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Credit Risk and Profitability of ASEAN Commercial Banks: Granger Causality Test

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Abstract

The purpose of this research is to study the profitability and credit risk causality of ASEAN commercial banks. Using data from 118 ASEAN commercial banks from 2002 to 2017, we measure profitability by the ratio of net return to assets (ROA) and net return to equity (ROE). Banking credit risk is measured by the ratio of loan loss provision to assets (LLP). We set up panel vector autoregression (PVAR) to estimate this relationship. Our results indicates that there is a two-way causal relationship between ASEAN bank's profitability measured by (ROA) and credit risk. Meanwhile, there is an only one-way relationship between profitability by ROE on credit risk and the opposite direction does not occur. Our results support the "bad management", "skimping" and "moral hazard" hypotheses of Berger and DeYoung (1997). The results of this study are the basis for providing information for executives managers to improve the bank's profitability while ensuring safety.

Keywords: *ASEAN, Bank Profitability, Credit Risk, PVAR.*

INTRODUCTION

The ASIAN countries experienced a prolonged severe financial crisis followed by a deep recession in 1997 and were affected by the financial crisis in the US in 2008 (Sufian, 2010). Profitability and credit risk is a key issue that bank managers always pay attention. Bank profitability is often traded off by banks' fragility. In the context of ASEAN countries, after the 2008 financial crisis, the rapid growth of bank mergers and acquisitions led to changes in the banking and financial structure such as financial integration, privatization and deregulation, financial reform and foreign banking penetration. Furthermore, investment banks, mutual funds, and insurance companies are now competing with the core business of commercial banks (Sufian, 2010).

In this context, the profitability and credit risk are very important for the existence and development of commercial banks. Therefore, the relationship between profitability and credit risk has always attracted academics around the world in recent years (Fu et al., 2014; Tan, 2016; Kasman and Carvallo, 2014). However, most studies evaluate the one-way effect between profitability and credit risk such as (Berger and DeYoung, 1997; Fiordelisi et al., 2011; Schaeck and Cihák, 2014). The causal relationship between profitability and credit risk has been studied in Africa (Radić et al., 2011), America (Kasman and Carvallo, 2014) or

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Asia in China's financial markets (Tan and Floros, 2018). Research on this topic in ASEAN emerging markets is scarce. Therefore, the study of the causal relationship between profitability and credit risk in ASEAN commercial banks is very important and valuable.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Profitability and credit risk in the banking system are identified endogenously, which are interrelated. Because they are both a driving force for banks to improve efficiency and also a factor affecting the financial health of the banking system (Fiordelisi et al., 2011; Tan, 2016). If an investor does not expect to receive a return commensurate with the credit risk premium, who will not invest in a credit risk portfolio. In other words, these discussions are not intended to answer the question of why a bank cannot achieve maximum profitability in terms of credit risk operating environment. The relationship between credit risk and bank performance was first studied by Berger and DeYoung (1997), and later by Koutsomanoli-Filippaki et al. (2009) developed.

Impact of credit risk on profitability

Research by Berger and DeYoung (1997) builds the "bad luck" hypothesis suggests that an increase in bad debt will reduce bank efficiency and lead to a decline in profitability. There is a causal relationship between them. At this time, the increase in bad debt is due to bad influences from the economic environment such as inflation, poor growth from the economy, unemployment, unstable interest rate, and increased money supply. Commercial banks must strengthen their management tight credit portfolio, and loans near maturity. Banks have to pay an expense for management activities such as debt monitoring and collection, proactive bad debt management, and debt sale. From here, the cost efficiency is reduced, affecting the profitability of the bank. With the above argument, the author hypothesizes: H_1: The change in credit risk is the cause of the change in profitability

The Impact of Profitability on Credit Risk

The goal of maximizing profitability should be easily influenced at all costs achieved, leading to commercial banks being exposed to many risks. Research by Berger and DeYoung (1997) builds the hypothesis of "bad management" and suggests that low bank efficiency leading to reduced profitability is a signal of weak business administration performance and There is a causal relationship (Granger–cause) causing high NPLs. Expectations in this relationship are negative between bad debt and bank profitability. That is, low-cost efficiency, and declining profitability are signals of poor governance in terms of loan portfolio management, credit monitoring, operating cost management, etc.; Besides, the lack of strict control and monitoring of expenses from managers should lead to a decrease in efficiency and an increase in bad debt groups.

In addition to proposing the "bad management" hypothesis, the study of Berger and DeYoung (1997) also builds the "skimping" hypothesis and suggests that a bank wants to maximize profitability in long-term, its must choose to cut costs in the short-term (such as skipping the cost of credit appraisal, monitoring loans, etc.), so they have to bear the consequences of bad debts appearing in the future. At this time, bank efficiency is higher, bank profitability will increase, but in the long run, it will adversely affect credit quality and form bad debts. This negative relationship is thought to be the trade-off of future loan performance (i.e., expected long-term profitability maximization) for short-run bank cost efficiency. Here, the bank's key decision lies in the conflict between short-term operating costs and loan quality issues.

Contrary to the "skimping" hypothesis of Berger and DeYoung (1997), the "risk-averse management" hypothesis by Koutsomanoli-Filippaki et al. (2009) argued that senior executives often tend to avoid risks, thus increasing costs for monitoring, controlling, and guaranteeing loans to reduce bad debts. Therefore, the concern about the effects of the financial crisis and asymmetric information explains the relationship to be in the same direction, meaning that the cost-effectiveness increases proportionally with the rate of increase of the impact profitability to reduce the bad debt ratio positively.

Finally, the "moral hazard" hypothesis refers to the conflicting relationship between credit risk and bank profitability and that low-capital banks often have an incentive to invest in risky assets and the long run, the credit risk will increase. Therefore, banks with relatively low capital will be the cause of inefficient loans. Conversely, high-capital banks often do not face ethical risk or ineffective loans. Meanwhile these loans assess the cost-effectiveness. This, showing that the inefficiency in terms of costs will lead to a decline in profitability is the basis for increasing banking risks in the future. Based on the above reasoning, this chapter proposes the following hypothesis:

H_2: The change in profitability will be the cause of the change in credit risk

METHOD

Data

Data of studies are taken from the bank scope's source. To avoid frequency, we consider the consolidated financial report. We filter the data as commercial banks, including listed and unlisted banks, and eliminate banks with less than five reporting years and those with the latest reporting year smaller than 2016. After cleaning the data, the final sample included 118 commercial banks in eight countries: Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam, between 2002 and 2017. It is unanimously converted to USD currency at the local currency/USD exchange rate from the IMF source.

Calculation Based on Profitability and Credit Risk

Bank profitability is measured by ROA and ROE (Athanasoglou et al., 2008, Tan, 2016), in particular:

$$\text{ROA} = \frac{\text{Net profit}}{\text{Total assets}}, \text{ and ROE} = \frac{\text{Net profit}}{\text{Total equity}}$$

Based on financial statement data, credit risk is measured by the loan loss provision ratio (LLP) (Fu et al., 2014; Tan and Floros, 2013), and it is determined as follows:

$$\text{LLP} = \frac{\text{Loan loss provision}}{\text{Total assets}}$$

Panel Vector Autoregression Model-PVAR

We consider the causal relationship between profitability and credit risk through a system of the PVAR model. The two variables included in the model are profitability and credit risk, and lags of the two variables in which the short-term dynamic relationship is defined (Delis et al., 2017; Fiordelisi et al., 2011).

Following Berger and DeYoung (1997) and Delis et al. (2017), the dynamic relationship between endogenous variables is shown in the PVAR asset with $Z_{i,t} = [Pro_{i,t}, LLP_{i,t}]'$ as a vector of k endogenous variables for bank i at time t. The dynamic relationship between endogenous variables is shown in the equation: $Z_{i,t} = A_{0i} + A\ell z_{t-1} + u$ (1)

Where, A_{0i} is a (k × 1) time constant intercept vector for each specific bank, $A\ell z_{t-1}$is the matrix (k × k) of the coefficients of lagged variables (parameters for estimation), $A(\ell) = \sum_{j=1}^{p} A_j \ell^{j-1}$ to collect the partial and cross-sectional effects of the dependent variable lags in the observations. u is a (1×k) vector of measurement errors with the characteristic:

$$E(e_{it}) = 0, E(e_{it}e'_{it}) = \sum e, E(e_{it}e'_{it}) = 0 \text{ for all } t$$

The coefficient of A_{0i} in eq. (1) is correlated with the error part. Therefore, to solve the above problem, especially in panel data with many observations with few time points, the GMM estimation and the lag of observations are used as instrumental variables.

After performing the regression system PVAR equation, we estimate the impulse response functions (IRF) and analyze the variance (VDC) to determine the orthogonal shocks between the variable profitability and credit risk. We use the IFR to assess the current and future response of profitability to shocks to credit risk and vice versa. VDC is calculated as the percentage change in proportion explained by the credit risk shock over time and vice versa.

Approach to the research of của Kasman and Carvallo (2014) and Saeed and Izzeldin (2016), we determine the causal relationship between profitability and credit risk according to the system of PVAR equations at the same time proposed as follows:

$$Pro_{it} = f(\alpha, Pro_{(i,lag)}, LLP_{(i,lag)}, u) \quad (2)$$

$$LLP_{it} = f(\beta, LLP_{(i,lag)}, Pro_{(i,lag)}, u) \quad (3)$$

Where, Pro is the bank's profitability. The LLP is the loan loss provision ratio representing credit risk, i is the bank, lag is the number of lag orders (lag = 1,...j), t is the time (t = 2002,...2017, u is the remainder.

RESULTS AND DISCUSSION

Profitability and Credit Risk Results

Table 1 statistics describes the observed variables (Obs), mean (Mean), standard deviation (std. Dev), min (Min), and maximum (Max) of the banks. Table 1 shows that the average value of profitability with ROA and ROE is 0.017 and 0.558, much lower than 1.54 (ROA) and 10.75 (ROE) in Indonesia, 1.24 (ROA) and 9.68 (ROE) in Malaysia 2011-2015 (Moudud-Ul-Huq et al., 2018). Besides, the credit risk of ASEAN commercial banks at 0.03 is similar to the study by Fu et al. (2014) has an LLP of 0.16 in Asian commercial banks.

Table 1: Statistics Describe the Variables for ASEAN Banks

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	1,761	0.017	0.052	-0.052	1.568
ROE	1,761	0.558	0.281	-4.099	0.911
LLP	1,761	0.036	0.489	0.000	20.397

Note: LLP is loan loss provision ratio; ROA and ROE are Profitability.

PVAR Model Results

To implement the regression PVAR model, it is necessary to choose the optimal lag length of the independent variable in the system of Eq. (2) and (3). We choose the delay length so that the minimum values of MBIC, MAIC, MQIC, and CD are maximum. The results in Table 2 show that the optimal delay length is 1, similar to Hou et al. (2018).

Table 2. Optimal lag length selection for PVAR model on estimation sample

lag	CD	J	J p value	MBIC	MAIC	MQIC
1	0.4248	.	.	.	.	.
2	-0.2405	.	.	.	.	.
3	-15.496	.	.	.	.	.
4	0.0779	.	.	.	.	.

Note: The values of MBIC, MAIC, and MQIC are minimum, and CD is maximum

For the PVAR estimation, a necessary condition to perform the analysis of the values obtained from the model is necessary to check the stability of the variables. In this study using unbalanced panel data, the Fisher 3 Phillips-Perron (PP) base unit test is consistent with the hypothesis H0 that all panel data are unstable. The ADF test is usually very sensitive to the choice of lag length, so the optimal lag length criterion is obtained from the results of Table 1. The results of the Fisher Phillips-Perron unit root test in Table 2 show that all three variables ROA, ROE, and LLP have been tested with p-values with significance below 5%. Therefore, we reject hypothesis H0 and assert that all panel data are not balanced with ROA, ROE and LLP are stationary. PVAR satisfies the stationary condition.

Table 3: Fisher-Type Unit Root Test for ROA, ROE, and LLP

Inverse chi-squared (246)		**Statistic**	**p-value**
Inverse normal			
	P	1,114.597	0.000
	Z	-20.557	0.000
Inverse logit t (619)	L*	-26.365	0.000
Modified inv. chi-squared	Pm	39.159	0.000
ROE			
Inverse chi-squared (246)	P	809.897	0.000
Inverse normal	Z	-12.486	0.000
Inverse logit t (619)	L*	-16.787	0.000
Modified inv. chi-squared	Pm	25.422	0.000
LLP			
Inverse chi-squared (246)	P	786.336	0.000
Inverse normal	Z	-11.352	0.000
Inverse logit t (619)	L*	-16.088	0.000
Modified inv. chi-squared	Pm	24.360	0.000

Note: lag length is one; base on Dickey-Fuller test.

The results of Table 4 show that the absolute value of the characteristic solution inverse is within the unit circle (see Figure 1 and 2), so it can be concluded that the variables in the unbalanced panel data are stable. Pvar satisfies stability condition.

Table 4. Eigenvalue Stability Condition in PVAR

Eigenvalue Real	Imaginary	Modulus
Model: ROA and LLP		
.688	0	.6881
-.478	0	.4784
Model: ROE and Z score		
0.758	0	0.758
-0.120	0	0.120

Note: The stability condition of PVAR when all the eigen values lie inside the unit circle (see Figure 1 and 2)

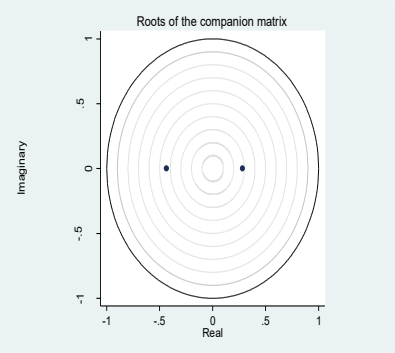

Figure1. Stability condition of PVAR: ROA and LLP

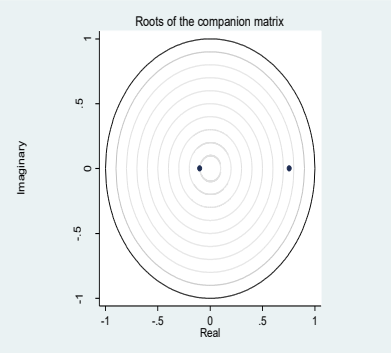

Figure2. Stability condition of PVAR: ROE and LLP

Table 5 presents the results of estimating the Granger causality between profitability and credit risk of Asean commercial banks, with the model (1) column (2) showing the Granger causality between ROA and LLP; model (2) column (3) shows the Granger causality between ROE and LLP.

Table 5. Analysis of Granger causality, model (1) between ROA and LLP; model (2) between ROE and LLP

Variable	ROA	ROE
	Mô hình (1)	Mô hình (2)
ROA_{t-1}	-0.436***	
	[-2.91]	
LLP_{t-1}	0.00952***	0.0113
	[11.07]	[1.48]
ROE_{t-1}		0.105
		[0.85]
LLP		
ROA_{t-1}	0.0850***	
	[3.49]	
LLP_{t-1}	0.281***	0.042
	[11.01]	[1.54]
ROE_{t-1}		-0.140**
		[-2.22]
N	1512	1512
Hansen's J $chi^2(24)$	32.698	32.356
p-value	0.111	0.118

Note: This table presents PVAR estimates with (1) the Granger causality between ROA and LLP variables; (2) the Granger causality between between ROE and LLP. The symbols *, ** and *** represent significance at 10%, 5%, and 1%. PVAR-Granger causality Wald test: H0 is excluded variable does not Granger-cause equation variable, H1 is excluded variable with the Granger-causes equation variable.

An interesting thing about this research result, in the model (1), column (2) Table 5 shows that the increase in credit risk is the cause for the increase in profitability by ROA with a 1% significance level. In contrast, an increase in ROA profitability also increases credit risk at a 1% significance level. That is, there is a positive causal relationship between profitability measured by ROA ratio and credit risk measured by credit risk provision ratio to total assets (LLP) together. This result is consistent with the proposed research hypotheses H1 and H2.

Besides, in model (2) column (3) Table 5 shows that the change of credit risk does not change ROE profitability. In contrast, the change in ROE profitability is the cause of the change in credit risk. That is, when ROE is reduced, credit risk will increase at a 5% significance level. This result is consistent with hypothesis H2, supporting the hypothesis of bad management, "skimping" and "moral hazard" of Berger and DeYoung (1997), similar to the study of Duho et al. (2020), and Abdelaziz et al. (2020). Thus, this result indicates that there is no causal relationship between the ratio of the net return on equity (ROE) and credit risk as measured by the loan loss provision ratio to total assets ratio (LLP). This is a sign of attention in the management of bank administrators.

Impulse Response Functions and Variance Decompositions (IRFs and FEVD)

Estimating through the PVAR model also analyzes the IRFs repulsion function along with the decaying variance matrix (FEVDs). For the IRF push-response function, a shock to the credit risk ratio results in a slight change in ROA profitability at the first stage, then gradually disappears in the subsequent stages (lower left corner of Figure 3.a). In

contrast, the ROA profitability shock remained unaffected by credit risk at all stages (upper right corner of Figure 3.a).

Meanwhile, a shock to credit risk ratio slightly reduces profitability by ROE in the first stage and is not affected in subsequent periods (bottom right corner of Figure 3.b). In contrast, the shock to profitability by ROE remained unaffected by credit risk at all stages (top right corner of Figure 3.b).

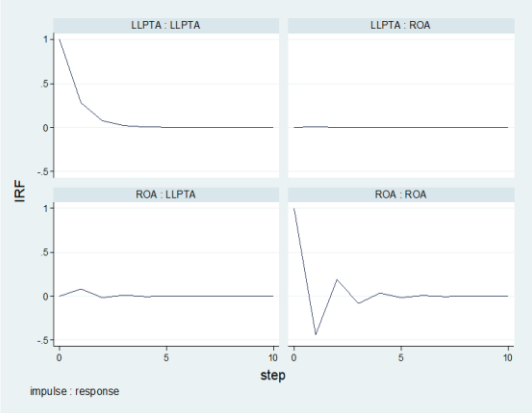

Figure 3. (a) Impulse–responses functions for one lag VAR of ROA and LLP

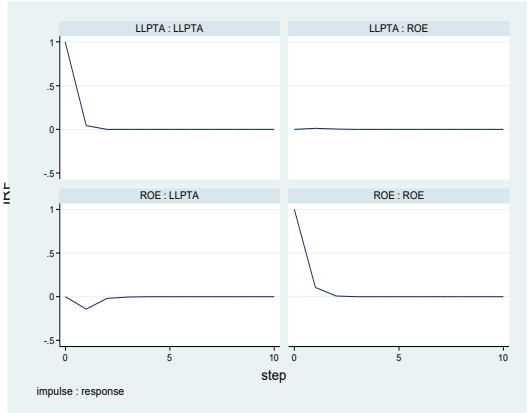

Figure 3. (b) Impulse–responses functions for one lag VAR of ROE and LLP

The results of Table 6 analysis of variance analysis are shown in detail: The change in profitability ROA and ROE are explained by the LLP of 0% for the first period, respectively; and about 0.008% and 0.001% for subsequent periods. In the opposite direction, the change in LLP is explained by the change in profitability by ROA at only 0.001% in all stages; While the profitability by ROE in the first stage is 0.001% and increases to 0.003% in the following stages.

Table 6. Forecast Variance Decomposition for Impulse Variable: ROA and LLP; ROE and LLP

Response variable and Forecast horizon	Model (1): ROA and LLP		Response variable and Forecast horizon	Model (2): ROE and LLP	
	Impulse variable			Impulse variable	
	ROA	LLPTA		ROE	LLPTA
ROA			ROE		
0	0	0	0	0	0
1	1	0	1	1	0
2	0.992	0.008	2	0.999	0.001
3	0.992	0.008	3	0.999	0.001
4	0.992	0.008	4	0.999	0.001
5	0.992	0.008	5	0.999	0.001
6	0.992	0.008	6	0.999	0.001
7	0.992	0.008	7	0.999	0.001
8	0.992	0.008	8	0.999	0.001
9	0.992	0.008	9	0.999	0.001
10	0.992	0.008	10	0.999	0.001
LLPTA			LLPTA		
0	0	0	0	0	0
1	0.001	0.999	1	0.001	0.999

2	0.001	0.999	2	0.003	0.997
3	0.001	0.999	3	0.003	0.997
4	0.001	0.999	4	0.003	0.997
5	0.001	0.999	5	0.003	0.997
6	0.001	0.999	6	0.003	0.997
7	0.001	0.999	7	0.003	0.997
8	0.001	0.999	8	0.003	0.997
9	0.001	0.999	9	0.003	0.997
10	0.001	0.999	10	0.003	0.997

Source: Authors synthesize themselves

CONCLUCION

The article studies the causal relationship between profitability and credit risk of Southeast Asian commercial banks. The author measures profitability by the net return on total assets ratio (ROA) and the net return on equity ratio (ROE). Bank credit risk is measured by the loan loss provision to total assets (LLP). The study uses the PVAR method to estimate this cause-and-effect relationship. The author chooses a lag of 1 for the research model, the results show that there is a positive causal relationship between profitability (ROA) and credit risk. Meanwhile, profitability (ROE) and credit risk have no causal relationship. That is, there is only a negative impact of profitability (ROE) on credit risk and vice versa, the research results did not find any evidence.

IRFs and FEVD indicate that the causal relationship between profitability and credit risk is quite close for Asean commercial banks. The shock to credit risk will change the profitability to decrease and increase slightly in the first stage, then not affect in the next stages. Similarly, when there is a shock to profitability ROA and ROE but credit risk remain unaffected by all periods. In addition to providing empirical evidence for the causal relationship between profitability and credit risk of Southeast Asian commercial banks, the article has some policy implications for bank administrators. Firstly, well control costs, closely monitor the lending stage; Pay attention to the profitability of risky assets, thereby having appropriate lending policies to improve profits while ensuring safety. Second, consider cutting costs (supervisory costs, borrower screening, appraisal costs, etc.) to achieve short-term profitability with future credit risks. Third, bank administrators continue to make financial soundness, and identify potential credit risks in banks.

REFERENCES

Abdelaziz, H., Rim, B. & Helmi, H. (2020). The interactional relationships between credit risk, liquidity risk and bank profitability in mena region. *Global Business Review*, 23(3), 561-583.

Athanasoglou, P. P., Brissimis, S. N. & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money,* 18, 121-136.

Berger, A. N. & Deyoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance,* 21, 849-870.

Delis, M., Iosifidi, M. & Tsionas, M. G. (2017). Endogenous bank risk and efficiency. *European Journal of Operational Research,* 260, 376-387.

Duho, K. C. T., Asare, E. T., Owodo, R. A., Onumah, R. M. & Onumah, J. M. (2020). Bank risk, profit efficiency and profitability in a frontier market. *Journal of Economic and Administrative Sciences,* 36, 381-402.

Fiordelisi, F., Marques-Ibanez, D. & Molyneux, P. (2011). Efficiency and risk in European banking. *Journal of Banking & Finance,* 35, 1315-1326.

Fu, X. M., Lin, Y. R. & Molyneux, P. 2014. Bank competition and financial stability in Asia Pacific. *Journal of Banking & Finance,* 38, 64-77.

Hou, X., Li, S., Li, W. & Wang, Q. (2018). Bank diversification and liquidity creation: Panel Granger-causality evidence from China. *Economic Modelling,* 71, 87-98.

Kasman, A. & Carvallo, O. (2014). Financial stability, competition and efficiency in Latin American and Caribbean banking. *Journal of Applied Economics,* 17, 301-324.

Koutsomanoli-Filippaki, A., Margaritis, D. & Staikouras, C. 2009. Efficiency and productivity growth in the banking industry of Central and Eastern europe. *Journal of Banking & Finance,* 33, 557-567.

Moudud-Ul-Huq, S., Ashraf, B. N., Gupta, A. D. & Zheng, C. (2018). Does bank diversification heterogeneously affect performance and risk-taking in Asean emerging economies? *Research in International Business and Finance,* 46, 342-362.

Radić, Riordelisi, Rirardone, R. (2011). *Price competition, efficiency and riskiness in investment banking*. Centre for Emea Banking Finance and Economics Working Paper Series, 2011 (07), 1-27.

Saeed, M. & Izzeldin, M. (2016). Examining the relationship between default risk and efficiency in Islamic and conventional banks. *Journal of Economic Behavior & Organization,* 132, 127-154.

Schaeck, K. & Cihák, M. (2014). Competition, efficiency, and stability in banking. *Financial Management,* 43, 215-241.

Sufian, F. (2010). The impact of the Asian financial crisis on bank efficiency: The 1997 experience of Malaysia and Thailand. *Journal of International Development,* 22, 866-889.

Tan, Y. (2016). The impacts of risk and competition on bank profitability in China. *Journal of International Financial Markets, Institutions and Money,* 40, 85-110.

Tan, Y. & Floros, C. (2013). Risk, capital and efficiency in Chinese banking. *Journal of International Financial Markets, Institutions and Money,* 26, 378-393.

Tan, Y. & Floros, C. (2018). Risk, competition and efficiency in banking: Evidence from China. *Global Finance Journal,* 35, 223-236.