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Assessing the Resilience of ASEAN Banking Systems: the Case of the Philippines

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Assessing the Resilience of ASEAN Banking Systems: the Case of the Philippines

Jose Ramon G. Albert and Thiam Hee Ng

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ADB Working Paper Series on Regional Economic Integration

Assessing the Resilience of ASEAN Banking Systems: The Case of the Philippines

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Abstract

Since the global financial crisis in 2008/09 there has been heightened concern about the resilience of banking systems in Southeast Asia. This paper proposes a methodology that uses a macroprudential perspective to assess the resilience of banking systems in member countries of the Association of Southeast Asian Nations. It then proceeds to apply this methodology to examine the resilience of the Philippine banking system. Data on financial soundness in the Philippine banking system are utilized in a vector autoregression model to study the dynamic relationships that exist among financial and macroeconomic indicators. Using impulse response functions, a simulation of financial ratios in the banking system is conducted by assuming unlikely but plausible stress scenarios to determine whether banking system credit and capital could withstand the impact of such circumstances. In the stress scenarios, the estimated impact of macroeconomic shocks on nonperforming loan and capital adequacy ratios is generally minimal. The results, however, do suggest that the Philippine banking system has some vulnerability to interest rate and stock market shocks. The results of such stress testing provide a better understanding of the level of preparedness required for managing risks in the financial system, especially in the wake of continuing global economic uncertainty.

Keywords: Banking System, Macroprudential, Stress Testing, the Philippines, Panel VAR

JEL Classification: C33, E44, G21

1. Introduction

In recent years governments have made international commitments to work toward inclusive growth and equitable development, but many Southeast Asian economies such as the Philippines are facing challenges in meeting these goals. Episodes of financial distress have further exacerbated constraints on the region's economies. Mortgage delinquencies and foreclosures, coupled with failures in the over-leveraged financial sector in the United States (US), and the subsequent impact on the global financial system have shown that vulnerabilities in the financial system of a single entity or group of entities can have a cascading effect in the global system and real economy.

As concerns rise that the effects of the 2008/09 global financial and economic crisis are far from over, there is interest within ASEAN in ensuring that domestic financial systems are healthy enough to withstand the protracted effects and pressures from additional episodes of instability that may arise. We will examine how the Philippine banking system[1] would react if the country were hit by unlikely but plausible scenarios such as rising inflation, a slowdown in economic growth, and sharp increases in interest rates. Banks are generally viewed as vulnerable to various macroeconomic shocks. A decrease in economic activity and volatility in prices could wreak havoc with the financial situation of households and businesses, and in turn increase the number of nonperforming loans (NPLs). Changes in interest rates could have an effect on capital. Stress testing simulations are meant to identify financial vulnerabilities and provide policymakers and regulators, as well as the banks themselves, with inputs on the management of risks facing the financial system. While stress testing gained some prominence after the 1997/98 Asian financial crisis, especially as it became a major component of the Financial Sector Assessment Program (FSAP) launched by the International Monetary Fund (IMF) and the World Bank, these exercises consist of a number of variegated analytical tools.

A macroprudential approach to monitoring financial system soundness has been adopted in this study. This approach has both cross-sectional and time series dimensions, and consequently requires panel data known as financial soundness indicators (FSIs) at the level of financial institutions, or at least sub-sectors of the financial system, across time. The latest results from the FSAP in the Philippines[2] describe the country's banking system as dominating the financial system, with assets of the banking sector comprising two-thirds of the assets of the entire financial system. Thus, this paper will consider the financial health of the Philippine banking sector, especially as it is the primary supplier of liquidity in the domestic economy.

The macroprudential approach provides an analytical tool for linking macroeconomic variables, risks, and financial system stability. Early detection of financial vulnerabilities can allow policymakers to take preemptive monetary policy actions, particularly in the formulation and implementation of corrective measures for managing risks, and give

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1 The paper focuses on the Philippines as detailed data on banking system in other ASEAN economies were not available.

2 International Monetary Fund (2010).

market participants in the financial system an opportunity to adjust their business strategies.

While cross-country studies[3] have been conducted to examine financial system soundness, the results of such studies have yielded limitations largely owing to data issues, especially arising from the low frequency of FSI data gathered, and methodological challenges. Estimating relationships among various FSIs and predicting crisis periods is challenging because data collected will only provide ex post dynamics. The correlation of liquidity and credit risks across institutions and over time, as well as the instability of estimates of reduced-form parameters due to feedback effects, further limits the use of these econometric models. Despite these limitations, examinations of available FSI data validate the views of risk managers about the expected changes in risk factors and can be used as an initial indicator of the influence of how a change in a certain variable would affect FSIs. Consequently, the results of these analyses may provide useful inputs to shape needed policy interventions.

In this study, a vector autoregression (VAR) approach is employed on monthly FSIs—as well as monthly data on interest rates, exchange rates, inflation, and industrial production—to provide a better understanding of emerging vulnerabilities in the Philippines' financial system and the economy as a whole. Specifically, we utilize impulse response functions to show the response of one variable of interest (e.g., a measure of credit risk) to a shock in another variable of interest (e.g., inflation) while holding other variables constant. Sector-level panel data from the Philippines are used to study the relationship between financial health and macroeconomic conditions.

The outline of this paper is as follows. Section 2 reviews the macroprudential approach and some macroprudential literature, particularly as it relates to stress testing. Section 3 describes the data and stress testing methodology employed in this study. Conclusions and policy prescriptions are provided in the last section.

2. Assessing the Health of a Financial System

A macroprudential approach[4] to understanding, explaining, and predicting financial sector developments requires taking into account the financial system as a whole. Macroprudential monitoring and evaluation involves compilation and examination of various indicators that can provide a broad picture of the stability and efficiency of a financial system, as well as identify potential future threats to systemic stability. A top–down calibration is employed with the objective of limiting the chances of financial system-wide distress.

In contrast a microprudential, bottom–up perspective examines individual institutions, products, and markets with the objective of limiting the likelihood of failure of individual institutions and thus protecting investors and depositors, regardless of systemic consequences or impacts on the overall economy. Whereas a microprudential paradigm

[3] Schou-Zibell et al (2010).
[4] Schou-Zibell et al (2010).

assumes risk to be exogenous, the macroprudential framework looks at the interactions within the system as a whole, allowing for endogeneity or feedback.

Prudential tools of macroprudential frameworks can be tailored to an individual institution's contribution to systemic risk in instances where tighter standards may, for example, be applied to institutions with larger contributions, in clear contrast to common prudential standards for regulated institutions in a microprudential approach.

Macroprudential data includes FSIs, macroeconomic indicators, market based data, qualitative information, and structural information. Key FSIs are generally in the form of financial ratios that describe the current health of financial institutions and serve to quantify various sources of risks to the financial system. FSIs include data on measures of capital adequacy and credit.

A key step in macroprudential monitoring is selecting the FSIs to examine. When assessing the risk exposure of the financial system, should analysis be restricted to the banking sector? What relevant portfolios are to be analyzed? Answering these questions will be partly constrained by data availability. A core set of FSIs[5] have been identified by the IMF for macroprudential surveillance that cover the banking sector, reflecting the important role of the banking sector in financial systems. After all, banks are suppliers of liquidity to the system and as has been observed in history: the impact of financial stress at banking institutions can have large macroeconomic costs.

In the Philippines, the banking sector is reported to be the single largest component of the financial system[6] and it is likely to continue being the main source of finance to the private sector. The Philippine banking system comprises universal and commercial banks, thrift banks, and rural and cooperative banks. Rural and cooperative banks, which are owned privately and by cooperatives, respectively, cater largely to farmers and merchants in rural areas. Thrift banks, which include savings and mortgage banks, and private development banks, focus their services on small and medium-sized enterprises. Commercial banks have all the powers given to thrift banks as well as the power to purchase and sell foreign currency, act as a broker for customers, advise investment management accounts, loan safety deposit boxes, and engage in quasi-banking functions. Universal banks have the broadest scope of banking services. In addition to the authority to carry out all the services rendered by other categories of banks, universal banks also have the ability to conduct the functions of an investment house, whether directly or indirectly through a subsidiary.

Prior to 2000, the Philippine banking system had a "pattern of frailty in the face of adverse shocks."[7] In the aftermath of the 1997/98 Asian financial crisis, comprehensive reforms in the banking system were implemented, which included increased minimum capital requirements, for purposes of strengthening the prudential and supervisory systems, as well as for safeguarding the financial soundness of the banking system.

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5 International Monetary Fund (2006).
6 BSP (2010).
7 Gochoco-Bautista (1999).

FSI data becomes informative when compared across time and economies (or across institutions or sub-sectors within a financial system). For instance, Figure 1 illustrates how the Philippines fared relative to selected neighboring economies in terms of risks on credit (measured by the ratio of NPLs to gross loans) and capital (measured by the banking sector's risk-weighted capital ratios). These financial performance indicators as well as other FSI data (Appendix Table A-1)[8] suggest that prior to the 2008/09 global financial crisis, there had been systematic improvement in the health of the Philippine banking system, even when benchmarked against neighboring South East Asian economies.

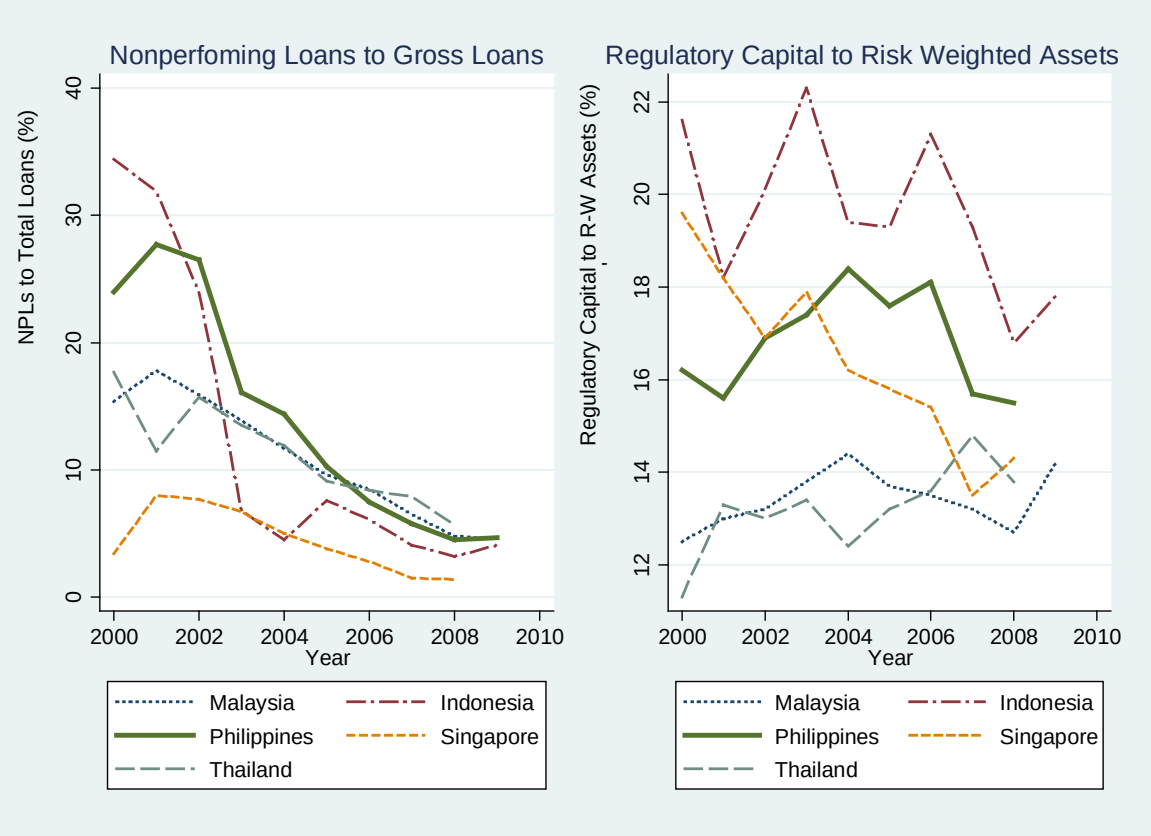
The percentage of NPLs in the Philippine banking sector decreased from a peak of 27.7% in 2001 the single digits by 2006. The decline has been attributed to steady progress in the disposition of the idle assets of banks, especially in the private sector, and to the sustained though modest rise in total loans of banks. Patterns in the risk-weighted capital ratios suggest that the banking system remains well capitalized, with such ratios stable and well above the Basel I standard of 8%. While trends in these FSIs suggest that the Philippine banking system is healthy, there are no assurances with regard to its resiliency to the ongoing effects of the 2008/09 global financial and economic crisis, especially as the crisis has been marked by a number of transmission channels that could place additional pressures on the financial system in the short- and medium-term.

A number of econometric models may be employed to describe linkages between various FSIs and facilitate estimation of the impact of downturns in macroeconomic variables, possibly including the interest rate and foreign exchange rate channels on a number of key FSIs. Such quantitative work is an element of a broader qualitative assessment of existing and potential financial vulnerabilities. Econometric analyses of the FSIs exploit both time series and cross-sectional dimensions. Time series analysis is useful to assess the buildup of financial sector vulnerabilities over time. Panel studies evaluate the effects of country-specific or bank-specific factors. Typically, these econometric analyses take the form of early warning systems (EWSs), or stress-testing, which are both concerned with unlikely events that—if and when realized—could lead to serious consequences for financial system health.

Models for EWSs involve estimating the probability of crises. A crisis is typically defined as some event occurring if a set of macroeconomic variables (jointly) exceed critical thresholds. These models typically estimate the likelihood of exchange rate, banking, or twin crises, with historical data of a set of leading indicators, typically by way of some underlying logit–probit or discriminant analysis.

[8] Schou–Zibell et al (2010).

Figure 1: Share of Nonperforming Loans and Capital Ratios, 2000–2009



NPLs = nonperforming loans; and R-W Assests = risk-weighted assets.

Source: Centennial Group.

Stress-testing,[9] on the other hand, involves an evaluation of the resilience of the financial system in the event of a crisis resulting from extreme but plausible scenarios that are usually based on historical data or even the experiences of other economies. These simulations are carried out at the aggregate level and at the level of individual institutions based on a forward-looking and internally consistent framework for analyzing key linkages between the financial system and the real economy. Aggregate or macro-stress testing is conducted by banks themselves (to help them manage risks), central banks and regulatory authorities (as part of their oversight functions of banking systems), and international agencies. Starting in 1999, the IMF and World Bank, through their joint FSAP, have also been carrying out aggregate or macro stress tests to gain insights in potential threats to the financial health of banking systems, such as credit and market risks.

[9] International Monetary Fund (2010).

Stress tests for credit risks look into rising loan defaults and NPLs. Much attention in the literature has been given to credit risks as an essential element of the Basel II framework,[10] in part because data on banks' NPLs are readily available. While results often yield useful insights, they do not provide a way of examining the effects of developments in credit structure. A declining NPL ratio may be the result of an improvement in credit quality or the selling of the loans. Stress tests for market risks examine how changes in exchange rates, interest rates, and prices affect the value of capital and bank assets. Changes in exchange rates are often linked to negative macroeconomic conditions such as a rise in unemployment and economic downturns. The 2008/09 global financial and economic crisis accentuated the importance of expanding the scope of examining individual risks to banks to include system-wide risks.

In designing a stress scenario there are a number of issues to contend with including (i) the choice of risks to be analyzed—such as credit, interest rates, and liquidity—and whether these risks are to be studied in piecewise or integrated form; (ii) whether single or multiple risk factors are to be shocked; and (iii) the extent of the shocks assumed (and whether these assumptions are based on historical or hypothetical scenarios) as well as the time horizon for the effects of these shocks. These decisions are often made depending on data availability. While there may be a preference for simulating a comprehensive scenario involving multiple risk factors, this may also involve increased computational burden and difficulties in the practical understanding of stress testing results.

The collection of stress-testing methods[11] for assessing the financial sector may be categorized as "piece wise approaches" where individual FSIs are predicted by way of structural macro-econometric models[12] or statistical models[13] such as regression, time series, and panel data tools with some assumed macroeconomic stress scenarios, and "integrated approaches"[14] that combine the analysis of market and credit risks into a single estimate of the probability distribution of aggregate losses under a particular stress scenario. However, results from stress tests often give only a partial picture of the full range of risk exposures and the extent of risk-taking by entities within the financial system. Data availability strongly influences the approach and sophistication of the stress testing tool. In addition, many of these models do not pay enough attention to cross-correlation of risk measures over time and across institutions in a financial system. Measurement errors and feedback effects also pose serious challenges to parameter estimation and to stress testing results. There are also limitations regarding the FSIs themselves, which by their very nature are backward- rather than forward-looking measures of financial soundness. Examinations of FSIs in econometric models consist of assuming that past realizations of FSIs together with other relevant factors will help us determine future expected outcomes.

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10 Basel Committee on Banking Supervision (2005).

11 See Sorge and Virolainen (2006), Sorge (2004), Evjen et al. (2005), and Blaschke et al. (2001) for reviews of stress-testing methodologies and their limitations.

12 See de Bandt and Oung (2004).

13 Boss (2002) employs a logistic regression model for default probabilities, while Pesaran et al. (2005), Hoggarth et al. (2005), Filosa (2007), and Fong and Wong (2008) use a VAR model to assess the impact of macroeconomic variables on default probabilities.

14 Elsinger et al. (2002).

Despite such limitations and technical complexities inherent in the development of the macroprudential analysis toolbox, there is a common view among financial system stakeholders that stress testing exercises complement other quantitative and qualitative analysis of the health of the financial system. Stress tests assist banks, regulators, supervisors, and other stakeholders in spotting emerging risks, measuring the relative importance of different shocks, and understanding the evolution of risk over time and across groups of entities in a financial system.

3. Data and Methodology

As part of a macroprudential assessment of the health of the Philippine banking sector, we examine the dynamic patterns of NPL ratios and (risk-weighted) capital adequacy ratios from Bangko Sentral ng Pilipinas (BSP) data from 1999–2010 in three subsectors: (i) universal and commercial banks, (ii) thrift banks, and (iii) rural and cooperative banks. The BSP reports[15] that as of end-June 2010, the bulk of the country's 773 banking institutions consist of rural banks (661). However, the 38 universal and commercial banks account for the largest share (nearly 90%) of the total resources of the banking system amounting to PHP6.6 trillion. Individual bank level data, while preferable for analysis, were not available for this study.

Although there are a number of risks in the banking system, credit and capital risks are examined in this study as they are widely viewed as the primary risks. We look into selected financial ratios and the effects on these ratios of selected economic indicators including the volume of production index (total manufacturing), monthly average nominal US dollar to Philippine peso foreign exchange rate, monthly inflation, and a monthly measure of interest rates (lending rate on all maturities). This approach was justified from the perspective that systemic risk in credit and capital are often rooted in macroeconomic factors.

The aggregate portfolio of the banking sector is expected to depend on economic activity. During a recession, business activity and income deteriorate, and such conditions are expected to worsen the NPL ratio. Interest rates are an essential factor as they represent the direct cost of borrowing. Thus, changes in interest rates affect borrowing: if the cost of borrowing increases considerably, then more firms and households will likely be unable to repay their loans. Abrupt changes in foreign exchange rates and prices are also likely to lead to a rise in NPLs. Foreign exchange shocks are expected to decrease capital, especially among domestic banks. Economic stability, as indicated by industrial production, is also expected to affect capital adequacy. Summary statistics of the variables used are given in Appendix Table A-2.

A preliminary assessment was made on all the economic time series and financial ratios to examine the presence of unit roots.[16] Graphical inspections and formal statistical tests

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15 BSP (2010).

16 Denoting the differencing operator by Δ so that $\Delta y_t = y_t - y_{t-1}$, we say that a time series y_t is integrated of order d, denoted $I(d)$, if differencing the series d times yields a stationary series, that is, a series with

(Appendix Table A-3) suggest that all time series and panel data in the study are either stationary or integrated of order one. Gaps in the data series did not allow for the use of panel cointegration tests.

To examine the relationships among the financial ratios and the macroeconomic variables, we employ panel-data VAR models. A VAR model is commonly used for explaining and forecasting systems of interrelated time series. Through an impulse response function, a VAR model enables us to analyze the dynamic impact of shocks on the system of variables. The distinction of a VAR model when compared to other econometric models is that it treats every endogenous variable in the system as a function of the lagged values of all endogenous variables in the system. A panel-data VAR model makes use of the traditional VAR model with the extra feature of having panel-data, which adjusts model estimates to account for unobserved individual heterogeneity, in this case representing the banking subsectors.

A panel VAR model (of order p) may be represented by the reduced-form equation

$$Z_{i,t} = \Gamma_0 + \Gamma_1 Z_{i,t-1} + \cdots + \Gamma_p Z_{i,t-p} + f_i + d_{i,t} + e_t$$

where Z_t is a vector of endogenous variables, $\Gamma_0, \Gamma_1, \ldots, \Gamma_p$ are matrices of coefficients to be estimated, and e_t is a vector of forecast errors that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables. For a panel VAR, we need to impose the restriction that the underlying structure is the same for each cross-sectional unit. This restriction is likely to be violated in practice and may be dealt with by allowing for individual heterogeneity at the level of the endogenous variables by introducing fixed effects that are denoted by f_i in the panel VAR model. The model also allows accounts for sub-sector specific time dummies, $d_{i,t}$, which may be viewed as aggregate, sub-sector specific macro shocks. These dummies are eliminated in the estimation by subtracting the means of each endogenous variable calculated for each sub-sector year. The error vector e_t is assumed to be normally distributed with mean $\mathbf{0}$ and covariance matrix $\mathbf{\Sigma}$. Estimation of the panel VAR parameters is through a generalized method of moments procedure where the transformation matrix contains appropriate instrumental variables for the system of equations.

Two separate panel VAR models of order 3 are estimated for the available data that relate each of the financial ratios to industrial production, foreign exchange, interest rates, inflation, and a stock market index. All the variables were demeaned. For the case of variables that were not ratios—volume of production index, foreign exchange, and the Philippine stock exchange all-shares index—we apply a log transformation before

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time invariant mean and time invariant variance. If a data generation process yields a time series that is I(d) with $d \geq 1$, then it is said to be a unit root process. Unit root testing enables the identification of stochastic trends. The common test employed for unit root testing is the Augmented Dickey–Fuller test (Dickey and Fuller 1979); Pesaran (2003) develops a simple t test for unit roots in heterogeneous panels with cross-section dependence, based on the mean of individual Augmented Dickey–Fuller t-statistics of each unit in the panel.

demeaning in order to stabilize the variation in the data. That is, the vector of endogenous variables for the first panel VAR consisted of

$$Z_t = \{\mathrm{NPL}\mathrm{dm}, \log(\mathrm{VOPI})\mathrm{dm}, \mathrm{INTRST}\mathrm{dm}, \mathrm{INFL}\mathrm{dm}, \log(\mathrm{FOREX})\mathrm{dm}, \log(\mathrm{PSE})\mathrm{dm}\}$$

while for the second panel VAR, the endogenous variables were

$$Z_t = \{\mathrm{CAR}\mathrm{dm}, \log(\mathrm{VOPI})\mathrm{dm}, \mathrm{INTRST}\mathrm{dm}, \mathrm{INFL}\mathrm{dm}, \log(\mathrm{FOREX})\mathrm{dm}, \log(\mathrm{PSE})\mathrm{dm}\}$$

While a higher order panel VAR model to account for lingering lag effects and the use of more covariates for the FSIs would have been desired, data availability only allowed for the specification utilized here. Appendix Tables A-4a and A-4b list the estimated reduced form parameters of the two panel VAR models. While typically the use of some transformations on the ratios (e.g., logit transform or a Helmert procedure)[17]would be able to address nonlinearities, empirical results suggest only minor improvements to model fit.

The variance–covariance matrix of the underlying panel VAR residuals is unlikely to be a diagonal matrix, therefore the residuals will need to be orthogonalized so that the model will be identifiable. A common approach to achieve this is by applying a Cholesky decomposition, which is equivalent to adopting a particular ordering of the endogenous variables and allocating any correlation between the residuals of any two elements to the variable that is ordered first. This leads to a sensitivity of the subsequent impulse response analysis to the ordering of the variables. To deal with this sensitivity, the variables were ordered in ascendance according to the likely speed of reaction to a particular shock. That is, variables at the beginning of the panel VAR are assumed to be affecting the subsequent variables contemporaneously but are only affected themselves by shocks from these other variables after a lag. In particular, the macro-variables, industrial production and (retail price) inflation, were ordered at the beginning as they react only after a lag to the financial and market variables. Variables at the end of the VAR would be assumed to be affected by the preceding variables immediately, and only affect the preceding variables after a lag.

Calculations were performed with Stata software.[18] Results suggest that financial ratios are strongly autocorrelated. For instance, NPL affects itself in the next period. A relationship of macroeconomic variables with financial ratios can also be observed. High economic activity results in a decline in the NPL ratio as well as in a higher ROA. A positive change in interest rates with a 1-month lag is associated with higher NPL ratios as financing costs increase for debtors. Exchange rates are found to have varying effects on financial ratios depending on the lag. This is expected since the impact of the exchange rate on repayment conditions for borrowers is ambiguous (e.g., depreciation of the domestic currency favors exporters but harms importers).

While the estimated parameters in Appendix Tables A-4a and A-4b provide a scheme for forecasting the financial ratios, these are not very useful in analyzing the dynamic

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17 Arellano and Bover (1995).

18 The Stata add-on employed for the calculations was developed by Love and Ziccino (2006).

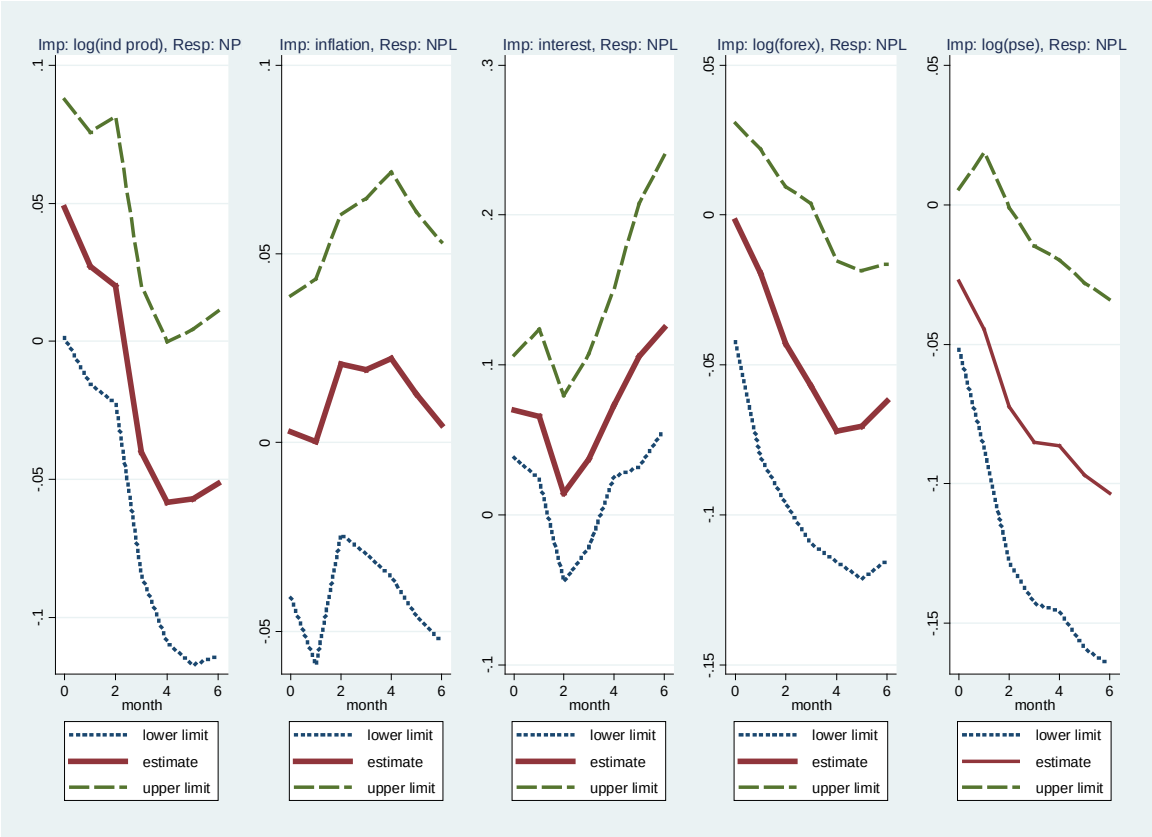
relationships of the FSIs since the errors in the reduced-form equation are forecast errors rather than structural errors. A shock to a particular variable such as foreign exchange not only directly affects that variable but is also transmitted to all the other endogenous variables such as the financial ratios through the dynamic (lag) structure of the VAR. To understand the dynamic structure in a VAR model, it is informative to look at the impulse response function, which traces the effect of a one-time shock to one of the innovations (error terms) on the current and future values of the FSIs, under the assumption that this innovation returns to its expected value of zero in subsequent periods and that all other innovations are equal to zero. If the innovations are contemporaneously uncorrelated, interpretation of the impulse response is straightforward: the ith innovation is simply a shock to the ith endogenous variable. A change in i^{th} innovation will immediately change the value of the current i^{th} endogenous variable, and it will also change all future values of all endogenous variables because of the VAR structure that relates variables with lagged values.

Figures 2 and 3 display the impulse response functions for a stand-alone, one-time shock to individual macroeconomic risk factors (industrial production, inflation, interest rates, the foreign exchange rate, and the Philippine stock exchange all-share index) and their respective impact on the NPL and risk-weighted capital adequacy ratios. From the impulse response functions, we observe that there is an immediate impact of stresses from industrial production on the NPL ratio, but the effect dies out quickly. The foreign exchange rate affects NPL ratios more in the long-term than in the short-term. Inflation hardly has any impact on NPL, while interest rates and the stock market appear to have the most visible impact on NPL ratios. For capital adequacy, only interest rates and the equities market have demonstrable impacts, with interest rates affecting short-term behavior, while the stock market indicator has a clearer effect in the long-term. For instance, a one-time 1 percentage point increase in interest rates yields a 0.6% increase in the NPL ratio after 1 month and a 1.3% increase after 6 months. Except for the impulse response of interest rates on NPLs and of the equities market on capital adequacy, the estimated financial ratio elasticities are often within the bounds of zero, indicating the considerable resilience of these ratios to macroeconomic shocks.

Typically, a variable can explain almost all of its forecast error variance at short horizons while explaining smaller proportions at longer horizons. In a VAR model, the forecast error variance decomposition provides information on the proportion of the movements in the FSIs (e.g., NPL ratio due to its own shocks versus shocks to the other variables such as economic growth, exchange rate, and interest rates).The forecast error variance decomposition for the panel VAR models (Appendix Tables A-5a and A-5b) shows how much of the future error variance of each of the financial ratios can be explained by shocks to the macroeconomic variables, as well as the other financial ratios at quarter t. The shock to each financial ratio (own shock) at month t can explain at least 84% of the variance of the forecast error of the particular financial ratio at month t + 1. The shocks to FSIs other than the particular financial ratio have a relatively small effect at month t on the forecast error variance of the ratio at month t + 1. By month t + 12, more than 16% of the forecast error variance of NPL can be explained by shocks to other FSIs, with interest rates dominating the future forecast error variance of NPL, making this variable an important determinant. For capital adequacy ratios, at month t + 12 shocks to FSIs other than capital adequacy explain 12% of the variance of forecast error with the

equities market indicator and interest rates contributing the most to forecast error variance.

Figure 2: Impulse Response Functions of Nonperforming Loans Ratio to Various Shocks

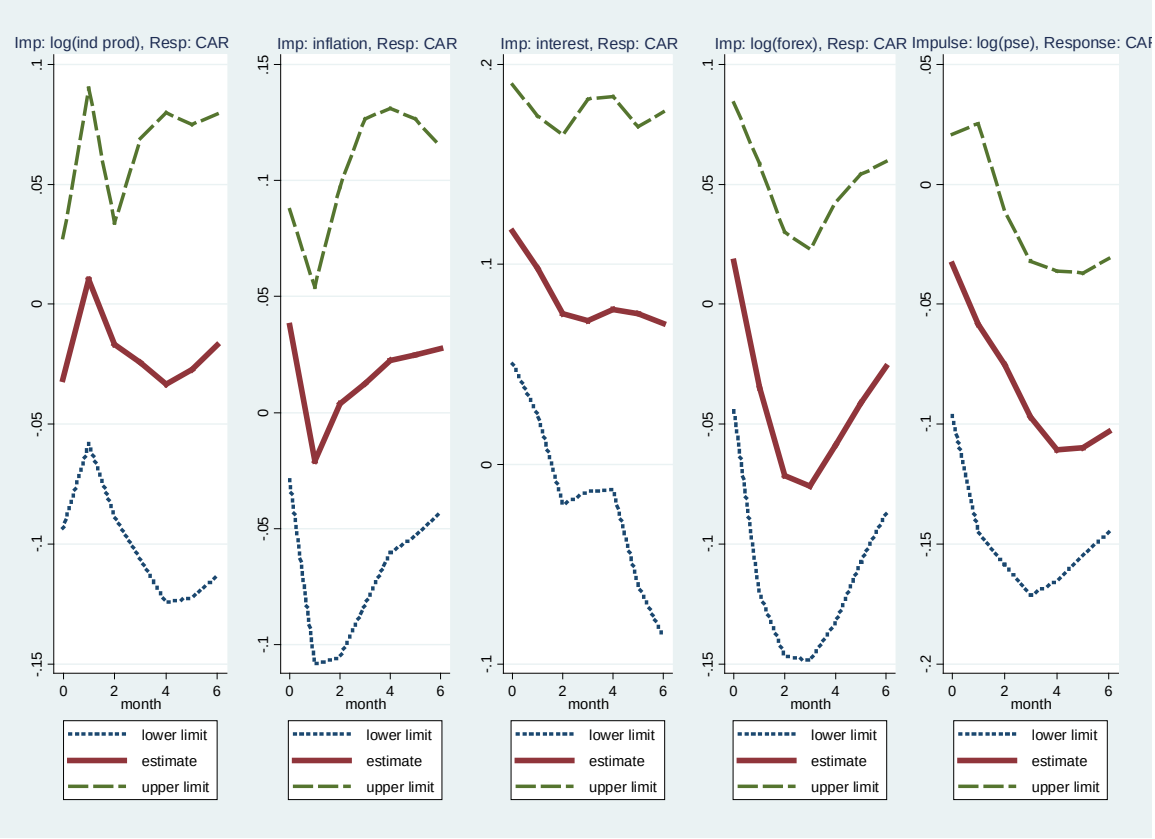


NPL = nonperforming loans.

Note: The figures represent the impact of a 1%change in industrial production, inflation, interest rates, the exchange rate, and the stock market index on the ratio of non-performing loans.

Source: Authors' calculations.

Figure 3: Impulse Response Functions of Capital Adequacy Ratio to Various Shocks



CAR = capital adequacy ratio.

Note: The figures represent the impact of a 1% change in industrial production, inflation, interest rates, the exchange rate, and the stock market index on capital adequacy ratios.

Source: Authors' calculations.

In designing and calibrating macroeconomic stress scenarios, we first consider changes in risk factors based on historical developments during January 1999–June 2010. Extreme changes across months in the macroeconomic and equities market variables are listed in Table 1.

Table 1: Extreme Changes in Macroeconomic Variables

	Extreme Negative Change		Extreme Positive Change	
Macroeconomic Market Indicator	**Change**	**Period**	**Change**	**Period**
Industrial Production	–23.9 index points	Jan2009	11.9 index points	May 2000
Foreign Exchange Rate	–2.7 pesos	Feb 2001	2.4 pesos	Oct 2000
Interest Rate	–1.6 percentage points	Feb 2002	2.7 percentage points	Nov 2000
Inflation	–1.9 percentage points	Dec 2008	1.9 percentage points	Apr 2008
Philippine Stock Exchange All-Shares Index	–350 index points	Oct 2008	208 index points	May 2008

Source: Authors' calculations.

Having identified these extreme empirical changes in the study period, we consider other possible severe stress conditions, such as a change two standard deviations in a particular direction of a macroeconomic or market variable that would be expected to yield a rising NPL (cf. Appendix Table A-2). We then quantify the direct impact of the simulated stress scenario on the balance sheet of the banking sector, focusing on the expected change in both financial ratios as suggested by the impulse response function analysis of the two panel VAR models.

The impact of each stress scenario is shown in Tables 2 and 3. Here, we find the changes in the estimated NPL ratio and capital adequacy ratio with and without the shock from month 1 through month 6, after the one-time shock was assumed to have been felt in December 2010. (This is preferred to comparing the post-shock value of the financial ratio in the given time horizon to its initial level.) While only changes in one risk factor are considered in each scenario, the dynamic lag relationships between the risk factors are accounted for in the panel VAR specification. In the stress scenarios, the estimated impact of the macroeconomic shocks on the NPL ratio and capital adequacy ratio is generally minimal although the stresses on interest rates and the equities market would tend to push the NPLs of rural and cooperative banks toward double digits. Such

results are plausible with corrective actions in monetary policy, given that the VAR model considers macroeconomic factors to be endogenous variables. The impact might be more pronounced if such reactions were not taken into account. Further robustness checks on the panel VAR were performed by changing the order of some endogenous variables and applying transformations on the variables, but similar results were obtained suggesting that the empirical analysis is not very sensitive to the specific model identification and specification scheme. Overall results are similar to the FSAP stress tests.[19]

Table 2: Impact of Stress Scenarios on Nonperforming Loans Ratio

Scenario	Month	Change in NPL (%)	Estimated NPL (%)		
			Universal and Commercial Banks	Thrift Banks	Rural and Cooperative Banks
10 percentage point drop in industrial production	1	–0.27	3.00	6.96	9.63
	2	–0.20	3.07	7.02	9.70
	3	0.40	3.67	7.63	10.30
	4	0.58	3.97	7.84	10.46
	5	0.57	3.96	7.83	10.44
	6	0.51	3.90	7.77	10.39
15 percentage point drop in industrial production	1	–0.41	2.87	6.82	9.49
	2	–0.30	2.97	6.92	9.59
	3	0.60	3.87	7.83	10.50
	4	0.87	4.26	8.13	10.75
	5	0.86	4.24	8.11	10.73
	6	0.77	4.16	8.03	10.64
5 peso depreciation in PHP–USD foreign exchange rate	1	0.02	3.30	7.25	9.92
	2	0.05	3.33	7.28	9.95
	3	0.07	3.34	7.30	9.97
	4	0.09	3.48	7.35	9.96
	5	0.09	3.47	7.34	9.96
	6	0.08	3.46	7.33	9.95
10 peso depreciation in PHP–USD foreign exchange rate	1	0.05	3.32	7.28	9.95
	2	0.11	3.38	7.33	10.01
	3	0.14	3.42	7.37	10.04
	4	0.18	3.57	7.44	10.05
	5	0.18	3.56	7.43	10.05
	6	0.16	3.54	7.41	10.03

[19] International Monetary Fund (2010).

Table 2: Continued

Scenario	Month	Change in NPL (%)	Estimated NPL (%)		
			Universal and Commercial Banks	Thrift Banks	Rural and Cooperative Banks
3 percentage point increase in interest rates	1	0.20	3.47	7.42	10.10
	2	0.04	3.32	7.27	9.94
	3	0.11	3.38	7.34	10.01
	4	0.22	3.60	7.48	10.09
	5	0.32	3.70	7.57	10.19
	6	0.37	3.76	7.63	10.25
6 percentage point increase in interest rates	1	0.40	3.67	7.62	10.29
	2	0.09	3.36	7.32	9.99
	3	0.22	3.50	7.45	10.12
	4	0.44	3.82	7.70	10.31
	5	0.63	4.02	7.89	10.51
	6	0.75	4.13	8.01	10.62
2 percentage point increase in inflation	1	0.00	3.27	7.23	9.90
	2	0.04	3.31	7.27	9.94
	3	0.04	3.31	7.27	9.94
	4	0.04	3.43	7.30	9.92
	5	0.03	3.41	7.28	9.90
	6	0.01	3.40	7.27	9.88
5 percentage point increase in inflation	1	0.00	3.27	7.23	9.90
	2	0.10	3.38	7.33	10.00
	3	0.10	3.37	7.32	9.99
	4	0.11	3.50	7.37	9.98
	5	0.06	3.45	7.32	9.94
	6	0.02	3.41	7.28	9.90
10% drop in equities market index	1	0.45	3.72	7.67	10.34
	2	0.72	4.00	7.95	10.62
	3	0.85	4.12	8.08	10.75
	4	0.87	4.25	8.12	10.74
	5	0.97	4.35	8.23	10.84
	6	1.03	4.42	8.29	10.91
20% drop in equities market index	1	0.89	4.17	8.12	10.79
	2	1.45	4.72	8.67	11.34
	3	1.70	4.97	8.93	11.60
	4	1.73	5.12	8.99	11.60
	5	1.94	5.32	9.19	11.81
	6	2.07	5.45	9.32	11.94

NPL = nonperforming loans.
Note: Change representing the difference between the value of the NPL ratio in a given time horizon with shock and without shock.
Source: Authors' calculations.

Table 3: Impact of Stress Scenarios on Capital Adequacy Ratio

Scenario	Month	Change in CAR (%)	Estimated CAR (%)		
			Universal and Commercial Banks	Thrift Banks	Rural and Cooperative Banks
10 percentage point drop in industrial production	1	–0.10	14.06	12.94	15.12
	2	0.17	14.36	13.35	15.33
	3	0.24	14.46	13.54	15.33
	4	0.33	14.56	13.73	15.35
	5	0.27	14.51	13.76	15.23
	6	0.17	14.43	13.75	15.08
15 percentage point drop in industrial production	1	–0.15	14.01	12.89	15.07
	2	0.25	14.45	13.43	15.41
	3	0.37	14.58	13.66	15.45
	4	0.50	14.73	13.89	15.52
	5	0.41	14.65	13.89	15.37
	6	0.26	14.52	13.83	15.17
5 peso depreciation in PHP–USD foreign exchange rate	1	0.04	14.20	13.09	15.26
	2	0.09	14.28	13.27	15.25
	3	0.09	14.31	13.39	15.18
	4	0.07	14.30	13.47	15.09
	5	0.05	14.29	13.54	15.01
	6	0.03	14.29	13.61	14.95
10 peso depreciation in PHP–USD foreign exchange rate	1	0.09	14.25	13.13	15.31
	2	0.18	14.37	13.36	15.34
	3	0.19	14.40	13.48	15.28
	4	0.15	14.37	13.54	15.17
	5	0.10	14.34	13.59	15.06
	6	0.07	14.33	13.64	14.98
3 percentage point increase in interest rates	1	0.29	14.45	13.34	15.52
	2	0.23	14.42	13.41	15.38
	3	0.22	14.43	13.51	15.30
	4	0.23	14.46	13.62	15.25
	5	0.23	14.47	13.71	15.18
	6	0.21	14.47	13.79	15.12
6 percentage point increase in interest rates	1	0.59	14.75	13.63	15.81
	2	0.45	14.65	13.63	15.61
	3	0.43	14.64	13.72	15.52
	4	0.46	14.69	13.86	15.48
	5	0.45	14.69	13.94	15.41
	6	0.42	14.68	14.00	15.34

Table 3: Continued

Scenario	Month	Change in CAR (%)	Estimated CAR (%)		
			Universal and Commercial Banks	Thrift Banks	Rural and Cooperative Banks
2 percentage point increase in inflation	1	–0.04	14.12	13.00	15.18
	2	0.01	14.20	13.19	15.16
	3	0.03	14.24	13.32	15.11
	4	0.04	14.27	13.44	15.06
	5	0.05	14.29	13.53	15.01
	6	0.06	14.32	13.63	14.97
5 percentage point increase in inflation	1	–0.10	14.05	12.94	15.12
	2	0.02	14.21	13.20	15.18
	3	0.06	14.28	13.36	15.15
	4	0.11	14.34	13.50	15.13
	5	0.12	14.36	13.61	15.08
	6	0.14	14.40	13.71	15.05
10 percent drop in equities market index	1	0.58	14.74	13.63	15.80
	2	0.75	14.95	13.93	15.91
	3	0.97	15.18	14.27	16.06
	4	1.11	15.33	14.50	16.13
	5	1.10	15.34	14.58	16.06
	6	1.03	15.29	14.61	15.94
20 percent drop in equities market index	1	1.17	15.32	14.21	16.39
	2	1.51	15.70	14.69	16.66
	3	1.94	16.15	15.24	17.03
	4	2.21	16.44	15.61	17.23
	5	2.19	16.43	15.68	17.15
	6	2.06	16.32	15.64	16.98

CAR = capital adequacy ratio.
Note: Change representing the difference between the value of the CAR in a given time horizon with shock and without shock.
Source: Authors' calculations.

Over a number of decades, the growth of the Philippine economy has been rather modest, especially when compared with the performances of neighboring economies. The first and second quarters of 2010 were pleasant surprises to Philippine economic managers. For the stress test, we assumed a slowdown in the last quarter of the 2010. Without considering other risk factors, the effect of this economic slowdown was not strong on NPL, although rural and cooperative banks were found to suffer from more credit losses than other subsectors of the banking system.

For the simulated foreign exchange shock, a direct channel for the impact of the shock would reflect a revaluation of the banks' portfolio, but the direct effect of extreme exchange rate fluctuation is rather low for both NPL and the capital adequacy ratio,

perhaps because the Philippine economy is not as driven by exports as neighboring economies.

A rapid increase in interest rates is found to decrease the economic value of the banking system. Under such stress conditions, the volume of assets with long-term interest rate fixation would substantially exceed the volume of liabilities with long-term interest rate fixation, and the price of these assets decreases, thus increasing the volume of NPLs. Rural and cooperative bank are found to have the weakest position among all subsectors for such shocks, a position magnified by the relatively larger share of real estate loans in their portfolios. A rise in interest rates would worsen the financial situation of debtors who have loans with floating rates or loans with short-term fixed interest rates.

Finally, as far as the inflationary shock, higher inflation would be expected to lower the real value of outstanding loans, thus easing conditions for borrowers. Higher inflation would also reduce the value of real interest rates and encourage economic activity, and consequently lead to a decline in NPLs. Unlike other stress conditions, the impact does not taper off 6 months after the simulated shock.

4. Conclusions and Policy Implications

This paper aimed to apply a methodology to assess the resilience of a national banking system. Using data from the Philippines, it analyzes the relationship between FSIs in the Philippine banking sector and macroeconomic factors such as industrial production, the exchange rate, interest rates, inflation, and the Philippine stock market. A panel VAR model was then employed to link credit and capital risks, and to provide a quantitative measure of the vulnerability of the banking system to substantial changes in risk factors.

The stress testing exercise conducted suggests that a temporary but significant slowdown of the economy would not be expected to substantially threaten the banking sector, which is a plausible expectation provided there would be an adequate monetary policy response that has a positive effect on the quality of the credit portfolio. A rise in interest rates would increase the burden of debtors with loans with short-term fixed interest rates. However, even this stress scenario does not have a very strong impact on the banking system. Neither does depreciation of the local currency relative to the US dollar. The behavior of the equities market appears to have some effect on the banking sector, which suggests the need for further macroprudential monitoring, especially in light of the recent global financial and economic crisis. In the aggregate, credit and capital risks are not very susceptible to macroeconomic and market shocks, but rural banks would be vulnerable if NPL ratios rose into double digits. A comprehensive picture of credit risks faced by the banking system needs to cover the household sector as well, which is not part of this study.

Philippine banks appear to be sufficiently capitalized owing to macroprudential policy tools that BSP has put in place such as capital requirements and additional capital buffers. Trends in FSIs suggest adequate bank asset quality, resulting from a number of measures taken to clean up balance sheets prior to the study period and improvements

in risk management that led to the Philippines having minimal direct exposure to the bursting of US asset bubbles in 2008/09.

Although the macro stress test results show the resiliency of the Philippine banking sector to many stress conditions, they also suggest vulnerability to interest rate and stock market shocks, and thus the need for continued vigilance in maintaining monetary stability and regulatory frameworks for the equity market. With stable and sound banking and financial systems, the possibility of simulated stress conditions and their corresponding disruptions to economic activity being realized are minimized. However, some stress conditions such as asset price bubbles may require a significant change in interest rates, which would cause material damage to other parts of the economy. Policymakers will need additional policy tools other than interest rates, particularly when faced with competing policy objectives such as price stability versus financial stability.

The stress test results reported here and those generated in the FSAP stress test[20] contribute to understanding banking system vulnerabilities. Individual banks may consider performing their own stress tests as part of a financial soundness assessment and risk management. If these stress tests are performed regularly and their results are analyzed, the tests can help assess how the various risks facing the banking system change over time and identify possible action agendas. Appling these lessons to the Philippines, a systematic macroprudential approach to the supervisory framework, coupled with continued use of analytical tools such as stress tests and better legal frameworks for regulatory development, could increase capacity to monitor potential financial vulnerabilities and mitigate risks facing the Philippine banking system.

[20] International Monetary Fund (2010).

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Appendixes

Table A-1: Selected Financial Stability Indicators for the Philippines, 2000–2008

Financial Stability Indicators	Year								Data Source
	2001	2002	2003	2004	2005	2006	2007	2008	
Regulatory capital to risk-weighted capital	15.6	16.9	17.4	18.4	17.6	18.1	15.7	15.5	CG
Regulatory Tier 1 capital to risk-weighted assets	15.6	16.9	17.5	18.4	17.8	17.7	18.8		IFS
Return on assets plus capital asset ratio divided by the standard deviation of asset returns	12.1	25.4	24.4	8.7	3.3	3.2	3.9		CG
Bank nonperforming loans to total (Gross) loans	27.7	26.5	16.1	14.4	10.3	7.5	5.8	4.5	CG
Bank return on assets	0.4	0.8	1.1	0.9	1.1	1.3	1.3	0.8	CG
Bank return on equity	3.2	5.8	8.5	7.1	8.8	10.6	10.8	6.9	CG
Interest margin to gross income	66.1	38.6	59.7	60.3	64.4	58.9	56.5	60.4	CG
Core liquid assets to total assets	9.8	8.7	12.0	15.7	20.0	30.5	32.8	26.3	BS
Broad liquid assets to total assets	11.0	10.9	13.4	39.3	44.8	52.6	53.9	46.5	BS
Bank private credit to bank deposits	67.6	62.5	60.8	60.0	55.2	49.9	50.9		CG
Liquid assets to total short term liabilities	0.96	3.07	16.18	4.59	6.55	5.36	9.62	13.78	CG
Capital to assets ratio	13.6	13.4	13.1	12.6	12	11.7	11.7	11.1	CG
Spread between reference lending and deposit rates	3.66	4.53	4.25	3.90	4.63	4.48	5.00		WDI
Customer deposits to total (non-interbank) loans	147.8	160.1	164.6	166.6	181.3	200.3	196.5		CG
Equity to assets	14.2	15.5	15.2	12.6	13.0	12.2	10.2	9.3	CG

BS = Bankscope, CG = Centennial Group, IFS = International Financial Statistics of the International Monetary Fund, and WDI = World Development Indicators of the World Bank.

Source: Authors' calculations.

Table A-2: Summary Statistics for Nonperforming Loans Ratio, Capital Adequacy Ratio, Gross Domestic Product Growth, Foreign Exchange Rate, Interest Rate, and Consumer Price Index, January 1999–June 2010

FSI Variable Name	Description	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Npl	Nonperforming loans ratio	11.68	4.10	2.97	20.41	0.06	2.57
Car	Risk-based capital adequacy ratio	16.09	1.76	11.48	20.49	–0.25	2.97
Vopi	Volume of production index (total manufacturing)	91.79	9.51	56.40	111.60	–0.89	4.36
Forex	PHP–USD foreign exchange	49.02	5.27	37.84	56.34	–0.45	2.19
Intrst	Interest rate (lending rate on all maturities)	7.61	1.91	5.00	13.61	0.98	3.81
Infl	Inflation rate (in retail prices)	5.26	2.49	0.06	12.41	0.60	3.08
Pse	Philippine stock exchange (all-shares index)	1196.20	530.59	586.50	2361.15	0.64	2.08

FSI = financial stability indicator.
Source: Authors' calculations.

Table A-3: Results of Pesaran Panel Unit Root Tests on Financial Ratios and Augmented Dickey–Fuller Tests on Time Series of Macroeconomic Variables

Variable	Deterministic Terms	Lags	Test Statistic	P-value
Npl	constant, trend	2	PPU = –2.762	0.201
Δ npl	constant	1	PPU = –6.190	0.000
Car	constant, trend	2	PPU = –2.744	0.209
Δ car	constant	1	PPU = –7.803	0.000
Vopi	Trend	1	ADF = –4.636	0.0009
Forex	Trend	2	ADF = –1.987	0.6087
Δ forex	constant	1	ADF = –6.495	0.0009
Intrst	Trend	1	ADF = –4.494	0.0015
Pse	Trend	2	ADF = –2.226	0.4751
Δ pse	constant	1	ADF = 6.677	0.0000

Car = risked-based capital adequacy ratio; Forex = PHP-USD foreign exchange; Intrst = interest rate (lending rate on all maturities); Npl = nonperforming loans ratio; Pse = Philippine stock exchange (all-shares index); Vopi = volume of production index (total manufacturing).
Source: Authors' calculations.

Table A-4a: Estimated Reduced Form Parameters of Panel Vector Autoregression Model for Predicting Nonperforming Loans Ratio

	log _vopi	infl	intrst	log_forex	log_pse	npl
L1.log_vopi	0.536	–0.807	1.273	0.024	–0.109	–0.301
	(0.81)	(1.27)	(0.02)	(0.11)	(0.30)	(1.07)
L1. Infl	0.009	1.349	0.051	0.001	0.006	–0.001
	(1.35)	(0.05)	(0.00)	(0.01)	(0.00)	(0.03)
L1. _intrst	–0.006	0.018	1.051	–0.002	0.014	0.000
	(0.02)	(1.05)	(0.00)	(0.01)	(0.00)	(0.01)
L1.log_forex	0.560	3.526	6.247	1.247	0.713	–1.319
	(3.53)	(6.25)	(1.25)	(0.71)	(1.32)	(0.98)
L1.log_pse	–0.081	0.053	0.295	0.010	0.966	–0.386
	(0.05)	(0.29)	(0.01)	(0.97)	(0.39)	(0.71)
L1.npl	0.012	0.045	–0.016	0.000	0.003	0.953
	(0.05)	(0.02)	(0.00)	(0.00)	(0.95)	(43.40)
L2.log_vopi	0.053	0.485	–0.358	–0.037	–0.005	0.112
	(0.49)	(0.36)	(0.04)	(0.00)	(0.11)	(0.40)
L2. Infl	0.008	–0.168	–0.188	0.004	–0.018	0.066
	(0.17)	(0.19)	(0.00)	(0.02)	(0.07)	(0.88)
L2. _intrst	–0.003	–0.001	–0.245	0.000	–0.001	–0.090
	(0.00)	(0.24)	(0.00)	(0.00)	(0.09)	(1.47)
L2.log_forex	–0.388	–4.861	–0.600	–0.444	–0.570	0.260
	(4.86)	(0.60)	(0.44)	(0.57)	(0.26)	(0.11)
L2.log_pse	0.170	–0.355	–1.155	0.004	–0.002	–0.234
	(0.36)	(1.16)	(0.00)	(0.00)	(0.23)	(0.31)
L2.npl	–0.024	–0.048	–0.093	–0.001	–0.012	0.036
	(0.05)	(0.09)	(0.00)	(0.01)	(0.04)	(1.51)
L3.log_vopi	0.054	1.382	–0.226	0.014	–0.115	–0.940
	(1.38)	(0.23)	(0.01)	(0.11)	(0.94)	(2.50)
L3. Infl	–0.023	–0.273	0.093	–0.003	0.007	–0.070
	(0.27)	(0.09)	(0.00)	(0.01)	(0.07)	(1.64)
L3. _intrst	0.013	0.017	0.088	–0.001	–0.005	0.138
	(0.02)	(0.09)	(0.00)	(0.01)	(0.14)	(2.43)
L3.log_forex	–0.129	1.376	–5.309	0.142	0.053	1.007
	(1.38)	(5.31)	(0.14)	(0.05)	(1.01)	(0.57)
L3.log_pse	–0.110	0.680	0.882	–0.035	0.022	0.367
	(0.68)	(0.88)	(0.04)	(0.02)	(0.37)	(0.84)
L3.npl	0.014	–0.004	0.101	0.000	0.008	–0.010
	(0.00)	(0.10)	(0.00)	(0.01)	(0.01)	(0.57)

forex = PHP-USD foreign exchange; infl = inflation rate (in retail prices); intrst = interest rate (lending rate on all maturities); npl = nonperforming loans ratio; pse = Philippine stock exchange (all-shares index); vopi = volume of production index (total manufacturing).
Notes: T statistics in parentheses. All variables were demeaned for estimation purposes.
Source: Authors' calculations.

Table A-4b: Estimated Reduced Form Parameters of Panel Vector Autoregression Model for Predicting Capital Adequacy Ratio

	log _vopi	infl	intrst	log_forex	log_pse	car
L1.log_vopi	0.622	–0.940	0.721	–0.025	–0.150	0.827
	(8.93)	(1.61)	(1.66)	(2.44)	(3.43)	(1.46)
L1. Infl	0.027	1.616	0.129	0.003	–0.005	–0.131
	(2.52)	(24.76)	(1.89)	(1.81)	(0.81)	(1.38)
L1. _intrst	–0.001	0.035	0.923	–0.004	0.006	–0.033
	(0.14)	(0.72)	(13.30)	(2.90)	(1.05)	(0.48)
L1.log_forex	1.321	4.606	4.062	1.393	–0.339	–5.293
	(2.37)	(1.74)	(1.97)	(25.42)	(0.97)	(1.05)
L1.log_pse	0.115	0.548	0.759	0.035	0.813	–0.647
	(1.39)	(0.81)	(1.37)	(1.67)	(12.38)	(0.96)
L1.car	0.006	0.021	0.007	0.002	0.006	0.948
	(0.95)	(0.38)	(0.13)	(2.17)	(1.13)	(33.34)
L2.log_vopi	0.125	0.996	–0.154	0.003	–0.051	–1.173
	(1.44)	(1.31)	(0.35)	(0.24)	(1.24)	(1.41)
L2. Infl	–0.024	–0.632	–0.307	0.000	0.012	0.264
	(1.32)	(5.70)	(2.35)	(0.13)	(1.21)	(1.56)
L2. _intrst	–0.004	0.011	–0.130	0.003	0.004	–0.021
	(0.41)	(0.16)	(0.99)	(1.33)	(0.59)	(0.22)
L2.log_forex	–2.072	–8.106	–2.006	–0.533	1.182	2.866
	(2.26)	(1.94)	(0.60)	(6.20)	(1.95)	(0.35)
L2.log_pse	–0.103	–1.353	–1.433	0.039	0.254	0.217
	(0.86)	(1.29)	(1.63)	(1.52)	(3.56)	(0.21)
L2.car	–0.014	–0.039	–0.099	0.000	–0.007	0.001
	(1.68)	(0.52)	(1.32)	(0.10)	(1.00)	(0.05)
L3.log_vopi	–0.079	0.997	–0.301	0.030	–0.124	–0.008
	(0.88)	(1.89)	(0.78)	(2.58)	(2.67)	(0.01)
L3. Infl	–0.007	–0.059	0.146	–0.002	–0.012	–0.121
	(0.78)	(0.90)	(1.85)	(0.81)	(2.01)	(1.31)
L3. _intrst	0.013	–0.033	0.089	–0.001	–0.002	0.054
	(2.18)	(0.83)	(0.77)	(1.08)	(0.52)	(0.89)
L3.log_forex	0.814	3.683	–1.812	0.063	–0.517	2.925
	(1.77)	(1.66)	(0.83)	(1.04)	(1.75)	(0.69)
L3.log_pse	–0.035	1.142	0.545	–0.091	–0.067	0.128
	(0.40)	(1.32)	(0.92)	(4.51)	(1.01)	(0.20)
L3.car	0.010	–0.004	0.080	–0.002	0.002	–0.035
	(1.84)	(0.08)	(1.43)	(1.25)	(0.47)	(1.29)

car = capital adequacy ratio; forex = PHP-USD foreign exchange; infl = inflation rate (in retail prices); intrst = interest rate (lending rate on all maturities); pse = Philippine stock exchange (all-shares index); vopi = volume of production index (total manufacturing).
Notes: T statistics in parentheses. All variables were demeaned for estimation purposes.
Source: Authors' calculations.

Table A-5a:Forecast Error Variance Decomposition of Panel Vector Autoregression Model for Predicting Nonperforming Loans Ratio

Variable Predicted	Month	log _vopi	infl	intrst	log_forex	log_pse	npl
Npl	1	0.012874	4.64E-05	0.026866	2.18E-05	0.004132	0.95606
Npl	2	0.00886	2.45E-05	0.026599	0.001102	0.00794	0.955473
Npl	3	0.006858	0.000873	0.018589	0.004389	0.015719	0.953571
Npl	4	0.007576	0.001222	0.016152	0.008144	0.022693	0.944213
Npl	5	0.010153	0.001569	0.019349	0.012729	0.027158	0.929042
Npl	6	0.011686	0.001472	0.027254	0.015517	0.031952	0.912119
Npl	7	0.012298	0.001284	0.036743	0.016637	0.036597	0.896441
Npl	8	0.012406	0.001135	0.046152	0.016884	0.040548	0.882875
Npl	9	0.012335	0.001044	0.055311	0.01682	0.043885	0.870605
Npl	10	0.012173	0.000987	0.064145	0.01669	0.046853	0.859152
Npl	11	0.011961	0.000941	0.072495	0.016565	0.049702	0.848336
Npl	12	0.01171	0.000898	0.080217	0.016481	0.052544	0.83815

forex = PHP-USD foreign exchange; infl = inflation rate (in retail prices); intrst = interest rate (lending rate on all maturities); npl = nonperforming loans ratio; pse = Philippine stock exchange (all-shares index); vopi = volume of production index (total manufacturing).
Source: Authors' calculations.

Table A-5b: Forecast Error Variance Decomposition of Panel Vector Autoregression Model for Predicting Capital Adequacy Ratio

Variable Predicted	Month	log _vopi	infl	intrst	log_forex	log_pse	car
Car	1	0.003271	0.004711	0.045691	0.001085	0.003759	0.941483
Car	2	0.001908	0.003253	0.041213	0.002726	0.008031	0.942868
Car	3	0.001701	0.002307	0.036084	0.008329	0.012737	0.938842
Car	4	0.001971	0.002014	0.034233	0.01247	0.01974	0.929572
Car	5	0.002657	0.002167	0.034589	0.013701	0.027569	0.919318
Car	6	0.002958	0.002423	0.035415	0.013613	0.034057	0.911534
Car	7	0.002935	0.002781	0.036193	0.013031	0.038999	0.906061
Car	8	0.002768	0.003422	0.036734	0.012374	0.042696	0.902006
Car	9	0.002658	0.004657	0.037047	0.011786	0.045553	0.8983
Car	10	0.002668	0.006812	0.037176	0.011324	0.047902	0.894118
Car	11	0.002814	0.01011	0.037179	0.010994	0.049938	0.888965
Car	12	0.003139	0.014583	0.03708	0.010782	0.051785	0.882632

car = capital adequacy ratio; forex = PHP-USD foreign exchange; infl = inflation rate (in retail prices); intrst = interest rate (lending rate on all maturities); pse = Philippine stock exchange (all-shares index); vopi = volume of production index (total manufacturing).
Source: Authors' calculations.

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