Jurnal Ekonomi Malaysia 52(1) 2018 3 - 13
http://dx.doi.org/10.17576/JEM-2018-5201-1

Market Risk and Efficiencies of the Malaysian Banking Industry: The Post-merger and Acquisition

(Risiko Pasaran dan Kecekapan Industri Bank Malaysia: Pasca Penggabungan dan Pengambilalihan)

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ABSTRACT

This paper examines the effects of cost and profit efficiencies on post-merger bank market risk. We use Stochastic Frontier Analysis to estimate cost and profit efficiencies, and Value at Risk and Expected Shortfall to calculate the market risks. We measure the effects in panel analysis using data from banks listed on the Bursa Malaysia over the 2000–2015 period. The results show that the post-merger banks can sustain the market risk exposure from the global financial crisis. The increase in cost and profit efficiency increase the market risk. The findings could be used for the bank regulators and managers to focus on the efficiency-related initiatives to manage the market risk better.

Keywords: Malaysian bank; market risk; Stochastic Frontier Analysis; logit

ABSTRAK

Artikel ini mengkaji kesan kecekapan kos dan kecekapan keuntungan terhadap risiko pasaran era pasca penggabungan bank. Kami menggunakan Analisa Sempadan Stokastik (SFA) untuk menganggarkan kos dan kecekapan keuntungan, Nilai Beriisiko (VaR) dan Kekurangan Dijangka (ES) untuk mengira risiko pasaran. Kami mengukur kesan dalam analisis panel menggunakan data dari bank-bank yang tersenarai di Bursa Malaysia sepanjang tempoh 2000-2015. Hasil kajian menunjukkan bahawa bank-bank pasca penggabungan mampu mengekang pendedahan risiko pasaran dari kesan krisis kewangan global. Peningkatan kecekapan kos dan kecekapan keuntungan meningkatkan risiko pasaran. Penemuan ini boleh digunakan oleh pengawal selia bank dan pengurus bank untuk memberi tumpuan kepada inisiatif berkaitan kecekapan untuk pengurusan risiko pasaran yang lebih baik.

Kata kunci: Bank; risiko pasaran; Analisa Sempadan Stokastik (SFA); logit

INTRODUCTION

Following the Asian financial crisis (1997 – 1998), Bank Negara Malaysia (BNM) announced the merger plans for the finance companies in Malaysia in January 1998. One of the lessons learned from the crisis is that smaller banks are more vulnerable to crisis compared to a larger bank. The objective of the merger is to create stronger, effective, competitive and well capitalised domestic banks that can serve the domestic demands, withstand the future challenge arising from globalisation and liberalisation and contribute to sustainable economic growth[1]. Fast forward to 2002; ten banks were granted anchor bank status. Since then, (i) Multi Purpose Bank Berhad had become Alliance Bank Malaysia Berhad in 2001, (ii) Southern Bank Berhad was acquired by CIMB Group Holdings Berhad in 2007, and (iii) Eon Bank Berhad was acquired by Hong Leong Bank Berhad on 2011 (refer to Table 1 for the list of financial institutions).

TABLE 1. List of Post-Merger Financial Institutions

	Malaysia
1	Affin Holdings Berhad
2	Alliance Financial Group Berhad
3	Ambank (M) Berhad
4	CIMB Group Holdings Berhad
5	Hong Leong Bank Berhad
6	Malayan Banking Berhad - Maybank
7	Public Bank Berhad
8	RHB Capital Berhad

Since the global financial crisis, banking supervisors have realised the need to reform the market risk management in banks (Tian 2017). The Basel Committee on the Banking Supervision (BCBS) issued the revisions to the Basel II market risk framework

in 2011 to strengthen the market risk management of the banking sector (BCBS 2011). According to Berger, Hunter, and Timme (1993), when banks are having high levels of efficiency, the savings from the efficiency can be easily directed towards improving capital buffers. Thus, it will be able to absorb more risk, create higher safety and strengthen the banking industry. As the merger exercise is expected to be more resilient to risk, benefit from the economies of scale (Mohd Said et al. 2008) and improve efficiency (Othman et al. 2017), it is interesting to examine if the post-merger Malaysian banks are more efficient and resilient to the market risk.

Since the BCBS introduced Value at Risk (VaR) in 1996 (BCBS 1996), VaR has become the commonly used method to measure the bank market risk. In 2016, BCBS proposed using the Expected Shortfall (ES) as the latest measurement method to measure the bank market risk (BCBS 2016). ES can capture comprehensive information on the tail risk as highlighted after the financial market crisis. Since only a few researchers have examined the effects of bank market risk using both VaR and ES methods, there is a need to examine the differences between both methods empirically.

In addition, the cost and profit efficiencies are closely related to the banking scenario since banks strive to increase their revenue through a reduction in cost and increase in profits. According to Delis et al. (2009), despite there being many studies on bank efficiency, only a few researchers have examined efficiency using both cost and profit efficiencies measures. Furthermore, comparing between both cost and profit efficiencies facilitates comprehending the relationships between each other, whether it is a complementary or substitution relationship (Aiello & Bonanno 2013). The use of both types of efficiencies gives a complete assessment of the bank's performance (Kasman & Yildirim 2006).

This paper examines the effect of cost and/or profit efficiencies on bank market risk for the eight post-merger banks in Malaysia for the 2000–2015 period. The cost and profit efficiencies are constructed using Stochastic Frontier Analysis (SFA) and bank market risk by Value at Risk (VaR) and Expected Shortfall (ES). Our results show that the post-merger banks can sustain the market risk that occurred around the global financial crisis period. In addition, the increase in cost and profit efficiencies increase the market risk. The finding proves that the BNM consolidation program for the domestic banks has positive impacts on the Malaysian banking sector.

This study contributes in the following ways: (i) it uses VaR and ES method as the market risk measurement, (ii) the use of cost and profit efficiency in the SFA and (iii) extends Mohd Said et al. (2008) and Sufian's (2009) studies in terms of the sample period (2000 until 2015). By constructing the model, this article fills the gap in the empirical literature and presents new insights into how cost and profit efficiencies affect the post-merger Malaysian bank market risk. This article is structured as follows. Section II briefly reviews the related literature on post-merger and acquisition banks in Malaysia. Section III explains the development of the models (VaR and ES, Cost and profit efficiency, and Market Risk Model). Section IV presents the results and discussion. Section V summarises the conclusion while Section VI highlights the implication of the study.

LITERATURE REVIEW

The bank mergers and acquisitions in Malaysia in the late 1990s and early 2000s was pushed by BNM to strengthen the banking industry that was highly fragmented with a large number of small finance institutions (Sufian & Ibrahim 2005). In contrast to many studies on voluntary bank mergers and acquisitions, the merger efforts by BNM are an interesting area to study due to its rarity and as a case to determine the economic benefits arising from government interventions (Chong et al. 2006).

Research in banks merger and acquisitions in Malaysia mostly concentrated on the efficiency of banks (Ab-Hamid et al. 2017). The majority of researchers use nonparametric frontier analysis such as Data Envelopment Analysis (DEA) and Malmquist productivity index (MPI) to assess the efficiency of the merged banks (Abd-Kadir et al. 2010; Khalib et al. 2016; Mat-Nor et al. 2006; Mohd Said et al. 2008; Sufian & Habibullah 2013). From their findings, most of the authors found significant efficiency gains after the merger except for Mohd Said et al. (2008). Using data from 1998 to 2004, the authors found no significant differences in the banks' efficiency after the merger. As most of the researchers in Malaysia use DEA to measure efficiency, the parametric frontier analysis such as Stochastic Frontier Analysis (SFA) is not fully explored.

From the international banking literature, the SFA method is preferred because: (i) SFA model differentiates between inefficiency and statistical noise in the estimation of efficiency levels. In contrast to DEA, all deviations from the best-practice bank are incorporated in the error term. By incorporating all the deviations in the error term, the DEA model is sensitive to extreme observations and prone to measurement errors compared to the SFA model (Srairi 2010). (ii) The DEA model's results are sensitive to small samples. The small samples increase the probability for each bank to be seen as efficient (Button & Weyman-Jones 1992). (iii) Bauer et al. (1998) stated that even though parametric and nonparametric methods are found to be consistent with time, the parametric approach is more suitable to the competitive nature of the banking market. Since the SFA method could give better assessment of the efficiency compared to DEA (Semih Yildirim & Philippatos 2007), the usage of SFA could enhance the efficiency research in Malaysia.

In another research, Mahmood and Mohamad (2007) examined the operating performance using accounting ratios. Using four common operating ratios; (i) Return on Assets (ROA), (ii) Return on Equity (ROE), (iii) Profit Margin (PM), and (iv) Earning Per Share (EPS) and data from 1997 to 2002, the results showed significant post-merger improvements for eight anchor banks in Malaysia. The use of accounting ratios as performance measurements is criticised by Berger and Humphrey (1992). The authors argued that the use of accounting ratios is problematic compared to frontier analysis and emphasised that the frontier method addresses the effects of exogenous market factors while the accounting ratios simply cannot.

It is interesting to note that the risk effects of the merger are not fully examined in the Malaysian bank literature compared to other Asian Countries (Tamadonnejad & Abdul-Rahman 2017). Abdul Rahman (2010) examined the effect of five bank risk exposures (market, interest rate, exchange rate, total, and unsystematic risk) for pre- and post-merger of banks in Malaysia. Using dummy variables, the author found that the merger reduces the interest rate, total and unsystematic risk exposures. To the best of our knowledge, we could not find other research in Malaysia that examines the effects of bank market risk after the merger. This warrants further empirical study regarding the risk effects after the merger.

From the literature reviews, most of the researchers in Malaysian banks are focusing on the efficiency effects of the post-mergers using DEA and MPI. In contrast to international bank efficiency research, SFA is preferred to DEA (Lampe & Hilgers 2015). Thus, this paper examines the cost and profit efficiencies of banks using the SFA method. We also examine the bank market risk using the Value at Risk (VaR) and Expected Shortfall (ES) methods for the post-merger banks to assess their market risk exposures.

METHODOLOGY

Following De Haan and Poghosyan (2012) and Papadamou and Tzivinikos (2013), we employ panel data analysis to investigate whether the cost and/or profit efficiency can influence the bank market risk for merged banks in Malaysia. Our model has the following general form:

$$\begin{matrix}\textit{Bank Market}\\ \textit{Risk}\end{matrix} = \begin{matrix}f(\textit{Efficiency, Bank}\\ \textit{control variables})\end{matrix} \quad (1)$$

To measure the bank market risk, this study uses historical simulation model VaR and ES. It is calculated for each bank using daily stock returns. Let S_t denote the bank stock price at time t, then the stock return for each bank is:

$$r_t = 100 \times \ln\left(\frac{S_{t+1} - S_t}{S_t}\right) \quad (2)$$

Following Dowd (2005), the VaR confidence level, α and $p = 1 - \alpha$, where p is the probability of worst outcome q_p and is the p-quantile of a stock returns over some holding period (usually daily risk horizon). The scaling of historical simulation VaR to more than daily risk horizon requires thorough investigation of the nature of the stock returns distribution and it distorts the gamma effects (Alexander 2008). The VaR of the stock returns distribution at the confidence level, $\alpha = 90\%$ and daily risk horizon is equal to:

$$VaR = -q_p \quad (3)$$

The ES is the expected loss when the financial loss is greater than the VaR calculations. It calculates the expected value of the loss at the extreme end of the distribution when the VaR fails to calculate it. Following Dowd (2005), if the loss distribution is discrete, the ES is the average of the worst $100(1 - \alpha)\%$ of losses:

$$ES_\alpha = \frac{1}{1-\alpha}\sum_{p=0}^{n} p^{th}\ largest\ lost \times \begin{matrix}probability\ of\\ p^{th}\ largest\ lost\end{matrix} \quad (4)$$

Turning to the independent variables, both cost and profit efficiency are included. Cost and profit efficiency are estimated using the parametric Stochastic Frontier Analysis (SFA). The cost efficiency can be obtained by estimating a cost function with a composite error term. Aigner, et al. (1977) and Meeusen and Broeck (1977) specify a composite error term to the deterministic frontier in order to separate inefficiency and random error. The translog function to estimate the cost frontier takes the following form:

$$\begin{aligned} Ln\ TC = {} & \alpha_0 + \sum_{i=1}^{m}\alpha_i \ln y_i + \sum_{j=1}^{J}\beta_j \ln w_j + \\ & \frac{1}{2}\left[\sum_{i=1}^{m}\sum_{k=1}^{m}\delta_{ik}\ln y_i \ln y_k + \right. \\ & \left.\sum_{j=1}^{J}\sum_{h=1}^{J}\theta_{jh}\ln w_j \ln w_h\right] + \\ & \sum_{i=1}^{m}\sum_{j=1}^{J}\rho_{ij}\ln y_i \ln w_j + v_i + u_i \end{aligned} \quad (5)$$

where $\ln TC_i$ is the logarithm of the total costs for i-th bank. It represents the minimum cost of producing outputs Y_i with input prices W_i, β is a vector of unknown parameters: $u_i \sim i.i.d.N^{+}(0, \sigma_u^2)$ is a two sided error term captures measurement error and statistical noise, and is a one-sided positive error term that captures the effects of cost inefficiency relative to the frontier. The model incorporates the calculation of measurement error and statistical noise using maximum likelihood estimators. The total variance is $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and the Gamma ratio is $\gamma = \sigma_u^2/(\sigma_u^2 + \sigma_v^2)$. The ratio has a value between 0 and 1. A hypothesis test of $\gamma = 0$ serve as a test of the existence of the one-sided error for half-normal model (Kumbhakar et al. the 2015).

Symmetric restrictions require $\beta_{jk} = \beta_{kj}$. Because the cost function is homogeneous of degree one in the inputs prices, it should satisfy the following additional parameter restrictions:

$$\Sigma_j \beta_j = 1, \Sigma_j \beta_{jk}\ 0\ \forall\ k, \Sigma_j \beta_{jya} = \Sigma_j \beta_{jyb} = 0$$

Following Boucinha et al. (2013) and Shamsuddin and Xiang (2012), this study adopts (a) the translog as the commonly used functional form in the bank efficiency literature, and (b) the intermediation approach. Following Srairi (2010), we consider two outputs: (i) total loans, y1, and (ii) other earning assets, y2, (Inter-bank funds, investment securities, and other investments) and three inputs: price of labour (wl) measured as personnel expenses divided by the total assets, price of physical capital (wk) measured by operating expenses minus personnel expenses divided by fixed assets, and the price of funds (wf) measured as total interest expenses divided by total funding. To satisfy linear homogeneity at input prices, all variables are normalised by the price of capital.

Furthermore, this study estimates alternative profit efficiency. The alternative profit function is adapted to measure the profit efficiency. The dependent variable is ln $PE_i = \ln(PF_i + |PF_i^{min}| + 1)$, where PF_i is the profit before tax of the -ith bank. The term $\theta = |PF_i^{min}| + 1$ indicates the absolute minimum value of net profits over all banks in each year plus 1. The term θ is a constant added to every bank's profit so the natural logarithm is a positive number since the minimum profits can be negative. The composite error term is $v_i - u_i$. The inefficiency term enters the frontier with a negative sign because inefficiency reduces profits below the best-practice bank frontier. The measure of profit efficiency is defined as $PFE_i = \exp(-u_i)$. The efficiency scores take a value between 0 and 1 with values closer to one indicating a fully efficient bank.

To control for the global financial crisis that occurred in 2008-2009, this study constructs the Early Warning System (EWS) using the logistic regression (logit) approach instead of using a dummy variable. For the definition of the crisis, we opt for the first condition stated by Demirgüç-Kunt and Detragiache (1998), that is the ratio of nonperforming loans to total loan that exceeds ten percent. Our dependent variable, the crisis dummy, will take the value of zero when there is no crisis and the value of one when there is a crisis. We use the financial ratio corresponding to the CAMEL rating system as the explanatory variables for banking crisis (Canbas et al. 2005). For Capital adequacy - Equity to Total Assets (Lin & Yang 2016), Asset quality - Loan Loss Reserves to Gross Loans (Betz et al. 2014), Management capacity – Return On Average Equity (Betz et al. 2014), Earnings power - Return on Average Assets (Lin & Yang 2016), Liquidity position - (i) Net Loans to Total Assets and (ii) Liquid Assets to Total Debt Liabilities (Arena 2008), and Asset Size – natural logarithm of total assets (Lanine & Vennet 2006).

Based on the review above, this study formulates the equation below for the EWS

$$\ln \frac{\hat{P}_{Crisis}}{1 - \hat{P}_{Crisis}} = \hat{C} + \hat{\beta}_1 ETA + \hat{\beta}_2 LLRGL + \hat{\beta}_3 ROAE + \hat{\beta}_4 ROAA + \hat{\beta}_5 NLTA + \hat{\beta}_6 LATDL + \hat{\beta}_7 \ln SZ + \varepsilon \quad (6)$$

where, $\hat{P}_{Crisis}$ denotes the estimated probability of crisis. C is constant, $\hat{\beta}_i$, $i = 1$ *to* 7, are unknown CAMEL parameters and ε is the error term.

As proposed in previous studies (Akhigbe et al. 2012; Athanasoglou et al. 2008; Hakenes & Schnabel 2011; Papadamou & Tzivinikos 2013; Williams 2014), several bank control variables are incorporated in the model that can influence the bank market risk. Bank size (SZ) is measured by the natural log of total assets. Capital (CP) is measured using a ratio of total equity to total assets. Nonperforming loans (NPL) measured as the ratio of loan loss reserves over the gross loans. Noninterest income (NI) is measured by the ratio of noninterest income to revenue. Returns on Assets (ROA) serve as the indicator of profitability while Marketable Securities (MS) is measured by the ratio of marketable securities to total assets. The variable definitions are summarised in Table 2.

Based on the equation 1, this study produces four models to examine the cost and profit efficiency effect on the bank market risk. There are; (i) VaR - Cost Efficiency, (ii) ES - Cost Efficiency, (iii) VaR - Profit Efficiency, and (iv) ES - Profit Efficiency. Three types of panel data models; (i) Pooled, (ii) Random Effect (RE) and (iii) Fixed Effects (FE) Model are estimated. We use the Poolability F-Test and Breusch-Pagan LM test to determine whether the data is pooled. If it is not, then Hausman's specification test will be used to determine whether the data is fixed or random.

DATA DESCRIPTION

Our study focuses on eight listed banks in Bursa Malaysia (Malaysian Stock Exchange) that have undergone the merger and acquisition process. The financial statements are collected from the Bankscope database from the 2000–2015 period on an annual basis. The banks' annual reports are used when data is unavailable or for cross-references. The daily stock price data is collected from the Wall Street Journal website. Table 3 presents the descriptive statistics of variables used to analyse the bank market risk. The final sample consists of an unbalanced panel of eight banks comprising 124 observations. The differences between the VaR and ES methods could be seen by the lower mean for ES compared to VaR (–0.038 for ES and –0.024 for VaR). The cost efficiency is higher compared to the profit efficiency (0.894 for cost and 0.713

TABLE 2. Variable definitions

Variable	Definition
Dependent variable	
Value at Risk (VaR)	The negative of the quantile of the stock returns distribution
Expected Shortfall (ES)	The average of the worst of losses
Independent variable	
Cost Efficiency	Cost efficiency is estimated using the stochastic frontier analysis
Profit Efficiency	Profit efficiency is estimated using the stochastic frontier analysis
Early Warning Systems (EWS)	Early Warning Systems are constructed using logistic regression (logit) approach.
Bank size (SZ)	Bank size is measured by the natural log of total assets
Capital (CP)	Capital is measured using a ratio of total equity to total assets
Nonperforming loans (NPL)	Nonperforming loans is measured as the ratio of loan loss reserves over the gross loans
Noninterest income (NI)	Noninterest income (NI) is measured by the ratio of noninterest income to revenue
Returns on Assets (ROA)	Return on Assets
Marketable Securities (MS)	Marketable Securities (MS) is measured by the ratio of marketable securities to total assets

TABLE 3. Descriptive statistics of variables 2000 - 2015

Variable	Observations	Mean	Std. dev.	Min	Max
Value at Risk (VaR)	124	–0.024	0.011	–0.064	–0.005
Expected Shortfall (ES)	124	–0.038	0.019	–0.137	–0.009
Cost Efficiency	124	0.894	0.067	0.567	0.983
Profit Efficiency	124	0.713	0.133	0.347	0.931
Early Warning Systems (EWS)	124	0.282	0.411	0.000	1.000
Bank Size (SZ)	124	11.501	0.839	9.913	13.470
Capital (CP)	124	0.086	0.017	0.051	0.143
Nonperforming Loans (NPL)	124	0.068	0.059	0.004	0.265
Noninterest Income (NI)	124	0.344	0.106	0.182	0.638
Returns on Assets (ROA)	124	0.010	0.004	-0.020	0.020
Marketable Securities (MS)	124	0.193	0.045	0.093	0.338

Source: Bankscope

for profit). This shows that the banks are more efficient in managing the cost compared to profit. The EWS detected the probability of crisis in the sample with the maximum value of one. The differences in bank size (SZ) is high based on the standard deviation of 0.839. From the ROA, the banks have negative profits (min –0.020) and smallest standard deviations (0.004) in the sample.

RESULTS AND DISCUSSION

MARKET RISK (VAR AND ES)

From Figure 1, we can see that the bank market risks measured using VaR and ES methods are in reducing trends after the merger and acquisition exercise beginning from 2000 until 2006. The market risk started to increase beginning from 2007 where the global financial crisis begins and reaches its peak in 2008 (3.76% for VaR and 5.73% for ES). From then, the loss trend continues to reduce until 2015. The merger and acquisition initiative from the BNM to create stronger, effective, and competitive banks that can withstand the globalisation and liberalisation is a good initiative. Based on the bank market risk results, the losses arising from the market risk are reducing. Even when facing the global financial crisis, the losses from market risk are still less than the initial post-merger period. This show that the merged banks are more resilient to the global financial crisis.

EFFICIENCY

Table 4 reports the estimation results for the cost and profit efficiency models. For cost efficiency, from 14 variables used as independent variables, 12 are

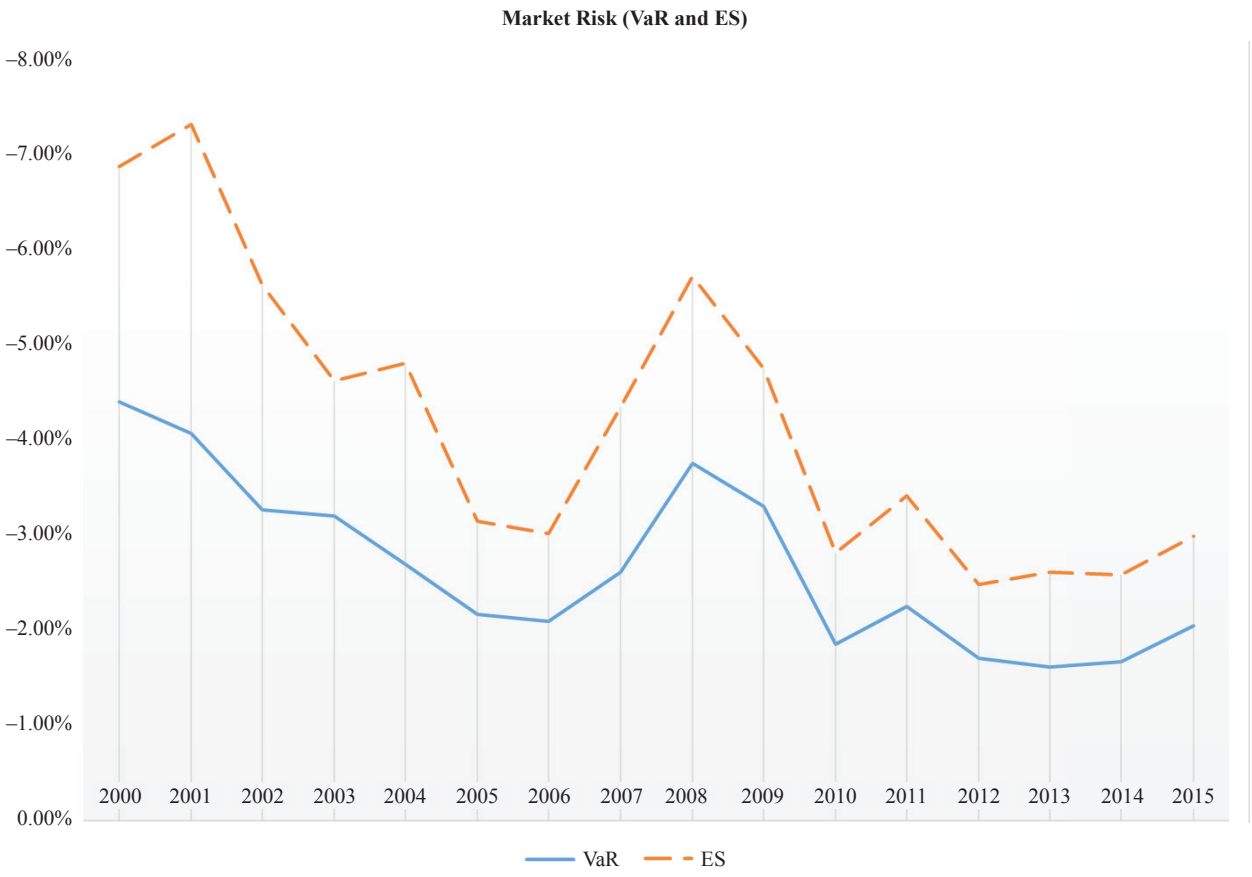

FIGURE 1. Bank Market Risk (VaR and ES) Yearly Mean Results (2000 – 2015)

TABLE 4. Stochastic Frontier Analysis parameter estimation for the cost and profit efficiency

Independent Variable	Description	Cost Efficiency	Profit Efficiency
Constant		2.651[a] (0.568)	5.652[b] (2.410)
ln *y*1	Total Loans	1.287[a] (0.188)	2.553[a] (0.621)
ln *y*2	Other earning assets (Inter-bank funds, investment securities, and other investments)	–0.272 (0.181)	–1.081 (0.663)
ln *wl*	Price of labour (wl) - personnel expenses divided by the total assets	0.745[a] (0.263)	1.892 (1.156)
ln *wf*	Price of funds (wf) - total interest expenses divided by total funding	–0.637[a] (0.239)	–0.807 (1.088)
ln *y*1 ln *y*1	Total Loans*Total Loans	0.167[b] (0.069)	0.297 (0.251)
ln *y*2 ln *y*2	Other earning assets*Other earning assets	0.144[a] (0.031)	0.246 (0.153)
ln *y*1 ln *y*2	Total Loans*Other earning assets	–0.172[a] (0.047)	–0.259 (0.187)
ln *wl* ln *wl*	Price of labour*Price of labour	0.484[a] (0.113)	1.204[b] (0.564)
ln *wf* ln *wf*	Price of funds*Price of funds	0.384[a] (0.148)	1.247[c] (0.681)
ln *wl* ln *wf*	Price of labour*Price of funds	–0.547[a] (0.126)	–1.222[b] (0.609)

(*Cont.*) TABLE 4

ln *w*1 ln *wl*	Total Loans*Price of labour	0.216[a] (0.062)	0.375 (0.255)
ln *w*1 ln *wf*	Total Loans*Price of funds	–0.110[c] (0.061)	–0.099 (0.267)
ln *w*2 ln *wl*	Other earning assets*Price of labour	–0.178[a] (0.061)	–0.522[c] (0.272)
ln *w*2 ln *wf*	Other earning assets*Price of funds	0.083 (0.062)	0.410 (0.294)
Log-likelihood		133.149	–63.429
Variance components:	$\sigma^2(y)$ =	0.021[a] (0.005)	0.222[a] (0.078)
	$\sigma^2(v)$ =	0.002[c] (0.001)	0.066[a] (0.023)
Gamma		0.901	0.769
Likelihood Ratio test of the one-sided error		6.455[b]	3.475[c]

[a]Significant level at 1%; [b]Significant level at 5% and [c]Significant level at 10%
Standard Error in parenthesis

statistically significant. The gamma value is high (0.901). The log-likelihood is 106.93 and likelihood ratio test is significant at 5% level. The sigma u-squared is significant at 1% level. The significant value of likelihood ratio and sigma u-squared indicates highly significant parameter estimates. Concerning for-profit efficiency, from 14 variables used as independent variables, five are statistically significant. The gamma value is high (0.769). The log-likelihood is –63.429 and likelihood ratio test is significant at 10% level. The sigma u-squared is significant at the 1% level. The significant value of likelihood ratio test and sigma-squared indicates significant parameter estimates.

TABLE 5. EWS logit model results

Independent Variable	Description	Logit
Constant		5.825 (16.467)
ETA	Capital adequacy - Equity to Total Assets	–0.747 (1.115)
LLRGL	Asset quality - Loan Loss Reserves to Gross Loans	2.679[a] (0.844)
ROAE	Management capacity – Return On Average Equity	0.595 (0.804)
ROAA	Earnings power - Return on Average Assets	–8.800 (10.319)
NLTA	Liquidity position - Net Loans to Total Assets	0.223 (0.153)
LATDL	Liquidity position - Liquid Assets to Total Debt Liabilities	0.069 (0.076)
Ln Size	Asset size – natural logarithm of total assets	–2.372[b] (1.001)
	Likelihood Ratio chi^2	119.35[a]
	Pseudo	0.808
	Correctly classified model	95.16%

[a]Significant level at 1%; [b]Significant level at 5% and [c]Significant level at 10%
Standard Error in parenthesis

EWS

Table 5 provides the EWS based on logit model results. The probability of crisis increases with the increase in Loan Loss Reserve to Gross Loans (1%) and reduces the probability with the increase in asset size (5%). Even though the other determinants are not significant, their inclusion has enabled this model to correctly classify the probability of crisis by 95.16% with the pseudo of 0.808.

BANK MARKET RISK MODEL

The results of the three tests (Poolability F-Test, Breusch-Pagan LM test and Hausman's specification test) preferred the fixed effects (FE) for the bank market risk models. Table 6 reported the bank market risk results using the FE model.

Using sample data from the post-merger period, the results show that the cost efficiency has significant and positive signs in the ES - Cost Efficiency model and are not significant in the VaR – Cost Efficiency model. The positive sign indicates that the increase in cost efficiency increases the bank market risk. This effect could be contributed from the heavily regulated and competitive nature of banking environment. To compete with other competitors, the bank has to offer products and services comparable to other competitors while keeping the cost to

TABLE 6. Bank Market Risk Model Results

Independent Variable	VaR – Cost Efficiency	ES – Cost Efficiency	VaR – Profit Efficiency	ES – Profit Efficiency
Constant	–0.183[a] (0.031)	–0.276[a] (0.058)	–0.226[a] (0.032)	–0.322[a] (0.063)
Efficiency	0.029 (0.018)	0.063[c] (0.034)	0.039[a] (0.010)	0.051[b] (0.021)
Early Warning Systems (EWS)	–0.003 (0.004)	–0.005 (0.008)	–0.000 (0.004)	–0.000 (0.008)
Bank size (SZ)	0.011[a] (0.002)	0.017[a] (0.004)	0.014[a] (0.002)	0.021[a] (0.004)
Capital (CP)	–0.007 (0.059)	–0.068 (0.110)	0.061 (0.057)	0.040 (0.109)
Nonperforming loans (NPL)	0.012 (0.036)	–0.049 (0.066)	0.042 (0.035)	–0.007 (0.067)
Noninterest income (NI)	0.013 (0.010)	–0.008 (0.018)	0.020[b] (0.009)	0.000 (0.018)
Returns on Assets (ROA)	0.242 (0.208)	0.028 (0.386)	–0.546[c] (0.295)	–1.021[c] (0.566)
Marketable Securities (MS)	–0.021 (0.024)	–0.028 (0.044)	0.013 (0.021)	0.030 (0.040)
R^2 - within	0.435	0.425	0.483	0.439
R^2 - between	0.064	0.126	0.065	0.185
R^2 - overall	0.224	0.264	0.223	0.260
F-Test	5.67[a]	2.95[a]	7.29[a]	3.15[a]
LM Test	0.00	0.00	0.00	0.00
Hausman Test	30.92[a]	18.45[b]	36.89[a]	19.50[a]
F Value	10.42[a]	10.01[a]	12.66[a]	10.60[a]

Standard Error in parenthesis
[a]Significant level at 1%; [b]Significant level at 5% and [c]Significant level at 10%

a minimum. In doing so, the bank may reduce the number of resources allocated to underwriting, monitoring, and controlling the products and services. While this action increases the cost efficiency, it also increases the bank market risk. This result supports the skimping hypothesis offered by Berger and DeYoung (1997) and is in line with the findings from Mohd Said et al. (2008) who reported the increase in cost efficiency affects bank risk.

The profit efficiency also shows a positive and significant sign in both models (VaR – Profit Efficiency and ES – Profit Efficiency). As for the positive effects of profit efficiency on bank market risk, banks usually offer more financial instruments to achieve higher profits. By offering more financial instruments, the bank has increased their exposure to bank market risk. As indicated by Liadaki and Gaganis (2010), the change in profit efficiency has significant and positive effects on stock prices. The results are in line with Saeed and Izzeldin (2016) and Shamsuddin and Xiang's (2012) findings.

As for bank control variables, the coefficients for (i) bank size, (ii) noninterest income, and (iii) returns on assets are significant. The positive signs for bank size in all models indicate that the increase in the bank size increases the bank market risk. This could be explained by the nature of the bank size. As the bank is accumulating more financial assets, the assets are prone to higher market risk exposure. The finding is supported by the Sufian and Habibullah (2013) that the increase in bank size increases the bank risk. For the positive effects of noninterest income in the VaR – Profit Efficiency model, DeYoung and Rice (2004) reported that the increase in noninterest income has resulted in the positive relationship between risk and return trade-offs. The negative sign for Returns on Assets (ROA) in profit efficiency models (VaR – Profit Efficiency and ES – Profit Efficiency) indicates that the increase in ROA lowers their market risks. This finding supports Srairi (2013) who reported that ROA shows a strong and negative association with bank risk.

CONCLUSION

The management of bank market risk has become a priority among banking supervisors. One of the lessons

learned from the global financial crisis is that bank market risk must be monitored and controlled constantly so that the loss does not spread frantically to other banks. From this study, we found that the cost efficiency, profit efficiency, bank size, noninterest income and returns on assets affect the bank market risk. This article fills the gaps in the literature by empirically examining the effects of efficiency using Stochastic Frontier Analysis (SFA) cost and profit efficiencies on bank market risk while proving the consolidation program for the domestic banks in Malaysia helps to reduce the exposure to market risks.

IMPLICATIONS OF THE STUDY

The findings of this study also provide insights for the stakeholders. As the banking supervisors strive to strengthen the risk management of the banking sector by using the ES method to measure the market risk, the results suggest that the VaR method should not be abandoned as it is a proven complementary method to measure market risk. The finding could be used by bank managers and supervisors to establish management tools for controlling market risk by implementing both cost and profit orientated policy.

ACKNOWLEDGMENT

This paper is based on the author Ph. D thesis. The authors would like to thank the editors and the anonymous referees for their constructive comments and suggestions. Their inputs have significantly help in improving the contents of this paper. This work was supported by the Universiti Kebangsaan Malaysia [grant number EP-2015-026].

NOTES

1 BNM Press Release

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