the presence of long-run relationships.</p>
<p><i>Hypothesis 2:</i> Better credit quality is a consequence of an improved macroeconomic environment and bank performance.</p>	<p><i>Objective 2:</i> To examine the effect of macroeconomic and bank-specific variables on the credit quality of the Top 24 UKBs.</p>	<p>Fully Modified OLS (FMOLS). The indicators are the same as those in the first objective.</p>	<p>GDP growth rate, exchange rate, interest rate, and return on assets, are more likely to influence the credit quality of the universal and commercial banking sector. Inflation rate and assets have minimal effects on the banks' non-performing loans ratio. All the explanatory variables, with the exception of assets and interest rate, have a negative relationship with credit quality.</p>
	<p><i>Objective 3:</i> To quantify the impact of macroeconomic and bank-specific variables on the credit quality of each bank in the Top 24 UKBs.</p>		

Summary

The Global Financial Crisis (GFC) of 2008 gave a lesson that no matter how big or how much money a bank makes, it can fail due to rising vulnerabilities. It prompted policy makers to implement stricter measures such as stress testing banks and the financial system in order to ensure its stability and soundness in the event of a shock. Macro stress testing is a tool that helps financial institutions find out if the banking industry will survive an economic downturn. This study ultimately seeks to find out if better credit quality results from an improvement in the macroeconomic environment and bank performance of the top 24 UKBs.

There are multiple literatures that discussed the

importance and effectiveness of macro stress testing of the top banks using different frameworks and methodologies. From this, two hypotheses were drawn. First, both macroeconomic factors and bank-specific features affect credit quality. Second, improved macroeconomic environment and specific bank performance result in better credit quality. Moving on, the framework of the study focused on the credit quality of default rate. It is a measure that reflects the credit risk and quality of the aggregate bank portfolio and key macroeconomic variables and bank-specific factors. The study used NPL ratio as an empirical measure of the probability of default. The macroeconomic factors used are GDP growth rate, inflation rate, interest rate, and exchange rate while the bank-specific features are assets and return on assets.

In order to prove the two hypotheses, three steps were followed. The first step was to examine the stochastic properties of the variables involved through the Panel Unit Root tests. Next step was to conduct a Panel Cointegration test in order to determine the presence of a long-run relationship. Lastly, the Fully Modified OLS (FMOLS) was employed to estimate the impact of the variables to credit quality.

Conclusion

To conclude, this paper conducted a macro stress test to discover the impact and relationship of macroeconomic and bank-specific factors to the credit quality of the top 24 Philippine UKBs. The first objective was to determine the presence of long-run relationships between the macroeconomic and bank specific variables using Panel Unit Root and Panel Cointegration tests. Results of the Panel Unit Root test showed that the variables present non-stationary properties at level and stationary at first difference, thus concluded as I (1). Due to its stochastic properties, it is possible to apply the Panel Cointegration method to test the existence of the stable long-run relationship among variables. The results indicate that majority of the tests reject the null hypothesis of no cointegration at significant levels. This provides evidence for a long-run relationship between NPL ratios of the top 24 UKBs and the explanatory variables.

Hence, the impact of these macroeconomic and bank specific factors can be estimated in the event of an adverse shock in the short run.

For the second objective, Fully Modified OLS (FMOLS) method was used in order to examine the effect of the macroeconomic and bank specific variables on the credit quality of the entire Top 24 UKBs. Results showed that macroeconomic growth, exchange rate, and return on assets are inversely and significantly related to credit quality while interest rate is positively and significantly related. The remaining variables, inflation rate and assets, were insignificantly related to credit quality where the former is negatively related while the latter is positively related. The assets variable is the only determinant that is inconsistent with economic theory. Furthermore, exchange rate and return on assets are the two variables that has the highest probability to affect the overall non-performing loans of the top 24 UKBs sector at 1% level of confidence.

For the last objective, the researchers employed the FMOLS to quantify the impact of macroeconomic and bank-specific variables on the credit quality for each individual bank under the Top 24 UKBs. There are six important findings that the model presents by comparing the coefficients and significance of the explanatory variables. First, macroeconomic growth significantly affects BDO Private Bank, Inc. the most. Second, an increase in nominal interest rate will significantly affect the credit quality of Bank of Commerce, BDO Private Bank, Inc., China Bank Corp., and Philippine Bank of Communications. Third, inflation has a significant impact on the banks' respective NPL ratios namely Philippine Bank of Communications, BDO Private Bank, Inc., and Philippine Veterans Bank the most. Fourth, the bank-specific factor, return on assets, affects the most number of banks compared to any of the explanatory variables. It has the biggest impact on BDO Private Bank and Bank of Communications as seen in their coefficients. Fifth, exchange rate significantly affects Asia United Bank's non-performing loans ratio due to its bank portfolio. Lastly, the constant term is estimated by the omission of predictors from a regression analysis. It captures the positive impact of diverse

unobservable bank-specific characteristics. It significantly affects the following banks: Bank of Commerce, Bank of the Philippine Islands, Banco de Oro Private Bank, Citibank, Development Bank of the Philippines, East West, Maybank, Mizuho, Philippine Veterans, RCBC, Security Bank, and Unionbank. Furthermore, the impact of the bank specific factors, specifically the return on assets, is found to be significant and quite pronounced in comparison to the impact of the macroeconomic factors on their respective credit quality. The findings suggest that policy prescription should be based more on the individual bank management strategies. Banks ought to focus on bank-specific factors over which the management has more control, thus they can present practical solutions given that they have guidelines and regulatory frameworks to improve their credit quality.

Future studies may look into modifying the macroeconomic and bank-specific variables by including other factors such as the stock market index, unemployment rate, and market power. In addition, the dependent variable can be changed to another parameter such as loss given default, exposure at default, and expected default frequency in order to have another insight regarding credit quality. These suggestions may produce different and better results in terms of consistency with economic theory. Another recommendation would be categorizing and grouping the banks similar to the study of Dua and Kapur as to gain an additional perspective on the credit quality of the entire UKBs. Lastly, future researchers should conduct a scenario analysis which includes examining the quantitative impact of a baseline scenario against a hypothetical modest and severe shocks. This will give the management and policy makers a better understanding of the interaction between variables and position themselves better in the event of a shock.

Bank Performance and Bank Relief Ordinances with Covid 19

To see the effect of Covid 19 to the Top 10 universal and commercial banks (UKBs) of the Philippines, a macro stress-test was applied to the non-performing loans ratio to total loans. The non-performing loans ratio of the Top 10 UKBs is consistently less than 5% for

the past two decades. It registered 1.7% for 2019 or less than 2% for the past 5 years. Predicting a 10% decrease in GDP and a 5% decrease in remittances for all quarters of 2020 is likely to result to a doubling of the non-performing loans ratio over a span of 10 periods, that is, from 2020 to the second quarter of 2022 (See Figure 3). This means that with the economic downturn experienced in 2020, the non-performing loans ratio will reach 3.4% by the end of 2020, and about 5.0% by the end of 2021. The top 10 UKBs will still comply with the Basel III ordinance of setting the non-performing loans ratio to less than 5.0%.

The presence of well capitalized and solvent big banks in the Philippines has resulted to a less fragile universal and commercial banking industry due to their low non-performing loans ratio. This has enabled them to implement several regulatory relief efforts. The Bayanihan to Heal as One Act (Bayanihan I) made effective on March 25, 2020 provided a minimum 30-day grace period on loan payments, without interest, penalties, or other fees charged on these payments. Six months later, the Bayanihan to Recover as One Act (Bayanihan II), which took effect on Sept. 15, 2020, doubled the grace period and increased its coverage. Separately, the Bangko Sentral ng Pilipinas (BSP) issued Memorandum No. M-2020-074 on Sept. 28, 2020 which required all BSP-supervised financial institutions to provide a one-time 60-day grace period for all existing, current and outstanding loans with principal and/or interest, with amortization falling due between Sept. 15 and Dec. 31, 2020 without incurring additional interest, penalties, fees, or other charges. The principal and accrued interest for the 60-day grace period may be paid in installments until Dec. 31 or as may be agreed upon by the involved parties.

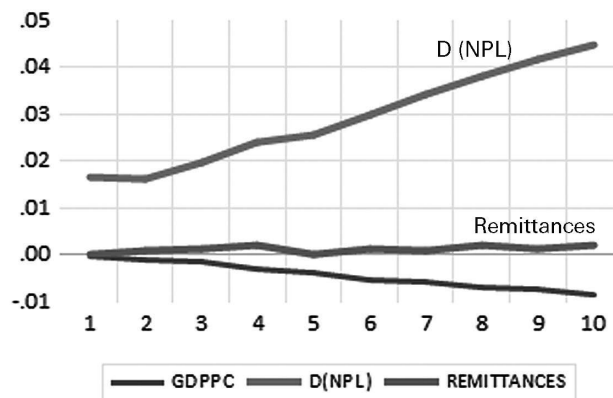


Figure 3. Accumulated Response of NPL to a 10% Decrease in GDP per capita and 5% Decrease in Remittances for 2020

Source of Basic Data: BSP

Other government support included the lowering of effective lending interest rates and reserve requirements, a three-year repayment term, and no collateral for loans below P3 million; conditional loan interest rate subsidies for affected learning institutions; and an increase in maximum loan amounts per borrower, reduced interest rates, and extended loan terms for micro, small and medium enterprises (MSMEs), cooperatives, hospitals, tourism companies and overseas workers affected by the pandemic. The government also initiated a low interest and/or “flexible term” loan program for operating expenses for businesses affected by the pandemic and provided guarantees for non-essential businesses. Moreover, it liberalized the grant of incentives for the manufacture or import of critical or needed equipment or supplies or essential goods and provided a loan interest rate subsidy to critically impacted businesses.

The general loan loss provision, which is part of a bank’s Tier 2 capital, is limited to 1% of a banks’ credit risk-weighted assets such that any excess amount will be considered in computing risk-based capital ratios. Non-bank financial institutions (NBFI) are also required to set up an allowance for credit losses and to report non-performing loans.

Bayanihan II and BSP Memorandum No. M-2020-074 provides certain reliefs to banks and NBFIs

regarding the mandatory grace period to borrowers. These include the staggered booking of allowances for credit losses, with banks and NBFIs given the option to insulate net earnings and capital from the effects of higher credit risk, cushioning the banks and NBFIs net earnings and capital; exemption of borrowers availing of the mandatory grace period from the limits on real estate loans when applicable, and from related party transaction restrictions, which gives the banks and NBFIs more opportunity to extend financial assistance to those affected by the pandemic; and non-inclusion in the bank's or NBFIs reporting on non-performing loans, reducing the regulatory burden on lenders as they extend more loans and restructure facilities of financially-burdened borrowers.

These concessions are necessary to avoid putting pressure on any one sector of society, especially on sources of finance. They also ensure that policies to achieve recovery are sustainable in the long run. In summary, due to the presence of a financially stable banking industry, they were willing to take the credit risk for the purpose of solidarity with micro, small and medium enterprises who are negatively affected by the pandemic.

Table 6. Estimated MST Specifications for Top 24 UKBs

Banks	GDP Growth Rate (g)	Interest Rate (i)	Inflation Rate (π)	Exchange Rate (e)	Return on Assets (R)	Assets (a)	Constant
Asia United Bank Corporation	-0.047034 (0.7793)	-0.027997 (0.7023)	0.104038 (0.2772)	-0.2275** (0.0303)	0.75586*** (0.0000)	0.025932 (0.2336)	-2296.70
Banco de Oro Universal Bank	0.074629 (0.7554)	0.084410 (0.2704)	0.060167 (0.5296)	0.024235 (0.7215)	-0.029114 (0.8130)	0.015687 (0.4458)	-20107.32
Bank of Commerce	-0.252701 (0.2935)	-0.161899** (0.0687)	0.013465 (0.8863)	-0.075206 (0.1693)	0.359915** (0.0433)	-0.1754* (0.1519)	18073.95
Bank of the Philippine Islands	-0.068423 (0.7741)	-0.026705 (0.7103)	-0.098150 (0.3040)	0.048709 (0.5039)	0.173152 (0.2657)	-0.002600 (0.9214)	2276.47
BDO Private Bank, Inc.	0.90043*** (0.0004)	-0.19382*** (0.0037)	-0.5722*** (0.0000)	0.116332 (0.1330)	-1.4159*** (0.0665)	-0.087730 (0.3541)	3031.71
China Bank Corp.	0.076465 (0.7485)	0.105870* (0.073)	0.041424 (0.075)	0.017522 (0.4840)	0.229962* (0.2063)	0.017482 (0.9533)	-5769.69
Citibank, N.A.	0.022069 (0.9262)	-0.023057 (0.8112)	0.031864 (0.8273)	0.054980 (0.7550)	-0.5268*** (0.2063)	-0.040636 (0.6711)	10057.73
Deutsche Bank AG	-0.062664 (0.7909)	0.010377 (0.8112)	0.020399 (0.8273)	-0.017328 (0.7550)	0.037396 (0.7263)	0.004397 (0.9533)	-203.70
Development Bank of the Philippines	-0.191655 (0.4231)	-0.064055 (0.3890)	-0.170360** (0.0732)	-0.028651 (0.7064)	-0.019945 (0.8931)	-0.013932 (0.1481)	5131.50
East West Banking Corp.	0.045620 (0.8481)	-0.055662 (0.4890)	-0.046660 (0.6222)	0.117513 (0.1625)	-0.4961*** (0.0002)	-0.019277 (0.3815)	2539.48
Hong Kong & Shanghai Banking Corp.	0.038327 (0.8723)	0.041966 (0.5116)	0.104467 (0.2697)	-0.034150 (0.6503)	-0.8102*** (0.0000)	0.049597 (0.5815)	-7485.40
Land Bank of the Philippines	-0.207976 (0.3876)	0.091305 (0.3010)	-0.2833*** (0.0042)	-0.089751 (0.2491)	-0.5907*** (0.0001)	0.05104** (0.0239)	-40633.25
Maybank Philippines Inc.	0.024107 (0.9199)	-0.039083 (0.5811)	0.056157 (0.3664)	0.079482 (0.2372)	0.086592 (0.6071)	-0.014684 (0.4362)	793.10
Metropolitan Bank & TCO	0.038347 (0.8721)	0.040840 (0.5490)	-0.013806 (0.8840)	-0.028718 (0.6739)	0.4155*** (0.0030)	0.020763 (0.3864)	-20195.10
Mirubo Bank LTD - Manila Branch	-0.00255 (0.9915)	-0.040507 (0.5811)	0.003660 (0.9688)	0.034975 (0.6592)	-0.4080*** (0.0065)	-0.014125 (0.7840)	570.77
Philippine Bank of Communications	-0.03024 (0.8997)	0.097235*** (0.0659)	-0.6082*** (0.0000)	-0.050315 (0.5473)	-1.7157*** (0.0000)	0.037541 (0.3525)	-2520.14
Philippine National Bank	-0.088442 (0.7105)	0.046238 (0.5904)	0.176452** (0.0664)	-0.001990 (0.9781)	1.8823*** (0.0000)	-0.001621 (0.9623)	-719.10
Philippine Trust Company	-0.057658 (0.8100)	0.061036 (0.4857)	-0.213464** (0.0296)	-0.040892 (0.4981)	-0.9711*** (0.0039)	-0.015068 (0.8724)	-1559.76
Philippine Veterans Bank	0.121413 (0.6984)	0.039390 (0.6499)	-0.4985*** (0.0000)	-0.047612 (0.4981)	-0.4654*** (0.0039)	-0.012516 (0.9709)	597.73
Rizal Commercial Banking Corp.	-0.034315 (0.8853)	-0.014703 (0.8430)	-0.2547*** (0.0097)	0.063415 (0.3250)	-0.3966** (0.0345)	-0.001018 (0.7758)	306.97
Security Bank Corp.	-0.030942 (0.8965)	-0.036475 (0.6163)	-0.243816** (0.0135)	0.056459 (0.4637)	-0.143218 (0.4231)	-0.000574 (0.7758)	2762.41
Standard Chartered Bank	0.050961 (0.8295)	-0.032410 (0.5594)	-0.41231*** (0.0001)	-0.046118 (0.4197)	0.117780 (0.4576)	0.160148 (0.2503)	-10754.88
Union Bank of the Philippines	-0.159689 (0.5063)	0.050656 (0.5019)	0.174833** (0.0659)	-0.082705 (0.2172)	0.4102*** (0.0022)	0.033893 (0.6056)	-4968.70
United Coconut Planters Bank	0.036237 (0.8792)	0.041894 (0.6246)	-0.4881*** (0.0000)	0.010022 (0.8726)	-0.6781*** (0.0011)	0.013374 (0.7895)	-2659.68

Source: Authors' calculations.

Source of Basic Data: BSP

- Notes: (1) Used Pooled Weighted FMOLS to account for the heterogeneity of the data.
(2) p-values are indicated in parentheses.
(3) Based on the Panel Co-integration Test by Pedroni, N23, The Bank of Tokyo-Mitsubishi UFJ LTD, was dropped from the test.
(4) Asterisks indicate the statistical significance of the coefficients at 10, 5, and 1 percent levels of confidence, respectively.