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Cost Efficiency and the Relationships with Risks in Vietnamese Banking Industry

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ABSTRACT

The issues related to the efficiency and risk management of the financial system has been a particular focus of regulators since the global financial crisis. Vietnamese commercial banks found it difficult to manage their outputs, input prices and control their performance in terms of cost efficiency, especially after financial crisis in 2008. In addition, the Vietnamese Government is trying to rank and force the banks to abide by the requirements of Basle 3 however Vietnamese banks generally lack the quantitative tools to perform such evaluations. This research is conducted to measure the efficiency of Vietnamese banks by applying Stochastic Frontier Approach (SFA). Previous studies conducted on banking in Vietnam did not allow for the effects of risks (credit risk, operational risk, and liquidity risk) on banks' cost efficiency. This research performs such an analysis by employing an unbalanced panel data set (mostly taken from Bankscope) of Vietnamese commercial banks covering 2006 – 2012, the empirical results show the cost efficiency scores of banks and the effects of risks on those scores. The results indicate a difference in means of efficiency scores between groups of bank in terms of ownerships. The second stage of this study focuses on three kinds of risk, including credit, operational, and liquidity risk; and their impacts on cost efficiency. Our research finds there are differences on the cost efficiency with respect to the type of risk; essentially while credit risk and operational risk have positive effects on cost efficiency, liquidity risk has a negative effect. This study also found varying impacts of risks on cost efficiency between groups of bank. In addition, the results of this paper confirmed a negative effect of a special event – the global financial crisis – on cost efficiency. The findings will have implications for bankers in managing their cost efficiency and Government in building quantitative tools to control the banking system.

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INTRODUCTION

The financial system plays an important role in the modern economies by their intermediate functions in the banking industry with a core role in influencing economic growth (Klein, 1971; Schumpeter & Opie, 1934). That is one crucial reason why the efficiency of banks has long been a conventional focus at both the theoretical and empirical level. A good understanding of the issues in this area would improve the efficiency of banking industry leading to higher profitability, greater amount of funds intermediated, suitable prices and service quality for customers across the banking system. This will contribute to both the banking industry and the economic development (Berger, Hunter, & Timme, 1993).

The Vietnamese economy and the banking industry had developed through two major periods in the last decade. The earlier period (before 2008) indicates a successful period for the Vietnamese economy and banking industry with very strong domestic product growth and loans growth, which concerns for high inflation rates (see Table 1). From 2008, the economy experienced a difficult period because of the effects of the previously overdeveloped period and the global financial crisis with the banking industry experiencing a particularly challenging environment when the loan interest and the exchange rates fluctuations playing a significant role during this period (see Table 1). In this environment, Vietnamese commercial banks faced difficulty in managing their performance in terms of efficiency and high risk in their daily operations. In addition, The Vietnamese Government is trying to rank the commercial banks on grounds of efficiency but they are lacking in quantitative tools to do that.

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Table 1: Key growth indicators of Macroeconomic (%).

	2006	2007	2008	2009	2010	2011	2012
GDP growth	8.2	8.5	6.3	5.3	6.8	5.9	5.03
Inflation	6.6	12.6	19.9	6.9	11.8	18.6	6.81

Source: www.gso.gov.vn

Empirical studies on bank efficiency have been conducted by using data of the banking industry around the world in both developed and developing countries. For example, studies of Dietsch & Lozano-Vivas (2000), Maudos *et al.* (2002), and Resti (1997) conducted in Europe. Other research conducted in Japan (Hensel, 2006), Australia (Shamsuddin & Xiang, 2010), cross countries (Berger & Humphrey, 1997; Pasiouras, Tanna, & Zopounidis, 2009), and in emerging markets like India, East Asian market (Dang-Thanh, 2010; Gardener, Molyneux, & Nguyen-Linh, 2011; Kalluru & Bhat, 2009; Sufian, Majid, & Zulkhibri, 2007; Vu & Turnell, 2010). Most of these studies applied two common approaches to measure bank efficiency: (1) non-parametric data envelopment (DEA) approach, (2) parametric stochastic frontier approach (SFA). SFA has been dominant in recent applications because of its advantage over DEA in terms of assuming statistical noise (Sun & Chang, 2011).

Another issue related to bank efficiency is risk management and the effects of risk on efficiency. Risk management has become a key area of banks' activity because of risk can transfer across the economies and the banking systems via intermediation (Allen & Santomero, 1997). The interrelationship between risk and bank efficiency has received much attention in recent years, especially after the Asian financial crisis in 1997 and the Global financial crisis in 2008. For example, studies of Berger and Young (1997), Altunbas *et al.* (2000), Fiordelisi *et al.* (2011), and Sun and Chang (2011) were conducted in Europe, Japan, and emerging Asian countries.

There are several studies conducted in Vietnam to measure the banking industry's efficiency, such as studies by (Dang-Thanh, 2010; Hung, 2007; Vu & Turnell, 2010), but there is one study by Vu and Turnell which employed Stochastic Frontier Approach (SFA) with data from 2000 to 2006 however this obviously fails to describe the current problems facing the Vietnamese banking industry, especially after the Global financial crisis in 2008. In addition, previous studies related to bank efficiency in Vietnam failed to mention the effects of risks. Given this background, this research conducted a study employing SFA for measuring bank efficiency in Vietnam over the period 2006 to 2012 with the objective discovering the effects of risks on efficiency. The aims of this study are to measure the efficiency of the Vietnamese banking industry by employing SFA with the aim of examining the relationships between credit risk, liquidity risk, operational risk, and bank efficiency with data from 26 Vietnamese commercial banks over the period 2006 to 2012. The results show the efficiency scores of banks in Vietnam, and compare the different scores in two groups of bank separated by ownerships. This paper also discovered the effects of three mentioned risks on cost efficiency under some special conditions, such as financial global event, and groupings of banks.

Literature review on bank efficiency and risk:

Measuring efficiency of commercial banks:

There is a long history in measuring the efficiency of a firm, in general, and of banks in particular, via three popular techniques namely ratio analysis, scale and scope efficiencies, and X-efficiency. The efficiency and competitiveness of banking system is not easy to measure because of the intangibility of its products and services (Kosmidou & Zopounidis, 2008). From the first view - a traditional view - the firm efficiency is measured through some accounting indicators, such as return on assets (ROA), return on equity (Meeusen & Van den Broeck), and cost-to-income ratio (European Central Bank, 2010). These measurements had been the most widely used and applied for a long time but no longer support the view that differences in the banks efficiency are led to the existence of a low competitive level. That is the main reason for calling into question the suitability of accounting indicators to measure the productive efficiency of banks (Maudos, Pastor, Pérez, & Quesada, 2002). In addition, ratio analysis only focuses on ratios between two variables that cannot cover the effects of variation determinants in relation to bank efficiency (Dang-Thanh, 2010). The scale and scope economies of banking have been extensively studied as bank efficiency. From this view, bank efficiency is examined by utilizing the trans-log cost functions that solves the problems experienced with using ratio analysis. However, there is a technical problem with this measurement in that it gives a poor approximation when applied to banks in different sizes and diverse products (Berger *et al.*, 1993).

The last technique employed in measuring banks efficiency is X-efficiency method, which overcomes the shortcoming of these previous views. X-efficiency analysis can show an approximation of the efficiency of banks in all sizes. In addition, this method evaluates the efficiency of individual bank through a multi-variables aspect that is the weakness of scale and scope economics view (Berger *et al.*, 1993; Dang-Thanh, 2010). Thus, the analysis of X-efficiency has recently replaced economies of scale and scope as the main method for empirical research (Maudos *et al.*, 2002). Recently, a large number of studies focused on measuring the X-efficiency of banks around the world through two main approaches, including nonparametric and parametric

approach. Nonparametric frontiers includes two models, they are data envelopment analysis (DEA) and Free Disposal Hull (FDH). These approaches, which represent a linear programming approach to efficiency analysis, have the advantage of computationally simple. These were applied in many studies examining bank efficiency to measure the efficient levels of the banking industry. However, nonparametric frontiers approaches, especially DEA, have the disadvantage in attributing measurement errors and other noise to the efficiency scores (Wezel, 2010). Stochastic frontier approach (SFA) is one of three main parametric frontier approaches that overcome the DEA disadvantage by modifying the traditional assumption of a deterministic production frontier (Sun & Chang, 2011). There were several studies the applied both approaches which showed the superiority of SFA over to the DEA through empirical data. Those studies also recommended the preferences for researchers in choosing specific approach in terms of trade-off between misspecification bias in (SFA) and measurement error in (DEA)(Erkoc, 2012; Wezel, 2010). Other kinds of parametric frontier approaches are the distribution-free approach (DFA) and the thick frontier approach (TFA)(Berger *et al.*, 1993). To sum up, the stochastic frontier approach (SFA) is one of the most suitable approaches for measuring the bank efficiency in an emerging market like Vietnam.

Research on banks efficiency has long attracted both theoretical and empirical interest. In terms of theoretical aspect, while traditional theories of financial intermediation have been built on the models of resources allocation based on perfect and complete markets, the contemporary banking theory showed the unsolved issues remain through an excellent survey on current state of banking literature by Bhattacharya and Thakor(Bhattacharya & Thakor, 1993; Santomero, 1984). Many empirical studies tried to discover the determinants of bank efficiency and measure their efficiency in both developed countries and developing countries around the world to have the best understand in this area. Several studies were conducted in Europe, such as France, Spain, Italy, and cross European countries (Dietsch & Lozano-Vivas, 2000; Maudos *et al.*, 2002; Resti, 1997) tested the effects of environment and regulation on banks efficiency. There were also some studies tried to measure the efficiency of banks in other developed countries, such as Japan (Hensel, 2006), Australia (Shamsuddin & Xiang, 2010), or cross countries (Berger & Humphrey, 1997; Pasiouras *et al.*, 2009). Because of the differences between the developing levels, the results of those mentioned studies could not apply totally into the developing countries or emerging market. So it still need to have studies used the data of these countries in doing research on banks efficiency which discovered some specific factors that affected the development of banks in emerging market like India, East Asian market (Dang-Thanh, 2010; Gardener *et al.*, 2011; Kalluru & Bhat, 2009; Sufian *et al.*, 2007; Vu & Turnell, 2010). There were only few studies conducted in Vietnam to measure the banking industry's efficiency, such as studies of (Dang-Thanh, 2010; Hung, 2007; Vu & Turnell, 2010). While Hung and Dang-Thanh applied DEA for their studies, there is only study of Vu and Turnell employed SFA with the data of the period from 2000 to 2006 that could not describe the current efficiency of the banking industry, especially after financial crisis in 2008. It is necessary to conduct a study that employs SFA for measuring bank efficiency, comparing those between two different groups in terms of ownerships in Vietnam for the period from 2006 to 2012.

Risks and bank efficiency:

Scholars and analysts recently have grouped banking risk into various categories. Santomero in his study in 1997 divided risk into six kinds, including systematic or market risk (interest rate risk), credit risk, counterparty risk, liquidity risk, operational risk, and legal risks. These categories is based on the services providing by banks (Santomero, 1997). There are some overlapped kinds of risk in those groups; for example, credit risk and counterparty risk are quite alike. Michel Crouhy, Dan Galai and Robert Mark in their book – “The essential of risk management” (2005) even classified risks into eight different kinds. They are credit risk, market risk, liquidity risk, operational risk, legal risks, strategic risk, business risk, and reputation risk. This classification is quite comprehensive though not particularly related to banks only (Mark, Galai, & Crouhy, 2005). These main risks are also grouped and classified in the Basel Accords issued by the Basel Committee on Bank Supervision under the first pillar. Then all other risks are defined and grouped in the second pillar of the Accords (Dam, 2010). This study only tends to focus on two in three main kinds of risks that are defined in the first pillar of Basel Accord III, including credit risk and operational risk, and liquidity risk that can cause the crisis contagion in financial market.

Liquidity risk is one major kind of risks that banks are facing since debt maturity transformation is one of their key business areas. This risk happens when banks “will not be able to meet its current and future cash flow and collateral needs, both expected and unexpected, without materially affecting its daily operations or overall financial condition” (Lopez, 2008).

In banking, credit risk directly related to the traditional functions of banks is taken for granted as a fundamental feature of the institutions. Through history, banks have found to manage this classic risk as a main part of their business. But it has just become one of the most concerns of all scholars, analysts and empirical managers from the day Bank for International Settlements (Galbis) Accord first set out a formalized universal approach to credit banks. Based on that first Accord, banks were required by their regulators to set aside a flat

fixed percentage of their risk-weighted assets as regulatory capital against default (Crouhy, Galai, & Mark, 2000). More formally, “credit risk arises whenever a lender is exposed to loss from a borrower, counterparty, or an obligor who fails to honor their debt obligation as they have agreed or contracted” (Dam, 2010). In the operation of banking industry, credit failures are not rare and they have direct, critical effects on various aspects of a bank, such as bank’s liquidity, cash flows, profitability, and eventually, reputation. That is the reason why credit risk management has become a hot topic debating in this area. Beside plenty of research on credit risk management conducted in developed countries, especially in Europe and US (Fiordelisi, Marques-Ibanez, & Molyneux, 2011; José M. Pastor, 2002), this topic also has been done research by using cross-countries data, such as studies of (Ali & Daly, 2010; Berger & DeYoung, 1997; Bonfim, 2009), and examined the credit risk in emerging market economies (Dam, 2010; Godlewski, 2005).

Another kind of risk that recently concerns banks is operational risk. Although this kind of risk may represent a significant share of a bank’s total risk, it is a quite new subject for the Basel Committee. It has been recently added into the risk catalog of the Basel Accord. Operational risk is not a well-defined concept. In the context of intermediation activities, it refers to a wide range of possible failures in the operation of the organization that are not directly related to market or credit risk. Operational risk risks associated with inadequate systems, management failure, faulty controls, and human errors (Crouhy *et al.*, 2000).

The interrelationship between risk and bank efficiency has received much attention in recent years, especially after the Asian financial crisis of 1997 and the Global financial crisis in 2008. One of the earliest studies, which focused on the effects of risk on efficiency, was a study of Berger and DeYoung in 1997. Its results suggested that there are both negative and positive effects of loan quality on efficiency; especially, there is a negative relationship between cost efficiency and risk in failed banks (Berger & DeYoung, 1997). Although Berger and DeYoung’s study had an intensive analysis of risk effects, its procedure based on the Granger causality test does not cover the causes of credit risk at individual bank level, but reaches a broader result at the industry level (Jose M. Pastor, 1999; José M. Pastor, 2002). To overcome the limitation of the previous studies in terms of credit risk measurement, a study of Fiordelisi *et al.* in 2011 used diverse measures of credit risk, including non-performing loans, 1-year ahead expected default frequency, and 5-year ahead expected default frequency, to examine its effects on efficiency through three separate models. In general, their result showed that “lower bank efficiency with respect to costs and revenues Granger-causes higher bank risk, thus confirming the “bad management” hypothesis” (Fiordelisi *et al.*, 2011). Besides credit risk, one of the most influent risks, many recent studies examined the relationship among different kinds of risks, such as market risk, operational risk, liquidity risk, etc. Sun and Chang considered three different kinds of risks, including credit risk, market risk, and operational risk in their study in 2011. While the reviewed paper were conducted and used the data of banking industry in Europe and emerging Asian countries, according the author’s knowledge, the previous studies which related to bank efficiency in Vietnam has not mentioned about the effects of risk on it. It is necessary to conduct a study that examine the relationship between risk and efficiency of Vietnam banking industry that has some specific characters in comparison with developed and other emerging markets.

Methodology and data:

Empirical method:

The data is analyzed through two stages. In the first stage, the efficiency of a number of Vietnamese commercial banks is measured by using Stochastic Frontier Approach (SFA). In the second stage, the effects of risk measures, including credit risk, liquidity risk, and operational risk on banks efficiency are examined.

First stage: Measuring efficiency of Vietnamese banking industry using SFA:

The first aim of this paper is to measure the efficiency of Vietnamese banking industry; this is achieved by using one of two common approaches, the parametric stochastic frontier approach (SFA) and the non-parametric data envelopment analysis (DEA). “DEA is a linear programming technique where the set of best-practice or frontier observations are those for which no other decision making unit (DMU) or linear combination of units has as much or more of every output (given inputs) or as little or less of every input (given outputs)” (Berger & Humphrey, 1997). This approach it built under the assumptions that there is no random error that make its disadvantage. Thus, the stochastic frontier approach (SFA) which modified the traditional assumption of a deterministic production frontier got its advantage (Sun & Chang, 2011). “The stochastic frontier approach (SFA) specifies a functional form for the cost, profit, or production relationship among inputs, outputs, and environmental factors, and allows for random error” (Berger & Humphrey, 1997). Because of the advantages of SFA in comparison with DEA related to attributing statistic noise to inefficiency, this study tends to employ the stochastic frontier approach (SFA) for measuring the efficiency of Vietnam banking industry for the most appropriate estimation.

Aigner *et al.* (1977) and Meeusen and van den Broeck(1977) employed the stochastic frontier approach, composed of a deterministic production frontier A later study by Wang (2002) made a combination of

traditional and extended models where TC_{it} represents total costs for the i th bank in year t , then Y_{it}, P_{it} are the vectors of the output and the price of input, respectively, and presented the equation as below:

$$TC_{it} = f_1(Y_{it}, P_{it}) + v_{it} + u_{it}, \quad v_{it} \sim N(0, \sigma_v^2), \quad u_{it} \sim N^+(\mu_{it}, \sigma_{it}^2) \quad (1)$$

$$\mu_{it} = \delta_0 + Z_{it}\delta$$

$$\sigma_{it}^2 = \exp(\gamma_0 + Z_{it}\gamma)$$

where v_{it} is the stochastic error term with i.i.d. normal distribution, u_{it} has a truncate normal distribution with an observation-specific mean (μ_{it}) and variance (σ_{it}^2) which are assumed a function of some determinants (Z_{it}) of its pre-truncated distribution. Lai and Huang (2010), and Sun and Chang (2011) both described the previous analyzed Wang's model as the best specification model among eight well-known stochastic frontier models.

Second stage: Examining the relationship between risk measures and cost efficiency:

The below equations are used to estimate the relationships between risks and efficiency:

$$x.eff_{it} = f_2(C.risk_{it}, Z_{it}) + \varepsilon_{it} \quad (2)$$

$$x.eff_{it} = f_3(L.risk_{it}, Z_{it}) + \varepsilon_{it} \quad (3)$$

$$x.eff_{it} = f_4(O.risk_{it}, Z_{it}) + \varepsilon_{it} \quad (4)$$

$$x.eff_{it} = f_5(C.risk_{it}, L.risk_{it}, O.risk_{it}, Z_{it}) + \varepsilon_{it} \quad (5)$$

where $C.risk_{it}, L.risk_{it}, O.risk_{it}$ represent for credit risk, liquidity risk, operational risk respectively; Z_{it} are control variables, and ε_{it} is the random error term (Fiordelisi *et al.*, 2011).

Equations (2), (3), (4) are used for testing the relationships between three kinds of risk separately on efficiency; and equation (5) test the combine effects of those risks on efficiency.

Model specification and data description:

The empirical method requires the information about outputs and input prices of the decision-making unit (DMU) in the industry. There are some different views to define banking industry as a service industry, such as intermediation approach, production approach, and value-added approach, which affect the output and input prices categories of an industry. This study bases on the intermediation approach to classify the outputs and input prices of banking industry. According to the intermediation approach, banks are considered as financial intermediaries that taking deposits from savers and making loans to economic agents requiring capital (Allen & Santomero, 1997). From this perspective, this study will focus on four outputs and two input prices. Four outputs previous adopted in studies of Bonin, Hasan & Wachtel (2005), and Berger, Hasan & Zhou (2009) include total loans (TL), other earning assets (OEA), total deposits (TD), and liquid assets (LA). Two input prices also applied widely in previous studies are the price of capital, and price of funds. In detail, price of funds (PF) measured by the ratio of interest expenses to total deposits, price of capital (PC) defined by the ratio of non-interest expenses to total fixed assets. In addition, the total costs (TC) of banks is the total of interest expenses and non-interest expenses (Altunbas, Evans, & Molyneux, 2001; Altunbaş, Gardener, Molyneux, & Moore, 2001).

This study focuses on testing the relationship among three kinds of risk, including credit risk, operational risk, and liquidity risk. In detail, credit risk can be measured by the ratio of loan loss reserves over gross loans (LLRGL). The operational risk is defined by the ratio of equity and total assets, and return on asset volatility (ROA-V). ROA_V is calculated by a logged 5-year standard deviation of ROA. The cash and due from banks is used to measure the liquidity risk (Altunbas *et al.*, 2000). The dependent variable is measured by the cost efficiency result of the first stage. A dummy variable (Y_crisis) for the special event – global financial crisis in 2008 - is also used. In addition, the paper employed another dummy variable, treated as an interaction term, to examine the different impacts between two groups of ownership: state-owned banks, and private banks; on the relationships of risks and cost efficiency.

An unbalanced panel data covering 2006 – 2012 of 26 Vietnamese commercial banks is analyzed by using Stata 12.0 software. The financial data, such as financial statements and other financial ratios, is taken from Bankscope, a comprehensive world banking information source provided by Bureau van Dijk.

RESULTS AND DISCUSSION

Measuring cost efficiency:

Table 2 reports summary statistics of all variables in estimating cost efficiency, including total cost (dependent variables), four outputs (total loans, other earning assets, deposits, liquid assets), and two input prices (price of capital, price of funds). The first results in standard deviation show that there is a big difference between volumes of the banks in terms of total cost and other assets.

Table 2: Statistics of variables used in estimating cost efficiency.

	Mean	Std. Dev.	Min.	Max.
Total cost (in thousand US \$)	1,750,717	903,102.1	850,673.3	6,369,942
<i>Output quantities (in thousand US \$)</i>				
Total loans	4,643,599	7,420,430	12,230.2	41,900,000
Other earning assets	2,653,774	3,225,281	2,550.8	17,000,000
Deposits	7,376,515	9,887,886	8,894.9	49,300,000
Liquid assets	1,922,471	2,227,626	2,641.9	11,600,000
<i>Input prices</i>				
Price of capital	129.7198	334.8648	1.6861	2816.307
Price of funds	0.068922	0.026265	0.011162	0.138566
<i>Note: All nominal monetary variables are transferred to the 2005 price level.</i>				

The results of maximum likelihood function estimations, employed the Wang's code (2002) using Stata 12.0 software, shown in Table 3. Although mean of cost efficiency scores is in medium level at approximate 60%, there is a big gap in cost management between banks in Vietnamese banking system when the cost efficiency scores strongly vary from 0.306 to 0.877. There are banks with a very high efficiency at nearly 90% and some are too low at fewer than 40%. This paper also tried to find the differences in cost efficiency between groups of banks divided by ownerships. As showing in Table 3, mean of state-owned banks' efficiency scores reached 0.802 in comparison with only 0.544 of private banks. From that results, it can preliminary conclude that the state-owned banks, which have the dominant portion of equity (over 50%) from the Government, are more efficient in cost management than the other group - the private banks.

Table 3: Summary of cost efficiency estimations.

	Mean	Std. Dev.	Min.	Max.
Number of observations: 166				
<i>Full sample</i>				
Ineff	1.852128	0.545828	1.139306	3.263317
Costeff	0.586688	0.167322	0.306437	0.877727
<i>State-owned banks*</i>				
Costeff1	0.802952	0.061507	0.700687	0.851129
<i>Private banks</i>				
Costeff2	0.544622	0.148082	0.306437	0.877727
<i>Note: This table reports the summary statistics of the inefficiency scores (Ineff) and cost efficiency scores (Costeff) which measured by using Stochastic Frontier Model (SFA).</i>				
<i>*Banks have the dominant portion of equity (over 50%) from the Government.</i>				

Relationships between risks and cost efficiency:

This paper employed Tobit regression to examine the relationships between risk measures and cost efficiency, the results are provided in Table 4. The process of testing the relationships went through four main models; models (1) – (3) examined the separate effects of respectively credit risk, operational risk, and liquidity risk, and model (4) examined the combine effects of three kinds of risk on cost efficiency that estimated from the last stage during the period 2003-2012. Four more models (5) – (8) also were conducted to examine the effects of ownerships on the relationships between risks and cost efficiency.

Model (1) in Table 4 only focuses on the effects of credit risk measured by the ratio of loan loss reverses over gross loan (LLRGL). It is found that this ratio has a significant positive effect on cost efficiency, which means a bank with higher loan loss reverses ratio will have higher cost efficiency. This result is in conflict with the conclusion of Sun and Chang (2011) in empirical research on some emerging Asian countries and shows an opposite phenomenon in Vietnam banking system, but suits to the conclusion of Berger and DeYoung (1997) about the existing of both positive and negative effects in this case. That might explain why most of banks in Vietnam have operated in a high credit risk ratio and they take risk to get a high cost efficiency.

Model (2) of Table 4 regards to the relationship between operational risk that is measured by the ROA volatility and cost efficiency. The result shows a strange trend of this relation in comparison with previous literature of Sun and Chang (2011) when the ROA volatility has a significant positive effect on cost efficiency. However, this trend is still in line with the results of the empirical studies in Polish banks and Turkey banks (Havrylchuk, 2006; Isik & Hassan, 2002), which also found the positive relationship. The implication from that is learned from the above-mentioned authors is a riskier bank in operation tends to be higher efficiency.

Model (3) of Table 4 found a significant negative effect of liquidity risk on cost efficiency. The result shows that a bank with higher amount of cash and due from banks has a lower level in cost efficiency. It is confirmed the conclusion of risk taking in the previous model that the safer banks in liquidity risk tend to be lower cost efficiency.

Model (4) examines the combine effects of three kinds of risks on cost efficiency and gets the same trends with the separate previous models. In addition, the paper also found the strong effects of some control variables, including total assets (TA_log), total deposit (TD_log), and Y_crisis – a dummy variable represents for the

financial crisis event in 2008, on dependent variables. Two of those three variables show the negative effects on efficiency, but the total assets. Going back to the results of the first stage in measuring cost efficiency, it is confirmed that the bigger banks in terms of total assets has the higher efficiency scores. The results also show that total deposit has a negative effect on cost efficiency. Because of the high pressure in interest expenses, banks with a big volume of deposit face a high liquidity risk and lead to low cost efficiency. In addition, it is confirmed through the analyzed data that the special event – financial crisis in 2008 – has a negative effect on cost efficiency. The banks have a lower efficiency in cost management after global financial crisis. All results of four models show a phenomenon and explain the action of Vietnam banking system in the last ten years that they have operated under high risk because there a positive trend in cost efficiency for higher risky banks.

This paper also tried to examine the effects of different ownerships structures on the relationships between risks and cost efficiency. To do this, the dummy variable (DSTATE) takes a value of one for the state-owned banks – which have a dominant proportion of equity (over 50%) from the Government – was used. Models (5) – (7) appear the results of separate effects of DSTATE on separate relationships between risks and cost efficiency, and the total effects of all risks are shows in model (8). From model (5), DSTATE has a positive effect on the relationships of credit risk, which means the positive impact of credit risk on cost efficiency in state-owned banks is higher than in private ones. In the other hand, from model (7), DSTATE has a negative effect on the relationships between liquidity risk and efficiency. It is concluded that the private banks suffer from high liquidity risk and low cost efficiency more than the other group – state-owned banks. On model (8), DSTATE shows insignificant results on credit and liquidity risks, but there are significant values with operational risk. As mentioned before, operational risk, which is measured by the ration of equity and total asset (ETA), and the ROA volatility (ROA_V), has the positive effect on cost efficiency. The results of model (8) appear a conflict impact of DSTATE on the relationships of ETA and ROA_V with cost efficiency. While DSTATE has a positive effect on ETA's relationship, which means the state-owned banks have advantage on high ETA ratio. It has negative effect on ROA_V's, which means the private banks with higher ROA-volatility is more efficient than the state-owned banks.

Table 4: Estimation results for the effects of risks on cost efficiency.

Dependent variable:	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Costeff								
<i>Independent variables:</i>								
LLRGL	0.0011068***			0.0009181***	-0.0009820***			-0.0003326***
ETA		0.0003162***		0.0003735***		0.0000298***		0.0001796***
ROA_V		0.0419050***		0.0090221***		0.1675942***		0.1654828***
CD_log			-0.0001168***	-0.0001830***			-0.0000459***	-0.0001059***
DSTATE					0.2112792***	0.1712671***	0.2574544***	0.1597303***
LLRGL*DSTATE					0.0015958***			0.0005883***
ETA*DSTATE						0.0007315***		0.0012742***
ROA_V*DSTATE						-0.2261843***		-0.2101796***
CD_log*DSTATE							-0.0002921***	-0.0002718***
TA_log	0.0121256***	0.0189399***	0.0296267***	0.0300854***	0.0385242***	0.0075630***	0.0169568***	0.0204572***
TD_log	-0.0094685***	-0.0096404***	-0.0227944***	-0.0179038***	-0.0309209***	-0.0050311***	-0.0134561***	-0.0133252***
Year_crisis	-0.0039869***	-0.0115648***	-0.2189711***	-0.0160740***	-0.0085903***	-0.0033666***	-0.0045348***	-0.0087936***
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Log likelihood	731.42558	714.61180	654.69762	575.59853	631.1911	796.0553	737.48653	669.5933
Observations	166	166	166	166	166	166	166	166
<p>This table reports the results of examining the relationships between three kinds of risk and cost efficiency. Models (1) – (3) examined the separate effects of respectively credit risk, operational risk, and liquidity risk, model (4) examined the total effects of three of risks on cost efficiency that estimated from the last stage during the period 2003-2012. The measures of risks are the ratio of loan loss reverses over gross loan (LLRGL), equity over total asset (ETA), return on asset volatility (ROA_V), cash and due from banks to total asset (CD_log). There are two control variables, including total assets (TA_log), total deposits (TD_log); and a dummy variable for the year 2008 - financial crisis event (Year_crisis). Model (5) – (8) try to compare the effects of ownerships on the relationships between risks and cost efficiency by adding a dummy variable (DSTATE), that takes a value of one for the state-owned banks.</p> <p>* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.</p>								

Conclusion:

This study employed Stochastic Frontier Approach to measure the cost efficiency of the Vietnamese banking industry by examining the relationships between risks and cost efficiency. The results show a difference in means of efficiency scores between groups of bank in terms of ownerships. In detail, the state-owned banks have a higher mean score than the private ones. This paper focuses on three kinds of risk; credit, operational, and liquidity risk; and their impacts on cost efficiency. There are differences in the trends of those effects. While credit risk and operational risk have positive effects on cost efficiency, liquidity risk has a negative effect. That means a higher risky bank in terms of giving credit and operating tends to be higher cost efficiency, and a safer bank in liquidity management lead to be lower cost efficiency. This study also found the different impacts of risks on cost efficiency between groups of bank. In addition, the results of this paper confirmed a negative effect of a special event – the global financial crisis – on cost efficiency.

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