

The Competitiveness and Efficiency of the Vietnamese Banking Sector in
the Face of Financial Liberalisation

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ABSTRACT

This thesis provides empirical evidence of the impact of financial liberalisation on the competitiveness and efficiency of the Vietnamese banking sector by applying a combination of non-parametric frontier estimation methods, stochastic frontier methods and Tobit panel data regression techniques. There have been few studies in Vietnam linking financial liberalisation to banking sector competitiveness and efficiency. In the thesis, these parametric and non-parametric methods are applied in a pilot study to measure the allocative efficiency at branch level of the Vietnam Bank for Agricultural and Rural Development (VBARD) – the largest bank in Vietnam in terms of total assets. The technical efficiency of the Vietnamese banking sector at bank level is then estimated using the same methods.

The empirical investigation of the thesis is based on the use of branch-level data and bank-level data for a sample of more than 50 branches of VBARD across the country over the period 2004–2008 and around 40 banks over the period 2002–2012. Using data envelopment analysis (DEA) to measure allocative efficiency at branch level and technical efficiency at bank level and using stochastic frontier analysis (SFA) to estimate cost and profit efficiency at branch level, the thesis suggests that the contributions of financial liberalisation to bank efficiency are generally mixed, depending on the measures of bank efficiency used and the sub-periods taken into account. The thesis presents weak empirical evidence of the positive impacts of financial liberalisation on efficiency improvements of the Vietnamese banking sector at both branch and bank level. Banking efficiency is inconsistently increased over the period of financial liberalisation as the financial market is more liberated and the size of the banking sector substantially increased. Hence, industry rationalisation through re consolidating and restructuring mergers and acquisitions (M&A) is required. The thesis suggests that both financial liberalisation and greater competition contribute to lower profit efficiency and higher costs for banks.

The thesis indicates that the Vietnamese banking system is dominated by large banks and that the state-owned commercial banks (SOCBs) are more efficient than the joint stock commercial banks (JSCBs), mainly because of their competitive advantage in terms of size. Furthermore, Vietnamese banking efficiency at both branch and bank levels is significantly improved by high levels of capitalisation, larger size and a better labour

force, while it is hampered by low loan quality. The findings also suggest that the northern banks in Vietnam are more efficient than the southern banks.

The empirical evidence of the thesis is also focused on investigating the impact of financial liberalisation on bank technical efficiency and productivity growth, making use of a *two-step* approach consisting of DEA and Tobit panel data regressions. The analysis conducted across the different location groups (north and south) suggests that the impact on the technical efficiency of banks is more pronounced in the northern areas than in the southern areas. Furthermore, the Tobit estimation takes into account bank-specific differences in terms of total assets, the equity–total assets ratio, the labour–capital ratio and the provision–capital ratio; the evidence suggests that these influences are also mostly significant under financial liberalisation. As a result, the thesis suggests that financial liberalisation reinforces an independent impact on the technical efficiency of banks.

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DECLARATION STATEMENT
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ABBREVIATIONS

| | |
|------|---|
| ADEA | Allocative data envelopment analysis |
| ADB | Asian Development Bank |
| ATM | Automated teller machine |
| CAGR | Compounded average growth rate |
| CAR | Capital adequacy ratio |
| DEA | Data envelopment analysis |
| DMU | Decision-making unit |
| FDI | Foreign direct investment |
| GDP | Gross domestic product |
| GSO | General Statistics Office of Vietnam |
| IMF | International Monetary Fund |
| IPO | Initial public offering |
| JSCB | Joint stock commercial bank |
| JVB | Joint venture bank |
| M&A | Mergers and acquisitions |
| MADM | Multi-attribute decision making |
| MIS | Management information system |
| NPL | Non-performing loan |
| OCRA | Operational competitiveness rating analysis |
| PCF | People's credit fund |

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| SBV | State Bank of Vietnam |
| SCP | Structure–Conduct–Performance |
| SOCB | State-owned commercial bank |
| SOE | State-owned enterprise |
| SWOT | Strength–Weakness–Opportunity–Threat |
| TFP | Total factor productivity |
| VBARD (or Agribank) | Vietnam Bank for Agricultural and Rural Development |
| VCB | Vietcombank (Bank for Foreign Trade of Vietnam) |
| VND | Vietnamese Dong (local currency) |
| WTO | World Trade Organization |

CHAPTER 1: INTRODUCTION

1.1. Background and rationale

With the commitments to the World Trade Organization (WTO) to open the banking sector and financial markets, Vietnam's local commercial banks are under pressure to improve their efficiency to meet international standards for corporate governance and sustain their competitiveness. Therefore, efficiency improvement is a key value driver to help Vietnamese banks cement their competitive positioning in the newly challenged business environment.

After a decade of rapid credit growth that started in 2002, in recent years Vietnam's central bank – the State Bank of Vietnam (SBV) – has restricted the expansion of banks' loan books by applying barriers and limits to credit for the non-production sector. Funding resources have become increasingly scarce and expensive as a result of the increasing interest lending rate, and firms have had to face liquidity and solvency problems that, in turn, have deteriorated the asset quality of banks. Given the persistence of poor data transparency, the Governor of the SBV announced in a Public Hearing hosted by the National Assembly in October 2011 that the non-performing loan (NPL) ratio had risen to 10% of the total outstanding loan book of the banking sector, however the individual NPL ratio declared by banks was around 3%. Meanwhile, according to Moody's estimates the problematic assets of the Vietnamese banking sector made up at least 15% of total assets. The increasing NPL ratio has led to an erosion of capital levels that in turn leads to (i) weakening of the capability of the banking system to absorb losses and (ii) constraints on the capability of the banking sector to provide credit for the economy. Under pressure to clean up the balance sheets of the banking system, over the past few years the Vietnamese government and the SBV have introduced several initiatives and a roadmap aimed at restructuring and consolidating the banking system.

For both external and internal key drivers, Vietnamese banks need to restructure and enhance their efficiency in order to face the increasingly competitive pressures and correct the shortcomings of the whole system. Consequently, studies into the efficiency of Vietnamese banks are valuable to assist the banks to formulate their business strategies. They are also important to help the authorities conduct policies that will facilitate the

banks to improve their efficiency and competitiveness and provide better services for the economy.

1.2. Aims and objectives

1.2.1. The aims of the thesis

The overall goal of this thesis is to define, measure, estimate and decompose the technical efficiency at bank level (for the main study) and the allocative efficiency at branch level (for the pilot study) of Vietnamese banks during the financial liberalisation period by applying both parametric methods and non-parametric methods (data envelopment analysis, or DEA). The **two-stage model** DEA method is applied in the thesis for two specific stages of banking business (the *production stage* and the *intermediation stage*). Both methods (parametric and non-parametric) are equally and consistently applied for both the pilot study and the main study.¹

1.2.2. The objectives of the thesis

To reach the goal of evaluating and investigating technical efficiency at bank level and allocative efficiency at branch level, the thesis focuses on the following objectives.

- To build a model that analyses the technical efficiency of Vietnamese banks and, for the pilot study, the allocative efficiency at branch level of the Vietnam Bank for Agricultural and Rural Development (VBARD).
- To identify intrinsic key value drivers consisting of environmental variables that significantly influence technical efficiency and allocative efficiency at bank level and branch level, respectively.
- To investigate the impacts of the financial liberalisation process on the efficiency of the Vietnamese banking sector.

¹ The reason for this approach – to investigate technical efficiency at bank level and allocative efficiency at branch level – is data constraints. For the pilot study at the branch level of VBARD, the collected data consists of price factors. Hence, the pilot study is able to examine the allocative efficiency of those branches of VBARD. However, the collected data for the main study is without price factors for both inputs and outputs. Consequently, the main study cannot estimate and investigate allocative efficiency at the bank level for the Vietnamese banking sector. Instead, technical efficiency is the focus of the main study. Theoretically, allocative efficiency and technical efficiency have the linkage that is reviewed and analysed in detail in Section 2.1.2.

- To identify a benchmark for the Vietnamese banking sector in terms of technical efficiency.²
- To make policy recommendations for restructuring and consolidating the Vietnamese banking system with the aim of enhancing its competitiveness and technical efficiency. The thesis provides empirical evidence to suggest that improving corporate governance and reconsolidating Vietnamese banks are the relevant solutions to enhance their competitiveness and technical efficiency.

1.3. Research methodology

The thesis makes use of both qualitative and quantitative analysis. The qualitative (phenomenological) analysis uses some simple statistical descriptions, based on the information content of the balance sheets and financial statements of Vietnamese commercial banks, to describe the technical efficiency and competitive position of those banks. The content analysis is also applied to the Vietnamese banking sector using Strength–Weakness–Opportunity–Threat (SWOT) analysis and the simple Structure–Conduct–Performance (SCP) paradigm.

The thesis also makes use of quantitative (positivist) analysis by applying both parametric and non-parametric methods. The data sources for the quantitative analyses are (i) the annual reports of commercial banks (balance sheets and financial statements) for the main study at bank level and (ii) monthly reports for the pilot study at branch level.

First, a pilot study on allocative efficiency at the branch level for the case of VBARD – the largest bank in terms of total assets – is implemented. All research questions and hypotheses of the thesis are tested for the pilot study. The data for the pilot study is extracted from the Data Warehouse of VBARD. The entire data sample of the pilot study is monthly panel data for the period 2004–2008 from more than 50 branches of VBARD across the country.

After that the empirical findings of the pilot study are used to modify and validate the research methodology for the main study examining technical efficiency at the bank level. Hence, the empirical findings of the pilot study are the cornerstone to the investigation of the technical efficiency of Vietnamese banks at the bank level. The data sample for the

² Rawson (2001) concludes that companies that are efficient across all models should be proposed as benchmarks for the industry. The benchmark companies give an indication of what types of company are more competitive.

main study is drawn from the annual reports, consisting of balance sheets and financial statements, of commercial banks in Vietnam. The entire data for each commercial bank during the period 2002–2012 is collected from its annual reports and provided by SBV. The average number of samples taken into the main study is around 40 banks. Hence, the main study is conducted using unbalanced panel data combined with cross-sectional data and time-series data.

To investigate the efficiency of Vietnamese banks, the thesis makes use of techniques generally categorised into two approaches: parametric and non-parametric. Parametric estimation uses econometric techniques; non-parametric estimation employs mathematical programming DEA. Further information about the parametric method is found in Bauer (1990). Meanwhile, typical debates about DEA are discussed by Sengupta (1999, 2002). By applying these methods, the thesis analyses allocative efficiency and technical efficiency at branch and bank level respectively. At the same time, the thesis decomposes the intrinsic key value drivers of allocative efficiency and technical efficiency for further analysis. Using these methods, the thesis examines the impacts of policy deregulation, during the financial liberalisation process in Vietnam, on allocative efficiency at the branch level and technical efficiency at the bank level. Policy recommendations are drawn out from the investigation.

The quantitative analyses and data processing in terms of the non-parametric approach are programmed using DEAP 2.1 software. All parametric analyses of the thesis are programmed using Frontier 4.1 software.³ The Tobit regression and other quantitative analyses in the thesis are programmed and executed using EVIEWS software.

1.4. Significance of the thesis

In seeking to support Vietnam to restore the momentum of growth and improve sustainable development, the World Bank Donor Group's strategy has been arranged broadly around the Vietnamese government's seven-point agenda: improving macroeconomic stability and competitiveness; strengthening the financial sector; reforming state-owned enterprises (SOEs); accelerating rural development; investing in people and promoting social equity; improving public administration; and promoting transparency and participation.

³ DEAP 2.1 and Frontier 4.1 are developed by Tim Coelli of the Centre for Efficiency and Productivity Analysis at the University of New England.

The Vietnamese government has implemented an ambitious programme to restructure the country's banking system. This programme has been granted an official loan of \$110 million by the World Bank. Hence, the impacts of the programme on the Vietnamese economy are significant. However, up to now there has been very little analysis of the impact of the Banking System Restructuring Program on the technical and allocative efficiency and competitiveness of Vietnamese banks.⁴ Therefore, the findings of the thesis are needed and useful not only to help policy makers in Vietnam adjust their policy-making processes but also to enable external donors in Vietnam to assess the efficiency and effectiveness of their donor funds. Last, but not least, the empirical findings are solid evidence for bankers in Vietnam to cement their strategic planning processes in line with their competitiveness and efficiency.

The study into the key value drivers of technical efficiency of Vietnamese banks may also be of interest to academics because of its contents, namely (i) the Vietnamese banking system is split in terms of location between the northern and southern banks, in terms of ownership between the state-owned and non-state-owned banks and in terms of timing before and after the financial liberalisation process; (ii) the Vietnamese banking system is decomposed into intrinsic key value drivers such as location, ownership, size, equity, asset quality, loan quality and policy deregulation; (iii) the competition policy in the Vietnamese banking sector conducted by SBV in the face of the globalisation process since joining the WTO is also reviewed in this thesis.⁵

Hence, the findings of the thesis will enable policy makers in Vietnam to fine-tune financial deregulation policy to conduct the restructuring strategy of the banking sector. Furthermore, the policy recommendations drawn out are particularly useful for the tactical business and strategic planning of commercial banks in Vietnam.

⁴The most up-to-date and solid studies into competitiveness in Vietnam are conducted by the Vietnam Economic Research Network (VERN) in collaboration with the Vietnam Economics Institute. However, all VERN studies into competitiveness focus strongly on the textile and garment, foodstuff or export-oriented industries in Vietnam. There is no study into the competitiveness and efficiency of the banking sector in Vietnam.

⁵ Competition policy in broad terms consists of two parts: (i) competition law or 'antitrust' law, and (ii) micro industrial policies, namely tariff and non-tariff policies, economic regulation designed to prevent anti-competitive practices and governing business practices (Khemani, 1994: 1). As a result, the most common objective of competition policy, accepted in the majority of countries, is to protect and preserve competition as the most appropriate means of ensuring efficient allocation of resources. The main objective of competition policy is to promote economic efficiency through maintenance and protection of the competitive process and/or free competition. The objective enhances consumer welfare adopted as one objective of competition policy in many competition laws of those countries. Besides that, other socioeconomic objectives, namely employment, pluralism, regional development, the preservation of free enterprise and the promotion of small and medium enterprises, are ascribed to competition policy.

1.5. Scope of the thesis

The title of the thesis is *The Competitiveness and Efficiency of the Vietnamese Banking Sector in the Face of Financial Liberalisation*. However, as a result of the literature review and the empirical findings in this field in Vietnam, and also as a result of the data constraints of the thesis, which are described in more detail in the following chapters, the scope of the thesis is narrowed as follows.

- (i) Concept and definition: based on the literature review in Chapter 2, it is concluded that (a) in terms of causality, the efficiency leads to competitiveness, and (b) the terms ‘competitiveness’ and ‘efficiency’ are interchangeable. Hence, the thesis focuses on analysing only the efficiency of banks in Vietnam rather than the competitiveness of those banks.
- (ii) Data sources: for the pilot study the thesis focuses on investigating the *allocative efficiency* at *branch level* of VBARD. However, because of a lack of data on input and output prices of the banks in Vietnam, the thesis focuses on investigating *technical efficiency* at the *bank level* for the whole banking sector rather than *allocative efficiency*.
- (iii) Data sample: the thesis investigates the technical efficiency of banks in the Vietnamese banking sector. In other words, the observations of the sample in the thesis consist of all banks operating in Vietnam (both local banks and foreign bank branches operating in Vietnam). Consequently, the thesis does not compare and score the efficiency of the onshore banks in Vietnam with the rest of the world.

1.6. Outline of the thesis

The thesis consists of eight chapters. The remainder of the thesis is structured as follows. In Chapter 2, the thesis reviews the theoretical background of the study. In this chapter, the literature on efficiency is discussed in depth, and then the theoretical background for measuring and decomposing bank efficiency is discussed. Chapter 2 also introduces the methods for measuring productivity change, and the methods for investigating the intrinsic key value drivers (determinants) of allocative and technical efficiency at the branch and bank level, respectively.

Chapter 3 helps to review and shape an overall landscape of the Vietnamese banking sector regarding the performance and competitiveness of those banks. In this chapter, the

thesis investigates the impacts of financial liberalisation policies on the technical efficiency of banks during the study period.

In Chapter 4, the literature synthesis is concluded from the literature review and empirical review of the previous chapters. Consequently, the aims, objectives, research questions and research hypotheses for both the pilot study and the main study are presented in this chapter.

Chapter 5 develops the research methodology for the thesis by introducing an analytical framework for allocative efficiency and technical efficiency at branch and bank level respectively. On the basis of the research methodology developed in Chapter 5, a pilot study is implemented in Chapter 6 using the analytical framework to analyse the allocative efficiency of branches of VBARD. At the same time, in this chapter, the detailed study and investigation of the competitive positioning of banks in Vietnam helps to suggest that the Bank for Foreign Trade of Vietnam (Vietcombank) rather than VBARD should be used as the benchmark of competitiveness and efficiency for all banks in Vietnam. Hence, the findings of the pilot study in Chapter 6 are investigated and validated in the next chapter – Chapter 7.

The main study into the technical efficiency of Vietnamese commercial banks is presented and investigated in Chapter 7, based on the lessons drawn from the pilot study in Chapter 6. Chapter 8 draws out the main conclusions from the empirical findings of both the pilot and main study, with several policy implications and recommendations for future study on this topic.

CHAPTER 2: THEORETICAL BACKGROUND

2.1. Literature review on competitiveness and efficiency

2.1.1. Definition of competitiveness

Competitiveness is a critical topic in economics and policy research. According to Frohberg and Hartmann (1997), competitiveness can be seen and evaluated at different levels, namely the economy level, the sector/industry level and the firm level. The concept of national-level competitiveness was first introduced by Porter (1990) and was debated in depth by the World Economic Forum (1995). According to Porter (1990), the competitive strategy of a firm should be established in the context of the attributes of its national environment that facilitate or limit competitive advantage.

The Aldington Report of the Select Committee of the House of Lords on Overseas Trade (1985) defines competitiveness at firm level. A firm is competitive if it can produce products and services of superior quality and lower costs than its domestic and international competitors. Competitiveness is synonymous with a firm's long-run profit performance and its ability to compensate its employees and provide superior returns to its owners.

According to Freebairn (1986), competitiveness is the capacity to provide outputs in the location and at the time they are sought at prices the same or better than those of other potential providers, with the return at least equivalent to the opportunity cost of employed resources. With the same opinion, Cockburn *et al.* (1998) conclude that competitiveness reflects the capacity of the firm to sell its products and services profitably. Hence, according to Cockburn *et al.* (1998), if a firm provides better-quality products or services at lower prices than its competitors, the firm is competitive. Cockburn *et al.* (1998) consider cost to be the critical factor of competitiveness among other determinants, namely price distortions, returns to scale, relative factor endowments and productivity differentials.

Furthermore, Frohberg and Hartmann (1997) conclude that competitiveness is significantly correlated with and explained by comparative advantage. However, competitiveness includes market distortions, which are not taken into account by comparative advantage. Consequently, Frohberg and Hartmann (1997) suggest that the

level of competitiveness of firms can be measured and compared in a given country or between economies. Such comparisons can be based on *ex-post* (past performance) competitive indicators, such as foreign direct investment (FDI), the real exchange rate and market share, or on the *ex-ante* (potential) competitive indicators of domestic resource costs, gross margins and production costs (competitiveness coefficient). Porter (1990) and Fanfani *et al.* (1995) heavily debate the measures of competitive process and potential competitiveness.

Because of such different definitions of competitiveness, Feurer and Chaharbaghi (1994) and Buckley *et al.* (1988) conclude that there is no unique and exact definition for competitiveness. As a result, competitiveness has different meanings for different organisations. However, these theoretical backgrounds of competitiveness are still the seminal theories and conceptual underpinnings.

2.1.2. Definition of efficiency

The theoretical discussions about competitiveness suggest that efficiency can be defined as strategic moves integrated into a firm's competitive strategy. In terms of microeconomics, both allocative and technical efficiency are the primary sources that enable the firm to get its economies of scope and economies of scale (James *et al.*, 1997; Nellis *et al.*, 2000). Furthermore, efficiency is a critical driver for the horizontal and vertical integration of the firm in terms of competitive strategy (Wolfgang, 2004).

Three types of efficiency – namely allocative (or price) efficiency, technical efficiency and productive efficiency – were initially classified by Farrell (1957). According to Banker *et al.* (1984) and Banker and Natarajan (2008), based on the available technology technical inefficiency is related to failure to operate at optimum production levels. Meanwhile, Afriat (1972) suggests that allocative efficiency is related to how the firm can optimise to combine its inputs given input prices.

For a company uses of m inputs $X = (X_1, X_2, \dots, X_m)$ at fixed prices $W = (W_1, W_2, \dots, W_m)$ to produce a single-fixed-price- P output Y , according to Liu (1998) **technical efficiency** is defined as the ratio of actual output divided by maximum output, $Y^*/f(X^*)$.

Consequently, an output Y^* produced using inputs X^* is technically efficient if $Y^* = f(X^*)$. However, it is technically inefficient if $Y^* < f(X^*)$. Hence, **technical efficiency** measures the capability of the firm to get the maximum output from given inputs.

Allocative efficiency represents a case in which the substitution ratio between inputs is equal to relative prices, that is, $f_i(X)/f_j(X) = W_i/W_j$ where $f_i(X) = \frac{\partial f(X)}{\partial X_i}$ and $f_j(X) = \frac{\partial f(X)}{\partial X_j}$.

Otherwise, according to Thomas (1997), if the inequality $f_i(X)/f_j(X) \neq W_i/W_j$ happens, the firm does not take advantage of the best ratio of inputs. As a result, **allocative efficiency** measures the capability of the firm to make use of inputs in optimal proportions given their prices.

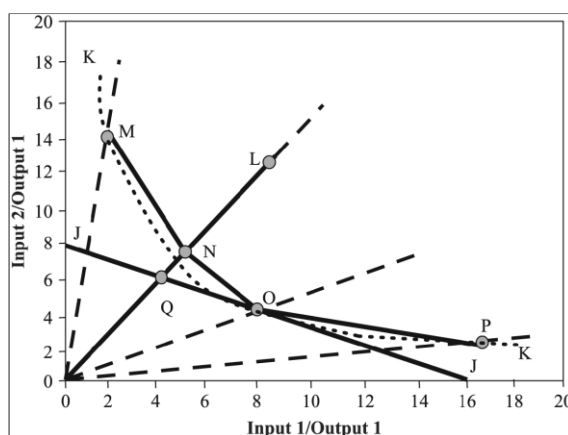
Productive efficiency is measured by three approaches, namely the output-based, input-based and profit-orientation approaches. According to Aigner and Chu (1968), Timmer (1971) and Kumbhakar (1987), productive efficiency is influenced by firm size, wages of workers, capital structure, geography, capital-labour ratio, ownership, domestic competitiveness, export-oriented features and other factors.

Figure 2.1 demonstrates in detail the linkage between technical efficiency and allocative efficiency in terms of input. Figure 2.1 presents six decision-making units (DMUs), each of which produces only one output using two inputs. The curve KK in Figure 2.1 is the output isoquant predicting the theoretical production frontier. Each combination of the inputs in the curve makes the equivalent DMU produces the maximum output.

Meanwhile, the curve MP represents the observed production frontier of the technically efficient DMUs 2 to 5 located at points M, N, O and P respectively in the curve MP.

It can be seen that DMU 1, producing at point L above isoquant KK, is technically inefficient. Meanwhile, DMU 3 is better than DMU 1 in terms of efficiency because DMU 3 uses less input to produce more output. As a result, DMU 3 is a benchmark for DMU 1. Consequently, the technical inefficiency between DMU 1 and DMU 3 is the distance from point L to point N.

Figure 2.1: Technical and allocative efficiency



Source: Rickards (2003: 234).

2.2. Competitiveness measurement approaches

A brief summary of methodology for measuring firm-level competitiveness in a country or between countries is discussed in Cockburn *et al.* (1998) and Swann and Taghavi (1992). Meanwhile, other authors suggest other key competitiveness measures. For example, the Bureau of Transport and Communications Economics (1993) implies price and service quality; Encaoua (1991) suggests cost and productivity; Good and Rhodes (1991) focus on price and productivity; Good *et al.* (1995) and Windle and Dresner (1995) suggest productivity, efficiency and profitability; Oum and Yu (1998) consider cost; Chang and Yeh (2001a) and Young *et al.* (1994) consider service quality; Truitt and Haynes (1994) think of service quality and productivity; Schefczyk (1993) thinks of operational performance; and Janic (2000) suggests safety. Consequently, Prescott and Grant (1988) conclude that there is no perfect technique for measuring competitiveness at the *firm level*. In other words, each individual competitiveness measure cannot reflect the overall competitiveness of firm. Hereunder, there is a brief summary of the main analytical approaches to measuring competitiveness at the *firm level* by Buckley *et al.* (1988).

Buckley *et al.* (1988), in an international survey of competitiveness measures, conclude that in principle there are three approaches to measuring competitiveness at the firm level: (i) competitiveness performance, (ii) competitiveness potential and (iii) management process. Using that framework, Buckley *et al.* (1988) suggest that competitiveness should not be analysed as a static feature but as a dynamic one. Buckley *et al.* (1988) also summarise the measures of competitiveness at the country, industry, firm and product levels, as shown in Table 2.1.

Table 2.1: Indicators of competitiveness

| Level | Performance | Potential | Management process |
|--------------|--|--|---|
| Country | <ul style="list-style-type: none"> – Export market share – % manufacturing in total output – Balance of trade – Export growth – Profitability | <ul style="list-style-type: none"> – Comparative advantage – Cost competitiveness – Productivity – Price competitiveness – Technology indicators – Access to resources | <ul style="list-style-type: none"> – Commitment to international business – Government policies – Education/Training |
| Industry | <ul style="list-style-type: none"> – Export market share – Balance of trade | <ul style="list-style-type: none"> – Cost competitiveness – Productivity | <ul style="list-style-type: none"> – Commitment to international business |

| | | | |
|---------|--|---|--|
| | <ul style="list-style-type: none"> - Export growth - Profitability | <ul style="list-style-type: none"> - Price competitiveness - Technology indicators | |
| Firm | <ul style="list-style-type: none"> - Export market share - Export dependency - Export growth - Profitability | <ul style="list-style-type: none"> - Cost competitiveness - Productivity - Price competitiveness - Technology indicators | <ul style="list-style-type: none"> - Ownership advantage - Commitment to international business - Marketing aptitude - Management relations - Closeness to customer - Economies of scale and scope |
| Product | <ul style="list-style-type: none"> - Export market share - Export growth - Profitability | <ul style="list-style-type: none"> - Cost competitiveness - Productivity - Price competitiveness - Quality competitiveness - Technology indicators | <ul style="list-style-type: none"> - Product champion |

Source: Buckley *et al.* (1988: 180-181).

2.2.1. Multi-attribute decision-making model

Chang and Yeh (2001a, 2001b) set up a competitiveness index based on a set of competitive performance features of firms, namely market valuation, earnings protection, financial stability, operating efficiency, asset utilisation and liquidity. Accordingly, Chang and Yeh (2001a, 2001b) suggest that the competitive positioning of a firm is based on five competitiveness dimensions – cost, productivity, service quality, price and management – as shown in Table 2.2.

Table 2.2: Performance measures used for competitiveness index evaluation for airlines

| Dimensions | Performance measures |
|------------------|--|
| C1, Cost | C11 Unit operating cost (total operating cost / available seats – kilometres) |
| C2, Productivity | C21 Labour productivity (total passenger revenue / total employee numbers) |
| | C22 Fleet productivity (total revenue passenger kilometres / total aircraft numbers) |
| | C23 Passenger load factor (total passengers carried / total seats available) |

| | | |
|---------------------|-----|--|
| C3, Service quality | C31 | On-time performance (1 – (total flights delayed / total flights departed)) |
| | C32 | Safety (number of accidents / million-hours flown) |
| | C33 | Flight frequency (total number of flights / total number of routes) |
| C4, Price | C41 | Average fare (total fare revenue / total revenue passenger kilometres) |
| C5, Management | C51 | Revenue growth (annual growth rate of total operating revenues) |
| | C52 | Net profit margin (total net profit / total operating revenue) |
| | C53 | Market share (total passengers carried / total passengers in the market) |

Source: Chang *et al.* (2001a: 408).

The non-parametric multi-attribute decision-making (MADM) model developed by Chang and Yeh (2001a, 2001b) requests to find out the weights of attributes of those indicators to set up the competitiveness index for firms. There are three methods that the MADM could apply to explore the weight for the competitiveness index: (i) the simple additive weighting method (SAW), (ii) the weighted product method (WP), and (iii) the technique for order preference by similarity to ideal solution (TOPSIS).

These methods concern the valuation of competitiveness of a set of n firms A_i ($i = 1, 2, \dots, n$). The competitiveness of these firms is measured using a set of m competitiveness criteria C_j ($j = 1, 2, \dots, m$). Each C_j criterion is broken down into p_j sub-criteria C_{jk} ($k = 1, 2, \dots, p_j$) as described in Table 2.2. Using the criteria, the MADM is developed by the two sets of data as follows.

- (i) The weighting vector $W = (w_1, w_2, \dots, w_j, \dots, w_m)$ and sub-weighting vector $w_j = (w_{j1}, w_{j2}, \dots, w_{jk}, \dots, w_{pj})$ with $j = (1, 2, \dots, m)$ and $k = (1, 2, \dots, p_j)$. There are no reliable subjective weights that could be gained; hence the competitiveness criteria are set up in such a way that equal weights are taken into account as follows:

$$w_j = 1/m, \quad j = 1, 2, \dots, m \quad \text{and} \quad w_{jk} = 1/p_j, \quad k = 1, 2, \dots, p_j \quad (2.1)$$

- (ii) The decision metrics $X = \{x_{ij}, i = (1, 2, \dots, n); j = (1, 2, \dots, m)\}$ and $Y_{C_j} = \{y_{ki}, k = (1, 2, \dots, p_j); i = (1, 2, \dots, n)\}$. These matrices (X and Y_{C_j}) show the ratings of firm A_i in terms of performance respecting to criterion C_j and performance measures C_{jk} . The values of Y_{C_j} are given from the actual performance that is assumed to be normalised. Meanwhile, the X matrix is calculated by

aggregating the weighted ratings based on the sub-level performance measures as follows.

$$(x_{1j}, x_{2j}, \dots, x_{nj}) = W_j Y_{C_j} / \sum_{k=1}^{pj} w_{jk} \quad (2.2)$$

Given two sets of data, the MADM model aims to rank all firms by producing a competitiveness value in respect to all the competitiveness criteria for each individual firm. Because the weights and ratings of firms are based on the MADM method produced by an interval scale. Consequently, Chang and Yeh (2001a, 2001b) apply the three methods of SAW, WP and TOPSIS. The SAW method is considered as the weighted sum of the performance ratings. The WP sets up the weighted product method for the overall score S_i of each firm. Meanwhile, the TOPSIS method suggests that the most competitive firm is not only the shortest distance from the positive benchmark but also the longest distance from the negative benchmark.

Following the same MADM approach developed by Chang and Yeh. (2001a, 2001b), as mentioned above, Xi *et al.* (2014) developed the analytic hierarchy process and principal component analysis (AHP-PCA) method to investigate the competitiveness of Chinese commercial banks. The competitiveness scores of Chinese banks based on the AHP-PCA model show that the competitiveness of SOCBs is weaker than that of JSCBs.

2.2.2. Industrial competitiveness model

Oral (1986) and Oral and Ozkan (1986) set up an industrial competitiveness model to suggest that the degree of competitiveness of a firm is based on three determinants: cost superiority, industrial mastery and the political-economic environment. These determinants are described by external and internal criteria measuring the level of competitiveness, as follows.

$$\begin{aligned} \text{Operational mastery} &= \theta = F_A / F_P \\ \text{Strategic proficiency} &= \theta_p = F_p / R \\ \text{Industrial mastery} &= \theta_A = F_A / R \end{aligned} \quad (2.3)$$

where F_A , F_P and R are the current, potential and comparative positions of a firm, respectively. As a result, Oral (1986) and Oral and Ozkan (1986) develop an indicator to measure the competitiveness of a firm, shown in Equation 2.4.

$$\begin{aligned} \text{Actual competitiveness level} &= L_A = \theta_A \Pi_A \\ \text{Potential competitiveness level} &= L_P = \theta_P \Pi_P \end{aligned} \quad (2.4)$$

where Π is cost superiority of the firm in relation to a given competitor and presented in Equation 2.5.

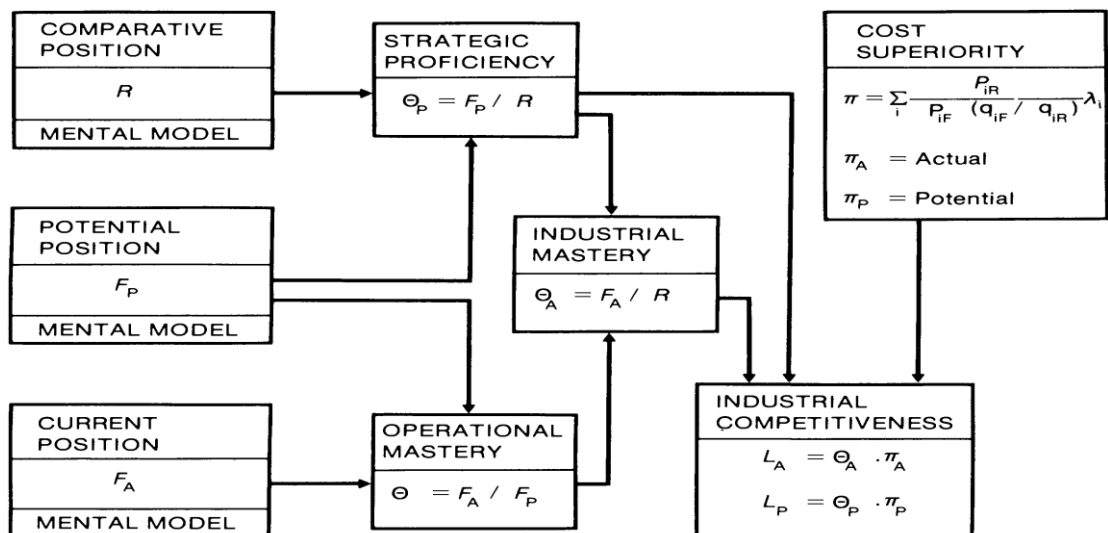
$$\Pi = \sum_i \frac{P_{iR}}{P_{iF} (q_{iF} / q_{iR})} \lambda_i \quad (2.5)$$

where:

- P_{iR} is the price or unit cost of input i to the competitor;
- P_{iF} is the price or unit cost of input i to the firm;
- q_{iR} is the quantity of input i used by the competitor to produce and transport one unit of output to the market;
- q_{iF} is the quantity of input i used by the firm to produce and transport one unit of output to the market;
- λ_i is the share of input i in the unit-cost-to-compete.

According to Oral (1986) and Oral and Ozkan (1986), a firm is more competitive than its competitor if the value of L_A is greater than 1. The critical weakness of the industrial competitiveness model is its applicability, as Oral and Ozkan (1986) concluded application of the model with all its details may be very time-consuming and expensive, if not impossible. To make the model workable to find a ‘typical’ foreign competitor, Oral (1986) and Oral and Ozkan (1986) developed a reduced-form model, as described in Figure 2.2.

Figure 2.2: The second-stage model of industrial competitiveness



Source: Oral and Ozkan (1986: 351).

2.2.3. Operational competitiveness rating analysis model

Parkan (1994), Jayanthi *et al.* (1996), Parkan *et al.* (1997), Parkan and Wu (1999) and Parkan (2005) are the main authors who develop and apply the operational competitiveness rating analysis (OCRA) method in analysing competitiveness at the firm level. OCRA is a non-parametric method, like the DEA method, used to measure efficiency. It applies simple, flexible, non-repeated computations to gain estimated ratings for the relative operational performance of production units. Using the ratings, OCRA allows the differences of firms' profiles and competitive priorities to be shown. The critical strength of this method is in incorporating the qualitative dimensions of performance to measure the competitiveness.

Parkan (2005) suggests that the OCRA model measures operational performance by using benchmarked cost and revenue data through three computational steps, as follows.

- Input efficiency performance ratings
- Output efficiency performance ratings
- Overall efficiency performance ratings

The ratings produced by the OCRA model enable comparison of the operational performances of firms. Hence, as Parkan (2005) suggests, the fundamental conclusions of the OCRA model imply that the two concepts of competitiveness and efficiency have the same meaning and are interchangeable. The OCRA model analyses the competitiveness of firms by benchmarking the firms' performances through two stages, as follows.

- Comparison of each firm's performance to its benchmark.
- Comparison of all firms' actual performances against their benchmarks.

Similarly, Han *et al.* (2014) investigate the competitive advantage of Chinese commercial banks by applying four efficiency indicators, namely profit efficiency, service efficiency, social productive efficiency and growth efficiency. Based on employee salary as the proxy of labour input, Han *et al.* (2014) conclude that the efficiency of JSCBs is lower than that of SOCBs. Following the OCRA model, Poshakwale and Qian (2011) suggest the positive and significant effects of financial reforms on the competitiveness and production efficiency of Egyptian banks. Poshakwale and Qian (2011) also investigate the competitiveness of Egyptian banks based on their production efficiency. At the same

time, Suhaimi *et al.* (2012) investigate the significant linkage between the competitiveness and profit efficiency of Malaysian banks, suggesting that non-information-technology expenditure and ownership significantly contribute to the competitiveness of those banks.

2.2.4. Cost competitiveness approaches

Cost-based competitiveness is a solid criterion for evaluating the overall sustainable competitiveness (sustained profitability) of a firm. According to Cockburn *et al.* (1998), the proxy measurement for competitiveness is the same as physical unit cost, which is the ratio of total cost divided by the value of output. If the physical unit cost is adjusted by the retail price, then the physical unit cost becomes the monetary unit cost. The differences in terms of quality are considered as non-cost determinants of competitiveness. In terms of monetary unit costs, all non-cost determinants are fully presented because those differences are included in the price of product.

According to Cockburn *et al.* (1998), under the perfect competition condition producers are profit-making and competitive in the long term if their unit costs do not exceed unity. According to Cockburn *et al.* (1998), the unit-cost method is the only approach that measures competitiveness and its determinants at firm level. This is the critical strength of this approach. However, the fundamental weakness of this approach is the need for a benchmark competitor. Hence, the competitiveness of a given firm depends entirely on the choice of the peer (benchmark competitor).

Therefore, if unit cost is less than 1, the difference between unit cost and unity predicts pure profit. The competitiveness measure is therefore a proxy for the firm's profitability. As a result, the lower the unit cost, the more chance firms could expand and/or overcome the uncomfortable business environment. Hence, lower unit cost is fundamental for firms to get higher competitiveness rankings. It is suggested that, if unit cost is used as a ranking indicator, it can help to rank the relative competitiveness level for each single firm or group of firms.

As Cockburn *et al.* (1998) conclude, the model compares the cost structure of firms with that of foreign competitors. The critical shortcoming of this approach is a lack of clarity in the explanation of how to choose a valid and suitable foreign competitor for comparison with domestic peers. Cockburn *et al.* (1998) fail to provide guidelines for the

method used to select the foreign competitors taken into their study for comparison with domestic firms.

Frohberg and Hartmann (1997) imply that production costs and/or gross margins are the critical success factors used to analyse competitive advantage between firms. However, according to Frohberg and Hartmann (1997), the biggest weakness of gross margins is their application scope. Furthermore, gross margins do not successfully reflect the influences of quasi-fixed factors on the competitiveness of the firm. In fact, gross margins are based on a detailed cost structure of production inputs. Consequently, gross margins could be optimum indicators for competitiveness comparison at the firm or product level.

Meanwhile, Oum and Yu (1998) suggest using a multilateral unit cost index. The index is developed from the translog function of variable cost. According to Oum and Yu (1998), if the unit cost (average cost) of a firm is sustainably lower than the unit cost of its competitors, then the firm is considered to be cost competitive. Based on the index, the unit cost of the firm is decomposed into its determinants, namely efficiency, input prices, output attributes and network. The determinants are effective provided that the influences of output attributes and network are adjusted. Assuming that the main effects on cost competitiveness are a result of input prices, this index could be considered approximately as the real comparative cost competitiveness. This indicator could be taken from the residual total factor productivity index that is further debated by Oum and Yu (1995).

Using the model, Oum and Yu (1998) decompose unit cost into sources, namely size, output mix, input prices, business characteristics, time effects and efficiency. Hence, with this model Oum and Yu (1998) theoretically link competitiveness with efficiency. Accordingly, Oum and Yu (1998) conclude that:

$$\text{Cost competitiveness (CC) indicator} = \text{Effects of input prices} + \text{Effects of efficiency} \quad (2.6)$$

Following the same approach, Davutyan and Yildirim (2013) make use of the shadow input–output prices and the shadow unrealised profit scores that operationalise the Hicksian concept of ‘*monopolistic quiet life*’ to measure the competitiveness of banks in the Turkish banking sector. Davutyan and Yildirim (2013) also point out that there is a theoretical linkage between efficiency and competitiveness by concluding that profit efficiency is positively related to total assets, suggesting important economies of scale and scope.

2.2.5. Demand-based competitiveness approaches

2.2.5.1. The revenue-based approach

The traditional hypothesis of monopoly power is the underlying background for the relationship between market structure and competition. Accordingly, Matgorzata (2005) points out the ‘*structural models*’ hypothesis, suggesting that concentrated markets tend to be more collusive. Consequently, monopolistic profits earned by banks are a result of a wider margin of intermediation. Meanwhile, Gunalp and Celik (2006) summarise the ‘*non-structural model*’ approach called as ‘*new empirical industrial organisation*’ Panzar and Rosse (P–R) model that measures competition using the ‘*H-statistic*’ indicator. De Bandt and Davis (2000) show that the P–R approach requires a number of working assumptions. Firstly, the bank must be treated as a single-product firm, suggesting that the bank is viewed as a unit producing intermediation services using labour, physical capital and financial capital as inputs. Secondly, higher input prices must not be correlated with higher-quality services that generate higher revenues. The correlation would bias the computed *H-statistic*. According to Molyneux *et al.* (1996), this assumption suggests that if one rejects the hypothesis of a contestable competitive market then this bias cannot be too large. Thirdly, banks must be in long-run equilibrium.

Al-Muharrami *et al.* (2006) summarise the bank revenue function as a proxy for competitiveness that is determined by factor prices and other bank-specific variables as shown in the Table 2.3 below.

Table 2.3: P–R model results from other studies

| Authors | Period | Countries | Findings |
|-------------------------------------|---------------|-----------------------------------|---|
| Shaffer (1982) | 1979 | New York | Monopolistic competition |
| Nathan and Neave (1989) | 1982–84 | Canada | 1982: perfect competition; 1983–84: monopolistic competition |
| Lloyd-Williams <i>et al.</i> (1991) | 1986–88 | Japan | Monopoly |
| Molyneux <i>et al.</i> (1994) | 1986–89 | France, Germany, Italy, Spain, UK | Monopoly: Italy; monopolistic competition: France, Germany, Spain, UK |
| Vesala (1995) | 1985–92 | Finland | Monopolistic competition for all but two years |
| Molyneux <i>et al.</i> (1996) | 1986–88 | Japan | Monopoly |
| Coccorese (1998) | 1988–96 | Italy | Monopolistic competition |
| Rime and Stirroh (2002) | 1987–94 | Switzerland | Monopolistic competition |
| Hondroyiannis <i>et al.</i> (1999) | 1993–95 | Greece | Monopolistic competition |

| | | | |
|------------------------------|---------|------------------------|---|
| Bikker and Groeneveld (2000) | 1989–96 | 15 EU countries | Monopolistic competition |
| De Bandt and Davis (2000) | 1992–96 | France, Germany, Italy | Large banks: monopolistic competition in all countries; small banks: monopolistic competition in Italy, monopoly in France, Germany |
| Bikker and Haaf (2002) | 1988–98 | 23 OECD countries | Monopolistic competition |
| Hempell (2002) | 1993–98 | Germany | Monopolistic competition |
| Coccorese (2004) | 1997–99 | Italy | Monopolistic competition |

Source: Al-Muharrami *et al.* (2006: 7).

2.2.5.2. The client’s choice approach

Jagelavičienė *et al.* (2006) conclude that a bank should take a competitive position in the competition process based on its strengths and opportunities. Zineldin (1996, 2002) and Zineldin and Bredenlów (2001) argue that the strategic positioning of a bank is a conceptual construct to make distinctions between the ways in which a bank may interact with customers in a marketplace through offering products and services to enhance the bank’s position in relation to its competitors. Kotler (1994) concludes that a bank’s competitive positioning reflects how consumers perceive its products and services in comparison with those of its competitors. As a result, customer perception of a bank and its image is a key success factor for the bank.

From the literature, Kotler (1994), Lovelock (1983), Ries and Trout (1986), Schmenner (1986) and Stemper (1990) conclude that there are four positioning strategies for banks. These positioning strategies are briefly suggested by Zineldin (1996, 2002), Zineldin and Bredenlów (2001) and Jagelavičienė (2006), as follows.

- Institutional positioning
- Distribution/delivery system and staff positioning
- Product/service line positioning
- Segment positioning

According to Zineldin (2005), positioning is significantly influenced by customers. Based on the literature review of Zineldin (1996, 2002, 2005) in the Table 2.4 lists a number of determinants of bank choice that could be examined by conducting significant large-scale surveys.⁶

⁶ Further information about this kind of survey can be found in Gupta and Torkezadeh (1988), who surveyed 500 residents of Winnipeg, Canada, and Zineldin (1995), who surveyed 300 firms in Sweden.

Table 2.4: Determinants of bank selection

| Factor (rating on 5-point) | |
|--|--|
| No | No |
| 1 Reputation | 10 Efficiency in correcting mistakes |
| 2 Recommendation by others | 11 Price competitive on loans |
| 3 Interesting advertising | 12 Price competitive on savings |
| 4 Convenience of location | 13 Price competitive on service charges |
| 5 Opening hours | 14 Safety of funds and high confidence |
| 6 Friendliness and helpfulness of personnel | 15 Speed of service and decision making |
| 7 High technological services | 16 High ability of flexibility in loan negotiations |
| 8 Full service provider | 17 Accuracy in transaction account management |
| 9 First with new supporting, facilitator and different products/services | 18 Offer information and knowledge of customer's accounts and services offered |
| | 19 Availability of loans |

2.3. Efficiency measurement approaches

Berger and Mester (1997a, 1997b) find that price factors are ignored in the non-parametric methods. These non-parametric methods measure technical inefficiency in a bank producing a few outputs from many inputs. These methods are unable to measure allocative inefficiency without relative prices. Furthermore, for the banks specialising in different inputs or outputs, the non-parametric methods cannot help to compare those banks in terms of efficiency. As a result, Berger and Mester (1997a, 1997b) conclude that *technological optimisation, rather than economic optimisation, is the main focus of the non-parametric methods*. That is why Berger and Mester (1997a, 1997b) suggest that it is necessary and compulsory to conduct a study on efficiency using a combination of both parametric and non-parametric methods. Additionally, the cost and profit efficiency concepts are not the focus of non-parametric methods.

Bustad *et al.* (2006) and Andersen *et al.* (2009) point out that the two schools of thought (parametric and non-parametric methods) have actively and expansively developed in this field of literature. Delis and Koutsomanoli (2009) also compare the parametric (stochastic frontier approach) and non-parametric techniques (DEA) and highlight the similar outcomes between the predictions of cost and profit efficiency. Similarly, Kempkes and Pohl (2010) also apply both DEA and stochastic frontier analysis in the same data sample to compare the results. However, the two branches of methodology have evolved

separately as concluded by Berger (1993) the lack of correspondence among the efficiency levels for the different measurement approaches suggests that more research comparing these techniques is requested. Koetter and Meesters (2013) verify this conclusion by suggesting the efficiency scores differ considerably between the two approaches. Koetter and Meesters (2013) indicate the underlying reasons for those differences in terms of specification choices and theoretical approach. Dong *et al.* (2014a, 2014b) investigate and test the consistency of efficiency scores for Chinese banks measured by the DEA and stochastic frontier analysis methods. Based on the moderate consistency evidence between the two methods, Dong *et al.* (2014a, 2014b) recommend that methodological cross-checking analysis, by applying multiple techniques of frontier efficiency analysis, should be conducted in efficiency studies. This conclusion is verified and validated by Drake *et al.* (2009), who state that there are significant differences in terms of ranking of banks, mean efficiency scores and the dispersion of efficiency scores. As a result, cross-checking analysis should be conducted in order to demonstrate the modelling dependence. Sharma *et al.* (2013) briefly sum up a comprehensive survey of the literature on banking efficiency using parametric and non-parametric methods, suggesting the same gap in the existing literature. Furthermore, Wilson (2012) and Simar and Wilson (2014) indicate the challenges for the parametric approach to derive the efficiency in terms of optimal logic combinations of inputs and outputs. Representing such challenges for the parametric approach, Simar and Wilson (2014) provide a detailed discussion of various non-parametric approaches to handle those challenges.

2.3.1. The parametric methods

The econometric techniques fit well with the cost and profit efficiency model. According to Berger and Mester (1997a, 1997b) and Sylvanus (2000), the parametric methods are the free distribution approach, the thick frontier approach and the stochastic frontier approach. For a brief literature summary of this field, Berger (1993, 1995) and Berger and Mester (1997a) suggest three parametric approaches for measuring efficiency, namely cost efficiency, standard profit efficiency and alternative profit efficiency.

2.3.1.1. Cost efficiency

According to Berger (1993, 1995) and Berger and Mester (1997a), cost efficiency is defined as a calculation of the cost difference between a bank and a benchmark (the best-performance bank). Cost efficiency is extracted from a cost function that is dependent on variables, namely input prices, output quantities, fixed inputs or outputs, other

environmental factors and stationary residuals. The normal cost function to measure cost efficiency is described below.

$$C = C(m, y, n, q, u_c, e_c) \quad (2.7)$$

Berger and Mester (1997a) define m as the prices vector of variable inputs, y as the quantities vector of variable outputs, n as the quantities of fixed inputs or outputs, q as the market and environmental variables, u_c as the inefficiency factor and e_c as the residuals. Berger and Mester (1997b) suggest measuring cost efficiency by transforming the cost function (Equation 2.7) into logarithm form, as follows.

$$\ln C = f(m, y, n, q) + \ln u_c + \ln e_c \quad (2.8)$$

According to Berger and Mester (1997b), the total of $\ln u_c + \ln e_c$ is considered as a composite error term. Berger and Mester (1997b) also confirm that the main difference between the various techniques for measuring X-efficiency is in terms of distinguishing the two items $\ln u_c$ and $\ln e_c$. Berger and Mester (1997b) define $\ln u_c$ as the inefficiency term and $\ln e_c$ as the random error term.

According to Berger and Mester (1997b), given the same *exogenous variables* (m, y, n, q) the cost efficiency of an individual bank is measured as the ratio between estimated cost to produce the same output as the benchmark bank divided by the actual cost of this bank after adjustment of the residual terms.

$$\text{Cost EFF}^b = \frac{\hat{C}^{\min}}{\hat{C}^b} = \frac{\exp[\hat{f}(m^b, y^b, n^b, q^b)] \times \exp[\ln \hat{u}_c^{\min}]}{\exp[\hat{f}(m^b, y^b, n^b, q^b)] \times \exp[\ln \hat{u}_c^b]} = \frac{\hat{u}_c^{\min}}{\hat{u}_c^b} \quad (2.9)$$

where \hat{u}_c^{\min} is determined as the minimum \hat{u}_c^b in the sample.

2.3.1.2. Standard profit efficiency

Standard profit efficiency, according to Berger and Mester (1997b), is estimated from a function with output prices and a given level of input as well as other variables that help to investigate how a bank can produce the maximum possible profit. Berger and Mester (1997a) suggest that variable profits are derived from variable costs based on the standard profit function. In other words, the profit in this function is earned from revenues of various inputs and outputs. Berger (1993) also suggests that output prices in this function

must be considered as *exogenous variables*. This assumption could explain the inefficiencies in terms of choice of outputs relative to the prices.

As for the cost function form, the standard profit function is presented in translog form, as follows.

$$\ln(\pi + \theta) = f(m, p, n, q) + \ln u_\pi + \ln \varepsilon_\pi \quad (2.10)$$

where, π represents the bank's variable profits consisting of the entire interest and fee income of the variable outputs after deducting variable costs; θ is a constant added to every bank's profit; p represents the prices vector of the variable outputs; $\ln \varepsilon_\pi$ is a residual term; and $\ln u_\pi$ is inefficiency. The frontier efficiency based on the profit function is called X-efficiency or managerial efficiency. Profit efficiency rather than cost efficiency is used in measuring the manager's performance because profit efficiency is a more accurate evaluation method of how well managers create revenue as well as control costs.

Based on the model, Berger and Mester (1997a) suggest that standard profit efficiency is determined by forecasted actual profits divided by forecasted maximum profits earned by the best-performance bank.

$$\text{Std } \pi \text{ EFF}^b = \frac{\hat{\pi}^b}{\hat{\pi}^{\max}} = \frac{\left\{ \exp[\hat{f}(w^b, p^b, z^b, v^b)] \times \exp[\ln \hat{u}_\pi^b] \right\} - \theta}{\left\{ \exp[\hat{f}(w^b, p^b, z^b, v^b)] \times \exp[\ln \hat{u}_\pi^{\max}] \right\} - \theta} \quad (2.11)$$

where \hat{u}_π^{\max} is the maximum value of \hat{u}_π^b .

Berger and Mester (1997a) conclude that both the standard profit efficiency ratio and the cost efficiency ratio have a maximum value of 1 for a best-performance bank in terms of profit maximisation (the benchmark). However, standard profit efficiency may have a negative value.

2.3.1.3. Alternative profit efficiency

Berger and Mester (1997a, 1997b) suggest that the approach is based on output levels to measure the the profit difference between a bank and a benchmark bank (which has maximum profit). The explanatory variables in the alternative profit efficiency function are the same as those in the standard profit efficiency function. The similar *exogenous variables* that are used in the cost efficiency function are also applied for the alternative

profit efficiency function. Furthermore, the standard profit efficiency function measures inefficiency as deviations from optimal output. The alternative profit efficiency function assumes that output prices are variable and could influence on profits, while variable output in this function is fixed as in the cost efficiency function. The alternative profit function is established in log format as follows.

$$\ln(\pi + \theta) = f(m, y, n, q) + \ln u_{a\pi} + \ln \varepsilon_{a\pi} \quad (2.12)$$

This function is similar to the standard profit function. The only difference is in terms of variable y , which is replaced by q . As a result, the alternative profit efficiency is measured by the forecasted actual profits divided by the forecasted maximum profits of the benchmarked best-performance bank.

$$\text{Alt } \pi\text{EFF}^b = \frac{a\hat{\pi}^b}{a\hat{\pi}^{\max}} = \frac{\left\{ \exp\left[\hat{f}(w^b, y^b, z^b, v^b)\right] \times \exp\left[\ln \hat{u}_{a\pi}^b\right] \right\} - \theta}{\left\{ \exp\left[\hat{f}(w^b, y^b, z^b, v^b)\right] \times \exp\left[\ln \hat{u}_{a\pi}^{\max}\right] \right\} - \theta} \quad (2.13)$$

Based on the format, the changes of the alternative profit efficiency are dependent on the output prices. Meanwhile, efficiency is not influenced by errors of quantities output.

2.3.1.4. Function forms of the parametric approaches

Based on the literature review for the efficiency studies, it suggests that the production and cost functions normally represent a function with a dependent variable explained by one or more explanatory variables. All these functions can be shown in the general following form.

$$y = f(x_1, x_2, \dots, x_N) \quad (2.14)$$

where y is the dependent variable and x_n ($n = 1, \dots, N$) are explanatory variables. To specify the functional form is the critical procedure in setting up the relationship between the dependent and explanatory variables summed up in Table 2.5, where γ , β_n and β_{mn} are unknown parameters to be estimated.

Table 2.5: Common functional forms

| | |
|--------------|---|
| Linear | $y = \beta_0 + \sum_{n=1}^N \beta_n x_n$ |
| Cobb–Douglas | $y = \beta_0 \prod_{n=1}^N x_n^{\beta_n}$ |

| | |
|-------------------------------------|--|
| Normalised quadratic | $y = \beta_0 + \sum_{n=1}^N \beta_n x_n + \frac{1}{2} \sum_{n=1}^N \sum_{m=1}^N \beta_{nm} x_n x_m$ |
| Quadratic | $y = \beta_0 + \sum_{n=1}^{N-1} \beta_n \left(\frac{x_n}{x_N}\right) + \frac{1}{2} \sum_{n=1}^{N-1} \sum_{m=1}^{N-1} \beta_{nm} \left(\frac{x_n}{x_N}\right) \left(\frac{x_m}{x_N}\right)$ |
| Translog | $y = \exp\left(\beta_0 + \sum_{n=1}^N \beta_n \ln x_n + \frac{1}{2} \sum_{n=1}^N \sum_{m=1}^N \beta_{nm} \ln x_n \ln x_m\right)$ |
| Generalised Leontief | $y = \sum_{n=1}^N \sum_{m=1}^M \beta_{nm} (x_n x_m)^{1/2}$ |
| Constant elasticity of substitution | $y = \beta_0 \left(\sum_{n=1}^N \beta_n x_n^\gamma\right)^{1/\gamma}$ |

Source: Coelli *et al.* (2005: 211).

Based on Equations 2.8, 2.10 and 2.12, the stochastic function form developed by Aigner *et al.* (1977), Meeusen and van den Broeck (1977) and Battese and Coelli (1992), the translog production and cost function have an error term that consists of two components: one accounting for random effects and the other for technical efficiency. These models can be expressed in the following functions.

- The production function: $Y_{it} = \beta x_{it} + (V_{it} - U_{it}) \quad i = 1, \dots, N; t = 1, \dots, T \quad (2.15)$

- The cost function: $Y_{it} = \beta x_{it} + (V_{it} + U_{it}) \quad i = 1, \dots, N; t = 1, \dots, T \quad (2.16)$

The stochastic function forms are based on the following underlying assumptions.

$$v_{it} \approx N(0, \sigma_v^2) \quad (2.17)$$

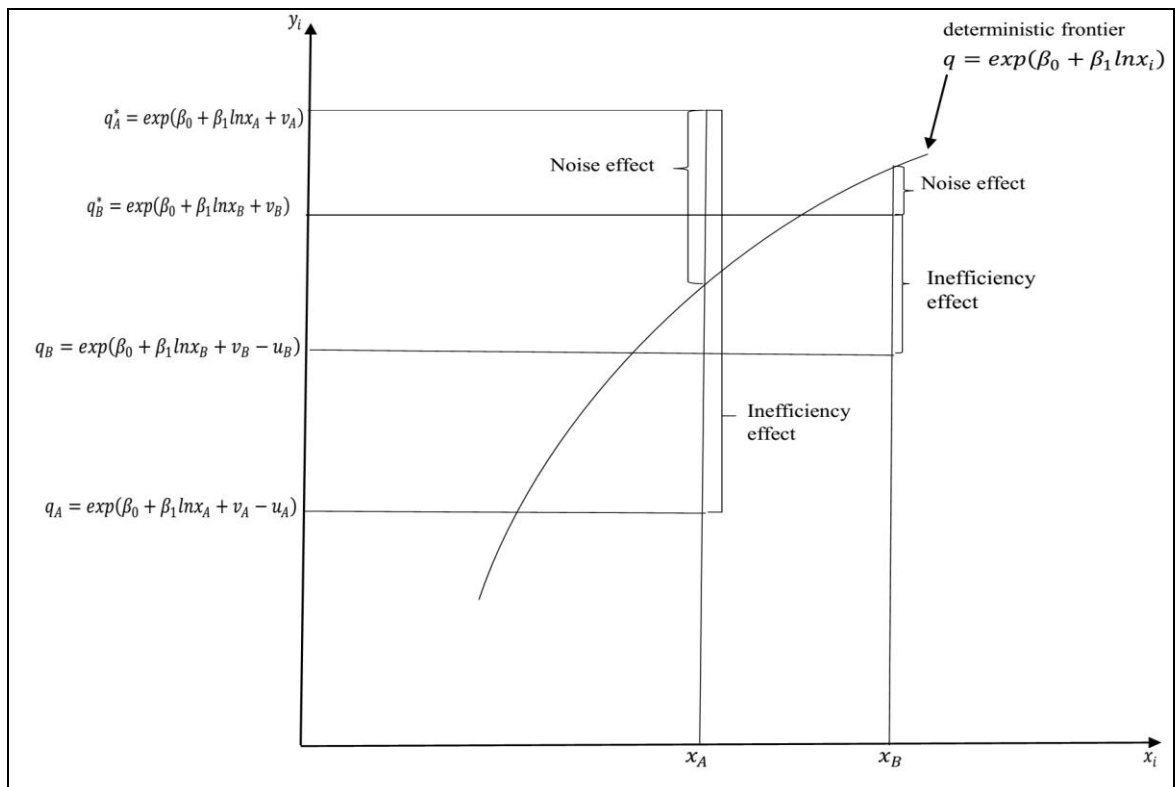
$$u_i \approx N^+(0, \sigma_u^2) \quad (2.18)$$

Under assumptions (2.17) and (2.18), v_i are independently and normally distributed with zero mean and variances of σ_v^2 . Meanwhile, u_i are non-negative independently distributed as half-normal or truncated random variables with zero mean and variances of σ_u^2 . Furthermore, in the model the variables are explained as follows.

- ✓ Y_{it} is the logarithm of the production/cost of the it h firm in the t th time period.
- ✓ x_{it} is k vector of transformation of the input quantities (for production function), input prices (for cost function) and outputs of the it h firm in the t th time period.
- ✓ β is a vector of unknown parameters.

- ✓ V_{it} is a random variable that is assumed to be normal distribution $N(0, \sigma_v^2)$ and independent of U_{it} .
- ✓ U_{it} is a non-negative random variable that is assumed to account for technical inefficiency or cost inefficiency and follow the normal distribution of $|N(0, \sigma_U^2)|$.

Figure 2.3: The stochastic production frontier



Source: Coelli *et al.* (2005: 244).

The measures of technical efficiency and cost efficiency are shown in Table 2.6. In the case of the production function, the efficiency measured in Table 2.6 (EFF_i) takes a value between zero and 1. Meanwhile, should the cost function be applied then the (EFF_i) will range from 1 to infinity.

Table 2.6: Efficiency measurement

| Cost or production | Logged dependent variable | Efficiency (EFF_i) |
|--------------------|---------------------------|------------------------|
| Cost | Yes | $\text{Exp}(U_i)$ |
| Production | Yes | $\text{Exp}(-U_i)$ |

2.3.1.5. Summary

Berger and Mester (1997a) conclude that if the following conditions are satisfied, the efficiency could release helpful information:⁷

- i. Differences in banking service quality are not substantially measured.
- ii. Banks cannot achieve every scale and mix of product due to the incomplete variable outputs.
- iii. Banks have market power in deterring prices because the output markets are imperfect competition.
- iv. Output prices are not correctly determined; as a result the output prices are unable to provide correct instructions to chances for earning the profits and revenues, as mentioned in the standard profit efficiency model.

Sylvanus (2000) observes that, if a bank's profit is lower or its cost higher than those of the benchmark after adjusting residual terms, then the bank is defined as inefficient. In other words, the bank is inefficient if the estimated residual terms – namely $\ln u_c$, $\ln u_\pi$ and $\ln u_{a\pi}$, mentioned in Equations 2.24, 2.26 and 2.28 respectively – are significantly different from the values of the best-performance bank.

Mester (2003) concludes that the inefficiency and residual terms in the *stochastic frontier approach* are decomposed by explicit assumptions on the statistically distributional format of those error terms. The *stochastic frontier approach* was initially developed by Aigner *et al.* (1977) and applied to banks by Ferrier and Lovell (1990). Upon that basis, Mester (2003) assumes that the normally distributed residual error in this function, $\ln \varepsilon$, is a two-sided distribution. Meanwhile, the half-normally distributional inefficiency term, $\ln u$, is a one-sided distribution. Bank inefficiency could be measured and estimated from the parameters of the two distributions. The expected value of $\ln u$, given the condition of $\ln u + \ln \varepsilon$, $\ln \hat{u} \equiv E(\ln u | \ln u + \ln \varepsilon)$, is a proxy for measuring inefficiency.⁸

⁷ These suggestions are supported by studies that have tested price-taking versus price-setting behaviour for banks (Hancock, 1986; English and Hayes, 1991; Hannan and Liang, 1993).

⁸ Other distributions have also been used, for example normal truncated normal (Stevenson, 1980; Berger and DeYoung, 1995; Mester, 1996); normal-gamma (Stevenson, 1980; Greene, 1990); and normal-exponential (Mester, 1996).

According to Berger and Mester (1997a), some distributional assumptions could be removed because there is a lack of data in the banking sector. In such a case, the *distribution-free approach* should be applied. This method is applied by banks and thereafter also replicated in Berger and Mester (1997b), with the main conclusions that during a period for each firm there is a so-called core inefficiency or average efficiency. The core inefficiency is definitively differentiated from random terms because Berger and Mester (1997b) assume that core inefficiency is consistent over a period, while random terms over time are persistently moving average. Meanwhile, focusing on the third parametric method, the *thick frontier approach*, Bauer *et al.* (1998) conclude that this approach does not apply the point estimates for each bank's inefficiencies.

Furthermore, Berger and Mester (1997a) suggest that the errors in each individual regression consist of both inefficiency, $\ln u$, and a random component, $\ln \varepsilon$, which tend to moving average. Hence, the average residuals of the entire regressions $\ln \hat{u}$ are considered as a measure for the inefficiency term, $\ln u$. For the debates about the functional form of the parametric methods used to estimate efficiency, the literature sums up two popular functional forms that are usually used as the *translog* and the *Fourier-flexible* form.

Based on the efficiency estimation using the parametric method, total efficiency can be decomposed into various types of efficiency. Berger and Mester (1997a) defines *scale efficiency* by dividing the forecasted minimum average costs by actual average costs, provided that both types of average costs are adjusted to be on the frontier function. These costs are allocated in the frontier function by making $\ln u_c$ the minimum value while $\ln \varepsilon_c$ is zero. Meanwhile, the *total cost efficiency* is derived from the scale and *X-efficiency* ratios.

2.3.2. The non-parametric methods

Referring to the discussion of Berger and Mester (1997a, 1997b) about the strengths and weaknesses of the non-parametric methods, Sylvanus (2000) points out there are two typical non-parametric methods: *free disposable hull* (FDH) analysis and DEA. However, for empirical studies DEA is preferred over the FDH method.

DEA allows the development of a model in which Y is a matrix of m outputs

$Y = (y_1, y_2, \dots, y_n) \in R_+^m$, X is a matrix of n inputs $X = (x_1, x_2, \dots, x_n) \in R_+^n$ and k is the number of firms. A matrix of observed outputs is dimension (m, k) and a matrix of observed inputs Z is dimension (n, k) . A transformed set is produced from the model:

$$T = \{(x, y): y \leq Yz, Xz \leq x, z \in R_+^n\} \quad (2.19)$$

where vector z_i stands for firm i with input and output (x_i, y_i) that combines all feasibility integration of inputs X to produce outputs Y . The technical efficiency of firm i can be estimated by solving the problem:

$$\theta^*(x_i, y_i) = \max\{\theta: (x_i, \theta, y_i) \in T\} \quad (2.20)$$

where $\theta_i y_i$ is the optimum output of firm i given its current technology. The firm is said to be efficient if θ is equal to 1. If θ is more than 1, then the firm is technically inefficient. As a result, $1/\theta$ is the ratio between actual output and optimum output.

A linear programming system can be set up from Equation 2.19 as follows.

$$\begin{aligned} \theta_i y_{ij} &\leq y_{j1} z_{1i} + y_{j2} z_{2i} + \dots + y_{jk} z_{ki} & j = 1, 2, \dots, m. \\ x_{11} z_{1i} + x_{12} z_{2i} + \dots + x_{1k} z_{ki} &\leq x_{1i} \\ x_{21} z_{1i} + x_{22} z_{2i} + \dots + x_{2k} z_{ki} &\leq x_{2i} \\ \text{-----} & \\ x_{31} z_{1i} + x_{32} z_{2i} + \dots + x_{nk} z_{ki} &\leq x_{ni,i} & i = 1, 2, \dots, m \end{aligned} \quad (2.21)$$

Consequently, scale efficiency and pure technical efficiency are two components determining technical efficiency. Pure technical efficiency can be calculated from a new transformation:

$$T' = \{(x, y): y \leq Yz, Xz \leq x, z \in R_+^n, \sum_{i=1}^n z_i\} \quad (2.22)$$

Pure technical efficiency for firm i can be calculated by $1/\lambda^*(x_i, y_i)$ where $\lambda^*(x_i, y_i)$ is from:

$$\lambda^*(x_i, y_i) = \max\{\lambda: (x_i, \lambda, y_i) \in T'\} \quad (2.23)$$

Using that estimation, Equation 2.21 is rewritten as another linear programming system:

$$\text{Max}(\lambda_i)$$

Subject to:

$$\lambda_i y_{ji} \leq y_{j1} z_{1i} + y_{j2} z_{2i} + \dots + y_{jk} z_{ki}, \quad j = 1, 2, \dots, m$$

$$x_{11}z_1 + x_{12}z_2 + \dots + x_{1k}z_k \leq x_{1i} \tag{2.24}$$

$$x_{21}z_1 + x_{22}z_2 + \dots + x_{2k}z_k \leq x_{2i}$$

.....

$$x_{n1}z_1 + x_{n2}z_2 + \dots + x_{nk}z_k \leq x_{ni} \quad i = 1, 2, \dots, n$$

$1/\lambda^*(x_i, y_i)$ is the measure for pure technical efficiency of firm i . Firm i is pure technically efficient if $\lambda^*(x_i, y_i)$ equals 1. Meanwhile, firm i is said to be pure technically inefficient if $\lambda^*(x_i, y_i)$ is greater than 1.

The scale efficiency of firm i is obtained from $\theta^*(x_i, y_i), \lambda^*(x_i, y_i)$ in Equations 2.21 and 2.24:

$$\phi^*(x_i, y_i) = \theta^*(x_i, y_i) / \lambda^*(x_i, y_i) \tag{2.25}$$

The firm is operating at constant return to scale if $\phi^*(x_i, y_i)$ equals 1. If $\phi^*(x_i, y_i)$ is different from 1, then it suggests the firm is operating at decreasing or increasing return to scale. Hence, technical efficiency (TE) can be measured as follows:

$$\text{TE} = \text{Pure technical efficiency (PTE)} * \text{Scale efficiency (SE)} \tag{2.26}$$

Charnes *et al.* (1978) assume constant return to scale (CRS) for this model, while Banker *et al.* (1984) assume variable returns to scale (VRS) applied in this model. The efficiency scores converted into their corresponding statistical ranks can help the non-parametric tests to be investigated. To explore whether there are any significant trends in average X-efficiency, the statistical ranks are applied in trend analysis. Brockett *et al.* (1999) introduce the methodology where a ‘rank matrix transformation’ is developed to produce the ranking data converted from the original non-metric quality data of DEA window analysis.

2.3.2.1. The two-stage banking approach

Lim and Randhawa (2005) make use of DEA to assess the efficiency of banks in Hong Kong by developing a *two-stage banking approach* consisting of both the financial intermediation stage and production stage. The impacts of key value drivers, namely ownership, size and financial deregulation, on the efficiency of banks are also considered.

This approach was developed and improved upon by Drake *et al.* (2006) to investigate the impacts of environmental factors consisting of financial deregulation on banking efficiency in Hong Kong.

Both approaches are integrated into a *two-stage* banking model in an analytical framework developed by Lim and Randhawa (2005) that is inherited from Denizer *et al.* (2000). In stage 1, known as the production stage, the goal of the banks is to collect deposits. To reach this goal the banks must use their inputs, namely human resources, physical capital and other resources. Following this stage, in stage 2 the bank operates as a financial intermediary to transfer the funds mobilised in the first stage in terms of deposits to the final end-users in terms of credit and investments. The entire function of the bank in this stage is conducted and supported by its reputation, expertise and other skills. The outcome of the approach is a set-up composite index as the average of efficiency scores from the two stages in an attempt to provide an overall perspective on bank efficiency. This index helps to rank banks that are relatively more efficient in both stages. Some researchers have used both the production and intermediation approaches to estimate efficiency in their models. Examples of those papers are Wheelock and Wilson's (1995) study in the US, Ashton's (2001) study on British retail banks, and Lim and Randhawa's (2005) research for the banking sectors of Hong Kong and Singapore.

The choices of variables as well as the empirical findings on this topic are significantly dependent on the definition of the bank's function. According to this *two-stage* approach, banks are regarded as *production units* if the banks operate at the *first stage (production approach)*. According to Freixas and Rochet (1997), these banks make use of physical capital and labour resources to provide document-processing services and transactions for their clients. Consequently, their outputs are measured as transaction volume and the number of accounts provided for the client, while to produce those outputs the banks have to face the total cost incurred consisting of the operating cost. Denizer *et al.* (2000) suggest that the approach uses dollar amounts as a proxy because of data constraint problems.

Lim and Randhawa (2005) show that banks are considered as *financial intermediaries* in the *second stage (intermediation approach)*. According to Freixas and Rochet (1997) this approach is another way of banking business analysis. The intermediation approach considers the funds transferred from the depositors to the borrowers through the intermediary services of banks. Hence, the balances of collected deposits and other sources of borrowed funds are inputs in this stage and called financial capital. Meanwhile,

the outstanding credit balance and other investments are considered as outputs in this stage. Jha *et al.* (2013) examine the technical efficiencies of commercial banks in Nepal using both approaches, namely the intermediation approach and the profit-oriented approach, where the technical efficiency scores of the profit-oriented approach are lower than those of the intermediation approach.

The *two-stage* approach is also applied by Fukuyama and Matousek (2011) and Şahin *et al.* (2013) for the Turkish banking sector to investigate changes in banking efficiency as a result of the impacts of the financial crisis. Avkiran (2011) also makes use of the *two-stage* approach to examine the bank efficiency scores that are associated with key financial ratios of Chinese banks by the regression of the ratios on estimated efficiency scores. Wang *et al.* (2014) find empirical evidence to prove the *two-stage* model is more effective than the conventional DEA model in exploring the efficiency of the Chinese banking sector. Meanwhile, Zha *et al.* (2015) modify the *two-stage* approach to decompose the operational processes of Chinese banks into the productivity and profitability stages and measure the efficiencies of Chinese banks.

Ebrahimnejad *et al.* (2014) also apply a similar *two-stage* banking model to calculate banking efficiency by taking into account intermediate measures and constraints. Shyu *et al.* (2014a, 2014b) apply the *two-stage* approach to analyse the efficiency of banks in China, Taiwan, South Korea, Hong Kong, Malaysia, Thailand, Singapore and the Philippines, suggesting that the competition edges of banks are based upon acting more as a producer or as an intermediary. The findings confirm the importance of the *two-stage* approach in exploring the true managerial efficiencies of banks and in providing solutions to improve their competitive position. Similarly, Karray and Chichti (2013) provide empirical evidence suggesting that the scores of banking technical efficiency in 15 developing countries are significantly influenced by the choice of an intermediation or a value-added approach for measuring efficiency.

2.3.2.2. Benchmarking

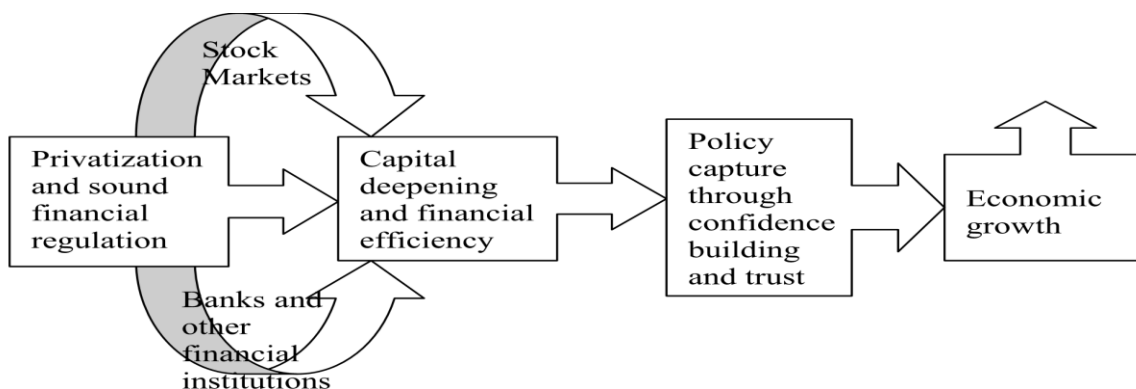
Finding the ‘best’ virtual DMU – a *benchmark* – for each real DMU via linear programming techniques is the focus of DEA analysis. If there is a complicated and unknown relationship structure between the multiple outputs and multiple inputs, then the benchmark is considered as a suitable solution. Forker and Mendez (2001) comprehensively sum up the literature on benchmarking studies as follows.

- ✓ Camp (1989), McNair and Leibfried (1992), Spendolini (1992), Wiesendanger (1992), and Bendell *et al.* (1993) give techniques to perform benchmarking.
- ✓ Partovi (1994) presents discussions concerning the question of what to benchmark.
- ✓ Korpela and Tuominen (1996) describe the systems that support decision making for benchmarking.
- ✓ Voss *et al.* (1997) debate the linkage between benchmarking, and performance of a firm.

2.4. The impact of financial liberalisation on competitiveness and efficiency

There is a set of both endogenous and exogenous variables that significantly impact on the efficiency of a bank. However, one of the critical factors in this literature field is financial liberalisation. Gentzoglani (2003) shows that there is a downward trend in cost of capital in countries in the Middle East and North Africa (MENA) when their equity markets are liberalised. As a result of increased international competitiveness, there are greater funding chances with better conditions for firms in those countries. Theoretically, Gentzoglani (2003) sets up a hypothesis about the significant linkage between capital market liberalisation and reduced cost of fund for firms. This result is the cornerstone for each financial deregulation and restructuring programme implemented. Based on that argument, Gentzoglani (2003) presents the linkage in Figure 2.4. This conclusion is verified and validated in a study conducted by Kassem *et al.* (2014), which suggests bank efficiency in MENA countries is significantly influenced by inflation, economic growth, trade openness, exchange rates, bank profitability and bank capital.

Figure 2.4: The conceptual framework of the impacts of financial liberalisation



Source: Gentzoglani (2003: 4).

Gentzoglani (2003) synthesises that privatisation leads to increases in financial deepening, while the efficiency of the financial sector is determined by good corporate

governance that in turn leads to more efficient allocation of scarce capital, better productivity and higher growth. Bekaert *et al.* (2002) point out that financial deregulation and privatisation enhance the efficiency of domestic capital markets by facilitating the funds transferred from savers to investors. Hence, financial deregulation contributes to reducing the cost of fund. Consequently, Gentzoglanis (2003) suggests that there is improvement in competitiveness, solvency and operational efficiency. Meanwhile, Lucas (1988) and Miller (1999) intensively discuss the influence of the financial sector on economic indicators. The debates of Levine (2001) and Gentzoglanis (2003) are quantitatively demonstrated by applying the econometric methods for case studies in both developed and developing countries. As Henry (2003) suggests, there is a lack of agreement among these empirical studies.

Isik *et al.* (2007) and Yilmaz (2013) suggest that commercial banks in Turkey become more competitive over the liberalisation period as a result of the deconcentration process. Referring to the literature, Isik *et al.* (2007) suggest that there are viewpoints about the impacts of financial liberalisation on banking efficiency, described in Table 2.7.

Table 2.7: Studies on the impact of deregulation and financial reforms on bank efficiency

| Country | Method | Author (date) |
|-----------|--------|------------------------------------|
| Norway | DEA | Berg <i>et al.</i> (1992) |
| US | SCF | Humphrey (1993) |
| US | DEA | Grabowski <i>et al.</i> (1993) |
| US | DEA | Elyasiani and Mehdian (1992) |
| Turkey | DEA | Zaim (1995) |
| US | TFA | Humphrey and Pulley (1997) |
| Spain | DEA | Grifell-Tatje and Lovell (1997) |
| India | DEA | Bhattacharyya <i>et al.</i> (1997) |
| Taiwan | DEA | Shyu (1998) |
| Korea | DEA | Gilbert and Wilson (1998) |
| Thailand | DEA | Leightner and Lovell (1998) |
| Greece | DEA | Noulas (2001) |
| Australia | DEA | Sathye (2002) |

Note: DEA (data envelopment analysis), TFA (thick frontier approach), SCF (stochastic cost frontier)

Source: Isik *et al.* (2007: 3).

Barth *et al.* (2013) investigate the impacts of banking regulation reform on bank performance and stability by examining its effects on the operating efficiency of banks

over the sample in 72 countries during the period 1999–2007. The empirical evidence of the study points out the significantly positive linkage between bank efficiency and greater capital regulation stringency, the improvement of supervisory power and greater financial transparency. Casu and Girardone (2010) use a DEA model to examine the supporting evidence for the impacts of financial deregulation policies in the European Union (EU) on improving the efficiency of the banking sector. Chortareas *et al.* (2013) also use a DEA model to investigate the linkage between financial freedom and banking efficiency in the 27 countries of the EU. The empirical evidence of the study suggests a positive correlation between the openness of the financial system and the competitiveness of banks in terms of efficiency, especially in countries with freer political structures.

Arora (2014) finds out the drivers for producing efficiency differences of Indian banking sector are due to the liberalisation in the sector. The impacts of ownership and reforms on bank efficiency of Indian banks are investigated using a DEA model. Bardhan (2013) also uses the stochastic frontier methodology to calculate profit efficiency of three ownership groups of Indian banks during the post-reform period, suggesting that public sector banks are the best competitors in terms of profit efficiency. Similarly, Das and Ghosh (2009) and Das and Drine (2011) examine the effects of financial deregulation on profit and cost efficiency of Indian commercial banks during the post-liberalisation period. Some contrary findings are derived from these studies, which suggest the public sector banks in India get the advantage in terms of natural monopoly as being the first mover. Bardhan (2013) suggests that the application of prudential regulations in the Indian banking sector creates a positive impact on the profit efficiency of those banks. Casu *et al.* (2013) also examine the effects of banking reform on the efficiency of Indian banks by applying both parametric and non-parametric efficiency frontiers. The study points out that the sustained efficiency growth of Indian banks is mainly influenced by technological progress. The empirical findings about the impact of financial liberalisation on Indian banking efficiency are briefly reviewed by Kumar (2013), Kumar and Gulati (2013), and Kumar and Gulati (2014). As well as those case studies of India, Neupane (2013) makes use of the *two-stage* approach to investigate the determinants of banking efficiency in a neighbouring country of India: Nepal. The Tobit regression in Neupane (2013) suggesting that there is a positive correlation between the capital adequacy ratio (CAR), the debt to equity ratio and efficiency in the Nepalese banking sector.

Anis and Sami (2012) use the stochastic cost frontier to examine the cost efficiency of Tunisian banks in the face of the challenges of financial liberalisation. In this study, Anis

and Sami (2012) suggest that there is a reduction in the cost efficiency scores after introducing financial liberalisation as an environmental variable in the model. Furthermore, during the financial liberalisation period, the SOCBs are less efficient than the private banks. Fethi *et al.* (2011) investigate the impacts of the liberalisation and privatisation policies of the Egyptian government on the performance (efficiency) of the banking sector generally and different forms of banks' ownership particularly. The conclusions of Fethi *et al.* (2011) are also found in the study of Lee and Chih (2013) for the case of the Chinese banking sector, suggesting that stricter regulation could be negative for bank efficiency but good for bank stability. Following the same approach, Rezvanian *et al.* (2011) and Yin *et al.* (2013) investigate the impact of banking reform policies in China pre- and post-WTO accession on the cost efficiency of the banking sector and the differentiation in cost efficiency of those banks in terms of ownership. Meanwhile, Xu *et al.* (2015) use the DEA model to investigate the reaction behaviour of the four biggest SOCBs to the banking reform policies in China. The empirical evidence points out the significantly positive linkage between the financial reform and scale efficiency, productivity change and technical efficiency. Furthermore, the banking reform in China also facilitates the commercial banks to raise funds and to adapt the best code of conduct for corporate governance by conducting initial public offerings (IPOs). Hoque *et al.* (2015) show that banks conducting IPOs in China are more efficient than those that do not; however, there is no empirical evidence to suggest that bank efficiency improved after IPO. At the same time, the empirical evidence suggests that the outperformance of banks against their counterparts prior to IPOs disappears immediately after IPOs.

Nakane and Alencar (2004) investigate the connections between productive efficiency, competition and inflation in the banking sector in Brazil. Meng (2004) points out the relationship between efficiency in terms of economies of scale and scope of foreign banks in China and competitive strategy (product-driven, client-driven and multi-objective strategies). These findings are also concluded in detail by Rime and Stirroh (2002) for the case of Universal Banks in Switzerland. Fu (2004) and Fu and Heffernan (2007) examined the efficient-structure hypothesis and market-power hypothesis to test the relationship between X-efficiency and competition in China's banking sector.

Alshammari (2003) examines the SCP hypothesis with efficiency measured by economies of scale and scope for the Gulf Cooperation Council banking sector. This study suggests that there is no evidence supporting for market concentration hypothesis; as well as no linkage between market shares and banking efficiency. Yu (1998, 2003) investigates economies of scale and scope for the Taiwanese banking system through an econometric

model explaining profits with explanatory variables of scale efficiency, market risk indexes, share concentration, control variables, and cost efficiency.

Tefula (2001) implements *Granger-causality* tests for the validity of two sets of diametrical hypotheses summarised by Berger (1995): the bad management versus bad luck hypotheses and efficient structure versus market power hypotheses. The efficient structure hypothesis of X-inefficiency is statistically tested by the study. Following the methodology used to describe the profit-structure relationship in banking business developed by Berger (1995) and Berger and Mester 1997a, Boscia (2001) emphasises size as a successful competitive strategy for small banks in Italy in the face of the globalisation of the financial market. Kondeas (1998), using a stochastic frontier model, shows findings supporting the cost differences of banks between the EU countries and suggests the EU policy to promote competition through harmonisation of banking legislation in the region. Lee (1998) finds that the banks within the separated banking system countries operate less efficiently than do the banks within the universal banking system countries. As a result, banks operating more efficiently tend to make more profit and improve market shares that are consistent with the efficient structure hypothesis. This conclusion about the efficient structure hypothesis is also implemented in a validated study of Homma *et al.* (2014) for the case of the Japanese banking sector.

Tahir (1999) tests the linkage between efficiency (stochastic X-efficiency, cost-to-income ratio) and market concentration in Association of Southeast Asian Nations (ASEAN) banking, supporting both the relative efficiency and relative market power hypotheses. This conclusion is also validated by empirical evidence drawn out from the study conducted by Liu and Chen (2012) comparing bank efficiency differences between Indonesia, Malaysia and Thailand. Meanwhile, Sufian and Habibullah (2014) examine the evidence of the impact of economic freedom on banking efficiency in another ASEAN country – Malaysia – supporting regulation and supervision of activities undertaken by those banks. Okumus (1999) tests the linkages between efficiency and market structure and profitability of Turkish banks by setting up models based on the detailed analyses extracted from the balance sheets of the banking sector. With the same research purpose, Hou *et al.* (2014) examine the effects of market structure and risk tolerance on the technical efficiency of commercial banks in China, showing a strong correlation between intense market competition, risk taking and technical efficiency of the Chinese banks.

Molyneux (1993) shows statistical evidence for the European banking sector in terms of the efficiency hypothesis and the SCP paradigm, suggesting that a bank's profitability

depends on the staff-expenses ratio, the equity-to-assets ratio and market demand conditions. These hypotheses are also tested in a study implemented by Gunalp and Celik (2006) for the Turkish banking sector. Meanwhile, Agu (1984) remarks that the variables determining the performance of the Nigerian banking sector are demand, policy and structure. Furthermore, the performance of the Nigerian banking system is also significantly influenced by bank offices rather than the deposit concentration ratio.

Policastro (2004) shows the number of banks in most Latin American countries has reduced as a result of the M&A process aiming to avoid financial crisis rather than to reduce excess capacity that leads to improved competition and efficiency. Toledo (2004) tests the hypotheses of managerial X-efficiency in terms of economies of scope, economies of scale, tax, risk diversification, growth, synergy and '*too big or too important to fail*' on bank M&A. Yildirim (2002) and Koutsomanoli-Fillipaki and Staikouras (2004) apply the competition model developed by Panzar and Rosse (1977, 1982, 1987) to suggest that pricing strategies in respect to the input cost volatilities of Central and Eastern European banks in different market structures are totally different. Hence, the main efficiency determinants as suggested by Yildirim (2002) and Koutsomanoli-Fillipaki and Staikouras (2004) are bank size, capitalisation, profitability, market concentration, level of competition and level of problem loans. These empirical findings are validated by the studies of Havranek and Irsova (2013) and Hermesa and Meesters (2015), which examine the effects of financial reform and financial regulation on bank efficiency in Central European transition countries. Based on the models developed by Battese and Coelli (1995), Huang *et al.* (2015) also investigate the empirical evidence, suggesting that technical efficiencies for banks in Central and Eastern European countries are dominated by a technology gap. Barakat (2003) shows that economies of scale and scope do not support the natural monopoly in the Jordanian banking system.

Choi (2002) tests four specific hypotheses, namely the scale efficiency structure hypothesis, the X-efficiency structure hypothesis, relative market power and the SCP paradigm for the insurance industry. This is validated by Mora *et al.* (2005) for the Mexican banking sector. Choi (2002) and Choi and Weiss (2005) point out empirical findings suggesting the spurious relationships of the SCP paradigm in the insurance industry. Lee (2002) investigates the relationship between bank specialisation, market structure and profitability, measured using two different loan diversity indices and bank cost. Chen (2001) investigates the determinants of bank efficiency, namely monetary

policy, business cycle, macroeconomic factors, agricultural factors, specialisation, location and bank size.

Lee (1996) suggests that as market concentration declines and competition increases then efficiency increases. Wu (1995) finds that efficiency and welfare improvements in Taiwan's banking market are the result of deregulation of interest rates, increase in competition and free bank entry. Furthermore, Han (1994) points out reducing both X-efficiencies and scale-efficiencies should be considered as the result of the liberalisation and competition. Nauriyal (1993) recognises that small market size, with limited possibilities for expansion, and fierce competition are among the key drivers that make Chilean banks rely on specialised market niches to maintain profitability.

Nathan (1990) examines linkages between the cost efficiency (measured by economies of scale and scope) and competitiveness (measured by revenue elasticity) of Canadian banks. Nathan (1990) concludes that Canadian banks are in the status of monopolistic competition and cost efficient. Tolentino (1986) points out that the hypothesis of the Cobb–Douglas production function is rejected for Philippine banks because of imperfect competition. Brown (1982) suggests causality relationships between factors, namely market power, high market prices and industry profitability, as well as causality between concentration and market power.

Berger and DeYoung (1997) suggest a range of policies and debates concerning the causes of competitiveness and efficiency. They conclude that supervisory focus is the most important driver enhancing bank competitiveness. They also suggest that *a focus on the implicit relationship between measured efficiency and competitiveness could facilitate measurement of the cost efficiency of banks.*

As Neuberger (1998) concludes, there is a plethora of empirical evidence in banking business on performance, competition and market structure; most of the literature in the field seeks to ascertain the relationship between market concentration and performance.

Hence, based on the literature reviews of competitiveness and efficiency it can be seen that there are few studies directly focusing on the relationship between the two concepts of efficiency and competitiveness, especially their causality relationship.

2.5. Concluding remarks

The literature on banking competitiveness focuses on either the supply side or the demand side to compare banks' competitive positioning with peers in the market. However, the literature on banking efficiency focuses purely on the supply side. That is the critical difference between the literature on competitiveness and the literature on efficiency.

The debates in the literature about competitiveness and efficiency firmly suggest that each theoretical model or approach measures competitiveness and efficiency in different ways with different assumptions. However, these theoretical models share the same measuring methodology. The models aim to measure competitiveness and efficiency by finding a suitable ranking or rating for banks based on various criteria. The models aim to rank banks in order to identify competitiveness and/or efficiency. Hence, the indicators of both competitiveness and efficiency suggest the strength of a bank in competition with peers. The unique difference between the models is the way they identify the competitiveness and/or efficiency scorings for banks. Generally, the competitiveness and efficiency scorings are equal to or less than 1. Hence the competitiveness and efficiency estimates are somehow censored.

Furthermore, both the literature on competitiveness and the literature on efficiency normally require the identification of a *typical* competitor that is defined as a *benchmark* in order to compare its competitiveness and or efficiency level with peers. Finding the typical competitor is a complicated procedure for empirical studies in this field. This task is not precisely clarified and guided in the literature; hence this is one of the constraints of the literature in this field.

2.5.1. The determinants of efficiency and competitiveness

Based on the theoretical background debated by Schmidt and Lovell (1979), Kumbhakar *et al.* (1991), Atkinson and Cornwell (1994), Berger (1995, 1997, 1997a and 1997b), Yu (1998), and Wang and Schmidt (2002), it suggests the same endogenous and exogenous variables (key value drivers) explaining the competitiveness and efficiency of banks, as shown in Table 2.8. The production environment of a firm is considered as a number of 'exogenous' variables (Yu, 1998: 570). Meanwhile, Gaynor and Pauly (1990) suggest that the variables measuring the compensation structure should be considered as endogenous variables. Inputs and outputs are classified as endogenous or exogenous variables that should be dependent on different points of view.

Table 2.8: Endogenous vs. exogenous variables in determining competitiveness and efficiency

| No. | Endogenous variables | No. | Exogenous variables |
|-----|------------------------------------|-----|--------------------------------------|
| 1 | Bank size (equity) | 1 | Variable input prices |
| 2 | Quantities of inputs | 2 | Variable output prices |
| 3 | Total assets and off balance sheet | 3 | Auditing function |
| 4 | Loan quality risk | 4 | Capital adequacy |
| 5 | Asset quality | 5 | Level of competition |
| 6 | Ownership (structures, types) | 6 | Cost advantages |
| 7 | Financial capital | 7 | Macroeconomic basis |
| 8 | Leverage | 8 | Characteristics of banking sector |
| 9 | Marketing methods | 9 | Financial policies (banking reforms) |
| 10 | Cost savings | 10 | Corporate governance |
| 11 | Business lines | | |
| 12 | Asset utilisation | | |
| 13 | Profitability ratios | | |
| 14 | Strategic moves | | |
| 15 | Product strategy | | |

Ariff and Luc (2008) and Yao *et al.* (2008) provide empirical evidence suggesting that ownership significantly impacts on banking efficiency in China. In terms of ownership, the SOCBs are less cost and profit efficient than the JSCBs; furthermore, ownership reform and foreign competitor entrants have pushed Chinese banks to improve their efficiency. Asmild and Matthews (2012) and Dong *et al.* (2014a) follow up the approach and draw the same conclusion about the impacts of ownership on banking efficiency in China. Yin *et al.* (2013), based on a stochastic frontier analysis, show that after entry to the WTO the majority of SOCBs in China are less efficient. Xi *et al.* (2014) also suggest that, in terms of competitiveness, the JSCBs are stronger than the SOCBs. However, Han *et al.* (2014) suggest that among four efficiency indicators – namely service efficiency, growth efficiency, social productive efficiency and profit efficiency – in terms of service efficiency the SOCBs are more efficient than the JSCBs in China. Han *et al.* (2014) also suggest that, if employee salary is used as a proxy for labour input in the model instead of number of employees, then the SOCBs are more efficient than the JSCBs. This conclusion of Han *et al.* (2014) is also similar to other empirical studies on banking efficiency in Vietnam reviewed in Chapter 3, confirming that the critical underlying driver explaining this phenomenon is the low-paid salary system of SOCBs in both China and Vietnam compared with JSCBs. At the same time, Wang *et al.* (2014) suggest that

before financial reform the SOCBs are more efficient than the JSCBs but that, after the reform period, the efficiency difference between the Chinese SOCBs and JSCBs is narrowed. Furthermore, Zha *et al.* (2015) also find empirical evidence to suggest that in terms of pure technical efficiency the SOCBs are the best-performance banks compared with JSCBs and city-owned commercial banks.

Wang and Feng (2014) investigate the influences of property rights reform on the efficiency of Chinese SOCBs. The empirical evidence from the study shows that, following property rights reform conducted in China, the technical efficiency of the four biggest SOCBs is significantly improved. Xu *et al.* (2015), sharing the same conclusion as Wang and Feng (2014), suggest that the technical efficiency, scale efficiency and productivity change of the four biggest Chinese SOCBs are significantly improved over the financial liberalisation period. Sufian (2011) and Sufian *et al.* (2014) also bring more information about the impacts of ownership on the banking efficiency in Malaysia. According to Sufian (2011) and Sufian *et al.* (2014), the efficiency levels of the local listed banks are better than those of the foreign-ownership banks.

Meanwhile, using a two-stage model, Simper *et al.* (2014) investigate the dependence of the estimated DEA technical efficiency of Korean banks on equity, NPLs and loan loss provisions. Ab-Rahim *et al.* (2012) make use of the Tobit model to investigate the influences of those determinants on banking efficiency in Malaysia. The empirical evidence suggests a significantly positive linkage between banking efficiency scores and market concentration, demand density, population density and government ownership; meanwhile, asset quality, management quality, capitalisation, credit risk and macroeconomic conditions negatively influenced the efficiency scores. Andries (2011) makes the same conclusions on the impact of those variables on the efficiency of Central and Eastern European banking systems. Based on a case study of Ukraine, Zelenyuk and Zelenyuk (2014) provide validated findings for the recommendations concluded by Andries (2011). Accordingly, Zelenyuk and Zelenyuk (2014) suggest that size, type of ownership, business model, regional aspects and level of risk are the determinants that significantly explain the estimated efficiency of banks in Ukraine. Among other findings, they show that locally owned banks are significantly less efficient than foreign-owned ones. Hackethal *et al.* (2012) suggest that cost efficiency is statistically negatively linked with loan quality, bank size and local per capita income for German saving banks.

Among the operating environment factors that impact on bank efficiency in Sri Lanka, Bandaranayake and Jayasinghe (2014) and Thilakaweera *et al.* (2014) focus on

investigating the effect of ownership type on the efficiency of banks, suggesting that efficiency is significantly dependent on ownership type. Based on the intermediation approach, the domestic private banks are more efficient than the SOCBs in Sri Lanka; however, based on the profit-oriented approach, the empirical evidence shows that the domestic private banks are less efficient than the SOCBs and foreign banks. Meanwhile, Wanniarachchige and Suzuki (2011) suggest that, during the financial system reforms in India, in terms of both cost and revenue efficiencies the domestic banks are less efficient than the foreign banks.

Zouari and Taktak (2014) examine the relationship between banking efficiency and ownership structure in 15 Islamic countries, suggesting that there is no correlation between efficiency and ownership concentration in the banking sector in those countries. Ghozali (2014) uses a two-stage approach by applying a Tobit model to regress the technical efficiency scores estimated from a DEA model to the relevant determinants for the banking sector in one of the largest Islamic countries: Indonesia. Hadad *et al.* (2012) also use a DEA model to investigate banking efficiency in Indonesia. The main conclusion of these studies suggests that bank size, loan loss provisions and equity capital are among the significant determinants of efficiency for the Indonesian banks. Furthermore, Hadad *et al.* (2012) suggest that, in terms of ownership in Indonesia, the most efficient banking group is the SOCBs. The empirical evidence suggests that technical efficiency scores are significantly determined by ownership type, CAR, bank size, loan-to-deposit ratio, operating expenses and net interest margin. Meanwhile, Mahathanaseth and Tauer (2014) investigate the impacts of ownership on banking efficiency in Thailand following the 1997 East Asian financial crisis by decomposing the banking sector into SOCBs and private banks. Mahathanaseth and Tauer (2014) suggest that cost inefficiency of banks in Thailand is significantly dependent on the ratio of liquid assets to total assets, equity to total assets, NPL ratio and the number of branches. Manlagñit (2011) also investigates determinants affecting cost efficiency of the banking sector in another ASEAN country: the Philippines. The empirical findings show that the cost efficiency of Philippine banks is substantially influenced by asset quality and risk.

2.5.2. The theoretical linkage between efficiency and competitiveness

The key value driver of competitiveness is the ability of businesses to transform themselves; hence the World Bank (2006: 40) advises:

Productive efficiency and international competitiveness depend on a range of factors, from macroeconomic stability to sound policies for business to high-quality human resources to limited corruption. While it is perfectly legitimate for different cross-country ratings to focus on specific determinants of business performance, a comprehensive assessment of the strengths and weaknesses of a country needs to take them all into account.

As Karnani (1985) and Oral (1993) conclude, *there is a theoretical and empirical linkage between competitiveness and efficiency at firm level; however, there are few analytical models that cover the linkage between the two components because of the absence of analytical frameworks measuring competitiveness at the firm level consisting of all its internal and external factors.*⁹ Hence, Oral *et al.* (1999) suggest that the efficiency level of a bank is widely understood as an essential contributor to its competitiveness; however, efficiency is not explicitly linked with competitiveness.

Based on an industrial competitiveness model, Oral (1986), Oral and Ozkan (1986) and Oral *et al.* (1999) take advantage of the actual competitiveness level (L_A or L_{FR}) and the potential competitiveness level (L_p or L_{FR}) to show the linkage between competitiveness and efficiency at the firm level, as follows.

$$\ln L_{FR} = \ln Q_F - \ln Q_R + \left[\sum_k p_{KR} q_{KR} - \sum_k p_{KF} q_{KF} \right] \quad (2.27)$$

Hence:

$$d(\ln_{FR}) = \left[\frac{dQ_F}{Q_F} - \frac{dQ_R}{Q_R} \right] + \left[\sum_k \lambda_{KR} \frac{dp_{KR}}{p_{KR}} - \sum_K \lambda_{KR} \frac{dq_{KR}}{q_{KR}} \right] + \left[\sum_K \lambda_{KF} \frac{dp_{KF}}{p_{KF}} - \sum_K \lambda_{KF} \frac{dq_{KF}}{q_{KF}} \right] \quad (2.28)$$

where:

$$\lambda_{KF} = p_{KF} q_{KF} / \sum_K p_{KF} q_{KF} \quad (2.29)$$

$$\lambda_{KR} = p_{KR} q_{KR} / \sum_K p_{KR} q_{KR} \quad (2.30)$$

⁹ The same theoretical backgrounds for studies on competitiveness at the industry or country level as World Bank (2006) are popular; namely the Growth Competitiveness Index produced by the World Economic Forum, the Doing Business Ratings produced by the International Finance Corporation (IFC), the FDI Potential index produced by UNCTAD, and the Country Policy and Institutional Assessment (CPIA) developed by the World Bank. However, detailed studies on the relationship between competitiveness and efficiency at the firm level, especially for the bank, are still under development.

Based on this model, Oral *et al.* (1999) conclude that efficiency of the firm F and its competitor R measured by the total factor productivity (TFP) growth, are as follows:

$$\frac{dP_F}{P_F} = \left[\frac{dQ_F}{Q_F} - \sum_K \lambda_{KF} \frac{dq_{KF}}{q_{KF}} \right] \quad (2.31)$$

$$\frac{dP_R}{P_R} = \left[\frac{dQ_R}{Q_R} - \sum_K \lambda_{KR} \frac{dq_{KR}}{q_{KR}} \right] \quad (2.32)$$

Hence, the first equation in this model can be rewritten in the format:

$$d(\ln L_{FR}) = \left[\frac{dP_F}{P_F} - \frac{dP_R}{P_R} \right] + \left[\sum_K \lambda_{KR} \frac{dp_{KR}}{p_{KR}} - \sum_K \lambda_{KF} \frac{dp_{KF}}{p_{KF}} \right] \quad (2.33)$$

Based on the results of this equation, Oral *et al.* (1999) conclude that the relative production efficiency between firm F and its competitor R that is represented by $d(\ln L_{FR})$ is explained by:

- (i) *Cost effectiveness* measured by the difference between the weighted input

price change $\left[\frac{dP_F}{P_F} - \frac{dP_R}{P_R} \right]$ and

- (ii) *Cost effective purchasing* shown by $\left[\sum_K \lambda_{KR} \frac{dp_{KR}}{p_{KR}} - \sum_K \lambda_{KF} \frac{dp_{KF}}{p_{KF}} \right]$ that is

gained by making use of less expensive input sources and by better backward integration with suppliers.

According to the criteria of competitiveness developed by Oral (1986) and Oral and Ozkan (1986), both *cost effectiveness* and *cost effective purchasing* indicators are proxies for cost superiority of the firm, which is also understood as the cost competitiveness of the firm. Hence, by this model, Oral *et al.* (1999) demonstrate the linkage between cost competitiveness and efficiency of a firm by setting up an applicable model.

At the same time, Oum and Yu (1998) confirm that a firm is competitive compared with its competitors in terms of cost if its unit cost or average cost is sustainably lower than that of its competitors. Competitive advantage in terms of cost is called cost competitiveness. Sharing the same opinion as Oral *et al.* (1999), Oum and Yu (1998) confirm that the *cost competitiveness of a firm is a result of the firm being more efficient*

or paying less for its inputs than its competitors, or both. Hence, Oum and Yu (1998) suggest that *cost differentials between a firm and its competitors are derived by differences in factor prices and productive efficiency*. As a result, as Oum and Yu (1998) conclude, it is suggested that competitiveness at firm level is determined by the firm's efficiency.

Based on the cost competitiveness model mentioned in the previous section, Oum and Yu (1998) apply the findings and suggestions of Caves and Christensen (1988) and Fuss and Waverman (1992) to conclude that the difference in *unit cost* between any two observations, 1 and 0, can be decomposed into various sources, as shown in Equation 2.34.

$$\begin{aligned}
c^1 - c^0 = & s \left[\frac{1}{2}(d_y^1 c_y + d_y^0 c_y) - 1 \right] * [y^1 - y^0] & \left. \begin{array}{l} \\ \\ \end{array} \right\} & \text{(Size)} \\
& + s \left[\frac{1}{2}(d_k^1 c_y + d_k^0 c_y) * (k^1 - k^0) \right] \\
& + (1-s) \left[(k^1 - k^0) - (y^1 - y^0) \right] \\
& + s \left[\frac{1}{2}(d_r^1 c_y + d_r^0 c_y) * (r^1 - r^0) \right] & \text{(Output mix)} \\
& + s \left[\frac{1}{2}(d_w^1 c_y + d_w^0 c_y) * (w^1 - w^0) \right] & \left. \begin{array}{l} \\ \end{array} \right\} & \text{(Input prices)} \\
& + (1-s) (w_k^1 w_k^0) \\
& + s \left[\frac{1}{2}(d_z^1 c_y + d_z^0 c_y) * (z^1 - z^0) \right] & \text{(Operating characteristics)} \\
& + s \left[\frac{1}{2}(d_t^1 c_y + d_t^0 c_y) * (t^1 - t^0) \right] & \text{(Time effect)} \\
& + s \left[\frac{1}{2}(d_e^1 c_y + d_e^0 c_y) * (e^1 - e^0) \right] & \text{(Efficiency)}
\end{aligned} \tag{2.34}$$

Based on the model, Oum and Yu (1998) conclude that the cost competitiveness (CC) indicator is derived by summing the effects of input prices and efficiency. Hence, Oum and Yu (1998) successfully set up an analytical framework to highlight the linkage between competitiveness and efficiency at the firm level. Consequently, it is concluded that *the competitiveness of the firm is dependent on the efficiency of the firm*. Yildirim and Philippatos (2002) found that greater competition in the banking system (measured by the Panzar and Rosse *H-statistic*) is associated with greater cost efficiency, while Grigorian and Manole (2002) found that higher banking market concentration is associated with greater cost efficiency. Therefore, according to the debates of Oum and Yu (1998), the two concepts of competitiveness and efficiency are interchangeable because of the same meaning of the two concepts.

Consequently, the literature discussions in this chapter help to draw out the following critical conclusions.

- (i) Efficiency and competitiveness are the indicators that reflect the strength and capability of the firm in competing with peers in terms of cost, scale and scope; consequently the two concepts naturally have the same meaning.
- (ii) Efficiency is a *Granger-causality* that drives competitiveness.¹⁰ This conclusion in the literature suggests that entrepreneurs/bankers are able to keep the competitive positioning of their firms/banks in the market if their firms/banks are operating more efficiently than rivals.
- (iii) Furthermore, the key value drivers (determinants) of competitiveness and efficiency are also the same and interchangeable. Hence, theoretically, if firm A is more efficient than firm B then it can be concluded that firm A is more competitive than firm B.

With the consensus conclusion in the theoretical framework about the two concepts of *competitiveness* and *efficiency*, from now on the two concepts are considered to be interchangeable in the thesis. In other words, measuring efficiency and exploring its determinants also means measuring competitiveness and investigating its determinants.

¹⁰ *Granger-causality* is a statistical concept of causality based on prediction. *Granger-causality* helps to set up and implement a statistical hypothesis test for determining whether past values of one time series (*X*) contain information that helps forecast another (*Y*) and beyond the information contained in the past values of *Y* alone.

CHAPTER 3: OVERVIEW OF THE VIETNAMESE ECONOMY AND BANKING SECTOR EFFICIENCY

3.1. Vietnam economic overview

Vietnam is the second fastest growing country in East and Southeast Asia after Laos, offering tremendous growth potential in the coming years. Vietnam has registered growth rates between 5% and 9% over the last 10 years, and 5.3% year-on-year in 2012.

Vietnam's nominal gross domestic product (GDP) reached VND3,245 trillion (\$155.6 billion) as at 31 December 2012. On the back of the robust economic growth of the 10-year period 2003–2012, Vietnam's real GDP per capita has also increased by approximately 7.9% annually. Figures 3.1 and 3.2 outline Vietnam's real GDP growth and annual inflation for the period 2003–2012.¹¹

Figure 3.1: Real GDP growth rate

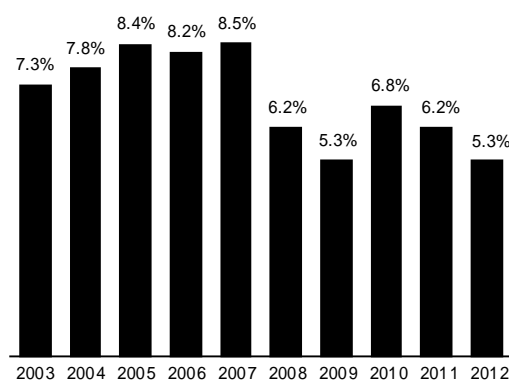
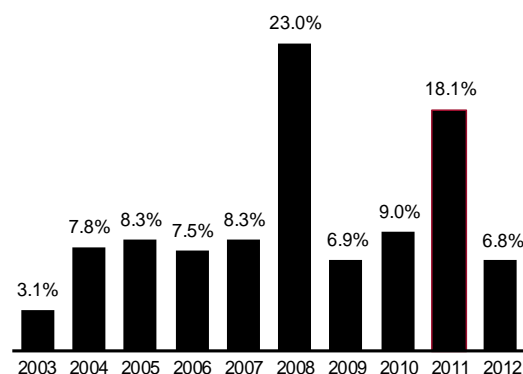


Figure 3.2: Inflation



Source: General Statistics Office of Vietnam (2015).

The banking sector in Vietnam at present is still in its early stages of development. With a total population of approximately 89.6 million people (the 14th largest in the world according to the US Census Bureau), the country's penetration rate is among the lowest rates globally. It is estimated by Vietnamese Banking Associate that only 15% of the population has a bank account, and that there is only one ATM for every 12,250 people and one bank outlet for every 20,000 people. Furthermore, currently 70.4% of the population live outside of urban areas and do not have access to banking facilities, such as

¹¹ The Vietnamese economy expands by 6.68% in terms of GDP growth in 2015, up from 6% in 2014. Meanwhile, price inflation is at an average level of 0.63% in 2015, which is a substantial decline from the level of 1.84% in 2014.

branches or the ATM network. In recent years, however, Vietnam has been undergoing rapid urbanisation, with the urban population increasing at a compounded average growth rate (CAGR) of 4.2% between 2003 and 2012.¹²

Vietnam’s key economic segments as measured by contribution to GDP are the manufacturing, agriculture and trade sectors. Based on the latest data, as of 2012, SOEs and state-related activities accounted for 36% of GDP, while private enterprises and foreign-invested enterprises accounted for only 11% and 18%, respectively. This highlights the significant growth opportunities available to private and foreign enterprises in Vietnam.

Figure 3.3: GDP structure by sector

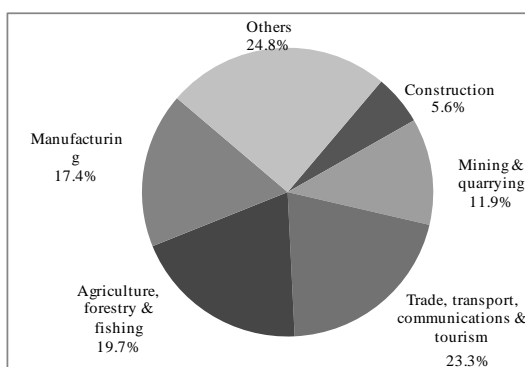
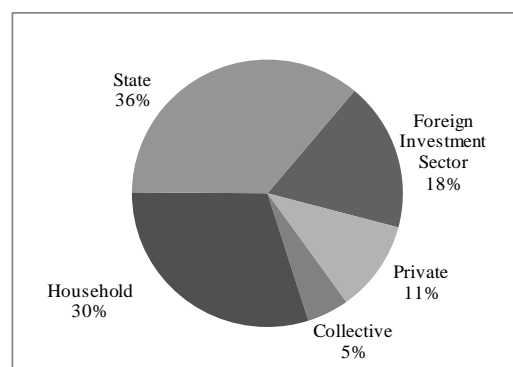


Figure 3.4: Contributors to GDP



Source: General Statistics Office of Vietnam (2015).

FDI and export growth have been key drivers of Vietnam’s resurging growth in recent years. FDI has grown substantially, at a CAGR of 30% since 2003, reaching a record \$210.5 billion in registered capital in 2012. Despite a dip in 2009, FDI recovered and continued growing in 2011 and 2012, with growth of 7.6% and 20.4% in those years, respectively. WTO membership, achieved in January 2007, has provided vital impetus to foreign investment growth, and will likely continue to stimulate both investment and market reforms in coming years.

In parallel, exports and imports have grown rapidly, at a CAGR of 19.8% and 17.7%, respectively, since 2003, becoming one of the key components of GDP growth. Exports have been driven primarily by commodities such as oil, coal and rice, as well as by light

¹² According to a World Bank survey conducted in 2014, 26.5% of respondents had a debit card in 2014, up from 14.6% in 2011. However, only 1.9% of respondents owned a credit card. The number of electronic point-of-sale transactions annually grew by 33.9% in 2014; however, the transaction values increased by 25%. During this period the number of transactions by ATM increased by 17.4%, while their value increased by 24.5%.

manufacturing goods such as garments, electronics and wood products. Despite a decline in export and import growth in 2009, both resumed rapid growth in 2010 and continued growing in 2011 and 2012, with growth at 18.6% and 11.6% for exports and 18.2% and 10.6% for imports for those years, respectively. The ratio of two-way trade to GDP increased from 46% in 2000 to 72% in 2012, highlighting the openness of Vietnam's economy in the run-up to WTO membership.¹³

Figure 3.5: Foreign direct investment

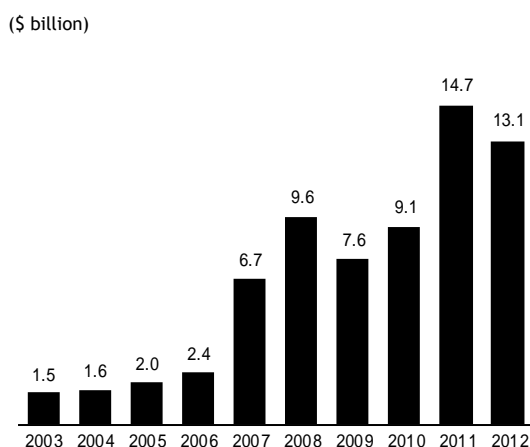
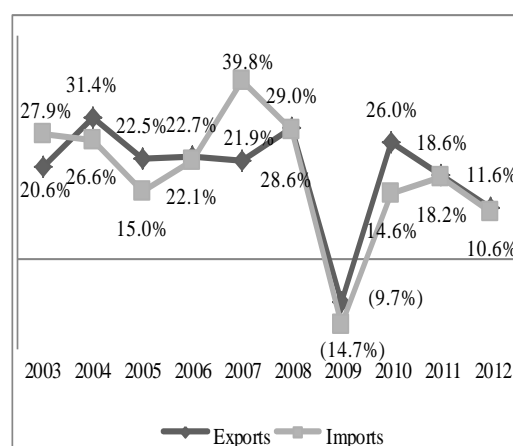


Figure 3.6: Export and import growth



Source: General Statistics Office of Vietnam (2015); Economist Intelligence Unit (2015).

3.2. Financial liberalisation and the development of the Vietnamese banking sector

Until 1988, Vietnam operated under a mono-banking system, with the SBV performing both central and commercial banking functions. Following key banking sector reforms in 1988, the banking sector became a two-tier system, with four SOCBs created to assume the SBV's commercial banking activities, while the SBV retained central banking responsibilities. Given the state-driven nature of the Vietnamese economy up until the recent economic reforms, both the SBV and the SOCBs traditionally focused on lending to SOEs.

¹³ Vietnam is a net exporter of crude oil. Thus recent lower global oil prices have created structural problems for the Vietnamese economy. On the one hand, lower oil prices facilitate a smooth environment for managing inflation; however, the trade and fiscal balances of Vietnam are eroded by this situation. Fortunately, dependence on oil exports in Vietnam has diminished substantially in recent years. Oil income contributed to 30% of government revenue in 2006, and crude oil accounted for 20% of exports. By contrast, in 2014 both ratios considerably reduced to 12% and 5%, respectively.

Barriers to entry were reduced in 1991, opening the market to competition from both foreign players (subject to strict restrictions limiting them to owning only a few branches) and private sector banks, known as JSCBs. This market liberalisation led to a large number of JSCB creations. These new JSCBs operated on a very small scale and, constrained by limited capital and branch coverage, began competing between themselves in the margins of the banking sector, which remained dominated by the major SOCBs. Over-competition among the JSCBs eventually brought about a round of restructurings and mergers, particularly in the period 1999–2001, as a result of which the number of JSCBs fell from 51 to a total of 34 currently operating.

The banking sector was further liberalised following the 2001 bilateral free trade agreement with the US (US BTA), which required Vietnam to gradually open its banking market to encourage foreign participation.¹⁴ Vietnam's accession membership in the WTO became effective on 11 January 2007. Under Vietnam's Schedule of Specific Commitments in Services as part of the WTO accession process, specific commitments were made by Vietnam regarding banking services. These commitments were intended to be undertaken subject to being in accordance with the relevant laws and regulations promulgated by the competent authorities of Vietnam to ensure consistency with Article VI of the GATS and Para 2(a) of the Annex on Financial Services. In addition, the offer of banking services or products is subject to the relevant institutional and juridical form.¹⁵

Under Vietnam's commitments to the WTO, foreign credit institutions are permitted to establish a commercial presence in Vietnam in a number of forms, including representative offices, branches of foreign commercial banks, commercial joint venture banks (JVBs) with foreign capital contribution not exceeding 50% of charter capital, and banks with 100% foreign-owned capital.¹⁶ The banking market is set to open up to full foreign competition, with the SBV currently reviewing the first applications from foreign banks (HSBC, ANZ and Standard Chartered Bank) seeking to operate locally incorporated, wholly owned banking subsidiaries in Vietnam.

¹⁴ Further information about the cornerstones of financial liberalisation in Vietnam can be found in the Appendix of Comparative matrix of AFAS, the BTA commitments and the WTO offers of Vietnam.

¹⁵ According to the Economist Intelligence Unit (2015), in 2014 Vietnam's financial asset base accounted for 450% of GDP, which is smaller in relation to the size of its economy than that of China (634%) or Malaysia (486%), but larger than that of Indonesia (111%), the Philippines (292%) and Thailand (373%).

¹⁶ The report of MCG Management Consulting (2006) suggests that China has conducted domestic reforms more quickly than its committed plan, even though the commitments of China are relatively extensive and more liberalised than Vietnam as well as other regional members of the WTO such as Thailand, Malaysia and the Philippines. Furthermore, benchmarked to other new WTO members like Kyrgyzstan, Latvia and Estonia, China's commitments are more structured and longer in terms of its transitional liberalisation process. The steady-state approach of China with rigid requirements on foreign banks has given significant time for mainland banks to restructure to enhance their competitive advantage against foreign peers.

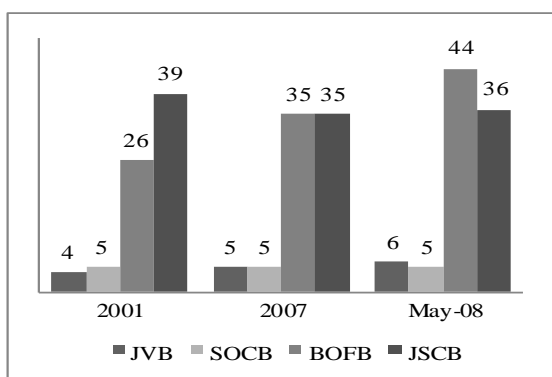
During the five years following Vietnam’s WTO accession, Vietnam limited the right of a foreign bank branch to accept deposits in VND from Vietnamese natural persons with which the bank did not have a credit relationship to a ratio of the branch’s allocated capital according to the schedule below:

- 1 January 2007: 650% of allocated capital.
- 1 January 2008: 800% of allocated capital.
- 1 January 2009: 900% of allocated capital.
- 1 January 2010: 1,000% of allocated capital.
- 1 January 2011: full national treatment.

Vietnam limited equity participation by foreign credit institutions in privatised Vietnamese SOCBs to the same level as equity participation by Vietnamese banks. For capital contribution in the form of buying shares, the total equity held by foreign institutions and individuals in each of Vietnam’s JSCBs could not exceed 30% of the bank’s chartered capital, unless otherwise provided for by Vietnam’s laws or authorised by a competent authority of Vietnam. A branch of a foreign commercial bank is not allowed to open other transaction points outside its branch office. Upon accession, foreign credit institutions are allowed to issue credit cards on a national treatment basis.

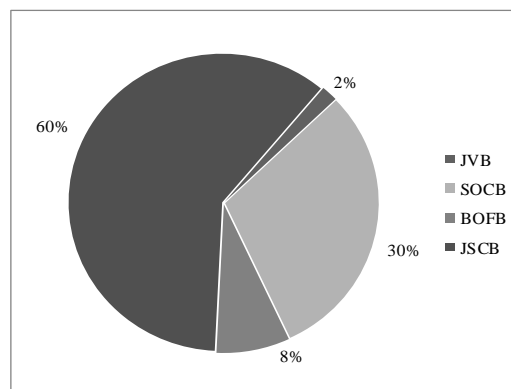
Figure 3.7: Banks and non-banking credit institutions in Vietnam

Number of commercial banks



JVB: Joint venture banks
SOCB: State-owned commercial banks

Commercial banks’ charter capital in 2007



BOFB: Branches of foreign banks
JSCB: Joint stock commercial banks

Source: Viet Capital Securities (2008: 4).

In parallel with the progressive liberalisation of Vietnam’s banking market, the banking sector has experienced rapid growth. Growth in domestic credit surpassed 20% each year in the period 2003–2009, fuelled by strong credit demand from both the corporate market and the retail market. Domestic credit increased rapidly in 2007, growing by 50.2%, but growth subsequently slowed in 2008 to 27.7%, after the economy was impacted by loan classification rules that led to more cautious corporate lending by the leading SOCBs. However, domestic credit growth rose once again in 2009, growing by 45.6%. Because of the high inflation return and the deterioration in the loan quality of commercial banks (with the average NPL ratio up to 10% from the level of 3%, as declared by the SBV Governor), the SBV tightened monetary policy during the period 2010–2012. The rapid credit growth of 2008–2009 associated with the rise in NPL is partially responsible for Vietnam’s economic hard landing in 2011–2012. Consequently, the credit growth rate in this period (2010–2012) significantly slowed, to 16.9%.¹⁷ Banking sector deposits in Vietnam during this period also grew rapidly, catching up with the expansion in lending. Consequently, according to the Economist Intelligence Unit (2015), the loans to deposits ratio (LDR) of the whole banking sector at the end of 2014 was about 93.3%. The following figures illustrate the trends in domestic credit and deposit in the period 2002–2012.

Figure 3.8: Credit (VND trillion)

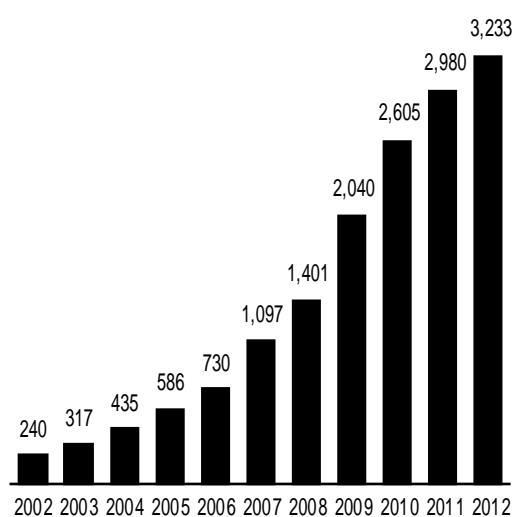
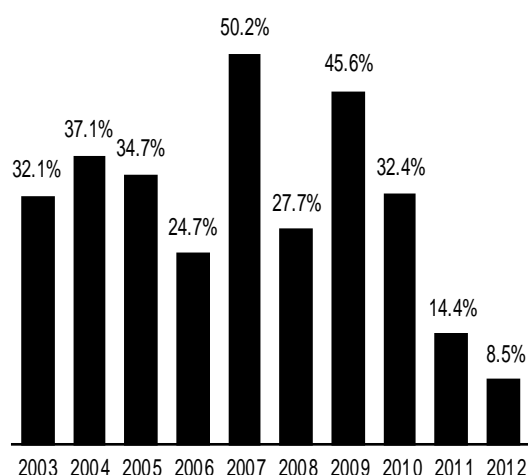


Figure 3.9: Credit growth (%)



¹⁷ Owing to the bad debt problems, Vietnamese banks have been reluctant to fund new loans. Hence, to facilitate credit growth the Vietnamese government has created an agency, the Vietnam Asset Management Company (VAMC), to exchange the bad debts of commercial banks for a special bond guaranteed by the SBV.

Figure 3.10: Deposits (VND trillion)

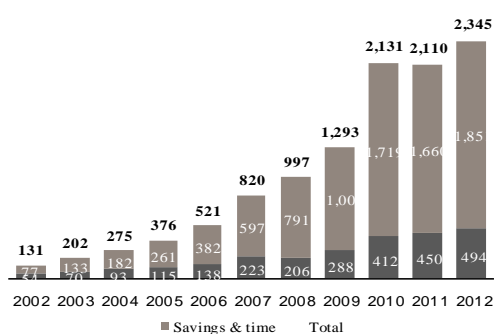
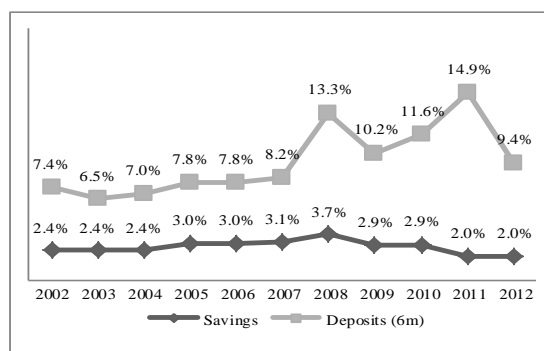


Figure 3.11: Deposit interest rates (%)



Source: Asian Development Bank (2009; Economist Intelligence Unit (2015); State Bank of Vietnam (2015).

Despite ongoing liberalisation and reform, the Vietnamese banking and financial services sectors remain in the early stages of development and offer significant market potential. Banking services penetration rates are low by international standards. This is a legacy of the cash economy that dominated Vietnam prior to market reforms. With a current total population of approximately 89.6 million people (the 14th largest in the world according to the US Census Bureau), it is estimated that only 15% of the population has a bank account, which is among the lowest rates globally, and that less than 10% of the population regularly uses bank fee-generating services (according to the Vietnam Banking Association). These rates represent the lowest among emerging Southeast Asian countries. Vietnam has historically been a cash economy, with salaries paid in cash and the population wary of depositing savings in banks. As the Vietnamese economy continues to transition from a cash economy to a sophisticated financial system, banking service penetration rates are expected to grow explosively.¹⁸

Table 3.1: Financial deepening in Vietnam

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Broad money (M2) | 329.0 | 411.2 | 532.3 | 690.7 | 922.7 | 1,283 | 1,510 | 1,910 | 2,480 | 2,770 | 3,455 |
| % change | 17.6 | 24.9 | 29.5 | 29.7 | 33.6 | 39.0 | 17.7 | 26.5 | 29.8 | 11.7 | 24.7 |
| % GDP | 61.4 | 67.0 | 74.4 | 82.4 | 94.8 | 112.1 | 110.2 | 115.2 | 125.2 | 109.3 | 106.5 |
| Credit to economy | 240 | 317 | 435 | 586 | 730 | 1097 | 1,401 | 2,040 | 2,605 | 2,980 | 3,233 |
| SOE share (%) | 38.7 | 35.5 | 34.0 | 32.8 | 31.4 | 31.5 | 30.9 | 29.4 | 18.7 | 17.3 | 16.9 |
| Others share (%) | 61.3 | 64.5 | 66.0 | 67.2 | 68.6 | 68.5 | 69.1 | 70.6 | 81.3 | 82.7 | 83.1 |

¹⁸ According to the World Bank, around 31% of adults in Vietnam had an individual bank account in 2014, up from 21.4% in 2011 (of which 0.5% had a mobile account). Furthermore, 47% of respondents surveyed by the World Bank confirmed having borrowed money in 2014, only 19% of those surveyed from a bank. At the same time, whereas 63% reported that they had saved money in 2014, only 14.6% deposited at a bank, while 11.6% of respondents saved money by community-based methods.

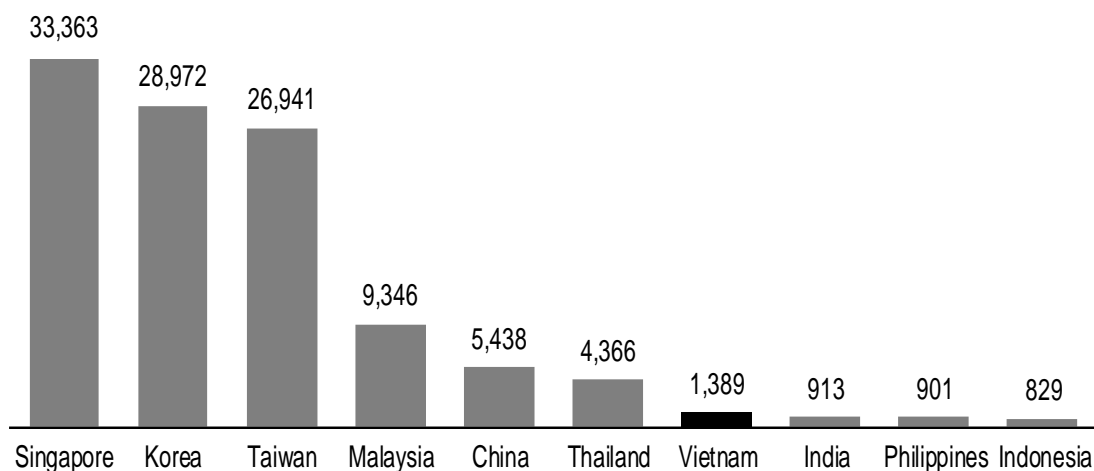
| | | | | | | | | | | | |
|----------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| % change | 22.2 | 32.1 | 37.2 | 34.7 | 24.6 | 50.3 | 27.7 | 45.6 | 27.7 | 14.4 | 8.5 |
| % GDP | 43.1 | 48.4 | 58.7 | 66.0 | 71.2 | 82.5 | 94.27 | 123.0 | 135.8 | 120.7 | 102.9 |

Source: Pham and Vo (2008); Asian Development Bank (2009); International Monetary Fund (2014); Indexmundi (2014).

In comparison to the low retail banking penetration, Vietnam’s corporate banking sector is relatively more developed. However, despite this, the weight of the overall banking system relative to GDP remains low. Total domestic credit activity was approximately 1.2 times GDP in the period 2009–2012, a ratio significantly lower than in more advanced developing economies in the region, such as Malaysia (1.4 times), China (1.5 times) and Korea (1.7 times). This indicates Vietnam’s significant potential for sustained banking sector growth in excess of GDP growth.

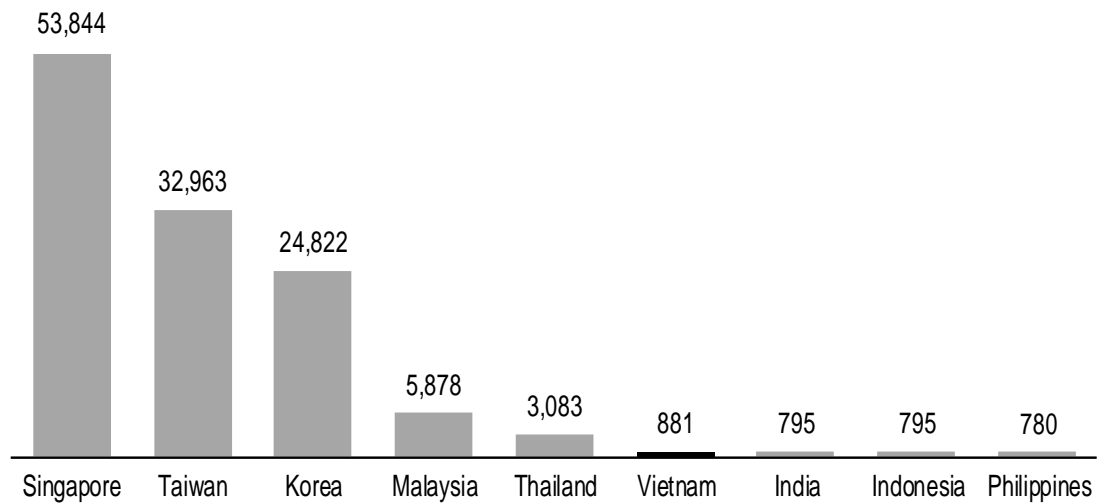
Moreover, with a relatively large population compared to GDP in Vietnam, domestic credit or deposits per capita are lower than those of neighbour emerging markets. ADB and IMF data for 2009–2012 shows that Vietnam had one of the lowest per capita credit and deposit levels among major emerging markets in Asia, with domestic credits and deposits of \$1,389 and \$881 per person, respectively. In comparison, per capita figures for China, Thailand and Malaysia were 3.1 times to 6.7 times higher for credit, ranging from \$4,366 to \$9,346, and 3.5 times to 6.7 times higher for deposits, ranging from \$3,083 to \$5,878. Vietnam’s low banking activity on a per capita basis highlights the enormous potential for banking sector development in the coming decade. The following figures set forth per capita banking activity information for major Asian countries.

Figure 3.12: Domestic credit per capita (selected Asian countries)



Source: Asian Development Bank (2009).

Figure 3.13: Deposit per capita (selected Asian countries)

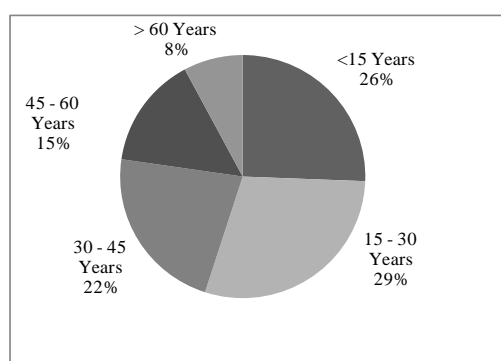


Source: Asian Development Bank (2009).

In addition to the transformative effects of the economic transition from a planned, cash-based economy to a free market system, Vietnam's financial service penetration is also being driven on the retail banking side by the combination of a young population and rapid urbanisation. Vietnam is estimated to have the second youngest population in Asia, after a post-war baby boom that reached a peak in the early 1990s. The median age of the Vietnamese population is 27.4 years, significantly lower than China's 35.2 or Thailand's 33.7 years, which results in a large demographic cohort presently entering the job market and raising its income, consumption and living standards. Moreover, the younger generations are early adopters of banking services. Banking penetration in the past has been held back by lack of access to banking facilities.¹⁹ Banks' expanding distribution coverage has also helped fill the gap and increase industry penetration. Further information about the characteristics of the Vietnamese economy as a whole and its banking sector can be found in Appendix 1.

¹⁹ The number of bank cards issued by local banks rose 15% from the end of 2013 to 76.13 million cards through the end of October 2014, just 3.04 million or 4% of which were credit cards, despite recording a considerable growth of 25%. Debit cards accounted for 69.83 million cards while the rest was prepaid cards, according to the SBV. In terms of operation scale, the number of domestic bank cards made up nearly 89.4% and the remaining was international cards. The central bank also noted that local banks had installed 15,809 ATMs and 159,067 point-of-sale (POS) machines across the country by the end of October 2014, up 3.6% and 23.1% (State Bank of Vietnam, 2014).

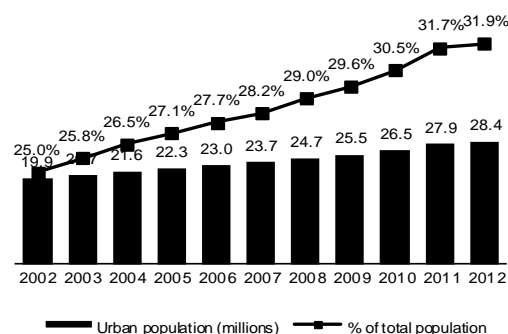
Figure 3.14: Vietnam population structure



89.6 million

Source: US Census Bureau (2012)

Figure 3.15: Vietnam urbanisation trends



Source: General Statistics Office of Vietnam (2015)

3.3. Competitive positioning in the Vietnamese banking sector

The top SOCBs and social policy banks clearly dominate the market, with the top five banks controlling a 50.2% market share by assets (excluding foreign bank branches). Below the incumbent SOCBs, the JSCBs attempt to gain market share in a highly competitive environment. The number of domestic banks increased rapidly until 2Q2008, when the SBV suspended the allocation of new domestic bank licences. However, it has allowed foreign banks to incorporate locally. Since 2008, there has been no change in the number of banks newly set up in Vietnam as a result of the strict restriction by the SBV to issue new operating licences for new banks.

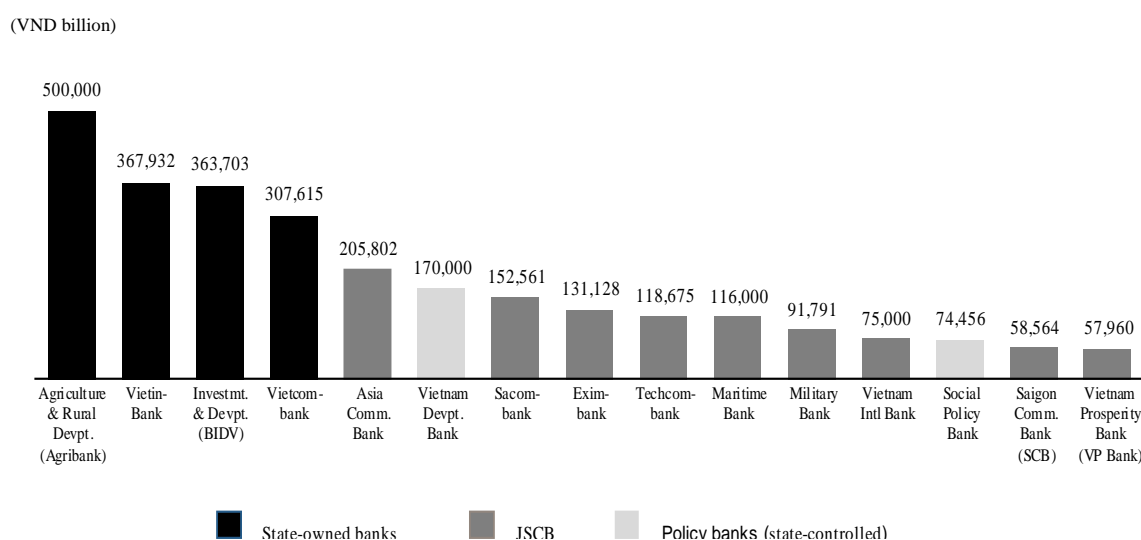
Table 3.2: Market share of Vietnamese commercial banks (%)

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Market share in deposits | | | | | | | | | | | | | |
| SOCBs | 77.0 | 80.1 | 79.3 | 78.1 | 75.2 | 74.7 | 68.8 | 59.3 | 56.1 | 49.7 | 47.7 | 49.3 | 48.7 |
| JSCBs | 11.3 | 9.1 | 10.1 | 11.2 | 13.3 | 15.7 | 21.8 | 30.4 | 35.9 | 41.1 | 40.4 | 39.6 | 40.1 |
| Foreign bank branches + JVBs | 10.3 | 10.0 | 9.4 | 9.3 | 9.7 | 8.0 | 8.1 | 8.8 | 6.6 | 7.5 | 10.6 | 9.8 | 10.1 |
| PCFs | 1.0 | 0.8 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 0.9 | 0.8 | 0.7 | 0.6 |
| Others | 0.4 | 0.0 | 0.1 | 0.3 | 0.8 | 0.6 | 0.3 | 0.5 | 0.3 | 0.8 | 0.5 | 0.6 | 0.5 |
| Market share in lending | | | | | | | | | | | | | |
| SOCBs | 76.7 | 79.0 | 79.9 | 78.6 | 76.9 | 73.0 | 64.5 | 55.1 | 55.7 | 54.1 | 49.3 | 49.4 | 49.7 |
| JSCBs | 9.2 | 9.3 | 9.5 | 10.8 | 11.6 | 15.0 | 21.2 | 32.6 | 33.8 | 36.7 | 37.1 | 39.2 | 37.6 |
| Foreign bank branches + JVBs | 12.4 | 10.4 | 8.8 | 8.9 | 9.5 | 9.6 | 9.3 | 10.2 | 8.4 | 7.1 | 11.8 | 10.0 | 11.6 |
| PCFs | 1.4 | 1.2 | 1.7 | 1.5 | 1.4 | 1.5 | 1.4 | 1.3 | 1.2 | 1.5 | 1.1 | 0.9 | 0.7 |
| Others | 0.3 | 0.1 | 0.1 | 0.2 | 0.6 | 0.9 | 3.6 | 0.8 | 0.9 | 0.6 | 0.7 | 0.5 | 0.4 |

Source: Pham and Vo (2008); Asian Development Bank (2009); MCG Management Consulting (2006: 12–14); State Bank of Vietnam (2015).

Figure 3.16 outlines the assets of Vietnam’s top 15 banks, which together hold approximately 80.3% of market share by assets (excluding foreign bank branches).

Figure 3.16: Total assets – top 15 banks (2010)



Source: Company audited financials and reports (where available); Newswires.

3.3.1. State-owned commercial banks

The SOCBs formed out of the SBV’s commercial banking operations were initially focused on specific sectors mandated by their respective charters. Although the SOCBs now classify themselves as universal banks and have been diversifying both their banking and non-banking operations, their business profiles remain partly characterised by their traditional roles. The five SOCBs (ranked by asset size) and their traditional roles are:

- *Vietnam Bank for Agriculture and Rural Development (VBARD)*, traditionally an agriculture and commodities finance specialist.
- *Bank for Foreign Trade of Vietnam (Vietcombank)*, the country’s import–export and trade-financing bank.
- *Bank for Investment and Development of Vietnam (BIDV)*, which provides development finance for infrastructure projects.
- *Industrial and Commercial Bank of Vietnam (Incombank)*, which specialises in industrial finance.

- *Mekong Delta Housing Bank (HBMD)*, which specialises in providing financing to the housing market.

The government also recently launched two policy banks, the Vietnam Development Bank and the Social Policy Bank, which are mandated to take over from the SOCBs in the provision of state-directed lending. Together, the SOCBs and the new social policy banks have historically dominated Vietnam’s banking sector, decreasingly holding close to 85%–65% of domestic banking assets during the period 2002–2012, and operating the largest distribution networks.

Figure 3.17: Equity/total assets of 4 SOCBs

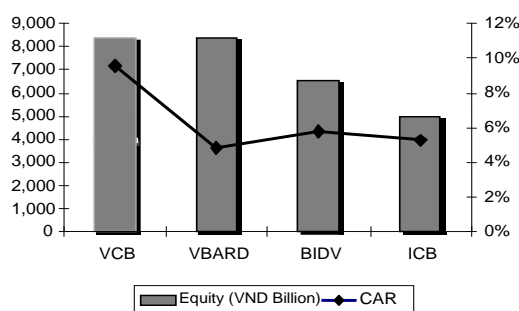


Figure 3.18: CARs of Vietnamese banks and other countries

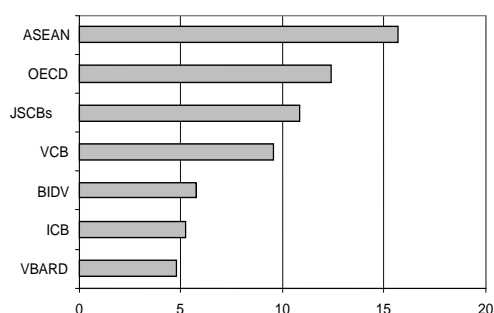


Figure 3.19: Outstanding debt/total assets of SOCBs in comparison with JSCBs and other countries

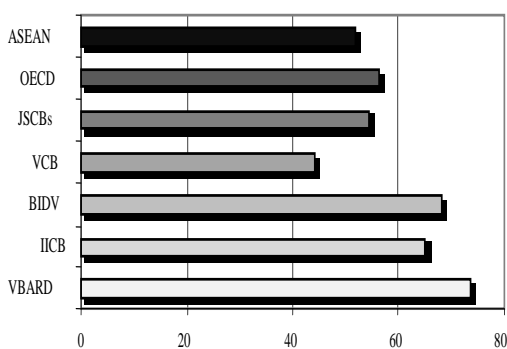
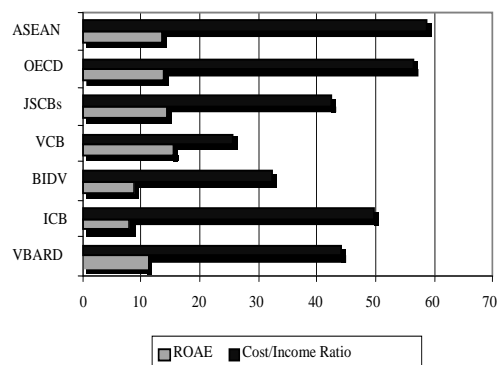


Figure 3.20: Performance of SOCBs in comparison with JSCBs and other countries



Source: Pham *et al.* (2007: 82).

Historically, the SOCBs have been weakly capitalised and have suffered from problem loans directed to SOEs. However, risk management reforms since 2001, and the transfer of social lending roles to policy banks, have significantly improved the health of the sector. In parallel, in 2001 the government implemented a recapitalisation scheme, infusing VND10.4 trillion (\$648 million) into the five SOCBs. Most of the new capital injected has been in the form of 20-year government bonds with an annual coupon of about 3.3%. In April 2007, the government further recapitalised Incombank, infusing

VND3.5 trillion (\$218 million) to put it on a more equal footing with Vietcombank and BIDV.

Since 2008, Vietcombank has successfully conducted its first IPO to sell 8% of its capital to the public with a price of 10.6 times its booking value. After that, the bank sold 15% of its stockholdings to Mizuho in 2011 to increase its capital to VND26.6 trillion (\$1,266 million). Following the case of Vietcombank, Incombank also conducted its first IPO in 2009 and sold 20% of its equity to Mitsubishi UFJ Financial Group to increase its capital to VND37.2 trillion (\$1,771 million). Meanwhile, BIDV conducted its first IPO in 2012 with its equity of VND28.1 trillion (\$1,338 million).

3.3.2. Joint stock commercial banks

JSCBs account for about 20% of domestic bank assets. JSCBs are primarily domestically funded, although some have received significant foreign investments. JSCBs' domestic capital comes in part from SOEs and domestic private enterprises, raising the risk of large related-party exposures.

Despite significant growth recently, JSCBs generally have limited operational scale and small capital bases, ranging from VND70 billion (\$4 million) to VND 2,089 billion (\$130 million), with an average of only VND670 billion (\$42 million) as at 31 December 2006. Since 2010, as a result of the compulsory request by the SBV, all JSCBs have increased the minimum capital to VND 3,000 billion (\$150 million). JSCBs also incur significant business and lending concentrations, often related to cornerstone investors or other associated entities. The more advanced JSCBs have, however, successfully targeted the retail and small and medium enterprise markets, where they have built competitive businesses. The leading two JSCBs, *Asia Commercial Joint Stock Bank* (Asia Commercial Bank) and *Saigon Thuong Tin Commercial Bank* (Sacombank), have captured sizeable market share, while the second-tier banks, comprising *Vietnam Technological and Commercial Joint Stock Bank* (Techcombank), *Vietnam Export Import Commercial Joint Stock Bank* (Eximbank), *Vietnam International Commercial Joint Stock Bank* (VIB), *Military Commercial Joint Stock Bank* (Military Bank), *Hanoi Building Commercial Joint Stock Bank* (Habubank) and *Saigon Commercial Joint Stock Bank* (Saigon Commercial Bank), face more challenges to raise themselves to the ranks of the market leaders among the JSCBs. Finally, the third-tier banks, comprising the remaining 26 JSCBs, face significant competitive challenges with potential market

consolidation driven by stricter capitalisation regulations being progressively implemented by the SBV.

Given increased competitive and regulatory challenges, JSCBs have made extensive efforts to secure strategic investments by foreign banking partners. For the JSCBs, such investments are key to gaining a sustainable competitive advantage in terms of brand positioning, product development, risk management, capital strength and management expertise. Owing to Vietnam's strong growth profile and banking sector profitability, foreign banks have shown considerable interest in pursuing such strategic investments in Vietnam in the recent years, as shown in Table 3.3.

Table 3.3: Foreign strategic investments in Vietnamese JSCBs

| Target Bank | Acquirer | Acquisition Announcement Date | State Acquired | Target Bank Asset Size* | |
|------------------------|--------------------|----------------------------------|-------------------|-------------------------|------------|
| | | | | VND trillion | \$ billion |
| Sacombank | ANZ Bank | 24 Mar 2006 | 10.0% | 24.9 | 1.5 |
| Asia Commercial Bank | Standard Chartered | 17 Jun 2005 | 8.6% | 44.6 | 2.8 |
| Techcombank | HSBC | 28 Dec 2005 | 10.0% | 17.5 | 1.1 |
| VP Bank | OCBC | 21 Mar 2006 | 10.0% | 10.2 | 0.6 |
| Orient Commercial Bank | BNP Paribas | 17 Nov 2006 | 10.0% | 6.4 | 0.4 |
| Southern Bank | UOB | 25 Jan 2007 | 10.0% | 9.2 | 0.6 |
| Techcombank | HSBC | 25 Jan 2007 | 10.0% | 17.5 | 1.1 |
| Habubank | Deutsche Bank | 01 Feb 2007 | 20.0% | 11.6 | 0.7 |
| Eximbank | SMBC | 30 Mar 2007 | 15.0% | 24.9 | 1.5 |
| PVFC | Morgan Stanley | 13 Nov 2007 | 10.0% | 34.5 | 2.15 |

Source: Company announcements; Newswires.

Note: * As at 31 December 2006.

3.3.3. Foreign bank branches

Until recent regulatory measures to introduce further banking sector liberalisation in line with WTO requirements (still pending implementation), foreign banks were allowed to open only two branches in the country, and were restricted in the provision of VND-denominated services. As a result, foreign bank branches generally focus entirely on serving foreign invested companies, large SOEs and foreign individuals in Vietnam. Some banks (for example, Citibank and ANZ) also target wealthy Vietnamese clients. Foreign bank branches have reportedly been instrumental in introducing new products to the Vietnamese market. At the same time, they have penetrated the retail market by offering automobile loans, housing loans and international credit card services. Two foreign banks, HSBC and Standard Chartered Bank, are currently in the process of applying for domestic banking licences pursuant to the newly liberalised rules on foreign banks' activities, and these banks plan to open 100%-owned subsidiaries once licences are obtained.

3.3.4. Banking sector leaders

The following table and figures provide further operational and financial details on Vietnam's four leading SOCBs and two leading JSCBs, which together make up 70.7% of the market by assets. Further detailed and up-to-date analysis of the leadership and competitive positioning of commercial banks in Vietnam is addressed in Chapter 6.

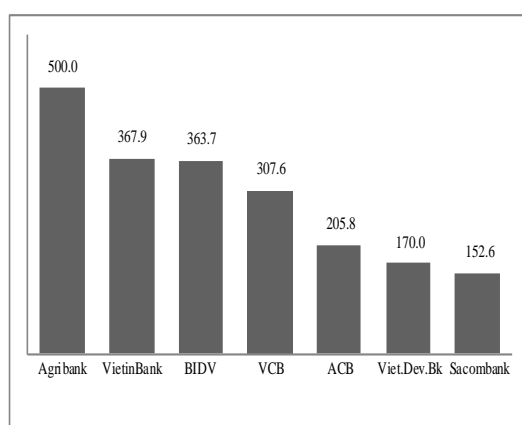
Table 3.4: Vietnam's leading banks
(as at 31 December 2006)

| Name | Full Name | Bank Type | Listing Date | Rank (by Total Assets) | Total Equity | (VND trillion) | | Number of Branches* |
|-------------|--|-----------|--------------|------------------------|--------------|--------------------------------|--------------------------|---------------------|
| | | | | | | Pre-Provision Operating Profit | Profit before Tax (Rank) | |
| VBARD | Vietnam Bank for Agriculture and Rural Development | SOCB | Exp 2008 | #1 | N.A. (#2) | N.A. | N.A. | 1.468 |
| Vietcombank | Bank for Foreign Trade of Vietnam | SOCB | Exp 3Q 2007 | #2 | 11.1 (#1) | 4.1 (#1) | 3.9 (#1) | 59 |
| BIDV | Bank of Investment and Development of Vietnam | SOCB | Exp 4Q 2007 | #3 | 7.6 (#3) | 3.2 (#2) | 1.2 (#2) | 103 |
| ICB | Industrial and Commercial Bank of Vietnam | SOCB | Exp 4Q 2007 | #4 | N.A. (#4) | N.A. | 0.8 (#3) | 137 |
| ACB | Asia Commercial Joint Stock Bank | JSCB | Feb 2007 | #6 | 1.7 (#6) | 0.7 | 0.7 (#4) | 46 |
| Sacombank | Saigon Thuong Tin Commercial Bank | JSCB | Jul 2006 | #7 | 2.9 (#5) | 0.6 | 0.6 (#5) | 62 |

Source: Company audited financials and reports (where available); Newswires.

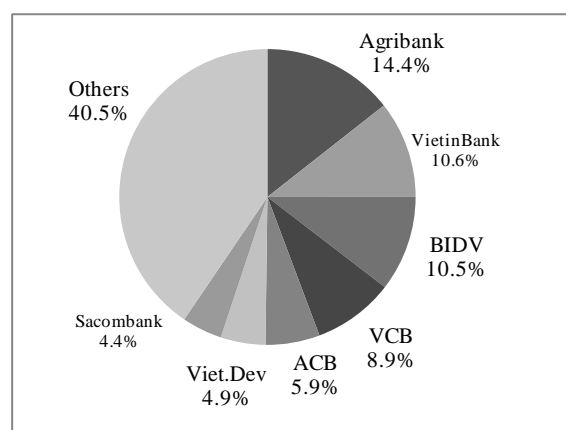
Note: (*) Excluding transaction offices or sub-branches. The definition of branches may differ between banks, notably between SOCBs and JSCBs. Certain JSCB branches would qualify only as sub-branches at SOCBs. All financial data based on VAS.

Figure 3.21: Total assets



Source: Company audited financials and reports (where available); Newswires (as at 31 December 2011).

Figure 3.22: Market share by assets



Source: Company audited financials and reports (where available); Newswires (as at 31 December 2011).

Note: Excluding foreign bank branches and joint-venture banks, for which the latest asset data is not available.

Figure 3.23: Gross loans

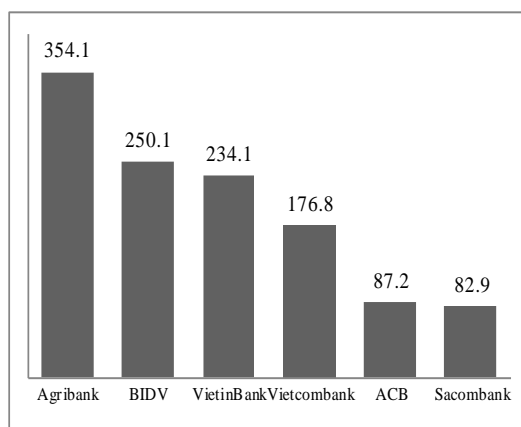
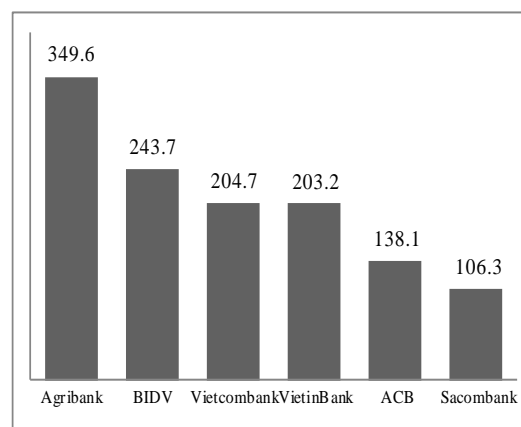


Figure 3.24: Total deposits



Source: Company audited financials and reports (where available); Newswires (as at 31 December 2010).

Figure 3.25: Return on average assets

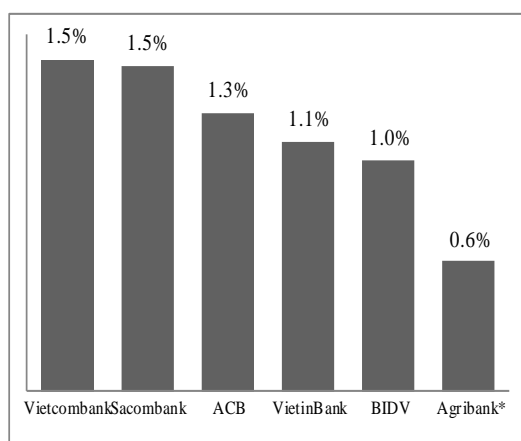
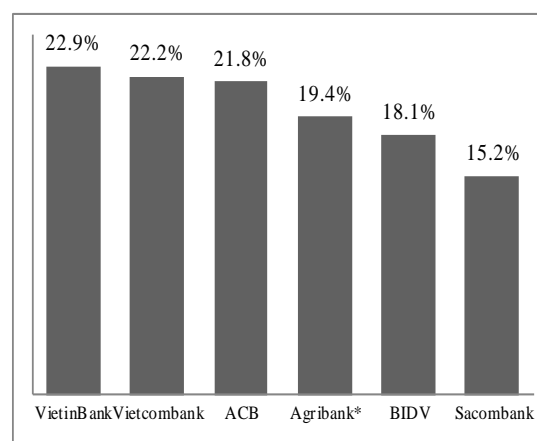


Figure 3.26: Return on average equity



Source: Company audited financials and reports (where available); Newswires (as at 31 December 2010).

3.4. Literature review on banking efficiency and competitiveness in Vietnam

3.4.1. Literature review on banking efficiency in Vietnam

The first ever study on efficiency of the banking sector in Vietnam is conducted by Hung (2007). After Hung (2007), there are other validated studies into banking efficiency in Vietnam, namely Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a, 2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015). Hung (2007) does not cover the entire banking sector in Vietnam. This study is based on the data of a limited number of commercial banks (13) for a short period (2001–2003) and makes use of the DEA method and the Malmquist index to investigate the efficiency of those banks. Even though the study did not represent the entire Vietnamese banking sector, its findings are very useful for an initial analysis

and overview of the efficiency of the Vietnamese commercial banks. Table 3.5 contains detailed descriptions of the variables used by Hung (2007).

Table 3.5: Definitions of the relevant variables

| | <i>Output</i> | | <i>Input</i> | | | <i>Input prices</i> | | |
|----------------------|------------------|---------------------|-----------------------|------------------|------------------------------------|--------------------------------------|-------------------------------|-----------------------------|
| | Y1 | Y2 | X1 | X2 | X3 | W1 | W2 | W3 |
| Variable name | Interest income | Non-interest income | Labour | Capital | Deposits | Price of labour | Price of physical capital | Price of deposits |
| Definition | Operating income | | Total labour expenses | Physical capital | Saving deposits and other deposits | Labour expenses/ number of employees | Physical capital expenses/ X2 | Total interest expenses/ X3 |

Source: Hung (2007: 64).

Using the DEA method, Hung (2007) draws out some findings about the efficiency of the 13 Vietnamese commercial banks. The study of Hung (2007) covers only 13 commercial banks, accounting for 14.8% of the total number of credit institutes in Vietnam (88 institutes) at that period.²⁰ From the findings, Hung (2007) suggests that the cost efficiency of the 13 commercial banks tends to increase over time from 57.5% in 2001 to 61.4% in 2003. Meanwhile, the technical efficiency tends to be higher than the allocative efficiency, namely 0.918 and 0.615, respectively. This empirical evidence suggests that the cost inefficiencies of the banks are a result of regulatory issues rather than managerial skills. Furthermore, according to Hung (2007) the overall pure technical efficiency of Vietnamese banks over the period is higher than the scale efficiency.

To further investigate the evolution of efficiency of the Vietnamese commercial banks over the period 2001–2003, Hung (2007) makes use of the Malmquist index.

Table 3.6: Malmquist index evolution over the period 2001–2003

| <i>Year</i> | <i>Effch</i> | <i>Techch</i> | <i>Pech</i> | <i>Sech</i> | <i>Tfpch</i> |
|-------------|--------------|---------------|-------------|-------------|--------------|
| 2002 | 0.980 | 0.924 | 1.041 | 0.941 | 0.906 |
| 2003 | 1.066 | 0.991 | 1.003 | 1.063 | 1.057 |
| Mean | 1.022 | 0.957 | 1.022 | 1.000 | 0.978 |

Source: Hung (2007: 67).

Note: In this table, the characteristics are explained as follows:

effch: technical efficiency change; **techch:** technical or technological change; **pech:** pure technical efficiency change; **sech:** scale efficiency change; **tfpch:** total factor productivity change (Malmquist index).

²⁰ Further information and the code of these institutes can be found in Appendix 2.

Hung (2007) concludes that during the period there is a 2.2% decline in terms of total factor productivity (TFP) because the average Malmquist index is 0.978. The 2.2% decline in TFP is mainly due to the 4.3% reduction of technological change. This suggests that the technical efficiency change of the Vietnamese commercial banks is less significant than the technological change. The empirical evidence also shows that during the period 2001–2003 the Malmquist index increased 5.7%, which suggests positive impacts of financial deregulation on the efficiency improvement of Vietnamese banks.

According to Hung (2007), the benchmark for the Vietnamese banking sector in this period is Vietcombank – one of the four biggest Vietnamese SOCBs. With the highest technical efficiency scores compared with peers in Vietnam, Vietcombank is considered as a benchmark for the Vietnamese banking sector, as shown in Table 3.7.

Table 3.7: Efficiency scores of Vietcombank and the mean of all sampled banks

| <i>Banks</i> | <i>CE</i> | <i>AE</i> | <i>TE</i> | <i>PTE</i> | <i>SE</i> | <i>Scale Type</i> |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|-------------------|
| Year 2001 (Mean) | 0.575 | 0.622 | 0.912 | 0.940 | 0.970 | |
| Bank for Foreign Trade of Vietnam | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | Cons |
| Year 2002 (Mean) | 0.628 | 0.690 | 0.895 | 0.974 | 0.919 | |
| Bank for Foreign Trade of Vietnam | 0.967 | 0.967 | 1.000 | 1.000 | 1.000 | Cons |
| Year 2003 (Mean) | 0.614 | 0.643 | 0.948 | 0.977 | 0.970 | |
| Bank for Foreign Trade of Vietnam | 0.917 | 0.917 | 1.000 | 1.000 | 1.000 | Cons |

Source: Hung (2007: 65).

However, in other empirical studies with different numbers of banks in the sample and different timeframes, the benchmark for the Vietnamese banking sector in terms of efficiency changes case by case. Vinh (2012) shows that during the period 2007–2011 the SOCBs are less efficient than JSCBs. In terms of technical efficiency, Vinh (2012) suggests the benchmark in Vietnam is VietABank (VAB). However, according to Nguyen and Stewart (2013) the SOCBs have the highest average technical efficiency among JSCBs and foreign banks, of which one foreign bank (HSBC Vietnam transformed from a branch status to a bank incorporated status in 2009) and two small JSCBs (TienPhong Bank and BaoViet Bank, both established in 2008) are the benchmarks for the banking sector in Vietnam for the period 1999–2009. Vu and Nahm (2013b) also provide empirical evidence that the SOCBs are more technically and allocatively efficient than other banks, supporting Vietcombank as a benchmark for the Vietnamese banking sector in the period 2000–2006.

Following up Hung (2007), Ngo (2012) also applies a DEA model to examine the efficiency evolution of the Vietnamese banking sector over the period 1990–2010. Ngo

(2012) investigates the impacts of environmental variables on the efficiency of Vietnamese banks in this period. The empirical evidence of Ngo (2012) suggests that banking efficiency is negatively correlated with the increasing size of the banking sector associated with a more free financial market.

Vinh (2012) uses the DEA model to provide empirical evidence of the increased efficiency of 20 Vietnamese commercial banks over the period 2007–2010. The Malmquist index estimated by Vinh (2012) shows a declining trend over the period 2008–2009, suggesting the efficiency of the Vietnamese commercial banks was negatively influenced by the global financial crisis of 2008.

Meanwhile, Minh *et al.* (2013) make use of a slacks-based DEA model to investigate the efficiency of 32 Vietnamese commercial banks in the period 2001–2005. The empirical findings show that there are a few banks that have superior efficiency. Minh *et al.* (2013) suggest that big banks are not more efficient than small banks. The *two-stage model* with a Tobit regression also implemented by Minh *et al.* (2013) shows the positive impacts of market share and bank size on estimated efficiency, while state ownership has a negative effect and there is no significant correlation with labour quality.

Nguyen and Stewart (2013) investigate the efficiency and degree of concentration of 48 commercial banks in Vietnam over the period 1999–2009 based on the efficiency hypothesis and SCP paradigm approaches. The empirical evidence of the study shows that the Vietnamese banking sector is still dominated by large commercial banks. However as a result of the financial liberalisation process the Vietnamese banking sector has become substantially less concentrated.

Vu and Nahm (2013a) investigate the determinants influencing the profit efficiency of the Vietnamese commercial banks during the period 2000–2006. Using a Tobit regression of the *two-stage approach*, Vu and Nahm (2013a) examine the impacts of environmental variables, namely ownership, bank characteristics, macroeconomic conditions and financial reform, on the profit efficiency of those banks in Vietnam. The empirical evidence shows that profit efficiency improved with high growth per capita GDP, low inflation rate, larger bank size and better corporate governance. Meanwhile, profit efficiency deteriorated in cases with a high level of capitalisation and low asset quality. However, Vu and Nahm (2013a) suggest the optimised CAR for Vietnamese banks is in the range of 4% to 14%. Meanwhile, Vu and Nahm (2013b) take into account the price factors to measure the allocative efficiency of Vietnamese banks, suggesting that the key

driver of inefficiency of Vietnamese banks is allocative inefficiency rather than technical inefficiency. Vu and Nahm (2013b) also provide no empirical evidence on the significant correlation between profit efficiency and deposit-taking regulations and CAR.

Nguyen *et al.* (2014) make use of the DEA approach to investigate the profit and cost efficiency of commercial banks in Vietnam during the period 1995–2011. Nguyen *et al.* (2014) also examine the impact of environmental variables, namely ownership, bank size and the global financial crisis, on the profit and cost efficiency of Vietnamese banks during this period. The findings of the study suggest that the average efficiency increased over the period, and there was no evidence supporting the impact of the global financial crisis on the efficiency of Vietnamese banks. Furthermore, in terms of ownership the JSCBs are less efficient than the SOCBs.

Matousek *et al.* (2014) make use of the approach developed by Simar and Wilson (2007) to investigate efficiency and its determinants for the case of the Vietnamese banking sector over the period 1999–2009. The empirical findings show that small and medium-sized banks are less efficient than large banks. However, banks with small branch networks and those that have been newly established are more efficient than other banks.

Nguyen and Simioni (2015) investigate the efficiency transformation of Vietnamese commercial banks during the period 2008–2012 and decompose the efficiency of those banks using the Färe-Primont productivity index. With this approach, Nguyen and Simioni (2015) suggest that the restructuring/reconsolidation decisions of the local authority in Vietnam (the SBV) substantially influence the efficiency of those banks. The empirical evidence indicates that to improve banking efficiency the restructuring policy conducted by the SBV must simultaneously focus on improving corporate governance and increasing the size of banks in Vietnam.

The studies of the efficiency of the Vietnamese banking sector – namely Hung (2007), Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a, 2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015) – are very useful but have some shortcomings, as follows.

- (i) The samples for these studies are generally small and do not represent the entire Vietnamese banking sector. For example, the sample for Hung's (2007) case study consists of 13 banks, accounting for 14.8% of the whole population of the banking sector in Vietnam (88 banks and non-bank credit institutes). As a result,

the findings of the studies need further investigation by expanding the sample size.

- (ii) The time period of the studies is short, normally focusing on the last decade of the twentieth century. The time period of Hung's (2007) study is also short, lasting from around 2001 to 2003. Consequently, these studies cannot be representative to show the impacts of financial deregulation and financial liberalisation on the performance and efficiency of the banking sector in Vietnam. Further studies expanding the horizontal timeframe should be conducted to validate these studies. Hence, it is necessary to extend the time period (data sample) for further studies to investigate the impacts of financial liberalisation on the efficiency of Vietnamese banks.
- (iii) Almost all the studies in Vietnam generally and Hung (2007) in particular make use of the non-parametric method (DEA) to investigate the efficiency of the banking sector in Vietnam. Hence, the shortcomings of the DEA method briefly discussed in Chapter 2 of the thesis apply to these studies. As a result, it is necessary to correct the shortcomings by conducting substitute studies based on the parametric methods.
- (iv) The studies are based on the DEA method, but the approach of the studies is not sufficiently clear. As explained in Chapter 2, DEA analysis of efficiency in the banking sector should focus on the *two-stage approach* that fully represents the characteristics of commercial banks. Hung (2007) focuses on the *production stage*, while Vinh (2012), Nguyen and Stewart (2013) and Vu and Nahm (2013a) focus on the *intermediation stage*. Hence, it is necessary to investigate the efficiency of commercial banks in Vietnam from the perspective of both the *production stage* and the *intermediation stage*.
- (v) The methodology developed by the studies is too simple. The input-oriented DEA model applied by Hung (2007) and Vu and Nahm (2013b) focuses on finding the allocative efficiency of banks consisting of three input prices of labour, physical capital and deposits. However, during the study periods (2001–2003 and 2000–2006 respectively) the prices of those inputs are heavily squeezed and intervened by local authorities in Vietnam, especially the SBV. As a result, the discretion of bankers to determine the prices of the inputs is very limited. Consequently, the studies of Hung (2007) and Vu and Nahm (2013b) on

the allocative efficiency of banks are questionable. Until now, due to the inflation pressures in Vietnam, SBV has never fully liberalised the interest rates (both lending and deposit rates) driven by the market. Hence, the shortcomings of the studies conducted by Hung (2007) and Vu and Nahm (2013b) should be addressed by one of the two following alternative solutions.

- (a) Conducting another validity study to find out the impacts of the SBV's intervention in the allocative efficiency of those banks by applying some proxy variable in the DEA model. However, if such a validity study is conducted by this approach then it must use different methods to allow comparison with the existing methods of Hung (2007) and Vu and Nahm (2013b). If the SBV's intervention on the input prices in this case is considered as an exogenous variable, then the validity study must use one of the two following methods briefly discussed in Chapter 2.
 - ✓ *Non-parametric approach*: the validity study should use the *two-stage* methodology to investigate the impacts of the SBV's intervention in terms of the input prices on banking efficiency. The *two-stage* methodology is detailed in Chapter 5. In the first stage, the DEA method is applied; in the second stage the measured efficiency scoring in the first stage is used as a dependent variable in a Tobit regression.
 - ✓ *Parametric approach*: the standard profit efficiency or alternative profit efficiency model described in Sections 2.3.1.2 and 2.3.1.3 of Chapter 2 must be used.
- (b) Banking efficiency in Vietnam should not be approached by analysing allocative efficiency. Instead, the studies of Hung (2007) and Vu and Nahm (2013b), or other studies in this field, should focus on technical efficiency or productive efficiency.
- (vi) Last but not least, Hung (2007) and Vu and Nahm (2013b) focus only on the trend of efficiency and decompose the efficiency of those banks into the natural components, such as technical efficiency change, technical or technological change, pure technical efficiency change, scale efficiency change, and TFP change. However, the intrinsic key value drivers that impact on the efficiency of banks in Vietnam are entirely ignored in the studies of Hung (2007) and Vu and

Nahm (2013b). How endogenous and exogenous variables such as assets, location, equity and ownership influence the efficiency of Vietnamese commercial banks is not investigated.

The thesis focuses on finding alternative and substitute methods/approaches to overcome the shortcomings of these studies, which require further study. As a result, a critical part of the goal and objectives of the thesis, is to help to advance and validate these empirical studies of banking efficiency in Vietnam. Consequently, the thesis aims to provide new substitute and validated evidence for them, as follows.

- (i) The thesis extends the time period (2002–2012) and sample size (average number of banks of 40).
- (ii) The thesis focuses on investigating both allocative efficiency at the branch level and technical efficiency at the bank level.
- (iii) The thesis applies both parametric and non-parametric methods for both the *production stage* and the *intermediation stage* in the banking sector (at branch and bank levels).
- (iv) The thesis decomposes the efficiency of banks into environmental variables (endogenous and exogenous) and investigates how those key value drivers impact on the efficiency of Vietnamese banks during the financial liberalisation period.

3.4.2. Literature review on banking competitiveness in Vietnam

The literature review in this field also shows that there are very few rigorous and systematic studies of the competitiveness of Vietnamese banks at the bank level. One of the studies systematically conducted in this field is the report of MCG Management Consulting (2006). This report is part of studies into the *Competitiveness and the Impact of Trade in Services Liberalisation in Viet Nam*, under the project VIE/02/009 *Capacity Strengthening to Manage and Promote Trade in Services in Viet Nam in the Context of Integration* sponsored by UNDP and co-implemented by the Ministry of Planning and Investment of Vietnam (MPI). The main analytical framework that the project uses for banking in Vietnam is the SWOT method. Furthermore, the project focuses on analysing

and exploring the impacts of financial liberalisation on competitiveness at the *banking sector level*. However, the project fails to investigate competitiveness at the *bank level*.

The MCG report also examines the impacts of financial liberalisation on the competitiveness of the banking sector in Vietnam by conducting a survey of 335 individual customers and 60 corporate customers. This report suggests how perception, client preferences of banking services, and reactions to new choices are affected during the liberalisation process. Hence, it can be seen that the approach of MCG to the competitiveness of the Vietnamese banking sector makes use of the method of the *client's choice approach* developed by Zineldin (1996, 2002 and 2005), as described in Section 2.2.5.2 of Chapter 2 of the thesis.

CHAPTER 4: LITERATURE SYNTHESIS

4.1. Background executive summary

Empirical efficiency studies normally investigate technical or productive efficiency and cost efficiency. In the banking sector, it is more relevant to estimate profit efficiency. In fact, interest naturally focuses on the magnitude and determinants of inefficiency. An individual bank's interest will be its productivity measured in terms of output growth as compared to other banks within the industry or whether its output growth increased or decreased over the years.

By using both the stochastic frontier method and DEA method, the output growth of each bank is decomposed into three components: output growth resulting from growth in inputs, output growth resulting from changes in technical efficiency, and output growth resulting from technological progress. Thus, if it is empirically observed that a bank has increased its productivity from one year to the next, the improvement is not necessarily a result of efficiency improvements alone, but may be a result of technological change or the exploitation of economies of scale (i.e. change in inputs) or a result of a combination of all three factors.

Analysing the productivity of the banking system is of interest from a policy perspective because if banks are becoming more productive then one might expect better performance, lower prices and improved service quality for consumers, as well as greater safety and soundness – provided that productivity improvements are channelled towards strengthening capital buffers that absorb risk. Investigating productivity differences across countries may help to identify the success or failure of policy initiatives or, alternatively, may highlight different strategies undertaken by banks. There is some evidence to support the view that financial deregulation leads to productivity growth (Berg *et al.*, 1992). Yet the main source of productivity growth is uncertain. Berg *et al.* (1992), for instance, find that productivity gains result from improvements in bank efficiency rather than shifts in the best-practice frontier; other evidence indicates that technical change is a more important determinant of productivity growth (Alam, 2001; Mukherjee *et al.*, 2006). The debate about the sources of productivity growth in the banking sector is therefore unresolved. In addition, the picture is further complicated

because there exist two competing methodologies – non-parametric and parametric – to estimate efficiency and its decomposition.

Based on the literature review, discussed in Chapter 2, and the empirical studies on efficiency and competitiveness for banking businesses in Vietnam mentioned in Chapter 3, it is suggested that the consensus conclusion of the literature synthesis is that the efficiency creates a *Granger-causality* leading to competitiveness in the banking sector. As a result, the literature review indicates that the two concepts of efficiency and competitiveness are interchangeable in use. However, the magnitude, size and significance of impacts of the endogenous and exogenous variables on efficiency are questionable and should be tested in further studies. The literature review shows there are few empirical studies that investigate the relationship or linkage between competitiveness and efficiency.

The background in the literature may be helpful to draw out some strengths and weaknesses of the literature in this field, as follows.

- Concept and definition: there are a lot of concepts relating to and definitions of efficiency and competitiveness at different levels, namely at economy/country, industry and firm level. Accordingly, there are also various methods to measure these concepts. However, these concept and variable measurement methods are not clearly criticised for their strengths and weaknesses. Furthermore, until now there has been no study in the literature to identify the best indicator of those variable measurements to present the efficiency and competitiveness in the banking business.
- Benchmark exploration: from the literature review it can be definitively confirmed that the most important critical success factor for such studies in this field is to find out the valid '*benchmark*'. As suggested by the literature, there are two ways to find the benchmark for competitiveness and efficiency analyses at the bank level:
 - (i) To identify a foreign 'benchmarked' bank and, using the foreign benchmark, to investigate the competitiveness and efficiency of domestic banks in relation to the benchmark. Hence, this approach attempts to compare the competitiveness and efficiency of domestic banks with that of a foreign competitor. This approach has certain advantages. All domestic banks are

compared with a foreign bank in terms of competitiveness and efficiency; hence this approach puts the domestic banks in the internationally competitive environment – an opened system. Consequently, the findings of such studies will be very relevant to inform the concluding remarks and policy recommendations for domestic banks to reach international practice standards in order to maintain competitive advantage in international markets. However, this approach also has some disadvantages. The greatest difficulty is identifying a suitable and relevant foreign bank for the benchmark. Because of the differences in characteristics between the domestic and foreign banking sectors as well as the market distortions and barriers implemented by the local authorities, it is hard to find a suitable foreign benchmark.

- (ii) To identify a domestic ‘benchmarked’ bank to compare the competitiveness and efficiency of other domestic banks with this benchmark. This approach investigates the competitiveness and efficiency of all local banks, consisting of SOCBs, JSCBs, JVBs, branches of foreign banks and other non-bank credit institutes. As with the first approach, this approach has certain advantages and disadvantages. The clearest advantage is its practical feasibility. This approach is manageable in terms of finding the domestic benchmarked bank. Identifying the best local bank in terms of efficiency and competitiveness among the population of all onshore banks to act as the domestic or resident benchmarked bank is definitely manageable. However, the approach also has certain disadvantages because of its closed characteristics. This approach bases the research entirely in the onshore banks. Hence, the findings on efficiency and competitiveness extracted from such studies are criticised in an opened banking sector with substantial linkages to the rest of the world. Hence, the considerations about the competitiveness and efficiency of onshore banks must be placed in an internationally integrated context.
- The influences of exogenous variables: the literature review suggests the positive impact of exogenous variables (capital, size, ownership, location, asset quality, loan quality, etc.) on both efficiency and competitiveness at the bank level. However, the background theory and empirical evidence are not sufficiently clear in terms of the impacts of financial liberalisation and financial deregulation policy on the competitiveness and efficiency of commercial banks. In fact, there are two conflicting viewpoints concerning the impact of financial liberalisation. One

viewpoint supports the positive influences of financial liberalisation on competitiveness and efficiency. The opposing viewpoint represents the negative impacts of financial liberalisation on competitiveness and efficiency. Furthermore, the magnitude and speed of those impacts are very different for each individual case study.

- Causality linkage between efficiency and competitiveness: the literature review presents some studies on the linkage between efficiency and competitiveness at the banking sector level. Generally, the literature suggests that the efficiency creates a *Granger-causality* leading to competitiveness. However, the conclusions about the causality linkage between efficiency and competitiveness in the literature review are unclear and mixed. Hence, further studies exploring the field are recommended.
- Scope of the literature: almost all studies in this field focus on the supply side of banks (based on the data of the bank itself), while there are very few demand-oriented studies (based on feedback from the bank's clients). As a result, the conclusions of the studies in this field are supply-oriented. Hence, the literature review suggests that further studies in this field are needed to integrate the supply-oriented and demand-oriented approaches.
- Literature sources: the literature review of the thesis is mainly based on doctorate dissertations in developed countries as well as on international refereed journals. Hence, the thesis does not widely review a wide range of empirical studies in this field. As a result, this is also considered as a shortcoming of the thesis.
- Methodology: in principle there are two methods for studying efficiency and competitiveness in the banking sector – parametric and non-parametric. The concluding remarks based on the two methods do not differ dramatically. However, there are still few studies comparing and combining the two methods in one integrated study. As a result, the literature review suggests further studies should apply and integrate both methods. Although there is no consensus in the literature for the 'best method' between the parametric and non-parametric approaches, Bauer *et al.* (1998) point out that it is not necessary to reach consensus but that it is instead important to find 'consistency' for the approaches to be most useful for regulators and decision makers. Indeed, by using multiple techniques the robustness of the results can be tested (methodologically cross-

checking). In fact, this requirement is not successfully and thoroughly tested and explored in the literature in this field. Based on the discussion, it can be seen that a methodology using both parametric and non-parametric methods could also have certain disadvantages:

- (i) The parametric method tries to set up an efficient frontier curve where the bank reaches so-called technical efficiency. This method is based on a range of banks to figure out such a curve; hence the bank on the curve may not be the real bank from the sample. Meanwhile, the non-parametric method identifies the best bank resulting from actual ranking of those banks; consequently this best bank is the real and actual benchmark. Hence, the benchmarked bank produced from the non-parametric method is a real bank. As a result, the two methods could produce two different benchmarks from the same sample: real and unreal. Consequently, the combination of the two methods in empirical studies will be challenging.
- (ii) Parametric and non-parametric methods differ in their assumptions regarding the shape of the efficient frontier and the existence of random errors. Non-parametric methods do not require any assumptions about the underlying functional form. Meanwhile, the parametric method requires imposing an explicit technology, but it can handle statistical white noise. Furthermore, the non-parametric method requires the degree of risk preference among banks to be identical and constant. At the same time, this method requires homogenous inputs. Meanwhile, the non-parametric method assumes that the labour market is perfect competition. Furthermore, this condition is clearly inapplicable in a frontier market like Vietnam, where the market barriers and heavy interventions of local regulators are normal practice. The parametric method in principle looks at the frontier curve of a bank producing an identical output from various inputs. In other words, the method focuses on analysing *economies of scale* (a bank producing a single output) rather than *economies of scope* (a bank producing various outputs). Meanwhile, the non-parametric method does not care

about the assumption. Hence, the efficiency measured by the non-parametric method could be economies of scope or economies of scale.

- (iii) The parametric method has a weakness in terms of functional form assumption, which creates efficiency measurement bias. Even though the parametric method decomposes deviations from the frontier into an inefficiency term and a random term, it is still disadvantageous that the inefficiency term is assumed to follow a standard statistical distribution such as gamma distribution, truncated normal distribution or half-normal distribution (Richmond, 1974; Kumbhakar, 1987; Kumbhakar *et al.* 1991). Meanwhile, the non-parametric method may give biased results because of data influenced by statistical noise. As a result, the properties of estimated results of this method are unable to be statistically tested. Furthermore, the computed frontier from this method is very sensitive to extreme observations (Bauer, 1990).
- In terms of approach: the literature review accesses the banking sector for two viewpoints based on the two stages of the banking process (the *production* and *intermediation* approaches). Consequently, the literature review could thoroughly analyse the competitiveness and efficiency of banks from the *upstream* to *downstream* business lines. However, the two-stage banking process approach also has some weaknesses. One of the most precise shortcomings of those approaches is unsuccessful and inconsistent to integrate the linkages of competitiveness and efficiency for *downstream* with *upstream* banking business.

4.2. Suggestions for empirical studies in Vietnam

The background of the Vietnamese banking sector in comparison with other emerging markets highlights some similarities and differences between the Vietnamese banking sector and those frontier markets. Hence, rigorous studies about the competitiveness and efficiency at the *bank level* in Vietnam are required in order to allow comparison with case studies conducted in other countries. Furthermore, based on the literature background, it is clear that there are few studies investigating competitiveness and efficiency at the bank level for the Vietnamese banking sector. Hence, the thesis is relevant to validate those studies in Vietnam.

As per the suggestions of the analytical and theoretical frameworks, to implement efficiency and competitiveness studies at the bank level it is necessary for the thesis to set up a 'benchmark' bank. The Vietnamese banking review (Sections 3.2 and 3.3) initially implies that Vietcombank should be used as a domestic benchmark in terms of efficiency and competitiveness for the Vietnamese banking sector.

4.3. Research aim, objectives, questions and hypotheses

4.3.1. Research aim

The overall aim of this research is to measure allocative efficiency at the branch level and technical efficiency at the bank level by finding a local benchmark for the banking sector in Vietnam, then to decompose allocative and technical efficiency at branch and bank level respectively into intrinsic features. After that the thesis focuses on investigating how the explanatory endogenous and exogenous variables that make up the financial liberalisation process affect allocative and technical efficiency at branch and bank level in Vietnam, respectively. The Vietnamese banking system's allocative and technical efficiency at the branch and bank level is approached using both parametric and non-parametric methods over a specified time span of 2002–2012.

Because of the lack of data and the scope of the thesis, it is very difficult, if not impossible, to identify the best suitable foreign bank to become the benchmark for the thesis. In fact, the literature review in Chapter 2 has the same problem as the other empirical studies in this research field. Almost all studies in this field simply nominate a given foreign bank to become the benchmark for comparison with domestic banks without any further explanation for the choice. This is considered as the most critical existing shortcoming in the literature. As a result, the thesis makes use of the second approach suggested by the literature review in this research field. In other words, as per the scope of the thesis set out in Section 1.5, with the naturally modest international integration of the infant banking sector in Vietnam, the thesis focuses entirely on the efficiency of onshore banks operating within the border of Vietnam without any comparison to offshore banks. As the concluding remarks drawn in Section 2.2 suggest that Vietcombank is the premier bank of the onshore banking industry in Vietnam, it is considered as the benchmark for the whole banking system in terms of technical efficiency. The thesis focuses on finding the relevant empirical evidence to test this hypothesis.

4.3.2. Objectives

To accomplish the overall above-mentioned goal of the thesis, the thesis is organised into a set of specific tasks, as outlined below.

- First, it makes use of theoretical frameworks to set up the analytical frameworks to measure allocative efficiency at the branch level and technical efficiency at the bank level. This is called the *basic model*.
- Second, it makes use of the results of the *basic model* to develop and run the so-called *two-stage model* bringing new endogenous and exogenous variables that explain for allocative efficiency at the branch level and technical efficiency at the bank level measured by the *basic model*.
- Third, it compiles a comprehensive data set consisting of outputs, inputs and other variables being the determinants that influence allocative efficiency at the branch level and technical efficiency at the bank level, namely bank size (equity, total assets), ownership, location, asset utilisation, liquidity position, leverage, profitability ratios, capital adequacy, financial liberalisation, etc.
- Fourth, it identifies the domestic benchmark bank for the Vietnamese banking sector by measuring and scoring the technical efficiency of other banks.
- Fifth, it measures allocative efficiency at branch level and technical efficiency at bank level for the banking sector in Vietnam from the collected data (mentioned in the 3rd objective) by using the *basic model* (mentioned in the 1st objective).
- Sixth, it decomposes the measured allocative efficiency at branch level and the measured technical efficiency at bank level from the *basic model* (mentioned in the 3rd objective) into intrinsic factors, separately.
- Seventh, it tests the impacts of the explanatory variables (equity, total assets, ownership, location, asset utilisation, liquidity position, leverage, profitability ratios, capital adequacy and financial liberalisation) on the measured allocative efficiency at branch level and technical efficiency at bank level resulting from the *basic model* by applying the *two-stage model*.
- Eighth, it makes some observations and concluding remarks and suggests policy implications to improve the technical efficiency of Vietnamese banks.

- Last but not least, it makes some recommendations for further studies in this field.

4.3.3. Research questions

The thesis considers the following research questions.

1. How can allocative efficiency at the branch level and technical efficiency at the bank level be measured and decomposed for the Vietnamese banking sector?
2. What statistically significant determinants influence allocative efficiency at the branch level and technical efficiency at the bank level for the Vietnamese banking sector? How can the influences of these determinants be measured and decomposed?

4.3.4. Basic theory

Based on the literature review and the research questions, the central theme of the thesis is as follows:

The allocative and technical efficiency at branch and bank level respectively of the Vietnamese banking sector tend to be improved during the financial liberalisation period (2002–2012). In the period, the measures of allocative and technical efficiency are estimated and decomposed into intrinsic factors using the parametric and non-parametric methods. Accordingly, the measures of allocative efficiency at branch level and technical efficiency at bank level of the Vietnamese banking sector in the period are statistically significant determined by endogenous and exogenous variables, namely equity, total assets, ownership, location, asset utilisation, liquidity position, leverage, profitability ratios, capital adequacy and financial liberalisation.

4.3.5. Hypotheses

With the basic theory and research questions mentioned in Section 4.3.3, the thesis focuses on the following hypotheses.

4.3.5.1. Research hypothesis

- H0 • *The null hypothesis:* The financial liberalisation process in Vietnam significantly forces Vietnamese banks to streamline their operations and ownership to improve their efficiency.

- *The alternative hypothesis:* The financial liberalisation process in Vietnam does not significantly force Vietnamese banks to streamline their operations and ownership to improve their efficiency.

4.3.5.2. Operational hypotheses

The research hypothesis is broken down into operational hypotheses, as follows.

- H1:
- *The null hypothesis:* The Bank for Foreign Trade of Vietnam (Vietcombank) is the domestic benchmarked bank in Vietnam in terms of efficiency.
 - *The alternative hypothesis:* The Bank for Foreign Trade of Vietnam (Vietcombank) is not the domestic benchmarked bank in Vietnam in terms of efficiency.
- H2:
- *The null hypothesis:* The financial liberalisation and deregulation policy positively promotes the efficiency of Vietnamese banks.²¹
 - *The alternative hypothesis:* The financial liberalisation and deregulation policy does not positively promote the efficiency of Vietnamese banks.
- H3:
- *The null hypothesis:* Each individual explanatory variable of equity, total assets, ownership, location, labour, asset utilisation, liquidity position, provision, profitability ratios, capital adequacy and financial liberalisation positively improves the efficiency of Vietnamese commercial banks.
 - *The alternative hypothesis:* Each individual explanatory variable of equity, total assets, ownership, location, labour, asset utilisation, liquidity position, provision, profitability ratios, capital adequacy and financial liberalisation does not positively improve the efficiency of Vietnamese commercial banks.
- H4:
- *The null hypothesis:* In terms of location, the Vietnamese commercial banks with business oriented in the north are more efficient than the southern-oriented commercial banks.²²
 - *The alternative hypothesis:* In terms of location, the Vietnamese commercial

²¹ This hypothesis is also raised and tested by Ataullah *et al.* (2004), Cockerill and Hang (2004), Sturm and Williams (2004), Dong and Featherstone (2006), and Isik *et al.* (2007) for other cases in other countries.

²² This hypothesis is also considered by Resti (1997) for the case of Italian banks.

banks with business oriented in the north are not more efficient than the southern-oriented commercial banks.

- H5:
- *The null hypothesis:* In terms of ownership, the SOCBs are more efficient than the non-state-owned commercial banks and the branches of foreign banks.²³
 - *The alternative hypothesis:* In terms of ownership, the SOCBs are not more efficient than the non-state-owned commercial banks and the branches of foreign banks.

²³ Whether foreign and domestic commercial banks operating in Vietnam have the same efficiency is the same hypothesis questioned and tested by Aly *et al.* (1990) and Elyasiani and Mehdian (1992). They use parametric (ANOVA) and non-parametric (Mann–Whitney, Kruskal–Wallis and Kolmogorov–Smirnov) methods to test the hypothesis. Further debates about this kind of test can be found in Isik *et al.* (2007).

CHAPTER 5: RESEARCH METHODOLOGY

5.1. Research methods

To answer the research questions and hypotheses presented in Chapter 4, the thesis sets up two analytical models that are empirically applied for both the pilot study (Chapter 6) and main study (Chapter 7) of the thesis: (i) the *basic model*, and (ii) the *two-stage model*. In this chapter, each model is introduced in detail and it is explained how each is intended to be applied in order to answer the research questions and hypotheses of the thesis.

5.1.1. *Basic model* measuring technical efficiency

The *basic model* is an analytical framework to measure the efficiency of commercial banks. Detailed descriptions of this analytical framework are given here.

As the background theories suggest, there are two separate streams in technical efficiency studies. The parametric approach, based on econometric methods, focuses on the residuals among actual observations and the theoretical efficient frontier. The non-parametric (DEA) approach is based on a linear programming algorithm. Hence, the *basic model* of the thesis consists of both methods for measuring efficiency at both branch and bank levels. A detailed description of the two methods for estimating and investigating efficiency at the branch and bank levels is given in this chapter. However, because of the data constraints described in Section 1.5, the *basic model* is appropriately applied to measure *allocative efficiency* at the branch level for the pilot study and to estimate *technical efficiency* at the bank level for main study.

5.1.1.1. Measuring technical efficiency based on the parametric method

Because of the data constraints described, for the parametric methods applied in the thesis, the two approaches of cost efficiency and alternative profit efficiency introduced in Section 2.3.1 are taken to investigate the *allocative efficiency* at branch level of VBARD and the *technical efficiency* at bank level of the Vietnamese banking sector. One way to examine the problem of inaccurate price data is to determine the extent to which measured prices help predict profits in the profit function. Humphrey and Pulley (1997) specify a bank profit function with both price and quantities included. A test of the joint hypothesis that all p parameters having zero value was not rejected by the data, whereas

the data did reject the hypothesis that all the γ parameters were zero. These results suggest that measured output prices do not have a theoretically predicted strong positive relationship with profits, and that output quantities do strongly predict profits, partly reflecting the scale bias problem that output quantities are not completely variable over the short term. The *basic model* is applied to measure the allocative efficiency of VBARD's branches over the period 2004–2008 and the technical efficiency of Vietnamese banks over the period 2002–2012. Hereunder two parametric methods for measuring efficiency in the *basic model* of the thesis are described: (i) the cost efficiency frontier and (ii) the production efficiency frontier.

5.1.1.1.1. Production function

The production function of the *basic model* is based on the model developed by Coelli (2002). The model is the same as the method developed by Mester (1996) and Rogers (1998). Note that in Equations 2.8 and 2.12, Berger and Mester (1997b) brings in another variable that is omitted in Equation 5.1. The omitted variable in Equation 5.1 against the initial Equations 2.8 and 2.12 is the z variable that represents market and environmental conditions. The z variable in this situation is considered as an exogenous variable. The model is described as follows.

$$Y_{it} = x_{it}\beta + (V_{it} - U_{it}) \quad (5.1)$$

where:

- Y_{it} is the logarithm of production of the i th bank in the t th time period.
- x_{it} is a $k \times 1$ vector of transformation of the input quantities of the i th bank in the t th time period.

V_{it} is normally distributed with zero mean and independent of $U_{it} = (U_i \exp(-\eta(t-T)))$ where η is a parameter to be estimated. However, U_i in the *basic model* is a non-negative truncated normal distribution $U_i \approx N(\mu, \sigma_u^2)$ according to Battese and Coelli (1988). The variance of the two residual items (σ_u^2 and σ_v^2) is parameterised by the maximum likelihood estimation method of Battese and Corra (1977), as follows.

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \quad \text{and} \quad (5.2)$$

$$\lambda = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2) \quad 0 \leq \lambda \leq 1 \quad (5.3)$$

A translog stochastic production frontier defined for the **basic model** is as follows.

$$y_{it} = \beta_0 + \beta_1 t + \sum_{t=1}^T \sum_{m=1}^M \beta_m \ln x_{mit} + \sum_{t=1}^T \sum_{i=1}^N \beta_n (\ln x_{nit})^2 + v_{it} - u_{it} \quad (5.4)$$

where: t is a time trend presenting the technical change.

β_s is an unknown parameter to be estimated.

To investigate the impacts of exogenous variables (environmental variables) on the measured efficiency in the production frontier, the **basic model** incorporates directly the environmental variables into the non-stochastic component of the production frontier. Hence, the production frontier (5.1) is converted into the form:

$$Y_{it} = x_{it}\beta + z_{it}\gamma + (V_{it} - U_{it}) \quad (5.5)$$

where γ is a vector unknown parameters and z_{it} is transformational vector of environmental variables. Consequently, if the environmental variables z_{it} are brought into the production frontier (5.5), then Equation 5.4 must be transformed into the form:

$$\begin{aligned} y_{it} = & \beta_0 + \beta_1 t_i + \sum_{t=1}^T \sum_{n=2}^{N-1} \gamma_n z_{nit} + \sum_{t=1}^T \sum_{m=1}^M \beta_m \ln x_{mit} + \sum_{t=1}^T \sum_{n=1}^{N-1} \sum_{m=1}^{M-2} \gamma_{nm} z_{nmit} \\ & + \sum_{t=1}^T \sum_{n=2}^N \gamma_{qn} z_{qnit} + \sum_{t=1}^T \sum_{i=1}^N \beta_n (\ln x_{nit})^2 + v_{it} - u_{it} \end{aligned} \quad (5.6)$$

Based on the production frontier, the technical efficiency of the i th bank is $TE_i = \exp(-u_i)$ which can be calculated as follows:

$$TE_{it} = \frac{y_{it}}{\exp(x_{it}\beta_i + v_{it})} = \frac{\exp(x_{it}\beta_i + v_{it} - u_{it})}{\exp(x_{it}\beta_i + v_{it})} = \exp(-u_{it})$$

or :

$$TE_{it} = E\{\exp(-u_{it})|y_i\} = \left[\phi\left(\frac{u_{it}^*}{\sigma_*} - \sigma_*\right) / \phi\left(\frac{u_{it}^*}{\sigma_*}\right) \right] \exp\left\{\frac{\sigma_*^2}{2} - u_{it}^*\right\}$$

Based on the Equation 5.1, if there are some restrictions then it could produce some special cases as follows:

- If an assumption of $\eta = 0$ is applied, then there is time-invariant inefficiency method developed by Battese, Coelli and Colby (1989); if an assumption of $\eta \neq 0$ is applied, then there is time-varying inefficiency method.
- If an assumption of $\mu = 0$ is applied, then we have the model with half-normal inefficiency effects at time period T developed by Pitt and Lee (1981).
- If the null hypothesis of $H_0 : \lambda = 0$ is accepted, meaning $\sigma_u^2 = 0$, then the term U_{it} should be removed from Equation 5.1. In other words, the null hypothesis predicts that the stochastic frontier production function must be required for the data sample and could be estimated by Ordinary Least Square (OLS) method. More information about this discussion can be found in Lee and Schmidt (1993) and Coelli (1993, 1994).

5.1.1.1.2. Cost function

The cost function in the *basic model* based on the model developed by Schmidt and Lovell (1979) and Battese and Coelli (1992, 1995) (for the log-likelihood functions) is as follows.

$$Y_{it} = x_{it}\beta + (V_{it} + U_{it}) \quad (5.8)$$

where:

- Y_{it} is the logarithm transformation of cost of production of the it h bank in the t th time period.
- x_{it} is a $k \times 1$ vector of transformation of the input prices and outputs of the it h bank in the t th time period.

As in Equation 5.1, the terms in Equation 5.8 of V_{it} are normally distributed with zero mean ($V_{it} \approx N(0, \sigma_v^2)$) and independent U_{it} . Meanwhile, U_{it} is non-negative random distribution ($U_{it} \approx |N(0, \sigma_u^2)|$). U_{it} is defined as cost of inefficiency in production; hence it reflects how far the firm operates above the cost frontier. Furthermore, the variances of the two residual items (σ_u^2 and σ_v^2) in cost function are also parameterised by the maximum likelihood estimation method as described in Equations 5.2 and 5.3. As a

result, other assumptions and hypotheses applied for the production function in Equation 5.1 are still valid for the cost function in Equation 5.8.

Assuming the firm produces M outputs $(q_{1i}, q_{2i}, \dots, q_{Mi})$ by using N inputs with their equivalent prices $(w_{1i}, w_{2i}, \dots, w_{Ni})$, if there is an imposing constraint of linear homogeneity in prices and the cost function in stochastic form, then Equation 5.8 has the following stochastic frontier:

$$y_{it} = \beta_0 + \beta_1 t + \sum_{t=1}^T \sum_{m=1}^M \beta_m \ln x_{mit} + \sum_{t=1}^T \sum_{i=1}^N \beta_n (\ln x_{nit})^2 + v_{it} + u_{it} \quad (5.9)$$

Similarly, with the production frontier in Equation 5.5, should the translog cost frontier 5.8 take into account the vector of environmental variables z_{it} , then Equation 5.8 should be transformed to the following form:

$$Y_{it} = x_{it}\beta + z_{it}\gamma + (V_{it} + U_{it}) \quad (5.10)$$

Consequently, based on Mester (1996) and Rogers (1998), Equation 5.9 is converted into the following form:

$$\begin{aligned} y_{it} = & \beta_0 + \beta_1 t_i + \sum_{t=1}^T \sum_{n=2}^{N-1} \gamma_n z_{nit} + \sum_{t=1}^T \sum_{m=1}^M \beta_m \ln x_{mit} + \sum_{t=1}^T \sum_{n=1}^{N-1} \sum_{m=1}^{M-2} \gamma_{nm} z_{nmit} \\ & + \sum_{t=1}^T \sum_{n=2}^N \gamma_{qn} z_{qnit} + \sum_{t=1}^T \sum_{i=1}^N \beta_n (\ln x_{nit})^2 + v_{it} + u_{it} \end{aligned} \quad (5.11)$$

where:

$$\begin{aligned} y_{it} &= \ln c_{it} - \ln w_{lit} \\ z_{nit} &= \ln w_{nit} - \ln w_{lit} \\ z_{nmit} &= \ln w_{nit} \ln w_{mit} - 0.5(\ln w_{mit})^2 - 0.5(\ln w_{nit})^2 \\ z_{qnit} &= \ln q_{it} (\ln w_{nit} - \ln w_{lit}) \end{aligned}$$

The translog cost frontier form can be detailed as follows.

$$\begin{aligned} \ln y_{it} = & \alpha + \sum_{j=1}^4 \beta_j \ln q_j + \sum_{l=1}^2 \varphi_l n_l + \frac{1}{2} \sum_{j=1}^4 \sum_{i=1}^4 \beta_{ji} \ln q_j \ln q_i \\ & + \frac{1}{2} \sum_{l=1}^2 \sum_{p=1}^2 \varphi_{lp} \ln n_l \ln n_p + \sum_{j=1}^4 \sum_{l=1}^2 \mu_{jl} \ln q_j \ln n_l + \ln u_z + \ln v_z \end{aligned} \quad (5.12)$$

where:

- y represents cost or profit depending on which frontier is estimated. Hence y could be a proxy for total cost (C) or profit ($\pi + \theta$).²⁴
- n_l is the quantity of fixed inputs l that consists of two variables: (i) total equity (**Equity**) and (ii) book values of fixed assets (**Fixassets**).
- m_k is the price vector of input k consisting of three variables: (i) ratio between the interest expenses and total deposits that is proxy for the price of time and savings deposits (**priceDEP**), (ii) ratio of wage payments divided by total assets proxy for price of labour (**priceLAB**), and (iii) depreciation expenses divided by fixed assets proxy for price of physical capital (**priceCAP**).
- q_j is the amount of output j that consists of four variables: (i) demand deposits (**Ddep**), (ii) time and savings deposits (**Sdep**), (iii) total outstanding credit including both long- and short-term outstanding credits (**Credit**), and (iv) net non-interest income consisting of non-interest income and fee income from off-balance business (**Feeincome**).

Based on the cost frontier, the cost efficiency of the i th bank is $CE_i = \exp(-u_i)$ which can be estimated and measured in the same way as the technical efficiency as mentioned in Equation 5.7 of the production frontier.

5.1.1.2. Measuring technical efficiency based on the non-parametric method

As the background shows up, the DEA method compares the inputs and outputs of banks without accounting the different economic value of each of them. To measure the technical efficiency of Vietnamese banks, the thesis makes use of the DEA method developed by Charnes *et al.* (1978) and applied by Denizer *et al.* (2000), Sathye (2002), Rezvanian and Mehdian (2011), Isik and Hassan (2002), Havrylchyk (2006), and Tulkens and Eeckaut (2006). According to Grigorian and Manole (2002), this method is suitable and highly recommended for transition economies like Vietnam.

²⁴ For some banks, π is negative. Hence under the translog functional form, the value of π should be adjusted to avoid the negative value. According to Berger and Bonaccorsi di Patti (2006: 1099), the θ term in the dependent variable of the alternative profit model of Equation 2.15 is taken by $|\pi^{\min}| + 1$ where $|\pi^{\min}|$ is the minimum absolute profit of the entire banks in a given year. As a result, the dependent variable of the minimum-profit bank in year t has the value $\ln(1) = 0$.

The DEA with the $[y_1 \dots y_m]$ and $[x_1 \dots x_n]$ presenting the output and input vectors for k banks compares the performance of each commercial bank with the benchmarked bank, which is defined as a convex combination of other banks. The DEA model measures the technical efficiency of a bank that produces an output vector y_j from an input vector x_j by solving the following linear programming problem:

$$\begin{aligned} & \text{Max}_{u,v} (u' y_j / v' x_j) \\ & \beta_{ji} = \beta_{ij} \text{ Subject to } u' y_j / v' x_j \leq 1, j = 1, \dots, k \text{ and } u, v \geq 0 \end{aligned} \quad (5.13)$$

As the background of the thesis makes clear, there are two stages in banking business that should be considered in banking efficiency analysis: (i) the production stage and (ii) the intermediation stage. Each stage has a specific range of input and output vectors. The thesis implements the technical efficiency measurement for Vietnamese banks in both stages. As a result, the inputs and outputs for the DEA model applied in the thesis depend on the given stage and are described as follows:

- If the DEA is applied in the *production stage*, then the measured technical efficiency is called **ProdEFF** and the following variables will be used.
 - ✓ Inputs: (i) total equity (**Equity**), (ii) total personnel expenses (**LAB**), and (iii) total interest expenses (**Intexp**).
 - ✓ Outputs: (i) total outstanding credit including both long- and short-term outstanding credits (**Credit**), and (ii) total non-interest income (**Feeincome**).
- If the DEA is applied in the *intermediation stage*, then the measured technical efficiency is called **InterEFF** and the following variables will be used.
 - ✓ Inputs: (i) financial capital proxy by deposits collected (**Ddep** and **Sdep**) and (ii) inter-bank funds (**Fedfund**).
 - ✓ Outputs: (i) total outstanding credit including both long- and short-term outstanding credits (**Credit**), and (ii) total interest income (**Interest**).

If the price data is available, then the DEA model measuring *technical efficiency* can be modified and turned into the allocative DEA (ADEA) model that enables the measurement of *allocative efficiency*. Using the available price data for the branches of VBARD, the ADEA model is applied for the pilot study in Chapter 6 to measure

allocative efficiency of the branches of VBARD. In such a case, instead of the linear programming (5.13) the thesis conducts an allocative DEA program (ADEA) that aims to minimise the cost to measure the cost efficiency for the i th bank of $CE = w_i'x_i^*/w_i'x_i$, as follows:

$$\begin{aligned} \min_{\lambda, x_i^*} & w_i'x_i^*, \\ \text{st} & -q_i + Q\lambda \geq 0, \\ & x_i^* - X\lambda \geq 0, \\ & I'\lambda = 1 \\ & \lambda \geq 0, \end{aligned}$$

w_i is a $N \times 1$ vector of input prices for the i th bank and x_i^* is the vector of input quantities for the i th bank that minimises the cost, while w_i is input prices and q_i is output levels

At both the production stage and the intermediation stage, technical efficiency is decomposed by the Malmquist change index, as shown in the following equation:

$$\begin{aligned} MalmIndex &= TC \times TEC \\ TEC &= TE \times SE \end{aligned} \tag{5.14}$$

where the components of the Malmquist index (*MalmIndex*) can be explained as follows: *TC* is technological change, *TEC* is technical efficiency change, *SE* is scale change and *TE* is pure efficiency change. The Malmquist index and its components mentioned in Equation 5.14 represents the impacts of the financial liberalisation process on the technical efficiency of banks during the study period.

Both parametric and non-parametric methods described in the thesis are empirically applied for the same database. Table 5.1 gives a summary of variables used in the main study to measure efficiency.

Table 5.1: Variables used to measure efficiency

| Variables | Named | Methods for measuring efficiency | | | |
|----------------------------------|--------------------|---------------------------------------|--------------------------------------|--|---|
| | | Parametric | | Non-parametric | |
| | | Cost efficiency (<i>CostEFF</i>) | Profit efficiency (<i>πEFF</i>) | Production stage (<i>ProdEFF</i>) | Intermediation stage (<i>InterEFF</i>) |
| Total cost | <i>C</i> | ☑ | NA | NA | NA |
| Total profit | ($\pi + \theta$) | NA | ☑ | NA | NA |
| <i>Output Quantities:</i> | | | | | |
| Demand deposits | <i>Ddep</i> | ☑ | ☑ | NA | ☑ |
| Saving deposits | <i>Sdep</i> | ☑ | ☑ | NA | ☑ |
| Outstanding credits | <i>Credit</i> | ☑ | ☑ | ☑ | ☑ |
| Non-interest income | <i>Feeincome</i> | ☑ | ☑ | ☑ | NA |
| Interest income | <i>Interest</i> | NA | NA | NA | ☑ |
| <i>Input Quantities:</i> | | | | | |
| Demand deposits | <i>Ddep</i> | NA | NA | NA | ☑ |
| Saving deposits | <i>Sdep</i> | NA | NA | NA | ☑ |
| Inter-bank funds | <i>Fedfund</i> | NA | NA | NA | ☑ |

| | | | | | |
|---|------------------|----|----|----|----|
| Total equity | <i>Equity</i> | ☑ | ☑ | ☑ | NA |
| Labour expenses | <i>LAB</i> | | | ☑ | NA |
| Physical capital | <i>Fixassets</i> | ☑ | ☑ | NA | NA |
| Interest expenses | <i>Intexp</i> | NA | NA | ☑ | NA |
| <p><u>Note:</u> In this table, the symbols are explained as follows:</p> <p>✓ ☑: this variable is applied for measuring the relevant efficiency in the column</p> <p>✓ NA: this variable is not applied for measuring the relevant efficiency in the column</p> | | | | | |

5.1.2. Decomposing the impacts of environmental variables on the efficiency estimated by the *basic model* based on the *two-stage model*

5.1.2.1. Methodology to take into account the impacts of environmental variables

To investigate the impacts of environmental variables on measured efficiency from the *basic model*, there are some approaches in the non-parametric methodology as summarised in Chapter 2. The environmental variables are incorporated into the DEA analysis as follows:

- In the first method, the efficiency of the i th bank is compared with those banks in the sample having a value of the environmental variable that is less than or equal to that of the i th bank. This approach ensures no bank is compared with another bank that has a more comfortable environment.
- The second method developed by Charnes *et al.* (1981) focuses on two main stages: (i) divide the whole sample into sub-samples according to the environmental variables, and then (ii) solve each single DEA with the equivalent sub-sample to assess the difference of the mean efficiency of the sub-samples.
- The third method is to incorporate environmental variables directly into the DEA formulation. This method requires that the environmental variables are non-discretionary input or output variables.
- The fourth method, the so-called *two-stage model*, is described in detail in Section 5.1.2.2. The *first stage* of the method focuses on solving a DEA model; in the *second stage* the efficiency scores measured in the *first stage* are regressed on the environmental variables.

For the parametric method, generally there are also two methods for investigating the impacts of environmental variables on the estimated efficiency from the *basic model*.

- The first method measures the impacts of exogenous variables (environmental variables) by directly taking the environmental variables into the production

frontier and cost frontier, as mentioned in Section 5.1.1.1 at Equations 5.5, 5.6, 5.10 and 5.11. With this analytical framework, production efficiency and cost efficiency are directly decomposed into environmental variables.

- The second method is also called the *two-stage model* and follows the same approach as the *two-stage model* of the non-parametric approach. This method runs the regression for the production frontier and cost frontier in the first stage in order to estimate the efficiency scores. Then the estimated efficiency scores in the *first stage* are regressed upon the environmental variables in the *second stage*.

5.1.2.2. The *two-stage model* of the thesis

The thesis makes use of the technical efficiency scores (*CostEFF*, π *EFF*, *ProdEFF*, *InterEFF*) measured from both the parametric methods and the non-parametric methods in order to conduct regressions in the *two-stage model*. The thesis considers the effects of endogenous and exogenous variables as mentioned in Table 5.2 on technical efficiency scores. As a result, following other studies in this field, namely Miller and Noulas (1996), Berger and DeYoung (1997), Resti (1997), Mukherjee *et al.* (2001), Casu *et al.* (2004), Sturm and Williams (2004), Havrylchuk (2006), Hoff (2007), Kneip *et al.* (2008), McDonald (2009), Pasiouras and Sifodaskalakis (2011), Simar and Wilson (2011), Maghyereh and Awartani (2012), Chan *et al.* (2014), Hanen *et al.* (2014), and Tandon *et al.* (2014), and based on Equations 2.11 and 2.21, the thesis sets up the following *two-stage model*:

$$EFF_i = \alpha + \beta_1 size_i + \beta_2 quality_i + \beta_3 ownership_i + \beta_4 leverage_i + \beta_5 profit_i + \beta_6 CAR_i + \beta_7 risk_i + \beta_8 location_i + \varepsilon_i \quad (5.15)$$

In Equation 5.15, EFF_i are the efficiency scores. These efficiency scores are measured and calculated based on the first stage in the *basic model*. The explanatory variables in Equation 5.15 are described in Table 5.2.

Table 5.2: The meaning of explanatory variables

| No. | Endogenous Variables | | No. | Exogenous Variables | |
|-----|----------------------|----------------------|-----|---------------------|----------------------|
| | <i>Meaning</i> | <i>Variable name</i> | | <i>Meaning</i> | <i>Variable name</i> |
| 1 | Bank size | <i>Size</i> | 1 | Capital adequacy | <i>CAR</i> |
| 2 | Asset quality | <i>Quality</i> | 2 | Location | <i>Location</i> |
| 3 | Leverage | <i>Leverage</i> | | | |
| 4 | Ownership | <i>Ownership</i> | | | |
| 5 | Profitability ratios | <i>Profit</i> | | | |
| 6 | Loan to asset ratio | <i>Risk</i> | | | |

For Equation 5.15, there are some regression techniques used to decompose factorial effects, namely ordinary least square regression (OLS) and Tobit regression. However, the OLS method has its disadvantages in measuring efficiency. Since efficiency scores are bounded in a range from 0 to 1, a standard assumption (BLUE) of OLS is violated.²⁵ Hence, the Tobit regression must be used to decompose factorial effects on those efficiency scores. Furthermore, because the technical efficiency scores are upper-bounded by 1, the Tobit regression must be applied to investigate factors correlating to the efficiency scores. Naturally, Tobit regression allows users to run the test in case of censored dependent variable.

In the model, α and β are parameters, and ε are error terms. The dependent variables (the estimated efficiency scores) of Equation 5.15 (EFF_i) are censored variables with the upper-bounded values of 1 and in the interval of $[0, 1]$. As a result, the Tobit model must be used to investigate the influences of the explanatory variables on those dependent variables (efficiency scores) with the maximum likelihood method. To estimate the parameters of the linear regression model, the maximum likelihood method makes some common assumptions regarding the distributions of the error terms. The errors in the model run by the maximum likelihood method are normally distributed. Under such assumptions, the errors (residuals) are independently distributed normal random variables with zero mean and variance σ^2 .

Consequently, the Tobit regression executed by the maximum likelihood method with the assumption on the normal distribution of the errors is as follows:

$$\begin{aligned} E[\varepsilon_i] &= 0 \\ \text{Var}[\varepsilon_i] &= \sigma_\varepsilon^2, \quad \text{Cov}[\varepsilon_{it}, \varepsilon_{js}] = 0 \quad \forall i, j, t, s \end{aligned} \quad (5.16)$$

Based on the the likelihood function of Equations 5.15 and 5.16, the joint probability density function is formed. Based on the likelihood function, it can express the observing likelihood of the sample as a function of the unknown parameters β and σ^2 . The maximum likelihood method allows estimating the parameter β by maximising the following function:

$$L\langle EFF | \beta, \sigma \rangle = (2\pi\sigma^2)^{-1/2} \exp\left\{-\frac{1}{2\sigma^2} \sum_{i=1}^I (EFF_i - x_i\beta)^2\right\} \quad (5.17)$$

²⁵ BLUE stands for best linear unbiased estimator. Given the Gauss-Markov assumptions, BLUE requests that out of all possible linear unbiased estimators, OLS gives the most precise estimates.

It is critical to evaluate if *ownership* (state-owned and non-state-owned) and *location* (north and non-north) have any impact on the scores of commercial banks to test hypotheses H4 and H5 from Section 4.3.5. Therefore, two dummy variables (*Ownership* and *Location*) are included in the Tobit regression reflecting these factors. *Ownership* is included in the Tobit model because hypothesis H5 of Section 4.3.5 states that SOCBs are more efficient than banks of other ownership types. The dummy variable for *Location* is also considered in the regression to explain hypothesis H4 of Section 4.3.5 in the sense that banks of various regions have different characteristics, market segment, business focus and management mechanism, which might impact on their efficiency levels.

The variable *Size*, which is often used as a proxy for bank size (total assets), may correlate with the efficiency scores of commercial banks. It is of great interest to investigate if banks that are larger in terms of *Size* are more technically efficient. Therefore, *Size* is included in the Tobit regression to decompose factorial effects. Since absolute values of banks' total assets are too large compared with other variables, and because they vary sharply from one bank to another, in order to identify the effect on efficiency scores, in this thesis *Size* scores of the banks are computed and used as a proxy. The *Size* scores are computed using the following method: maximum total assets of all banks/branches in the sample for each individual year are filtered out. Then the total assets of each individual bank for that year are divided by this benchmark maximum level. In this way, for each single year of the study period, the bank that has the highest total assets will have the highest *Size* score with a value of 1. The smaller the total assets, the lower the *Size* score assigned to a bank. As a result, the *Size* score will be bounded in (0, 1].

The variable *Leverage* is the ratio of total debt to total equity for each individual bank in each single year. This ratio represents how much external finance a bank should use for its business. If the ratio is found to be positively related to efficiency, Vietnamese commercial banks should boost their equity issuance. If there is a negative relationship, then commercial banks should seek more external debt financing to increase their efficiency. The *Leverage* scores are measured and calculated using the same method as the *Size* score.

The variable *Quality* should be considered as a proxy for the NPL ratio that represents the loan portfolio quality of the bank particularly and the asset quality of the bank generally. This ratio represents quality in terms of running the bank and also suggests the financial provision expenses that the bank should focus on. Hence, the *Quality* scores in principle

have a positive correlation with the efficiency scores. The *Quality* scores are measured and calculated using the same method as the *Size* score.

The variable *Profit* is measured by the ROE, ROA and NIM ratios that represent the profitability of banks. As the literature review in Chapter 2 suggests, the profitability of the bank has a significantly positive relationship with the efficiency of the bank. The *Profit* scores are measured and calculated using the same method as the *Size* score.

The variable *Risk* should be considered as a proxy for the total outstanding loan to total assets ratio. This ratio presents the capacity of the bank to lend and the liquidity capability of the bank. The higher the ratio the lower the liquidity capability management of the bank. As a result, as the literature review in Chapter 2 suggests, *Risk* is negatively correlated with the efficiency of banks. The *Risk* scores are measured and calculated using the same method as the *Size* score.

It is interesting to evaluate if change in equity could improve efficiency levels of Vietnamese banks. As reported in Chapter 3, the Vietnamese government has strictly set out new requirements on minimum registered capital for commercial banks. It is valuable to test if this regulation of minimum registered capital might help to enhance banks' efficiency. Since the absolute values of capital of different banks fluctuate sharply, they cannot be used for the Tobit regression. Instead, CAR ratio scores of the banks will be used in the Tobit regression. The CAR ratio score in the thesis is computed as follows. In each year, the highest CAR ratio is selected. The CAR ratio of other banks in that year is divided by this maximum one to produce capital ratio. That way, the bank having the highest CAR ratio will be labelled with the highest CAR ratio score valued at 1. The smaller the CAR ratio of a bank, the lower the CAR ratio score is. CAR ratio scores range from (0, 1]. This CAR ratio score is named as *CAR* in the Tobit regression.

5.1.3. Testing the impacts of financial liberalisation on efficiency based on the Malmquist index

In an attempt to predict the impacts of financial liberalisation on the technical efficiency of banks, the thesis decomposes the changes of the Malmquist index over time in order to find the impacts of the financial liberalisation process on technical efficiency of Vietnamese banks. Based on Equation 5.14, the Malmquist index is decomposed over the financial liberalisation period as follows.

Overall Technical Efficiency (CRSTE)

The following linear programming system is set to get the overall technical efficiency score.

$$\begin{aligned}
 & \text{Min}(\theta) \\
 & \text{Subject to :} \\
 & -(y_i/\theta) + Y\beta \geq 0 \\
 & x_i - X\beta \geq 0 \\
 & \beta \geq 0
 \end{aligned} \tag{5.18}$$

θ is the overall technical efficiency score for each bank that has upper-bounded value at 1. Y is $(m \times k)$ output matrix. X is $(n \times k)$ input matrix. β is a $(k \times 1)$ vector representing a set of banks lying on the production frontier that a studied bank is compared with.

Then, in Equation 5.14, the measured efficiency is further decomposed into pure technical efficiency and scale efficiency as follows.

Pure Technical Efficiency (VRSTE)

To compute pure technical efficiency, the above program is modified by adding an assumption that the sum of β coefficients is 1. Pure technical efficiency for i th bank denoted as $\lambda(x_i, y_i)$ is found from the following linear programming system:

$$\begin{aligned}
 & \text{Min}(\lambda) \\
 & \text{Subject to :} \\
 & -(y_i/\lambda) + Y\beta \geq 0 \\
 & x_i - X\beta \geq 0 \\
 & \beta_1 + \beta_2 + \dots + \beta_k = 1 \\
 & \beta \geq 0
 \end{aligned} \tag{5.19}$$

Scale Efficiency (SCALE)

Scale efficiency δ of the bank can be drawn out by dividing the overall technical efficiency score by the pure technical efficiency score. The formula is as follows.

$$\delta(x_i, y_i) = \theta(x_i, y_i) / \lambda(x_i, y_i) \tag{5.20}$$

If $\delta(x_i, y_i)$ is equal to 1, a bank is operating at constant return to scale. If this is not the case, the bank is operating at increasing or decreasing return to scale. To establish if the bank is operating at increasing or decreasing return to scale, overall technical and pure

technical scores must be considered. If $\delta(x_i, y_i)$ is not equal to 1 and $\theta(x_i, y_i)$ is not equal to $\lambda(x_i, y_i)$, the bank is operating at decreasing return to scale. If $\delta(x_i, y_i)$ is not equal to 1 and $\theta(x_i, y_i)$ is equal to $\lambda(x_i, y_i)$, the bank is operating at increasing return to scale.

By transforming Equation 5.20, overall technical efficiency can be seen as a product of pure technical efficiency and scale efficiency. The relationship is presented in Equation 5.21.

$$\theta(x_i, y_i) = \delta(x_i, y_i) \times \lambda(x_i, y_i) \quad (5.21)$$

In other words, overall technical inefficiency can be attributed to two causes: scale inefficiency and pure technical inefficiency. Therefore, solutions to improve overall technical efficiency can stem from two sets of efforts to enhance scale efficiency and pure technical efficiency.

Productivity Change and Decomposition of Productivity Change

With the available panel data, the Malmquist productivity index, which is the product of ‘catch-up’ and ‘frontier-shift’ terms, can be calculated within the DEA framework. The index presents two elements, namely technical efficiency and technological change of studied banks. The catch-up (or recovery) index identifies if a bank’s efficiency has improved or deteriorated from one period to another. The frontier-shift (or innovation/shock) term represents any change in a bank’s efficient frontiers over time.

TFP change between two data points is measured by calculating the ratio of the distances of each data point compared with a common technology. With a period s as the base period, the reference period is t . The efficiency change index is the ratio between technical efficiencies in the period t and the period s (in the CRS distance functions) respectively.

$$\text{Efficiency change} = \frac{d_0^t(y_t, x_t)}{d_0^s(y_s, x_s)} \quad (5.22)$$

The technological change is a geometric mean of the technology shift from one period to another:

$$\text{Technological change} = \left[\frac{d_0^s(y_t, x_t)}{d_0^t(y_t, x_t)} \times \frac{d_0^s(y_s, x_s)}{d_0^t(y_s, x_s)} \right]^{1/2} \quad (5.23)$$

The output-oriented Malmquist TFP change index between the period s and the reference period t , which is the product between efficiency change and technological change, is given by:

$$m_0(y_s, x_s, y_t, x_t) = \frac{d_0^t(y_t, x_t)}{d_0^s(y_s, x_s)} \times \left[\frac{d_0^s(y_t, x_t)}{d_0^t(y_t, x_t)} \times \frac{d_0^s(y_s, x_s)}{d_0^t(y_s, x_s)} \right]^{1/2} \quad (5.24)$$

This model further decomposes efficiency change into pure efficiency change and scale efficiency change (measured by adapting the true VRS distance function). The notations c and v represent constant returns to scale and variable returns to scale, respectively.

$$\text{Pure efficiency change} = \frac{d_{0v}^t(y_t, x_t)}{d_{0v}^s(y_s, x_s)} \quad (5.25)$$

Scale efficiency change is the geometric mean of two scale efficiency change measures:

$$\text{Scale efficiency change} = \left[\frac{d_{ov}^t(y_t, x_t)/d_{oc}^t(y_t, x_t)}{d_{ov}^s(y_s, x_s)/d_{oc}^s(y_s, x_s)} \right] \times \left[\frac{d_{ov}^s(y_t, x_t)/d_{oc}^s(y_t, x_t)}{d_{ov}^s(y_s, x_s)/d_{oc}^s(y_s, x_s)} \right]^{1/2} \quad (5.26)$$

A Malmquist index that is greater than 1 affirms TFP progress, while an index less than 1 implies worsening TFP.

5.2. Concluding remarks

Because the data for input and output prices of Vietnamese banks are not available, it is impossible to estimate *allocative efficiency* at the bank level for the main study in Chapter 7. Consequently, only *technical efficiency* at the bank level can be estimated in Chapter 7 based on the analytical framework developed in Chapter 5 and tested in Chapter 6 by a pilot study. Because the input prices data at the branch level of VBARD is available for the pilot study, *allocative efficiency* at the branch level is measured in Chapter 6 by applying the same analytical framework described in Chapter 5.

For the pilot study of Chapter 6, the thesis applies the parametric method developed in Chapter 5 to *directly* investigate the impacts of environmental variables on the estimated *allocative efficiency* scores of VBARD's branches. However, the main study in Chapter 7 does not make use of the parametric method to *directly* examine the impacts of environmental variables on the *technical efficiency* of the Vietnamese banking system at the bank level. Instead, in Chapter 7 the thesis makes use of the *two-stage model* to

indirectly investigate those impacts on the measured *technical efficiency* scores of Vietnamese banks.

Because of the differentiated data between the pilot study (at the *branch level*) and main study (at the *bank level*), as mentioned above, the fundamental methodology and analytical framework developed in Chapter 5 needs to be slightly modified according to the typical data available in Chapter 6 and Chapter 7 of the thesis. The modification and update of the research methodology is described in detail when the data of the pilot study and main study is in place for empirical analysis in the next chapters.

CHAPTER 6: PILOT STUDY

6.1. Competitive positioning of VBARD in the Vietnamese banking sector

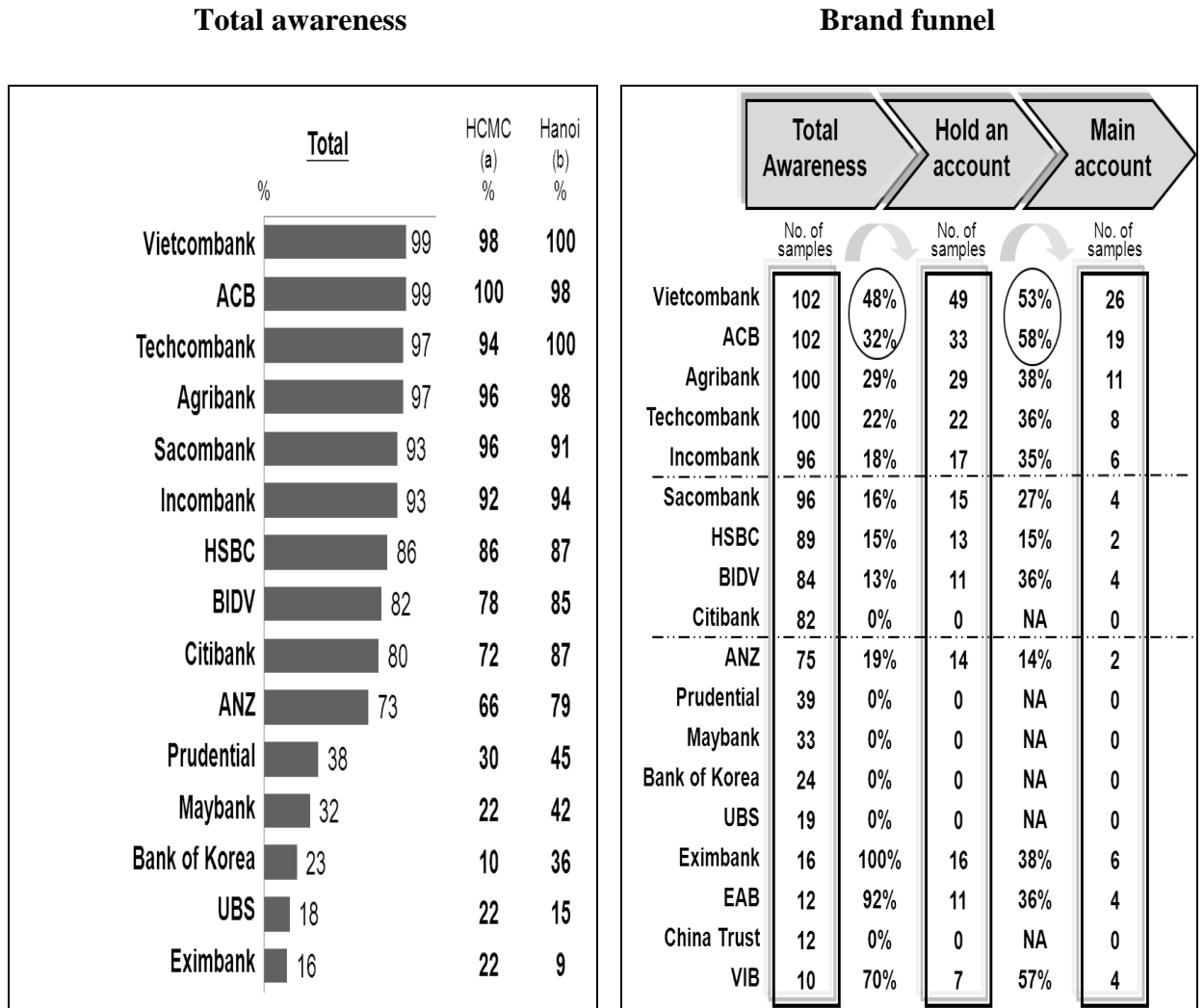
VBARD is the largest bank in Vietnam in terms of total assets and accounts the largest market share for both deposit and lending area. However, the bank's profitability is unequal relative to its asset size. In Vietnam, the incumbent SOCBs have relatively high provisioning expense levels, reflecting a legacy of loans to SOEs, whereas the newer JSCBs have lower provisioning expenses. Among SOCBs, VBARD is the clear standout follower in terms of profitability. Even though it is the largest bank in terms of total assets in the Vietnamese banking system, the profitability of VBARD is even lower than that of its peers in the private sector, namely ACB and Sacombank.

Historically, as with the other SOCBs, VBARD has been weakly capitalised and has suffered from problem loans directed to SOEs. In parallel, the Vietnamese government has implemented a recapitalisation scheme since the beginning 2001. The Vietnamese government infused VND10.4 trillion (\$648 million) into the five SOCBs. Most of the new capital injected has been in the form of 20-year government bonds with an annual coupon of about 3.3%. In April 2007, the government further recapitalised Incombank, infusing VND3.5 trillion (\$218 million) to put it on a more equal footing with Vietcombank and BIDV. Despite these government subsidies, the performance and efficiency of VBARD are still worse off among the SOCBs: lower CAR ratio, higher cost-income ratio and higher outstanding credit-total assets ratio.

6.2. Competitiveness of VBARD: Awareness of clients

The analysis uses some conclusions from a survey conducted by Cimigo, a market survey company, and requested by Vietcombank and UBS to prepare for a new product launch in Vietnam.

Figure 6.1: The market awareness of VBARD

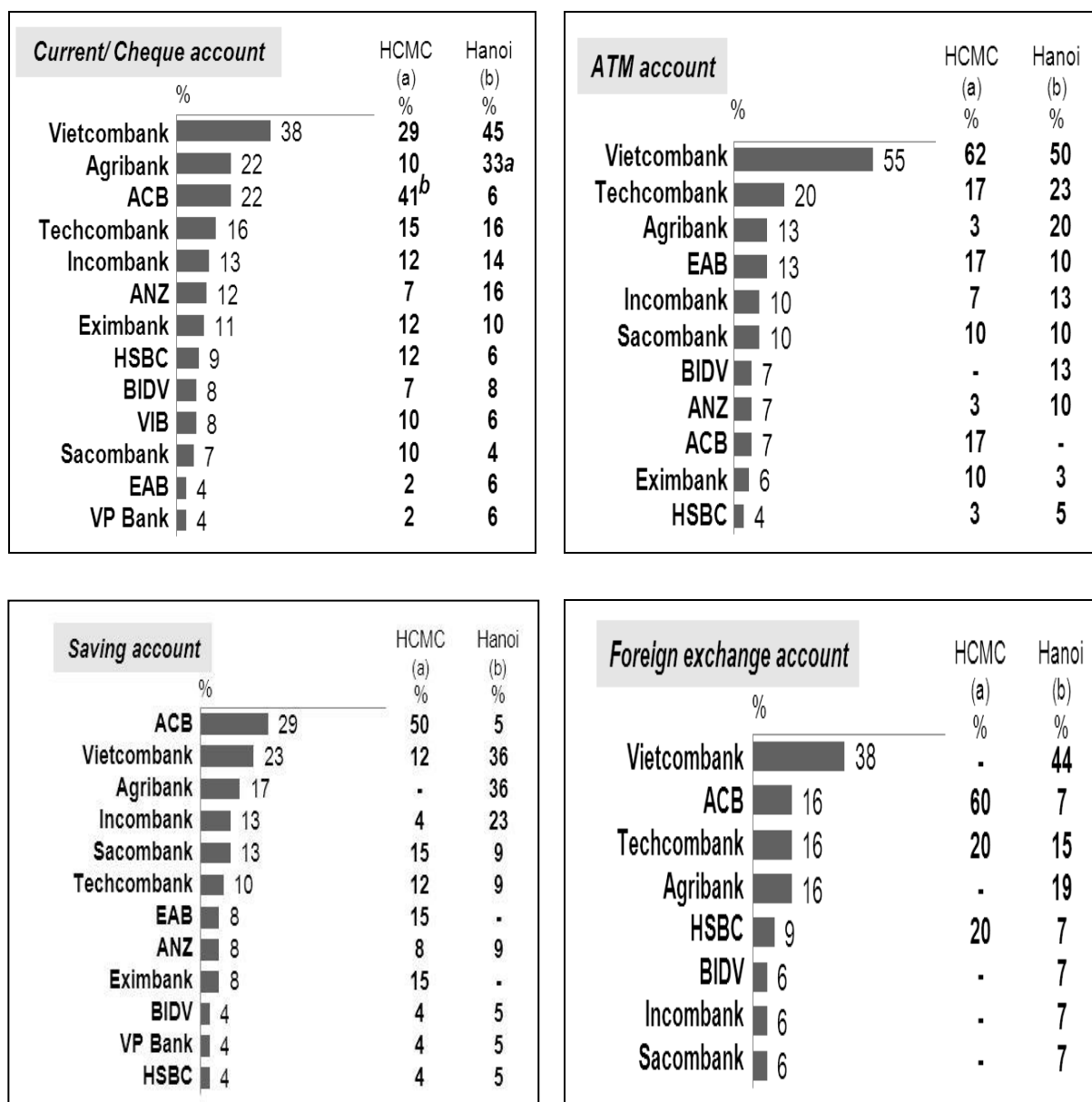


Source: Cimigo (2008).

This market survey shows that ACB and Vietcombank have total awareness up to 99%, closely followed by Techcombank and VBARD. This finding generally suggests that the competitive positioning of VBARD is acceptable at a high level with the top premier banks. This survey suggests Vietcombank is a potential benchmark for other banks to follow and compete with. This finding is solid empirical evidence to cement the null Hypothesis H2 of the thesis mentioned in Chapter 4.

Figure 6.1 helps to confirm the conclusions that the performance of VBARD is fair enough compared with other peers. More than 38% of account holders choose VBARD as their main bank, while Vietcombank is the main competitor of VBARD.

Figure 6.2: Bank share – Competitive position of VBARD

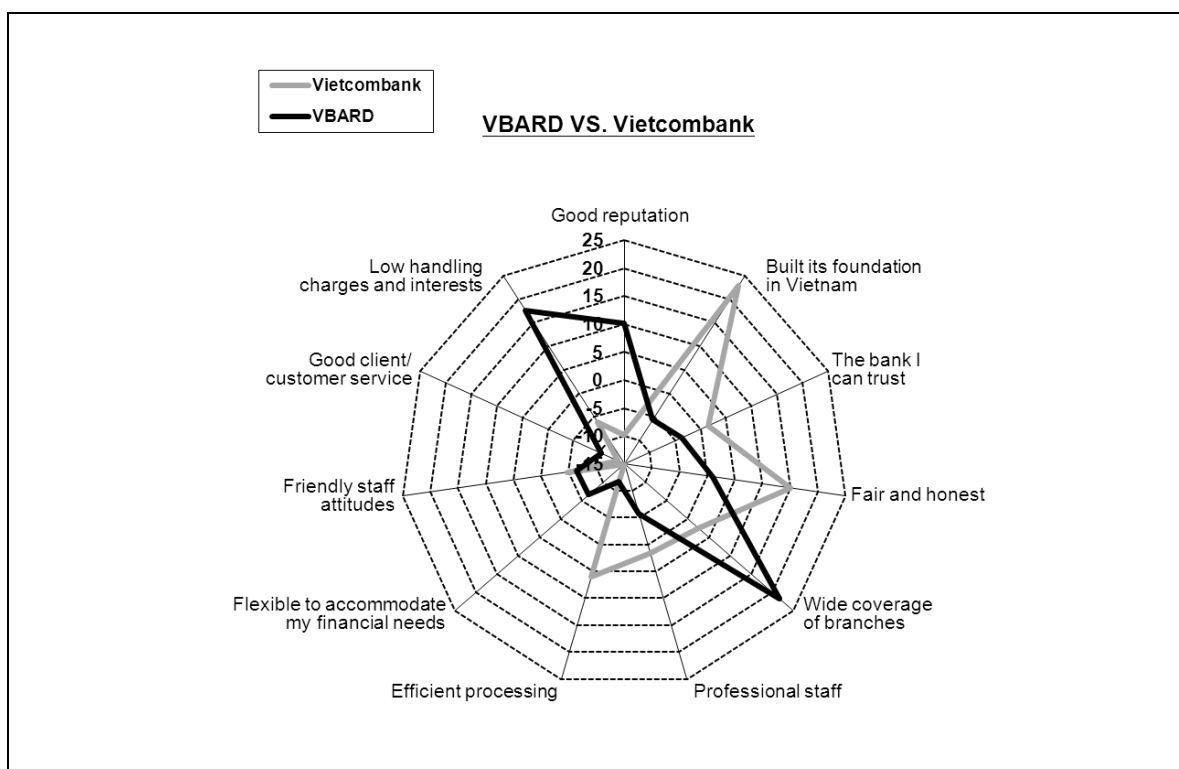


Source: Cimigo (2008).

The data in Figure 6.2 extracted from this survey shows that 22% of account holders are using VBARD and 22% ACB, while 38% are using Vietcombank's services. In Ho Chi Minh City (HCMC), the top bank selected by clients as the main service bank to open a current account with is ACB, while it is VBARD in Hanoi. For ATM accounts, more than 10% of holders are using VBARD. Some 17% of respondents hold a savings account with VBARD, while ACB is the most popular bank used, followed by Vietcombank. The saving account usage of ACB mainly comes from HCMC, and the corresponding usage of VBARD skews towards Hanoi. About 16% of the respondents hold a foreign exchange

account with VBARD, while Vietcombank is the leader in providing this service, especially in Hanoi.

Figure 6.3: Attribute association



Source: Cimigo (2008).

As shown in Figure 6.3, VBARD is known for its low handling charges and interest rate, as well as its wide branch coverage. Also, its reputation is perceived to be better than that of Vietcombank. Meanwhile, Vietcombank, as a national bank in Vietnam, makes efforts to create the image of ‘Built its foundation in Vietnam’ with its slogan *together for the future* is most obviously compared to other peers.

In Hanoi, VBARD is the head-on competitor of Vietcombank. Price competition or perception would be the immediate challenges to overcome for VBARD’s competitors, while the establishment of more branches at convenient locations would be the long-term goal to achieve in Hanoi.

Based on these survey findings, the main conclusions and recommendations for VBARD particularly and for SOCBs generally are the following.

- The Vietnamese banking sector is dominated by the local players, namely Vietcombank, ACB and VBARD, while the foreign banks, such as HSBC, Citibank and ANZ, have the strongest presence.

- VBARD, as a state-owned institution, is perceived as a bank with low offered-price and wide coverage of branches that was originally established in Vietnam.
- However, the market players consider VBARD to be providing poor-quality customer service. In addition, staff are seen as unfriendly and less flexible in accommodating the financial needs of customers.

6.3. Research aim and objectives of the pilot study

6.3.1. Research aim

Minh *et al.* (2012) use a DEA model with four inputs (namely deposits, net total assets, labour and personal expenses) and three outputs (namely loans, received interest and other interest income) to investigate the efficiency of 145 branches of VBARD during the period 2007–2010. The empirical findings of Minh *et al.* (2012) are described in Table 6.1.

Table 6.1: General results of technical efficiency of VBARD branches, 2007–2010

| | SCI under the assumption of CRS | | | | SCI under the assumption of VRS | | | |
|--------------|---------------------------------|------|------|------|---------------------------------|------|------|------|
| | 2007 | 2008 | 2009 | 2010 | 2007 | 2008 | 2009 | 2010 |
| Mean | 0.64 | 0.63 | 0.57 | 0.59 | 0.71 | 0.71 | 0.66 | 0.67 |
| Median | 0.62 | 0.61 | 0.53 | 0.56 | 0.68 | 0.71 | 0.64 | 0.66 |
| Maximum | 1.33 | 1.43 | 1.56 | 1.48 | 1.20 | 1.66 | 1.72 | 1.72 |
| Minimum | 0.35 | 0.38 | 0.32 | 0.36 | 0.37 | 0.40 | 0.35 | 0.38 |
| Std. Dev. | 0.17 | 0.16 | 0.17 | 0.16 | 0.19 | 0.20 | 0.20 | 0.19 |
| Observations | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 |

Source: Minh *et al.* (2012: 131).

Minh *et al.* (2012) provide empirical evidence that suggests a positive correlation between technical efficiency and the size of the VBARD branch (total assets as a proxy). As a result, Minh *et al.* (2012) is a validated study for the pilot study of the thesis. Some conclusions and recommendations of Minh *et al.* (2012) are relevant initial thoughts to be taken into account by the pilot study. However, the pilot study and Minh *et al.* (2012) are substantially different in terms of the following.

- The pilot study focuses on the period 2004–2008 with *monthly* panel data, while Minh *et al.* (2012) use a study period of 2007–2010 consisting of *annual* panel data. Hence, the nature of data of the two studies is absolutely different.

- ii. The research sample used by Minh *et al.* (2012) is 145 branches of VBARD, while the research sample of the pilot study is entirely different and consists of 27 branches in 2004–2005, 49 branches in 2006 and 61 branches in 2007–2008. Further information on the data used in the pilot study is available in Section 6.5.
- iii. Methodologically, Minh *et al.* (2012) is different from the pilot study of the thesis even though both studies use the DEA approach.

Naturally, the global objective of the pilot study is to test the relevance of the methodology, research questions and analytical framework of the main study as mentioned in Chapter 4 and Chapter 5 for the context of VBARD. Hence, the empirical findings of the pilot study will be a solid cornerstone for reviewing, readjusting and revising the research methodology and research questions for the main study accordingly. Consequently, as with the initial aim of the main study, the pilot study focuses on measuring the allocative efficiency of VBARD *at the branch level* by finding a *benchmark* in an attempt to investigate and decompose the allocative efficiency at branch level of VBARD into intrinsic features. After that the pilot study focuses on analysing how the explanatory variables (both endogenous and exogenous) impact on the measured allocative efficiency scores of VBARD branches. Hence, the pilot study focuses on answering three critical research questions: (i) how is the allocative efficiency of VBARD branches measured and decomposed?; (ii) what are the critical factors that impact on the allocative efficiency of VBARD branches?; and (iii) how is the allocative efficiency of VBARD branches transformed over the financial liberalisation period of 2004–2008 in Vietnam?

According to the research aim, VBARD's allocative efficiency at branch level is investigated using the parametric and non-parametric methods described in Chapter 5 of the thesis with some relevant modifications over a specified time span of 2004–2008. The validated study conducted by Minh *et al.* (2012) shares a part of the research aim of the pilot study.

6.3.2. Objectives

To accomplish the overall aim mentioned in Section 6.3.1, the pilot study is decomposed into a set of specific tasks that mirror the objectives of the main study mentioned in Section 4.3.2, as outlined below.

- Firstly, to apply a modified *basic model* to measure the allocative efficiency of VBARD at the branch level.
- Secondly, to identify the *benchmark* for VBARD's branches in terms of allocative efficiency based on the modified *basic model*.
- Thirdly, to decompose the measured allocative efficiency of VBARD's branches from the modified *basic model* into intrinsic determinants.
- Fourthly, to make use of the results of the modified *basic model* to investigate the impacts of environmental variables (endogenous and exogenous variables) on the measured allocative efficiency scores of VBARD's branches.
- Last but not least, to make essential recommendations to adjust the research methodology, research objectives and research hypothesis of the main study based on the empirical findings of the pilot study.

6.4. Research methods

The pilot study applies the modified *basic model* developed in Chapter 5. Hereunder, the thesis explains how the *basic model* is modified and applied in order to address the aim and objectives of the pilot study.

6.4.1. Modified *basic model* measuring the allocative efficiency of VBARD's branches

The *basic model* developed in Chapter 5 can help to measure the allocative efficiency of VBARD at the branch level if it is consistently modified. Accordingly, the two methods (parametric and non-parametric) of the *basic model* are modified and used for the pilot study using common panel data of VBARD's branches.

6.4.1.1. Measuring allocative efficiency and its determinants based on the parametric method

As a result of the lack of price outputs data (but with price inputs data available) at the branch level of VBARD, the pilot study applies two approaches of cost efficiency and production efficiency to investigate VBARD's branches. Hence, the modified *basic model* is applied to measure the allocative efficiency of VBARD's branches over a period of five years (2004–2008) consisting of the two following functions.

- **Production function:** Regarding the production functions from Equation 5.1 to 5.6 of the *basic model*, the pilot study of the thesis applies Equation 5.6 to measure the allocative efficiency of VBARD's branches as well as to investigate the impacts of environmental variables on the allocative efficiency of VBARD's branches.
- **Cost function:** Based on the cost frontiers developed in Chapter 5 from Equations 5.8 to 5.12, the cost function applied for the pilot study is based on Equation 5.12. This equation also helps to investigate directly the impacts of environmental variables on the allocative efficiency of VBARD's branches.

Using the *basic model* the environmental variables are directly incorporated into this analytical framework rather than applying a Tobit model to regress the estimated efficiency scores on those environmental variables, as suggested by the *two-stage model*. Seyedhoseini (2012) applies the same *two-stage model* for evaluating the branch efficiency of a large commercial bank in Iran. Yang and Liu (2012) also make use of the *two-stage model* to examine the efficiency of state-owned bank branches in Taiwan after financial liberalisation, suggesting that mixed-ownership bank branches are more efficient than state-owned bank branches. As described in Chapter 5, in the *two-stage model* all the estimated efficiency scores (outputs) from the first stage are the dependent variables (inputs) to the second stage. As a result, the pilot study does not apply the *two-stage model* to investigate the impacts of environmental variables on the allocative efficiency scores of VBARD's branches.

6.4.1.2. Measuring allocative efficiency based on the non-parametric method

The fundamental framework developed in Chapter 5 suggests that there are two stages in banking business considered in efficiency analysis: (i) the production stage and (ii) the intermediation stage. Each stage has the specific range of input and output vectors. The methodology is also applied at the branch level in some studies. LaPlante and Paradi (2015) use production, intermediation and profitability approaches to measure the efficiency of the top five banks in Canada. Tsolas and Giokas (2012) investigate the efficiency of branches of a large Greek bank, showing the linkage between production efficiency and branch transaction. The DEA methodology applied at the branch level is summarised by Paradi and Zhu (2013) for 80 DEA studies conducted in 24 countries. Based on the literature background, the pilot study measures the allocative efficiency scores for VBARD's branches at both stages. As a result, the DEA *basic model*

developed in Chapter 5 is modified and turned into the allocative DEA (ADEA) model that is applied for the pilot study as follows.

- The ADEA model is applied in the *production stage* to produce the allocative efficiency ***ProdEFF***, where the following variables are used for the model.
 - ✓ Inputs: (i) total equity (***Equity***), (ii) total personnel expenses (***LAB***), and (iii) total interest expenses (***Intexp***).
 - ✓ Input prices: (i) the price of equity (***priceEQU***),²⁶ (ii) the price of labour (***priceLAB***), and (iii) the price of deposits (***priceDEP***).
 - ✓ Outputs: (i) total outstanding credit, including both long- and short-term outstanding credits (***Credit***), and (ii) total non-interest income (***Feeincome***).

- The ADEA model is applied in the *intermediation stage* to measure allocative efficiency ***InterEFF***, where the following variables are used for the model.
 - ✓ Inputs: (i) financial capital proxy by demand deposits and saving deposits (***Ddep*** and ***Sdep***), and (ii) inter-bank funds (***Fedfund***).
 - ✓ Input price is a proxy by the price of deposits (***priceDEP***).
 - ✓ Outputs: (i) total outstanding credit, including both long- and short-term outstanding credits (***Credit***), and (ii) total interest income (***Interest***).

In the ADEA models of the pilot study, the environmental variables are also directly taken into account, as described in detail in Section 6.4.1.1. Consequently, for the non-parametric approach (the ADEA models), the pilot study does not apply the ***two-stage model*** consisting of Tobit regression developed in Chapter 5 to investigate the impacts of environmental variables on the measured allocative efficiency scores of VBARD's branches produced from the ADEA models.

6.4.2. Executive summary of the modified *basic model* applied for the pilot study

Both the parametric and non-parametric methods in the pilot study are applied for the same database of VBARD's branches. Below is a summary of variables applied in the

²⁶ This variable (***priceEQU***) is considered as a proxy for the ***opportunity cost*** of the equity of a branch, calculated as follows:
$$priceEQU = \frac{\text{Interest income}}{\text{Total outstanding credit}}$$

pilot study to measure the allocative efficiency of VBARD's branches. The unique difference between Table 6.2 and Table 5.1 in Chapter 5 is the variables of input prices. The *basic model* in Chapter 5 applied for the main study focuses on measuring technical efficiency at bank level without the price inputs. Meanwhile, the modified *basic model* of the pilot study aims to measure allocative efficiency at branch level; hence the variables in the modified *basic model* of the pilot study described in Table 6.2 consist of input prices.

Table 6.2: Variables used in the *basic model* measuring the allocative efficiency of VBARD's branches

| Variables | Name | Methods for measuring efficiency | | | |
|--|------------------|---------------------------------------|--|--|---|
| | | Parametric | | Non-parametric | |
| | | Cost efficiency (<i>CostEFF</i>) | Production efficiency (<i>πEFF</i>) | Production stage (<i>ProdEFF</i>) | Intermediation stage (<i>InterEFF</i>) |
| Total cost | <i>C</i> | <input checked="" type="checkbox"/> | NA | NA | NA |
| Total production | $(\pi + \theta)$ | NA | <input checked="" type="checkbox"/> | NA | NA |
| <u>Output Quantities:</u> | | | | | |
| Demand deposits | <i>Ddep</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA | <input checked="" type="checkbox"/> |
| Saving deposits | <i>Sdep</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA | <input checked="" type="checkbox"/> |
| Outstanding credits | <i>Credit</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Non-interest income | <i>Feeincome</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA |
| Interest income | <i>Interest</i> | NA | NA | NA | <input checked="" type="checkbox"/> |
| <u>Input Quantities:</u> | | | | | |
| Demand deposits | <i>Ddep</i> | NA | NA | NA | <input checked="" type="checkbox"/> |
| Saving deposits | <i>Sdep</i> | NA | NA | NA | <input checked="" type="checkbox"/> |
| Inter-bank funds | <i>Fedfund</i> | NA | NA | NA | <input checked="" type="checkbox"/> |
| Total equity | <i>Equity</i> | NA | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA |
| Labour expenses | <i>LAB</i> | NA | | <input checked="" type="checkbox"/> | NA |
| Physical capital | <i>Fixassets</i> | NA | <input checked="" type="checkbox"/> | NA | NA |
| Interest expenses | <i>Intexp</i> | NA | NA | <input checked="" type="checkbox"/> | NA |
| <u>Input Prices:</u> | | | | | |
| Deposits | <i>priceDEP</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Wage | <i>priceLAB</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA |
| Equity | <i>priceEQU</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA |
| Physical capital | <i>priceCAP</i> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | NA | NA |
| <p>Note: In this table, the symbols are explained as follows:</p> <p>✓ <input checked="" type="checkbox"/>: this variable is applied for measuring the relevant efficiency in the column</p> <p>✓ NA: this variable is not applied for measuring the relevant efficiency in the column</p> | | | | | |

6.4.3. Tests for consistency and correlation among the measured allocative efficiency indicators

As the literature review in Chapter 2 suggests, there are always differences between the results of the two approaches (parametric and non-parametric) in measuring efficiency. As Bauer *et al.* (1998) suggest, the technical efficiency derived from DEA methods is normally relative levels between inputs and outputs. Meanwhile, the parametric methods usually focus on economic efficiency (allocative efficiency), which involves the optimal mixes of inputs and/or outputs based on the reactions to market prices. Hence, the economic efficiency of the parametric methods requires both technical efficiency and allocative efficiency. As a result, on average the economic efficiency scores are generally lower than the technical efficiency scores because the technical efficiency needs input and output data, while price data is needed in measuring economic efficiency/allocative efficiency. In other words, there is usually inconsistency between the efficiency measurements due to the different concepts of and approaches to efficiency. To reduce the inconsistency between the parametric and non-parametric methods, according to Bauer *et al.* (1998), (i) the same concept of efficiency should be applied in analysis and measurement, and (ii) the methods should be applied to the same data set. Based on the debate, the pilot study focuses on analysing and measuring the same concept of efficiency (economic efficiency/allocative efficiency) in both methods (parametric and non-parametric) for the same data set. Charnes *et al.* (1988) suggest applying the so-called ‘*methodological cross-checking*’ in testing the consistency findings among various methods/approaches in efficiency studies. Hereunder are some consistency tests of measured allocative efficiency that based on the methods developed by Bauer *et al.* (1998):

- Rank-order correlations of the efficiency distributions.²⁷
- Identification of the consistency in terms of best-performance and worst-performance banks.

6.5. Data description

6.5.1. General data specification

The data sources for the quantitative analyses in the pilot study are based on the primary data of VBARD’s branches. The primary data is extracted from the **monthly balance**

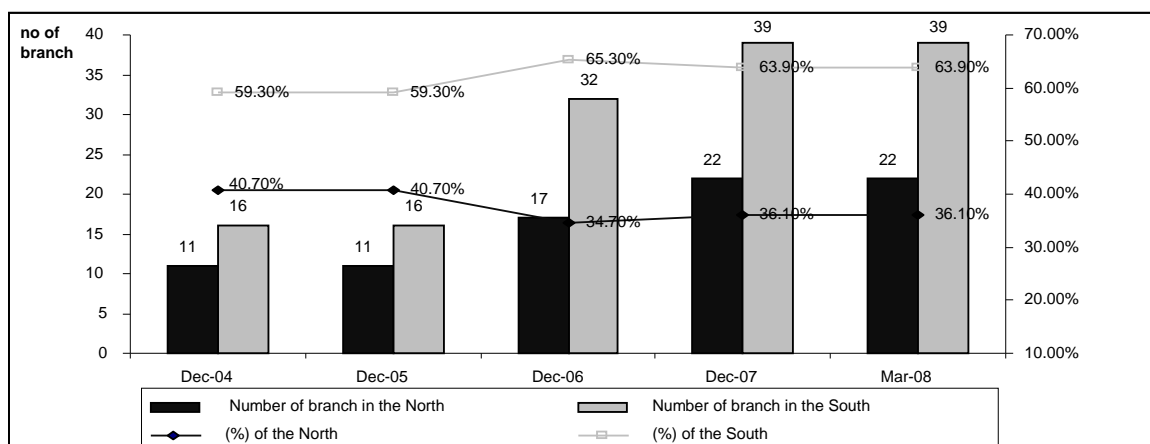
²⁷ It enables transformation of the allocative efficiency scores of VBARD’s branches into their corresponding ranks. As a result, the Spearman rank-order correlation is applied in the pilot study to investigate how close the rankings of VBARD’s branches are among each of the four allocative efficiency indicators, namely *CostEFF*, *π EFF*, *ProdEFF* and *InterEFF*. Furthermore, the Kruskal–Wallis test is applied to test for any significant differences between the four allocative efficiency measurements.

sheets with detailed structure breakdown assets and liabilities of VBARD's branches in the period from **December 2004 to March 2008**. The primary data of the pilot study is provided by the Finance Department of VBARD Head Office. The data for the pilot study is collected by the author under a research project sponsored by the Ford Foundation.²⁸

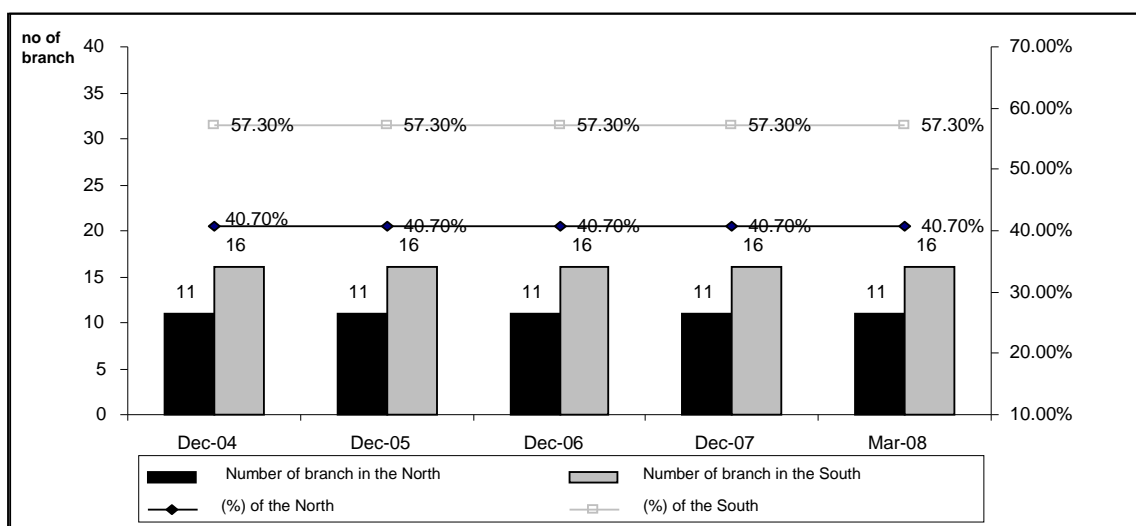
With the primary data collected, the data format of the pilot study is the unbalanced panel data or non-discretionary panel data for the parametric analyses. Meanwhile, in terms of literature it is naturally requested as balanced-data form for any DEA study. As a result, the data for pilot study needs to be transformed according to the requests of both parametric and non-parametric methods. Figure 6.4 is an executive summary for the data applied in the pilot study.

Figure 6.4: Data description of VBARD's branches

The unbalanced panel data for parametric methods



The balanced panel data for ADEA methods



²⁸ The Ford Foundation has requested the Institute of International Education (IIE) to provide a research grant No.1050-0152 under the management of IIE Program No.FF5H021 to enable the author to collect the primary data to conduct research into the competitiveness and efficiency of VBARD's branches in the face of WTO entry and also to produce recommendations to VBARD and the SBV on the means of addressing the challenges of increased competition.

6.5.2. Data description for the modified *basic model*

Based on the variables intended to apply for the modified *basic model* as described in Table 6.2, there follows a detailed description of the data of these variables. Because of the special characteristics of each method in the pilot study, the data applied in each method has typical features. As mentioned in Chapter 2, the data for the parametric method could be unbalanced; while the requested data for the DEA method must be balanced. As a result, the data for each method is described in Section 6.5.2.1 separately. The detailed statistical description of the whole data sample for the pilot study is summarised in Appendix 3.

6.5.2.1. Data description for the parametric approach

For the parametric method, because of the efficiency translog function approach applied in the pilot study, all the data must be converted into the logarithm form. However, in order to review the original data of the parametric analyses of the pilot study, the data is described in original form rather than in the converted logarithm form.²⁹

As described by Vu and Nahm (2013a), there is statistical evidence that the correlation coefficient between CPI and GDP deflator in Vietnam is approximately equal to 1. Consequently, Vu and Nahm (2013a) suggest that converting nominal values of data to the real values by deflator has no significant differences in estimated findings. Using the nominal data in the local currency (VND) rather than the real data is actual practice of all the banking efficiency studies in Vietnam conducted by Hung (2007), Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a), Vu and Nahm (2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015). As a result, the data of both the pilot study in this chapter and the main study in Chapter 7 of the thesis are also implemented using the nominal-value data rather than the real values.

Due to the unbalanced characteristics of the panel data (the differentiated number of branches in each year) in Appendix 3.1 the data is much diversified. The statistics of the unbalanced data from Appendix 3.1 suggest that there is a significant variation between the observations in each variable over the whole period (2004–2008).

²⁹ The statistics on the Vietnamese economy consisting of inflation, exchange rate and so on, described in Appendix 1.1, 1.2 and 1.3, can help to convert the entire data of VBARD nominated in local currency (VND) into USD values. The VND/USD exchange rates in 2004, 2005, 2006, 2007 and 2008 were 15,704; 15,816; 16,068; 16,017; and 17,483, equivalent.

In some cases, there is negative equity in the sample branches. This negative equity for some branches in some typical circumstances is not provided by regulation in Vietnam. In terms of the law, the SBV does not request commercial banks to grant a certain limit of equity for their branches. Instead, the commercial banks have different internal corporate governance policies in managing their branches' operations. Some banks allocate a limit of equity to their branches in terms of working capital and fixed assets. Based on the allocated equity, the bank can measure the performance of each individual branch. VBARD is among the banks that allocate equity to their branches. The negative equity booked in some branches in VBARD as mentioned in Appendix 3.1 is due to the loss in profitability and financial provision that the branch has accounted for. In other words, the negative profitability and financial provision expenses in some cases entirely consume the equity allocated for the branch. These circumstances lead to the negative equity of those branches.

6.5.2.2. Data specification for the non-parametric approach

Unlike the parametric method (translog production function), the non-parametric method (ADEA method) requires the data in use to be in the original form. Hence, the data applied for the ADEA programming in the pilot study is in its original state, as described in Appendix 3.2.

Due to the balanced nature of the panel data used for the DEA approach (the branches in each individual year are the same over the whole pilot study period), the panel data described in Appendix 3.2 suggests evidence of a stable and focused trend between the observations in each variable over the whole period. However, the differences in terms of size and operational scale between branches are still significant but not as different as the unbalanced data for the parametric approach. The difference between the maximum and minimum values of individual variables in the panel data is very significant, from ten times to a hundredfold.

6.5.3. Data description for the environmental variables

In addition to the data for variables described in Appendix 3.1 and Appendix 3.2, the pilot study also focuses on collecting the data for endogenous and exogenous variables that explain the allocative efficiency of VBARD's branches, as described in Appendix 3.3.

The data for those environmental variables is intended to test and investigate the impacts of those environmental variables on the allocative efficiency scores of VBARD's

branches. As Appendix 3.3 suggests, when all environmental variables are transformed into the logarithm form, their statistical descriptions are bounded in the range of [0, 1].

Appendix 3.3 shows the data for the environmental variables applied to measure the allocative efficiency scores (*CostEFF*, *π EFF*) that resulted from running the modified *basic model* with the parametric approach.

Meanwhile, Appendix 3.4 shows the data for the environmental variables applied for measuring the allocative efficiency scores (*ProdEFF*, *InterEFF*) that resulted from running the modified *basic model* with the non-parametric approach (ADEA).

A correlation matrix of environmental variables presented in Table 6.3 shows no strong correlation between those environmental variables for both parametric and non-parametric approaches. There is a unique high correlation between the variables *Leverage* and *CAR* that has a correlation ratio of near 1. These findings suggest that the higher equity (*CAR*) the branch has, the more debt (*deposit*) the branch can borrow (*Leverage*).

Table 6.3: Correlation between environmental variables

| For the parametric approach | | | | | | | | | |
|--|----------|----------|----------|----------|----------|----------|----------|----------|---------|
| | Size | Quality | Leverage | Risk | ROE | ROA | NIM | CAR | AREA |
| Size | 1.00000 | | | | | | | | |
| Quality | 0.40877 | 1.00000 | | | | | | | |
| Leverage | 0.31381 | 0.25827 | 1.00000 | | | | | | |
| Risk | -0.57782 | -0.29896 | -0.11485 | 1.00000 | | | | | |
| ROE | -0.02327 | -0.02327 | -0.10614 | -0.08420 | 1.00000 | | | | |
| ROA | 0.16105 | 0.16105 | 0.57584 | 0.01565 | 0.06150 | 1.00000 | | | |
| NIM | -0.06806 | 0.30789 | 0.35339 | 0.08592 | -0.08393 | 0.59005 | 1.00000 | | |
| CAR | 0.31152 | 0.26754 | 0.99772 | -0.10710 | 0.23762 | 0.59191 | 0.37245 | 1.00000 | |
| AREA | 0.19750 | -0.11485 | 0.00693 | -0.28218 | -0.09061 | -0.03356 | -0.02125 | -0.00230 | 1.00000 |
| For the non-parametric approach | | | | | | | | | |
| | Size | Quality | Leverage | Risk | ROE | ROA | NIM | CAR | AREA |
| Size | 1.00000 | | | | | | | | |
| Quality | 0.22616 | 1.00000 | | | | | | | |
| Leverage | 0.03396 | 0.10844 | 1.00000 | | | | | | |
| Risk | -0.68414 | -0.32175 | -0.06701 | 1.00000 | | | | | |
| ROE | 0.04349 | 0.04349 | -0.09591 | -0.11186 | 1.00000 | | | | |
| ROA | 0.04592 | 0.04592 | 0.49771 | -0.13928 | 0.46516 | 1.00000 | | | |
| NIM | -0.10628 | 0.31084 | 0.18902 | 0.00277 | 0.15064 | 0.40476 | 1.00000 | | |
| CAR | 0.03453 | 0.11672 | 0.99730 | -0.06311 | 0.18121 | 0.50755 | 0.20023 | 1.00000 | |
| AREA | 0.12089 | -0.06701 | -0.08570 | -0.26134 | -0.09648 | -0.12667 | -0.06551 | -0.10159 | 1.00000 |

6.6. Empirical analysis

In this section, the pilot study empirically applies the analytical framework developed in Section 6.4 with the data of VBARD at the branch level. Section 6.6 consists of the following sub-sections: (i) running the non-parametric model, and (ii) executing the parametric model.

6.6.1. Technical and allocative efficiency estimated with the ADEA model

In this section, the technical and allocative efficiency levels of VBARD's branches are computed for both the *production stage* and *intermediation stage*. Detailed results for technical and allocative efficiency scores of all VBARD's branches in the sample over the study period of 2004–2008 are presented in Tables 6.4 and 6.5.

The single-period analysis produced three sets of efficiency scores for each year from 2004 to 2008 for both the production stage and the intermediation stage: the allocative efficiency scores (AE), the technical efficiency scores (TE), and the cost efficiency (CE) scores (see Tables 6.4 and 6.5). Then a composite index measuring the overall efficiency of VBARD's branches for each single year of the period is also computed (see Table 6.7).

Table 6.4 shows the results for the allocative efficiency of VBARD's branches at the *production stage* with the inputs and outputs as follows.

- two outputs: total outstanding credit, fee income from off-balance business.
- three inputs: equity, wage payments, interest expenses.
- three equivalent input prices: opportunity cost of equity, average wage rate, average deposit interest rate.

Table 6.4: Summary of allocative efficiencies of VBARD branches from the *production stage*

| Year | No. of Branches in the Sample | No. of Branches with Inappropriate Data | No. of Evaluated Branches | Types of Technical Efficiency | Mean | Standard Deviation | Min | Max | No. of Efficient Branches |
|------|-------------------------------|---|---------------------------|-------------------------------|-------|--------------------|-------|-------|---------------------------|
| 2004 | 27 | 0 | 27 | TE | 0.919 | 0.149 | 0.377 | 1.000 | 18 |
| | | | | AE | 0.769 | 0.217 | 0.260 | 1.000 | 7 |
| | | | | CE | 0.714 | 0.254 | 0.251 | 1.000 | 7 |
| 2005 | 27 | 0 | 27 | TE | 0.927 | 0.141 | 0.438 | 1.000 | 19 |
| | | | | AE | 0.849 | 0.211 | 0.285 | 1.000 | 10 |
| | | | | CE | 0.792 | 0.247 | 0.242 | 1.000 | 9 |

| | | | | | | | | | |
|-----------|-----|---|-----|----|-------|-------|--------|-------|----|
| 2006 | 27 | 0 | 27 | TE | 0.893 | 0.174 | 0.482 | 1.000 | 17 |
| | | | | AE | 0.866 | 0.173 | 0.401 | 1.000 | 11 |
| | | | | CE | 0.776 | 0.230 | 0.303 | 1.000 | 10 |
| 2007 | 27 | 0 | 27 | TE | 0.849 | 0.167 | 0.417 | 1.000 | 10 |
| | | | | AE | 0.699 | 0.408 | -1.030 | 1.000 | 4 |
| | | | | CE | 0.590 | 0.406 | -1.030 | 1.000 | 4 |
| 2008 | 27 | 0 | 27 | TE | 0.846 | 0.163 | 0.407 | 1.000 | 9 |
| | | | | AE | 0.477 | 0.275 | -0.121 | 1.000 | 2 |
| | | | | CE | 0.407 | 0.279 | -0.121 | 1.000 | 2 |
| 2004-2008 | 135 | 0 | 135 | TE | 0.472 | 0.250 | 0.115 | 1.000 | 11 |
| | | | | AE | 0.556 | 0.287 | -0.918 | 1.000 | 2 |
| | | | | CE | 0.243 | 0.184 | -0.324 | 1.000 | 2 |

Note: TE = technical efficiency
CE = cost efficiency
AE = allocative efficiency = CE/TE

In all the studied years, the average technical efficiency and cost efficiency scores are on a gradual downside trend. Consequently, the average allocative scores during this period are also decreasing, which leads to technical efficiency of 0.472 and allocative efficiency of 0.556 for the entire period. It implies that all VBARD branches in this study did not use the most efficient available technology as well as their inputs for their operations. Therefore, if the branches boost technology advancement, their technical and allocative efficiency will be improved. These findings also suggest that during the financial liberalisation process (2004–2008) the efficiency of VBARD branches is not improved. Hence, this initially suggests some empirical evidence for addressing Hypotheses H0 and H2, mentioned in Chapter 4 of the thesis. Based on the empirical evidence from the pilot study, it is suggested that the null Hypotheses H0 and H2 should be rejected.

Furthermore, in the *production stage* ADEA model, out of the total 135 observations over the period 2004–2008, a minority number of VBARD's branches is in an efficient position, of which 11 branches (accounting for 8.15% of total branches) are technically efficient and 2 branches (1.48%) are both cost efficient and allocatively efficient. Consequently, 91.8% to 98.5% of VBARD's branch sample was under decreasing returns to scale. In other words, those branches should reduce their output or increase their output prices to improve their efficiency.

In 2004–2008, the average allocative efficiency for all VBARD branches in the *production stage* is 0.556. This implies that the average branch would incur 55.6% of its cost if it had operated on the efficient frontier. In other words, efficiency improvements

would allow the average branch to enjoy up to 44.4% in cost savings. It is interesting to note that the group of those branches forming the efficient frontier for the *production stage* is usually different from those constituting the *intermediation stage*.

In the next stage of empirical analysis, the technical efficiency scores of VBARD branches are measured with a different model where the *intermediation stage* of banking business is taken into account. Table 6.5 shows the results for the allocative efficiency of VBARD branches with the inputs and outputs as follows.

- two outputs: total outstanding credit, interest income.
- one input: total savings deposit.
- one equivalent input price: average deposit interest rate.

Table 6.5: Summary of allocative efficiencies of VBARD branches from the *intermediation stage*

| Year | No. of Branches in the Sample | No. of Branches with Inappropriate Data | No. of Evaluated Branches | Types of Technical Efficiency | Mean | Standard Deviation | Min | Max | No. of Efficient Branches |
|-----------|-------------------------------|---|---------------------------|-------------------------------|-------|--------------------|-------|-------|---------------------------|
| 2004 | 27 | 0 | 27 | TE | 0.483 | 0.340 | 0.095 | 1.000 | 6 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 27 |
| | | | | CE | 0.483 | 0.340 | 0.095 | 1.000 | 6 |
| 2005 | 27 | 0 | 27 | TE | 0.535 | 0.346 | 0.112 | 1.000 | 6 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 27 |
| | | | | CE | 0.535 | 0.346 | 0.112 | 1.000 | 6 |
| 2006 | 27 | 0 | 27 | TE | 0.656 | 0.305 | 0.216 | 1.000 | 8 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 27 |
| | | | | CE | 0.656 | 0.305 | 0.216 | 1.000 | 8 |
| 2007 | 27 | 0 | 27 | TE | 0.590 | 0.293 | 0.198 | 1.000 | 6 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 27 |
| | | | | CE | 0.590 | 0.293 | 0.198 | 1.000 | 6 |
| 2008 | 27 | 0 | 27 | TE | 0.635 | 0.292 | 0.223 | 1.000 | 6 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 27 |
| | | | | CE | 0.635 | 0.292 | 0.223 | 1.000 | 6 |
| 2004-2008 | 135 | 0 | 135 | TE | 0.411 | 0.291 | 0.047 | 1.000 | 11 |
| | | | | AE | 1.000 | 0.000 | 1.000 | 1.000 | 135 |
| | | | | CE | 0.411 | 0.291 | 0.047 | 1.000 | 11 |

Note: TE = technical efficiency
CE = cost efficiency
AE = allocative efficiency = CE/TE

The findings of the *intermediation stage* resulting from the ADEA model are significantly different from those of the *production stage*. On average, the overall technical efficiency of the VBARD branches is only 41.1%; while cost efficiency is the same at 41.1%. Consequently, the allocative efficiency of the VBARD branches is 100%. The high estimated allocative efficiency scores for the *intermediation stage* of the pilot study could be explained by the choice of variables applied in the model. In the *intermediation stage*, there is only one input variable while the number of output variables is two.

Unlike the *production stage*, in the *intermediation stage* ADEA model, out of the total 135 observations over the period 2004–2008, a major portion of the studied VBARD branches was in an efficient position in terms of allocative efficiency. Among the branches lying in the efficient frontier, there are 11 branches (accounting for 8.14% of the sample) that are both cost efficient and technically efficient. However, in the *intermediation stage* the empirical findings also show the same conclusion as the *production stage*, where 91.8% of VBARD’s branches in the sample are operating under decreasing returns to scale over the whole study period. Hence, this finding also suggests rejection of null Hypotheses H0 and H2 if the thesis is based on the empirical evidence of the pilot study at the *intermediation stage*.

These empirical findings from both the *production stage* and *intermediation stage* suggest that those VBARD branches accounting for 91.8% of the total sample should reduce their outputs and size if they aim at efficiency improvements.

During the pilot study period, the average technical efficiency at the *production stage* for VBARD branches for each year ranges from 0.84 to 0.92, while the average technical efficiency at the *intermediation stage* ranges from 0.48 to 0.65. These findings suggest that VBARD branches are more technically efficient in the mobilisation of funds and production of financial services (at the *production stage*). At the same time, these branches are less efficient in the utilisation of funds for financial intermediation: transforming deposits into loans (at the *intermediation stage*).

Table 6.6: Results of frequency analysis, period 2004–2008

| Branch | Production Stage | | | | Intermediation Stage | | | |
|--------|------------------|----|----|-----------|----------------------|----|----|-----------|
| | TE | AE | CE | Total no. | TE | AE | CE | Total no. |
| 1 | 3 | 2 | 2 | 7 | 5 | 5 | 5 | 15 |
| 2 | 1 | | | 1 | 1 | 5 | 1 | 7 |

| | | | | | | | | |
|----|---|---|---|----|---|---|---|----|
| 3 | 4 | 1 | 1 | 6 | 1 | 5 | 1 | 7 |
| 4 | 3 | 1 | 1 | 5 | 1 | 5 | 1 | 7 |
| 5 | 2 | 1 | 1 | 4 | 1 | 5 | 1 | 7 |
| 6 | 4 | 1 | 1 | 6 | 1 | 5 | 1 | 7 |
| 7 | 5 | 5 | 5 | 15 | 5 | 5 | 5 | 15 |
| 8 | | | | | 1 | 5 | 1 | 7 |
| 9 | | | | | 2 | 5 | 2 | 9 |
| 10 | | | | | 1 | 5 | 1 | 7 |
| 11 | 2 | 3 | 2 | 7 | 4 | 5 | 4 | 13 |
| 12 | 5 | 5 | 5 | 15 | 5 | 5 | 5 | 15 |
| 13 | | | | | 1 | 5 | 1 | 7 |
| 14 | 3 | 1 | 1 | 5 | 3 | 5 | 3 | 11 |
| 15 | 3 | 2 | 2 | 7 | 1 | 5 | 1 | 7 |
| 16 | 2 | 2 | 2 | 6 | 1 | 5 | 1 | 7 |
| 17 | 5 | | | 5 | 3 | 5 | 3 | 11 |
| 18 | 3 | | | 3 | 1 | 5 | 1 | 7 |
| 19 | 5 | | | 5 | 1 | 5 | 1 | 7 |
| 20 | 4 | 1 | 1 | 6 | 2 | 5 | 2 | 9 |
| 21 | | 1 | | 1 | 1 | 5 | 1 | 7 |
| 22 | 1 | | | 1 | 1 | 5 | 1 | 7 |
| 23 | 1 | 1 | 1 | 3 | 1 | 5 | 1 | 7 |
| 24 | 5 | 2 | 2 | 9 | 1 | 5 | 1 | 7 |
| 25 | 4 | 1 | 1 | 6 | 2 | 5 | 2 | 9 |
| 26 | 3 | 1 | 1 | 5 | 1 | 5 | 1 | 7 |
| 27 | 5 | 3 | 3 | 11 | 5 | 5 | 5 | 15 |

The results in Table 6.6 are based on frequency analyses which show the number of times a VBARD branch was identified as efficient over the whole period of the pilot study. This table allows identification of the most consistent and efficient VBARD branch in both stages (*production* and *intermediation*) over the pilot study period. In the *production stage*, the frequency analysis suggests that VBARD's branches no. 7 and 12 are the most consistent performers. In the *intermediation stage*, the frequency analyses suggests that VBARD's branches no. 1, 7, 12 and 27 are the most consistent performers, because all of them are identified as being efficient for every one of the five years in the pilot study. However, as mentioned earlier, being efficient in the *production* or *intermediation* stage alone is inadequate. The best-performing branch (the benchmark) must be efficient in

both stages. Table 6.6 shows that VBARD's branches no. 7 and 12 have the highest frequency score for both stages. These findings suggest that those branches are considered as being the best-performing branches – the benchmark for VBARD branches in terms of efficiency.

6.6.1.1. The impact of financial deregulation on the TFP growth of VBARD branches

The Malmquist index represented in Table 6.7 is explained in detail in Section 5.2.3 of Chapter 5. Ranking scores based on the Malmquist index numbers disclose that the top three branches in the whole period of 2004–2008 in terms of overall efficiency over the *production stage* are branches no. 5, 15 and 18. At the same time, over the *intermediation stage* the best three branches are no. 3, 8 and 14. A good depositor base provides these branches with a cheap source of funding that dramatically reduces their interest expenses. This finding explains the high overall efficiency score for the *production* and *intermediation stages* for these branches.

From the efficiency scores, the sources and the magnitude of inefficiencies for each branch can be identified. Altogether, there are five sources of inefficiency from the *production stage* (three inputs and two outputs) and three sources of inefficiency from the *intermediation stage* (one input and two outputs). Inefficient branches will need to reduce their inputs or improve their outputs accordingly in order to achieve optimal efficiency.

To determine the presence of any statistically significant trend in the efficiency scores of VBARD branches in the two stages, the pilot study applies rank statistics to test the hypothesis that there are no trends in efficiency at the *production* and *intermediation stages*. Causal observation of the efficiency scores suggests that there is some relationship between a branch's efficiency scores in the *production stage* and *intermediation stage*. The results running the Spearman's rank test described in Section 6.4.3 suggest that there is indeed a statistically significant correlation between efficiency scores for the *production stage* and the *intermediation stage* in the whole study period.³⁰ In fact, the Spearman correlation coefficient for the two stages is at +0.116 with a *T-test* of 0.584.

³⁰ The Spearman's rank correlation coefficient compares the orders or the ranks of the observations in each variable. If the ranking in each variable is similar, there is a high correlation between the two variables. The range of values for the rank correlation coefficient is from -1 to $+1$, with a value of 0 implying that there is no correlation between the two variables.

Table 6.7: Malmquist index by year and branch

| Branch | 2005 | | | | 2006 | | | | 2007 | | | | 2008 | | | | 2004-2008 | | | |
|--------|------------|------|----------------|------|------------|------|----------------|------|------------|------|----------------|------|------------|------|----------------|------|------------|------|----------------|------|
| | Production | | Intermediation | | Production | | Intermediation | | Production | | Intermediation | | Production | | Intermediation | | Production | | Intermediation | |
| | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank | Index | rank |
| 1 | 0.846 | 19 | 1.086 | 14 | 2.736 | 1 | 0.863 | 24 | 0.849 | 25 | 1.127 | 9 | 2.14 | 26 | 0.241 | 26 | 1.432 | 6 | 0.71 | 25 |
| 2 | 0.806 | 22 | 1.089 | 13 | 0.725 | 26 | 1.67 | 3 | 1.061 | 13 | 1.011 | 12 | 2.699 | 16 | 0.318 | 25 | 1.138 | 24 | 0.874 | 11 |
| 3 | 0.885 | 14 | 1.006 | 19 | 1.032 | 13 | 1.079 | 13 | 1.249 | 8 | 1.431 | 3 | 3.194 | 6 | 0.704 | 2 | 1.381 | 11 | 1.023 | 2 |
| 4 | 0.852 | 17 | 1.104 | 12 | 1.136 | 7 | 1.046 | 14 | 1.029 | 16 | 0.893 | 15 | 2.8 | 12 | 0.514 | 9 | 1.292 | 17 | 0.853 | 15 |
| 5 | 1.04 | 7 | 1.027 | 18 | 2.056 | 3 | 0.921 | 22 | 0.902 | 23 | 1.045 | 11 | 2.516 | 23 | 0.514 | 9 | 1.484 | 3 | 0.844 | 17 |
| 6 | 0.761 | 26 | 1.198 | 6 | 0.846 | 23 | 0.972 | 16 | 0.989 | 19 | 1.271 | 6 | 2.603 | 21 | 0.484 | 17 | 1.135 | 25 | 0.92 | 6 |
| 7 | 0.84 | 20 | 1.144 | 9 | 1.009 | 15 | 1.344 | 7 | 1.103 | 12 | 0.856 | 19 | 3.822 | 1 | 0.435 | 22 | 1.375 | 12 | 0.87 | 14 |
| 8 | 1.048 | 6 | 1.674 | 1 | 1.079 | 10 | 1.555 | 4 | 1.022 | 17 | 1.813 | 1 | 2.643 | 20 | 0.333 | 24 | 1.322 | 15 | 1.12 | 1 |
| 9 | 0.924 | 11 | 0.994 | 21 | 0.902 | 19 | 0.937 | 20 | 1.316 | 5 | 0.956 | 13 | 3.411 | 3 | 0.493 | 14 | 1.391 | 9 | 0.814 | 19 |
| 10 | 0.941 | 10 | 1.076 | 15 | 0.736 | 25 | 1.398 | 6 | 1.202 | 10 | 0.888 | 16 | 2.722 | 15 | 0.5 | 12 | 1.227 | 22 | 0.904 | 8 |
| 11 | 0.958 | 9 | 0.9 | 24 | 0.994 | 16 | 1.317 | 8 | 1.398 | 3 | 0.615 | 26 | 3.006 | 7 | 0.604 | 4 | 1.414 | 7 | 0.815 | 18 |
| 12 | 0.88 | 15 | 1.003 | 20 | 0.922 | 18 | 1.082 | 12 | 0.965 | 20 | 1.173 | 8 | 2.981 | 8 | 0.46 | 18 | 1.236 | 21 | 0.875 | 9 |
| 13 | 0.766 | 25 | 1.155 | 7 | 1.017 | 14 | 1.277 | 9 | 1.238 | 9 | 0.595 | 27 | 2.939 | 10 | 0.494 | 13 | 1.297 | 16 | 0.812 | 20 |
| 14 | 1.039 | 8 | 1.257 | 4 | 1.443 | 6 | 1.527 | 5 | 0.909 | 22 | 1.235 | 7 | 2.694 | 18 | 0.458 | 19 | 1.384 | 10 | 1.021 | 3 |
| 15 | 1.09 | 4 | 0.986 | 22 | 2.096 | 2 | 0.827 | 25 | 1.043 | 14 | 0.94 | 14 | 2.695 | 17 | 0.528 | 7 | 1.592 | 1 | 0.798 | 22 |
| 16 | 1.132 | 2 | 1.144 | 9 | 0.947 | 17 | 1.086 | 11 | 1.272 | 7 | 1.287 | 5 | 2.816 | 11 | 0.492 | 15 | 1.4 | 8 | 0.942 | 4 |
| 17 | 0.808 | 21 | 0.872 | 26 | 0.901 | 20 | 0.347 | 27 | 0.947 | 21 | 0.688 | 25 | 2.965 | 9 | 0.399 | 23 | 1.196 | 23 | 0.537 | 27 |
| 18 | 1.105 | 3 | 1.146 | 8 | 1.044 | 12 | 1.701 | 2 | 1.751 | 2 | 0.764 | 23 | 2.76 | 14 | 0.485 | 16 | 1.537 | 2 | 0.922 | 5 |
| 19 | 0.799 | 24 | 1.359 | 2 | 1.64 | 4 | 0.942 | 19 | 0 | 27 | 1.047 | 10 | 0 | 27 | 0.436 | 21 | 0 | 27 | 0.874 | 11 |
| 20 | 1.068 | 5 | 1.219 | 5 | 1.454 | 5 | 0.961 | 17 | 0.863 | 24 | 0.81 | 21 | 3.428 | 2 | 0.618 | 3 | 1.464 | 4 | 0.875 | 9 |
| 21 | 0.907 | 12 | 1.113 | 11 | 0.826 | 24 | 0.892 | 23 | 1.302 | 6 | 0.819 | 20 | 2.565 | 22 | 0.453 | 20 | 1.258 | 19 | 0.779 | 24 |
| 22 | 0.755 | 27 | 1.069 | 16 | 0.89 | 21 | 1.041 | 15 | 0.688 | 26 | 1.388 | 4 | 3.225 | 5 | 0.141 | 27 | 1.105 | 26 | 0.683 | 26 |
| 23 | 0.852 | 17 | 0.544 | 27 | 0.688 | 27 | 1.91 | 1 | 2.431 | 1 | 0.72 | 24 | 2.273 | 25 | 0.77 | 1 | 1.342 | 14 | 0.871 | 13 |
| 24 | 0.906 | 13 | 1.03 | 17 | 1.074 | 11 | 0.934 | 21 | 0.998 | 18 | 0.767 | 22 | 3.356 | 4 | 0.585 | 5 | 1.343 | 13 | 0.811 | 21 |
| 25 | 1.299 | 1 | 0.893 | 25 | 1.103 | 8 | 0.95 | 18 | 1.106 | 11 | 1.508 | 2 | 2.661 | 19 | 0.529 | 6 | 1.433 | 5 | 0.907 | 7 |
| 26 | 0.88 | 15 | 0.93 | 23 | 1.08 | 9 | 1.234 | 10 | 1.043 | 14 | 0.88 | 17 | 2.503 | 24 | 0.522 | 8 | 1.255 | 20 | 0.852 | 16 |
| 27 | 0.802 | 23 | 1.349 | 3 | 0.881 | 22 | 0.626 | 26 | 1.396 | 4 | 0.876 | 18 | 2.764 | 13 | 0.511 | 11 | 1.285 | 18 | 0.784 | 23 |

The conclusion is that the Spearman's rank correlation coefficient is significantly different from zero. This indicates a situation of positive correlation between the ranks of the efficiency scores for the *production stage* and the *intermediation stage*. For further detailed discussion on the efficiency improvement trend over the whole study period, the Malmquist index is decomposed into the intrinsic factors as described hereunder.

To further analyse the changes and trends in efficiency of the VBARD branches presented by the Malmquist index (TFPCH) in Table 6.7 during the study period, the thesis applies Equation 5.5 described in Section 5.2.3 of Chapter 5 to decompose the Malmquist index into its intrinsic components: EFFCH (*technical efficiency change*), TECHCH (*technological change*), PECH (*pure efficiency change*), and SECH (*scale change*). The mean EFFCH, TECHCH, PECH, SECH and TFPCH scores in the *production stage* as well as in the *intermediation stage* produced in Table 6.7 are presented in Figures 6.5 and 6.6, respectively. These figures illustrate historical developments on the averages of TFPCH, EFFCH, TECHCH, PECH, and SECH scores in the period 2004–2008, for VBARD branches in both the *production* and *intermediation stages*.

The TFPCH and its intrinsic components (EFFCH, TECHCH, PECH and SECH) are quite stochastic. The average level of the Malmquist index (TFPCH) for the *production stage* and the *intermediation stage* at 0.545 and 0.895 indicates that TFP reduced by 45.5% and 10.5% among the VBARD branches over the period, respectively. This reduction is attributable to both the mean score of the technical efficiency index (EFFCH) of 0.964 (a decline of 3.7%) and the technological change index (TECHCH) at 0.558 (a decline of 44.3%) for the *production stage*. For the *intermediation stage*, the average TFP decline of 10.5% is attributable to an increase of 33.9% in EFFCH and a decline of 24.5% in TECHCH. Hence, for both the *production stage* and the *intermediation stage*, the TFP reduction is led by technological change (TECHCH) more than technical efficiency change (EFFCH).

Meanwhile, technical efficiency change (EFFCH) is decomposed into pure technical efficiency change (PECH) and scale efficiency change (SECH). For the *production stage*, the technical efficiency change declines by 3.7% over the period due to the reduction of both pure technical efficiency (2.1%) and scale efficiency (1.6%). However, for the *intermediation stage*, the technical efficiency change remained positive over the period (increase of 33.9%) thanks to an improvement of both scale efficiency (14.7%) and pure technical efficiency (12.2%).

The line passing from 1.0 on the y-axis in these figures is the ‘*demarcation line*’. The points above this line indicate improvement, whereas the points below it indicate deterioration in the relevant index during the period. Figures 6.5 and 6.6 show there is an apparent negative shift after 2006. Although Figures 6.5 and 6.6 provide a highly volatile picture, the dominance of efficiency changes in driving the productivity growth of VBARD branches is very obvious from the figures, as the efficiency change indices of almost all branches are below the demarcation line after 2006. This empirical evidence suggests that there is an improvement in the technical efficiency of VBARD branches (*EFFCH*) for the period before 2006 and that the peak of technological change improvement of VBARD branches is reached at the year of 2006, after which there is a deterioration trend.

Figure 6.5: Changes in productivity, efficiency and technology – production stage

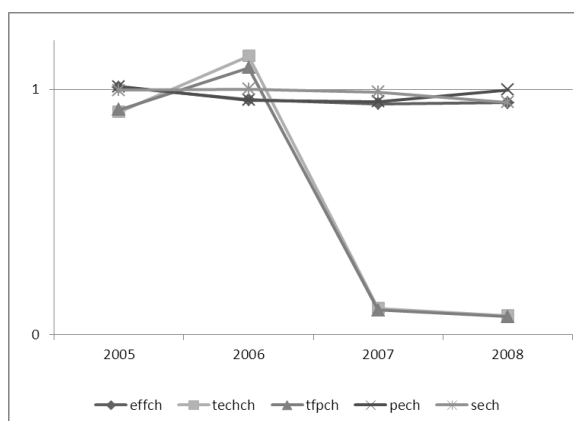
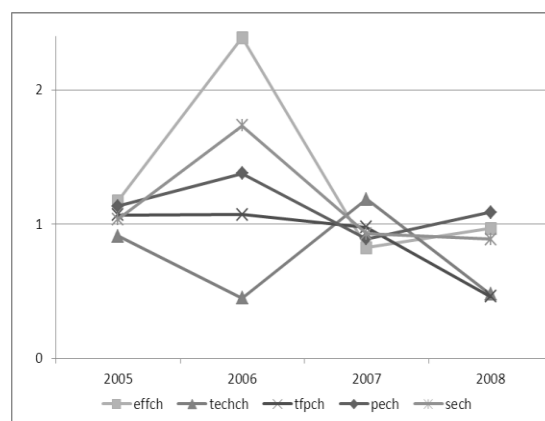


Figure 6.6: Changes in productivity, efficiency and technology – intermediation stage



This conclusion is a cornerstone for a conclusion that aims to answer Hypotheses H0 and H2, set out in Chapter 4 of the thesis. According to this empirical evidence, it is helpful to conclude that the null Hypotheses H0 and H2 of the thesis should be rejected for the pilot study from the case of VBARD. In other words, based on the pilot study of VBARD, it is suggested that the financial liberalisation and deregulation process in Vietnam negatively impacts on the efficiency of VBARD branches during the pilot study period of 2004–2008. This evidence also suggests that the year 2006 is the breaking point for the impacts of the financial liberalisation process on the efficiency of VBARD branches.

- Before 2006: the efficiency of VBARD branches is positively affected by the financial liberalisation process.
- After 2006: the financial liberalisation process negatively impacts on the efficiency of VBARD branches.

Hence, this solid evidence is an important implication for the main study on the efficiency of the banking sector at the bank level in Chapter 7. Accordingly, two critical issues must be tested and investigated for the main study in Chapter 7, as follows.

- (i) Find the empirical evidence to reject the null Hypotheses H0 and H2 of the thesis.
- (ii) Apply the breaking point in terms of time for the year 2006 to investigate the impacts of financial liberalisation on the efficiency of the banking sector in Vietnam. Following this suggestion, the main study in Chapter 7 is broken into two sub-periods: a period before 2006 and a period after 2006.

The productivity growth of the VBARD branches coincides with the financial liberalisation and deregulation policies in the 2000s, as shown in Figures 6.5 and 6.6. In essence, these changes observed in the productivity and efficiency measures depend on the changes in the outputs and inputs of the underlying branches. In other words, the negative outcome observed in the productivity of VBARD branches during financial liberalisation is a result of the developments in inputs and outputs of VBARD branches.

The results suggest that the technological change (*TECHCH*) initially declined as VBARD branches tried to adapt to the new business environment created by the financial liberalisation process. However, the technical efficiency of VBARD branches has eventually gained momentum and slightly improved after 2007. Most of the technology investments have been made in the beginning of the era, which increased the capital stock (fixed costs) of the VBARD branches substantially. In other words, the decrease in technical efficiency from 2004 to 2007 occurred when output volumes were growing at historically normal rates. Therefore, the overall efficiency decrease of these years is mainly a result of strong increase in input volumes. The steady productivity and efficiency growth in later years is to some extent due to utilisation of the idle capacity created in the advent of deregulation. The lower efficiency levels during the period could also be attributed to the financial distress experienced because of fierce competition from foreign rival entrants resulted from the WTO commitments implemented in Vietnam. This conclusion is reconfirmed by the detailed description of intrinsic components decomposed from the Malmquist index for each individual branch of VBARD in Table 6.8.

Table 6.8: Malmquist index summary of branch means in period 2004–2008

| Branch | Production Stage | | | | | Intermediation Stage | | | | |
|--------|------------------|--------|-------|-------|-------|----------------------|--------|-------|-------|-------|
| | EFFCH | TECHCH | PECH | SECH | TFPCH | EFFCH | TECHCH | PECH | SECH | TFPCH |
| 1 | 1.023 | 1.401 | 0.865 | 1.182 | 1.432 | 1.155 | 0.615 | 1.000 | 1.155 | 0.710 |
| 2 | 0.816 | 1.394 | 0.976 | 0.836 | 1.138 | 1.339 | 0.653 | 1.055 | 1.269 | 0.874 |
| 3 | 1.000 | 1.381 | 1.000 | 1.000 | 1.381 | 1.435 | 0.713 | 1.377 | 1.042 | 1.023 |
| 4 | 0.972 | 1.329 | 0.977 | 0.995 | 1.292 | 1.211 | 0.705 | 0.989 | 1.224 | 0.853 |
| 5 | 0.897 | 1.654 | 0.939 | 0.956 | 1.484 | 1.223 | 0.690 | 1.016 | 1.204 | 0.844 |
| 6 | 0.929 | 1.222 | 0.932 | 0.997 | 1.135 | 1.329 | 0.692 | 1.365 | 0.974 | 0.920 |
| 7 | 1.000 | 1.375 | 1.000 | 1.000 | 1.375 | 1.273 | 0.684 | 1.000 | 1.273 | 0.870 |
| 8 | 1.008 | 1.312 | 1.019 | 0.988 | 1.322 | 1.796 | 0.623 | 1.571 | 1.143 | 1.120 |
| 9 | 1.065 | 1.306 | 1.065 | 1.000 | 1.391 | 1.138 | 0.716 | 1.006 | 1.131 | 0.814 |
| 10 | 0.929 | 1.321 | 0.952 | 0.975 | 1.227 | 1.320 | 0.685 | 1.095 | 1.205 | 0.904 |
| 11 | 1.043 | 1.357 | 0.994 | 1.049 | 1.414 | 1.127 | 0.723 | 0.812 | 1.388 | 0.815 |
| 12 | 0.949 | 1.303 | 1.000 | 0.949 | 1.236 | 1.248 | 0.701 | 1.000 | 1.248 | 0.875 |
| 13 | 0.957 | 1.355 | 1.016 | 0.942 | 1.297 | 1.171 | 0.693 | 1.036 | 1.131 | 0.812 |
| 14 | 0.929 | 1.490 | 0.930 | 0.999 | 1.384 | 1.418 | 0.720 | 1.157 | 1.226 | 1.021 |
| 15 | 0.927 | 1.717 | 0.928 | 0.999 | 1.592 | 1.175 | 0.679 | 1.089 | 1.079 | 0.798 |
| 16 | 0.957 | 1.463 | 0.958 | 0.999 | 1.400 | 1.336 | 0.705 | 1.358 | 0.984 | 0.942 |
| 17 | 0.925 | 1.294 | 1.000 | 0.925 | 1.196 | 0.789 | 0.680 | 0.868 | 0.909 | 0.537 |
| 18 | 1.002 | 1.533 | 1.051 | 0.954 | 1.537 | 1.290 | 0.715 | 1.308 | 0.986 | 0.922 |
| 19 | 1.000 | 0.000 | 1.000 | 1.000 | 0.000 | 1.248 | 0.701 | 1.348 | 0.926 | 0.874 |
| 20 | 0.973 | 1.505 | 1.000 | 0.973 | 1.464 | 1.226 | 0.714 | 1.224 | 1.002 | 0.875 |
| 21 | 0.939 | 1.340 | 0.939 | 1.000 | 1.258 | 1.137 | 0.685 | 0.891 | 1.276 | 0.779 |
| 22 | 0.831 | 1.329 | 0.948 | 0.877 | 1.105 | 1.042 | 0.655 | 1.090 | 0.956 | 0.683 |
| 23 | 1.017 | 1.320 | 1.009 | 1.007 | 1.342 | 1.194 | 0.729 | 1.163 | 1.027 | 0.871 |
| 24 | 1.000 | 1.343 | 1.000 | 1.000 | 1.343 | 1.144 | 0.709 | 1.080 | 1.059 | 0.811 |
| 25 | 1.012 | 1.417 | 0.997 | 1.015 | 1.433 | 1.279 | 0.709 | 1.200 | 1.066 | 0.907 |
| 26 | 0.949 | 1.323 | 0.958 | 0.990 | 1.255 | 1.202 | 0.709 | 1.196 | 1.005 | 0.852 |
| 27 | 1.000 | 1.286 | 1.000 | 1.000 | 1.285 | 1.086 | 0.722 | 1.000 | 1.086 | 0.784 |

Note: Branches are categorised according to the following. Productivity growth: Malmquist index (TFPCH) > 1; Productivity loss: TFPCH < 1; Productivity stagnation: TFPCH = 1; Technical progress: TECHCH > 1; Technical regress: TECHCH < 1; Technical stagnation: TECHCH = 1; Efficiency, pure and scale efficiency increase: EFFCH, PECH and SECH > 1; Efficiency, pure and scale efficiency decrease: EFFCH, PECH and SECH < 1; No change in efficiency, pure and scale efficiency: EFFCH, PECH and SECH = 0.

The findings described in Table 6.8 suggest that, during the liberalisation period, increased funding costs, technical advances and competitive pressures are the critical drivers forcing VBARD branch managers to contract the scale of their operations by trimming excess labour and unprofitable business lines. Apparently opening policies in Vietnam in this period have been beneficial as the lifting of entry barriers brought in efficient and productive foreign banks from which local VBARD branches could learn new rules and code of practices.

The existing oligopolistic and highly concentrated market structure of VBARD is the key driver for the absence of a more effective competition at its branch level. The predominance of VBARD in the banking sector, especially the rural banking sector, has created an uneven playing field in the banking business because both its borrowing and lending operations have been politicised. Although VBARD and its branches have enjoyed the benefit of state support and public confidence with respect to the safety of deposits, VBARD should be considered as a major instrument for rent distribution in the political process. Those VBARD branches were also characterised by inefficient management, inadequate staff motivation and strict labour regulations.

6.6.1.2. Efficiency and its environmental variables from the non-parametric method

In the banking efficiency literature, there has been no consensus regarding the relationship between endogenous and exogenous variables and efficiency measures. To study the effects of those factors on a branch's efficiency, the thesis ranks the branches by those endogenous and/or exogenous factors based on the median values. To determine if there are any statistically significant differences between the efficiency of VBARD branches from the viewpoint of those endogenous/exogenous factors in the two stages (*production stage* and *intermediation stage*), the thesis applies the Kruskal–Wallis one-way ANOVA by ranks test on the pooled data of VBARD branches during the pilot study period.³¹

In Table 6.9, the thesis tests the impact of each individual endogenous and/or exogenous variable on the allocative efficiency of VBARD branches. The mean efficiency in Table 6.9 is statistically tested by the Kruskal–Wallis method. The *p-values* of the Kruskal–Wallis tests are shown in brackets in the table. The *p-values* that are recorded with three stars (***), two stars (**), and one star (*) suggest the Kruskal–Wallis tests are statistically significant at the 1%, 5% and 10% level of significance, respectively. Because the allocative efficiency of all VBARD branches in the *intermediation stage* is always in the frontier functions with a value of 1, as concluded by the empirical evidence in Section 6.6.1, the thesis does not take allocative efficiency into account. Instead of

³¹ In statistics, the Kruskal–Wallis one-way analysis of variance by ranks is a non-parametric method for testing equality of population medians among groups. Intuitively, it is identical to a one-way analysis of variance with the data replaced by their ranks. It is an extension of the Mann–Whitney U test to three or more groups. Since it is a non-parametric method, the Kruskal–Wallis test does not assume a normal population, unlike the analogous one-way analysis of variance. However, the test does assume an identically shaped and scaled distribution for each group, except for any difference in medians.

allocative efficiency, the pilot study takes cost efficiency and technical efficiency into comparison.

Table 6.9: Mean efficiency at production/intermediation stages

| | | Mean Rank | Kruskal–Wallis |
|--|---------------------|-----------|---------------------|
| (I) Production vs. Intermediation stage | | | |
| Cost efficiency | | 68.00 | 9.499 (0.090)* |
| Technical efficiency | | 67.00 | 7.851 (0.1646) |
| (II) Big vs. Small | | | |
| <i>Production stage</i> | | | |
| Cost efficiency | Big Branch | 33.5 | 4.235 (0.516) |
| | Small Branch | 33 | |
| Technical efficiency | Big Branch | 33.5 | 8.450 (0.133) |
| | Small Branch | 34 | |
| <i>Intermediation stage</i> | | | |
| Cost efficiency | Big Branch | 33.5 | 3.256 (0.661) |
| | Small Branch | 34 | |
| Technical efficiency | Big Branch | 33.5 | 3.256 (0.661) |
| | Small Branch | 34 | |
| <i>Overall</i> | Big Branch | 34 | 55.248 (0.317) |
| | Small Branch | 33.5 | |
| (III) Northern vs. Southern | | | |
| <i>Production stage</i> | | | |
| Cost efficiency | Northern Branch | 27.5 | 4.192 (0.122) |
| | Southern Branch | 40 | |
| Technical efficiency | Northern Branch | 27.5 | 10.206 (0.037)** |
| | Southern Branch | 40 | |
| <i>Intermediation stage</i> | | | |
| Cost efficiency | Northern Branch | 27.5 | 4.103 (0.534) |
| | Southern Branch | 40 | |
| Technical efficiency | Northern Branch | 27.5 | 4.103 (0.534) |
| | Southern Branch | 40 | |
| <i>Overall</i> | Northern Branch | 28 | 33.187 (0.648) |
| | Southern Branch | 40.5 | |
| (IV) High Asset Quality vs. Low Asset Quality | | | |
| <i>Production stage</i> | | | |
| Cost efficiency | High Quality Branch | 33.5 | 1.766 (0.622) |
| | Low Quality Branch | 33.51 | |
| Technical efficiency | High Quality Branch | 33.5 | 1.120 (0.891) |
| | Low Quality Branch | 33.5 | |
| <i>Intermediation stage</i> | | | |
| Cost efficiency | High Quality Branch | 33.5 | 2.248 (0.813) |
| | Low Quality Branch | 33.5 | |
| Technical efficiency | High Quality Branch | 33.5 | 1.542 (0.908) |
| | Low Quality Branch | 33.5 | |
| <i>Overall</i> | High Quality Branch | 34 | 38.866 (0.259) |
| | Low Quality Branch | 34 | |

| (V) High Performance vs. Low Performance | | | |
|---|------------------|------|------------|
| <i>Production stage</i> | | | |
| Cost efficiency | High Performance | 32.5 | 3.053 |
| | Low Performance | 32.5 | (0.548) |
| Technical efficiency | High Performance | 32.5 | 3.053 |
| | Low Performance | 32.5 | (0.548) |
| <i>Intermediation stage</i> | | | |
| Cost efficiency | High Performance | 32.5 | 2.260 |
| | Low Performance | 32.5 | (0.812) |
| Technical efficiency | High Performance | 32.5 | 14.438 |
| | Low Performance | 32.5 | (0.013)*** |
| <i>Overall</i> | High Performance | 33 | 35.438 |
| | Low Performance | 33 | (0.675) |
| (VI) High Tier vs. Low Tier | | | |
| <i>Production stage</i> | | | |
| Cost efficiency | High Tier | 32.5 | 8.399 |
| | Low Tier | 33 | (0.135) |
| Technical efficiency | High Tier | 32.5 | 15.946 |
| | Low Tier | 32.5 | (0.007)*** |
| <i>Intermediation stage</i> | | | |
| Cost efficiency | High Tier | 32.5 | 6.584 |
| | Low Tier | 32.5 | (0.253) |
| Technical efficiency | High Tier | 32.5 | 6.584 |
| | Low Tier | 32.5 | (0.253) |
| <i>Overall</i> | High Performance | 33 | 53.163 |
| | Low Performance | 33 | (0.390) |

The findings shown in Table 6.9 suggest the following main conclusions about the impact of each individual variable on the efficiency of VBARD branches.

- (i) In terms of *stage* (Production vs. Intermediation) there are statistically significant differences between the cost efficiency of VBARD branches; however, there are no statistical differences between the technical efficiency of VBARD branches. In this case the mean rank of cost efficiency scores of the branches is 68.
- (ii) In terms of *size* (Big vs. Small) there are no statistically significant differences between the technical efficiency or cost efficiency of VBARD branches at both the production and the intermediation stage.
- (iii) In terms of *location* (Northern vs. Southern) there are statistically significant differences between the technical efficiency of VBARD branches at the production stage. However, in other cases (cost efficiency at production stage; both cost and technical efficiency at intermediation stage) there is no difference between those efficiency measures. The mean rank of technical efficiency scores of the branches is 27.5 for the northern branches and 40 for the southern branches.

- (iv) In terms of *asset quality* (Good vs. Bad) the conclusion is the same as in the case of the *size* variable. There is no statistical evidence for differences between the technical and cost efficiency of VBARD branches.
- (v) In terms of *performance* (High vs. Low) there is unique statistically significant evidence for differences between the technical efficiency of VBARD branches at the intermediation stage. The mean rank of technical efficiency scores of the branches is 32.5.
- (vi) In terms of *capital adequacy* (High Tier vs. Low Tier) there is also unique evidence on the statistically significant difference between the technical efficiency of VBARD branches at the production stage. In this case, the mean rank of technical efficiency scores of the branches is 32.5.

The above conclusions about the impacts of the endogenous and exogenous variables on the technical and cost efficiency of VBARD branches are very relevant for addressing Hypotheses H3 and H4 in Chapter 4. Based on the empirical evidence from the pilot study of VBARD branches, it is suggested that the null Hypothesis H3 should be accepted and the null Hypothesis H4 rejected.

6.6.2. Technical and allocative efficiency estimated with the stochastic model

After measuring the efficiency of VBARD's branches by the ADEA method in Section 6.6.1, the pilot study continues estimating the production and cost efficiency of VBARD branches as well as decomposing those efficiency scores into the relevant environmental factors by some stochastic models. The assumption of multicollinearity for all regression equations in the pilot study is tested and presented in Appendix 3.5. The statistical evidence in Appendix 3.5 suggests rejecting the null hypothesis of no multicollinearity for some explanatory variables. Based on the multicollinearity tests, the entire regressions in the pilot study are run by the maximum-likelihood estimation method rather than the OLS method.

6.6.2.1. The production efficiency frontier

In this section, the allocative efficiency of VBARD branches is measured by the stochastic production frontier. A summary of the estimated results for the VBARD branches over the period is presented in Tables 6.10 and 6.11. Tables 6.10, 6.11 and 6.12

show the regression results for the allocative efficiency of VBARD's branches estimated from the stochastic production frontiers.

6.6.2.1.1. Return on equity as a proxy for profitability

Based on Equation 5.6 in Chapter 5, the estimated results of the first translog production frontier developed and empirically tested for the pilot study are presented in Table 6.10. The translog production frontier is the regression between the dependent variable of *ROE* (return on equity) representing profitability with the explanatory variables as follows.

- Time trend (t);
- Endogenous variables (x_{it}): *Sdep* (saving deposits), *Feeincome* (fee income), *Fixasset* (fixed assets), *Credit* (total outstanding credit);
- Exogenous variables (z_{it}): *Size* (total assets), *Quality* (asset quality presented by NPL ratio), *Risk* (liquidity risk), *CAR* and *Location* (the geography covered within the branch operation). In this model, the vector of exogenous variables (z_{it}) also consists of a constant.

As a result, the first translog production frontier applied for the pilot study follows the Cobb–Douglas functional form (*all variables are in the logarithm form*). In this regression, the thesis uses unbalanced panel data from 61 branches over five years (2004–2008), of which there are 27 branches in the first and second year, 49 branches in the third year and 61 branches in the fourth and fifth year.

$$ROE_{it} = \alpha_0 + \alpha_1 t_i + \alpha_2 Sdep_{it} + \alpha_3 Feeincome_{it} + \alpha_4 Fixasset_{it} + \alpha_5 Credit_{it} + \beta_0 + \beta_1 Size_{it} + \beta_2 Quality_{it} + \beta_3 Risk_{it} + \beta_4 CAR_{it} + \beta_5 Location_{it} + v_{it} - u_{it} \quad (6.1)$$

Table 6.10: The maximum-likelihood estimation for the *ROE* production frontiers

| | coefficient | standard-error | <i>z</i> -statistic | <i>p</i> -value |
|---------|-------------|----------------|---------------------|-----------------|
| Alpha 0 | -0.5450 | 0.1880 | -2.9000 | 0.0041*** |
| Alpha 1 | 0.0073 | 0.0060 | 1.2100 | 0.2262 |
| Alpha 2 | 0.0619 | 0.0194 | 3.2000 | 0.0016*** |
| Alpha 3 | 0.3440 | 0.0316 | 10.9000 | 0.0001*** |
| Alpha 4 | 0.0528 | 0.0328 | 1.6100 | 0.1091 |
| Alpha 5 | 0.6530 | 0.0280 | 23.3000 | 0.0001*** |
| Beta 0 | 0.2160 | 0.0455 | 4.7500 | 0.0001*** |
| Beta 1 | 0.2710 | 0.1050 | 2.6000 | 0.0101*** |

| | | | | |
|------------------------------------|---------|--------|---------|-----------|
| Beta 2 | -0.6510 | 1.0400 | -0.6280 | 0.5308 |
| Beta 3 | -0.1120 | 0.0487 | -2.3000 | 0.0222** |
| Beta 4 | -4.4500 | 0.9840 | -4.5200 | 0.0001*** |
| Beta 5 | -0.0154 | 0.0303 | -0.5090 | 0.6111 |
| Sigma-squared | 0.0111 | 0.0023 | 4.7900 | 0.0001*** |
| Gamma | 0.5280 | 0.1120 | 4.7200 | 0.0001*** |
| log likelihood function = 226.9554 | | | | |

Based on the regression results presented in Table 6.10, it points out the estimated time-trend coefficient (α_1) of 0.73% that suggests the annual average TFP change or technical progress of 0.73% per year but insignificant at 10% level. The marginal effects investigate the expected change of the dependent variable as a function of a change in a certain explanatory variable under the *ceteris paribus* assumption. The marginal effect measurement is required to interpret the effect of the regressors on the dependent variable. Consequently, the estimated coefficients of the dependent variables in Table 6.10 as well as the following tables in the thesis are statistically significant at the 1%, 5% and 10% level of significance, having three stars (***), two stars (**) and one star (*), respectively. This level of significance for each individual estimated coefficient is presented by its *p-value*. Other endogenous variables of the model – *Sdep*, *Feeincome* and *Credit* – are significant at the 1% level of significance, suggesting that the profit of VBARD branches is statistically significant with those inputs, namely saving deposits, fee income and total outstanding credit.

The sum of three production elasticities (0.0619 + 0.3440 + 0.6530) is 1.0589, which implies that there are slightly increasing returns to scale at the mean sample data. In terms of exogenous variables, the regression also predicts the significance at the 5% level of the positive relationship between profit and the size of the branch (*Size*), while it suggest the negative relationships between profit with liquidity risk (*Risk*) and equity (*CAR*). The LR test suggests that the included variables are significant at the 5% level of significance.

As a result, this empirical evidence suggests that null Hypothesis H3 should be accepted in terms of the variables *Sdep*, *Feeincome*, *Credit* and *Size*. However, this empirical evidence suggests that null Hypothesis H3 should be rejected in terms of the variables *Risk* and *CAR*.

6.6.2.1.2. Return on assets as a proxy for profitability

Similarly with the first production frontier, the second production frontier is also based on the regression between the dependent variable of return on total assets (*ROA*) representing profitability with the same explanatory variables as the first production frontier. However, due to the collinearity problem described in Appendix 3.5, the exogenous variable *Location* has been removed from the regression. As a result, the pilot study has the second translog production frontier as follows.

$$ROA_{it} = \alpha_0 + \alpha_1 t_i + \alpha_2 Sdep_{it} + \alpha_3 Feeincome_{it} + \alpha_4 Fixasset_{it} + \alpha_5 Credit_{it} + \beta_0 + \beta_1 Size_{it} + \beta_2 Quality_{it} + \beta_3 Risk_{it} + \beta_4 CAR_{it} + v_{it} - u_{it} \quad (6.2)$$

The translog production frontier (6.2) uses the same unbalanced panel data from 61 branches over five years, of which there are 27 branches in the first and second years, 49 branches in the third year and 61 branches in the fourth and fifth years. The translog production frontier (6.2) has been estimated with the results presented in Table 6.11.

Table 6.11: The maximum-likelihood estimation for the *ROA* production frontiers

| | coefficient | standard-error | <i>z</i> -statistic | <i>p</i> -value |
|--------------------------------------|-------------|----------------|---------------------|-----------------|
| Alpha 0 | 2.3600 | 5.2200 | 0.4510 | 0.6524 |
| Alpha 1 | -0.1070 | 0.1480 | -0.7260 | 0.4684 |
| Alpha 2 | 0.4800 | 0.1810 | 2.6500 | 0.0086*** |
| Alpha 3 | -0.0081 | 0.4240 | -0.0190 | 0.9848 |
| Alpha 4 | -0.0249 | 0.4480 | -0.0556 | 0.9557 |
| Alpha 5 | 0.3000 | 0.1660 | 1.8100 | 0.0724* |
| Beta 0 | 1.1300 | 0.9870 | 1.1400 | 0.2552 |
| Beta 1 | -6.2400 | 6.9100 | -0.9030 | 0.3677 |
| Beta 2 | -3.7000 | 11.8000 | -0.3130 | 0.7544 |
| Beta 3 | 0.3260 | 1.3700 | 0.2380 | 0.8121 |
| Beta 4 | -0.8740 | 1.6600 | -0.5260 | 0.5997 |
| Sigma-squared | 0.4630 | 0.4580 | 1.0100 | 0.3133 |
| Gamma | 0.9580 | 0.2910 | 3.2900 | 0.0012*** |
| log likelihood function = -133.94974 | | | | |

The estimated findings based on the translog production frontier (6.2) are not significantly as much as the production model (6.1). Based on the regression results in Table 6.11, it is suggested that the two variables of *Sdep* and *Credit* are significant at the 1% and 10% levels of significance respectively in terms of explaining profitability (*ROA*). The rest of the explanatory variables of the model are insignificant at the 10% level of significance in terms of explaining the independent variable (*ROA*). The technical progress coefficient (α_1) is -10.7%, suggesting that the VBARD branches have an annual average TFP reduction of 10.7%; however, the coefficient is insignificant at the 10%

level of significance. That is why the LR test suggests that those included variables are insignificant at the 5% level of significance.

The coefficient α_1 also supports the conclusion in Section 6.6.1.1 that the financial liberalisation process in Vietnam has not positively influenced the efficiency improvement of VBARD branches. Consequently, it again suggests that the null Hypotheses H0 and H2 of the thesis should be rejected. Furthermore, this empirical evidence also suggests that null Hypothesis H3, mentioned in Chapter 4, should be accepted in terms of the variables *Sdep* and *Credit*.

The regression parameterises the log-likelihood estimation in terms of Gamma ratio ($\gamma = \sigma_u^2 / \sigma^2$). This estimated ratio (0.958) is very high, implying that much variation in the composite error term is due to the inefficiency component.

6.6.2.1.3. Net interest margin as a proxy for profitability

The third translog production frontier model (6.3) follows the same functional form as the second translog production frontier (6.2). In this regression, the exogenous variable *Location* also has the colinearity problem.

$$NIM_{it} = \alpha_0 + \alpha_1 t_i + \alpha_2 Sdep_{it} + \alpha_3 Feeincome_{it} + \alpha_4 Fixasset_{it} + \alpha_5 Credit_{it} + \beta_0 + \beta_1 Size_{it} + \beta_2 Quality_{it} + \beta_3 Risk_{it} + \beta_4 CAR_{it} + v_{it} - u_{it} \quad (6.3)$$

The only difference between Equation 6.2 and Equation 6.3 is in terms of the independent variable. In the production frontier (6.3), the independent variable is the net interest margin (*NIM*).

Table 6.12: The maximum-likelihood estimation for the *NIM* production frontiers

| | coefficient | standard-error | <i>z</i> -statistic | <i>p</i> -value |
|---------|-------------|----------------|---------------------|-----------------|
| Alpha 0 | 0.3080 | 0.2690 | 1.1400 | 0.2535 |
| Alpha 1 | -0.0286 | 0.0082 | -3.4700 | 0.0006*** |
| Alpha 2 | 0.1420 | 0.0221 | 6.4100 | 0.0001*** |
| Alpha 3 | 0.6860 | 0.0400 | 17.2000 | 0.0001*** |
| Alpha 4 | 0.1460 | 0.0508 | 2.8700 | 0.0044*** |
| Alpha 5 | 0.0759 | 0.0128 | 5.9300 | 0.0001*** |
| Beta 0 | 0.4690 | -1.1100 | -1.1100 | 0.2693 |
| Beta 1 | -2.6000 | 0.7150 | -3.6400 | 0.0003*** |
| Beta 2 | 0.7640 | 0.4500 | 1.7000 | 0.0912* |
| Beta 3 | -3.4200 | 1.2200 | -2.8100 | 0.0053*** |

| | | | | |
|-------------------------------------|---------|--------|---------|-----------|
| Beta 4 | -0.5580 | 0.1850 | -3.0200 | 0.0029*** |
| Sigma-squared | 0.2510 | 0.0699 | 3.5900 | 0.0004*** |
| Gamma | 0.9170 | 0.0277 | 33.1000 | 0.0001*** |
| log likelihood function = 80.799124 | | | | |

The regression results for the production frontier (6.3) are shown in Table 6.12. This empirical evidence suggests that the unique explanatory variable of fee income (*Feeincome*) is statistically insignificant at the 10% level of significance. All other explanatory variables are significant at the 1% level of significance. The exception is *Quality*, which is significant at the 10% level of significance.

The time-trend coefficient (α_1) of -2.86% suggests annual average TFP change or technical progress of -2.86 %, which is significant at the 1% level. This coefficient suggests the technical change of the VBARD branches during the period has reduced 2.86% annually. The sum of elasticities of *Sdep*, *Feeincome*, *Fixasset* and *Credit* of (0.1420 + 0.6860 + 0.1460 + 0.0759 = 1.0499) again helps to confirm that there is an increasing return to scale in the sample of studied VBARD branches.

The three exogenous variables in the model (*Size*, *Risk* and *CAR*) also show a very significant relationship with the independent variable (*NIM*) at the 1% level of significance, while the variable *Quality* suggests a significant relationship at the 10% level of significance. Hence, the LR test suggests that those included variables are significant at the 5% level of significance. As a result, the empirical evidence in this situation helps to cement null Hypothesis H3 mentioned in Chapter 4 in terms of the variables of *Size*, *Quality*, *Risk* and *CAR*.

Similarly with the stochastic model (6.2) with *ROA* as a dependent variable, the parameterised log-likelihood Gamma ratio ($\gamma = \sigma_u^2 / \sigma^2$) in the model (6.3), as described by Equation 5.3 having value of 91.7% is fairly high, implying that much variation in the composite error term is due to the inefficiency component.

Table 6.13: Summary of production efficiencies of VBARD branches

| Year | No. of Branches in the Sample | No. of Branches with Inappropriate Data | No. of Evaluated Branches | Model | No. of Efficient Branches |
|------|-------------------------------|---|---------------------------|-------|---------------------------|
| 2004 | 27 | 0 | 27 | Pro1 | 6 |
| | | | | Pro2 | 27 |
| | | | | Pro3 | 6 |

| | | | | | |
|--|-----|---|-----|------|-----|
| 2005 | 27 | 0 | 27 | Pro1 | 6 |
| | | | | Pro2 | 27 |
| | | | | Pro3 | 6 |
| 2006 | 27 | 0 | 27 | Pro1 | 8 |
| | | | | Pro2 | 27 |
| | | | | Pro3 | 8 |
| 2007 | 27 | 0 | 27 | Pro1 | 6 |
| | | | | Pro2 | 27 |
| | | | | Pro3 | 6 |
| 2008 | 27 | 0 | 27 | Pro1 | 6 |
| | | | | Pro2 | 27 |
| | | | | Pro3 | 6 |
| 2004– 2008 | 135 | 0 | 135 | Pro1 | 11 |
| | | | | Pro2 | 135 |
| | | | | Pro3 | 11 |
| Note: - Pro1: the estimated findings of the stochastic production model (6.1) - Pro2: the estimated findings of the stochastic production model (6.2) - Pro3: the estimated findings of the stochastic production model (6.3) | | | | | |

The executive summary for the estimated findings of the stochastic production frontiers in this section is shown in Table 6.13. From Table 6.13 it can be seen that in the year 2004 there are 6 efficient branches among 27 branches in the sample for the (6.1) model, 27 efficient branches for the (6.2) model and 6 efficient branches for the (6.3) model. This is also found for the other years of 2005, 2007 and 2008. The only difference in this case is for the year 2006, where there are 6 efficient branches for both the (6.1) and (6.3) models. This is a very relevant finding to reconfirm the conclusion drawn in Section 6.6.1.1 that the year 2006 is the breaking point for the impacts of the financial liberalisation process on the efficiency of VBARD branches.

6.6.2.2. The cost efficiency frontier

The cost variables taken into account to measure the cost efficiency of the VBARD branches could be considered by the two following proxies as the independent variables of the cost frontiers.

- Total expenses (*Topex*)
- Operating expenses (*Opex*)

Meanwhile, the explanatory variables (the input prices and outputs) for the cost efficiency function of VBARD branches are named as follows.

- three outputs: saving deposits (*Sdep*), total outstanding credit (*Credit*), and non-interest income revenue from off-balance business (*Feeincome*)
- two input prices: price of deposits (*priceDEP*) and price of capital (*priceCAP*)

The statistical descriptions of those variables are presented in Appendix 3.1 and Appendix 3.2. Hence, for each proxy of cost variables mentioned above, the pilot study has a given cost efficiency function with the independent variables of total expenses (*Topex*) and operating expenses (*Opex*). Based on the stochastic cost frontier presented in Section 5.2.1.1 of Chapter 5, the thesis applies the cost frontier model that produces the regression results presented in Table 6.14 and 6.15. The translog cost function applied for the pilot study consists of three outputs, two input prices and five exogenous variables in the following form.

$$\begin{aligned} \ln c_{it} = & \alpha_0 + \alpha_1 * t_i + \sum_{n=1}^2 \alpha_n \ln w_{nit} + \sum_{p=1}^3 \alpha_p \ln q_{pt} + 0.5 \sum_{n=1}^2 \sum_{m=1}^2 \alpha_{nm} \ln w_{nit} \ln w_{mit} \\ & + \sum_{n=1}^2 \sum_{p=1}^3 \alpha_{np} \ln q_{pt} \ln w_{nit} + \sum_{p=1}^3 \alpha_{pp} (\ln q_{pt})^2 + \sum_{j=1}^5 \beta_j z_{jt} + v_{it} \end{aligned} \quad (6.4)$$

Where c_{it} is i th observation on cost variables (*Topex* or *Opex*), w_{nit} are input prices, q_{pt} are outputs and z_{it} are five exogenous variables consisting of *Size*, *Quality*, *Risk*, *CAR* and *Location*. Hence, with the three outputs and two input prices mentioned above, this translog cost function could be presented as follows.

$$\begin{aligned} c_{it} = & \alpha_0 + \alpha_1 * PriceDEP_{it} + \alpha_2 * PriceCAP_{it} + \alpha_3 * Sdep_{it} + \alpha_4 * Credit_{it} + \\ & \alpha_5 * Feeincome_{it} + \alpha_6 * (0.5 * PriceCAP_{it} * PriceDEP_{it}) + \\ & \alpha_7 * 0.5 * (PriceCAP_{it})^2 + \alpha_8 * 0.5 * (PriceDEP_{it})^2 + \\ & \alpha_9 * Sdep_{it} * PriceDEP_{it} + \alpha_{10} * Sdep_{it} * PriceCAP_{it} + \\ & \alpha_{11} * Credit_{it} * PriceDEP_{it} + \alpha_{12} * Credit_{it} * PriceCAP_{it} + \\ & \alpha_{13} * Feeincome_{it} * PriceDEP_{it} + \alpha_{14} * Feeincome_{it} * PriceCAP_{it} + \\ & \alpha_{15} * (Sdep_{it})^2 + \beta_{16} * (Credit_{it})^2 + \alpha_{17} * (Feeincome_{it})^2 + \\ & \beta_1 * Size_{it} + \beta_2 * Quality_{it} + \beta_3 * Risk_{it} + \beta_4 * CAR_{it} + \beta_5 * Location_{it} + v_{it} \end{aligned} \quad (6.5)$$

The multicollinearity tests for the explanatory variables of the cost frontiers in Tables 6.14 and 6.15 are also presented in Appendix 3.5. The variance inflation factors in

Appendix 3.5 suggest that there are significant multicollinearity linkages among those explanatory variables. As a result, the cost frontiers of the pilot study are also run by the maximum-likelihood estimation method instead of the OLS method.

Table 6.14: The maximum-likelihood estimation for the *Topex* cost frontiers

| | coefficient | standard-error | <i>z</i> -statistic | <i>p</i> -value |
|------------------------------------|-------------|----------------|---------------------|-----------------|
| Alpha 0 | 3.0377 | 1.2684 | 2.3949 | 0.0175*** |
| Alpha 1 | 0.5765 | 0.3289 | 1.7527 | 0.0812* |
| Alpha 2 | -0.5917 | 0.4278 | -1.3829 | 0.1682 |
| Alpha 3 | 0.6058 | 0.3390 | 1.7872 | 0.0754* |
| Alpha 4 | 0.0407 | 0.3503 | 0.1161 | 0.9077 |
| Alpha 5 | -0.1071 | 0.1336 | -0.8014 | 0.4239 |
| Alpha 6 | -0.0917 | 0.0375 | -2.4426 | 0.0154*** |
| Alpha 7 | 0.0306 | 0.0545 | 0.5612 | 0.5753 |
| Alpha 8 | -0.0508 | 0.0667 | -0.7621 | 0.4469 |
| Alpha 9 | 0.1250 | 0.0424 | 2.9449 | 0.0036*** |
| Alpha 10 | -0.0705 | 0.0610 | -1.1564 | 0.2489 |
| Alpha 11 | -0.0218 | 0.0517 | -0.4216 | 0.6738 |
| Alpha 12 | 0.1327 | 0.0611 | 2.1728 | 0.0310** |
| Alpha 13 | -0.0926 | 0.0135 | -6.8353 | 0.0001*** |
| Alpha 14 | -0.0126 | 0.0301 | -0.4189 | 0.6758 |
| Alpha 15 | 0.0113 | 0.0146 | 0.7734 | 0.4402 |
| Alpha 16 | -0.0045 | 0.0149 | -0.2992 | 0.7651 |
| Alpha 17 | 0.0140 | 0.0069 | 2.0278 | 0.0439** |
| Beta 1 | -0.4384 | 0.2548 | -1.7208 | 0.0868* |
| Beta 2 | 6.6227 | 1.0734 | 6.1701 | 0.0001*** |
| Beta 3 | -0.0457 | 0.0615 | -0.7425 | 0.4587 |
| Beta 4 | -2.1500 | 0.4973 | -4.3229 | 0.0001*** |
| Beta 5 | 0.0048 | 0.0216 | 0.2203 | 0.8259 |
| sigma-squared | 0.0060 | 0.0009 | 6.3931 | |
| Gamma | 0.8892 | 0.0315 | 28.1886 | |
| log likelihood function = 368.2555 | | | | |

In Table 6.14, the intercept coefficient (α_0) of 3.04 suggests that it is the expected mean value of total expense when all explanatory variables are zero. The other coefficients $\alpha_1, \alpha_3, \alpha_6, \alpha_9, \alpha_{12}, \alpha_{13}$ and α_{17} also suggest the statistically significant at 10% level of significance in terms of explaining the changes of total expenses (*Topex*).

Meanwhile, there are three exogenous variables among five variables that are statistically significant with total expenses (*Topex*). Those statistical relationships are represented by the significant coefficients of β_1, β_2 and β_4 .

This conclusion is again helpful to review Hypothesis H3 mentioned in Chapter 4. This finding suggests that null Hypothesis H3 should be accepted in terms of the endogenous

variables of input prices and outputs, namely *Sdep* and *Credit*, as well as the exogenous variables of *Size*, *Quality* and *CAR*.

Table 6.15: The maximum-likelihood estimation for the *Opex* cost frontiers

| | coefficient | standard-error | <i>z</i> -statistic | <i>p</i> -value |
|-----------------------------------|-------------|----------------|---------------------|-----------------|
| Alpha 0 | 3.4600 | 1.3500 | 2.5700 | 0.0110**** |
| Alpha 1 | 0.5740 | 0.3340 | 1.7200 | 0.0869* |
| Alpha 2 | -0.5730 | 0.4310 | -1.3300 | 0.1850 |
| Alpha 3 | 0.5910 | 0.3210 | 1.8400 | 0.0675* |
| Alpha 4 | -0.0267 | 0.3630 | -0.0734 | 0.9416 |
| Alpha 5 | -0.0949 | 0.1340 | -0.7060 | 0.4807 |
| Alpha 6 | -0.0932 | 0.0371 | -2.5200 | 0.0127**** |
| Alpha 7 | 0.0296 | 0.0542 | 0.5470 | 0.5852 |
| Alpha 8 | -0.0539 | 0.0669 | 0.0669 | 0.9467 |
| Alpha 9 | 0.1270 | 0.0432 | 2.9300 | 0.0038**** |
| Alpha 10 | -0.0696 | 0.0616 | -1.1300 | 0.2602 |
| Alpha 11 | -0.0225 | 0.0524 | -0.4280 | 0.6688 |
| Alpha 12 | 0.1290 | 0.0612 | 2.1100 | 0.0360** |
| Alpha 13 | -0.0934 | 0.0134 | -6.9500 | 0.0001**** |
| Alpha 14 | -0.0115 | 0.0281 | -0.4110 | 0.6819 |
| Alpha 15 | 0.0119 | 0.0139 | 0.8610 | 0.3905 |
| Alpha 16 | -0.0015 | 0.0154 | -0.0982 | 0.9219 |
| Alpha 17 | 0.0132 | 0.0070 | 1.9000 | 0.0594** |
| Beta 1 | -0.4260 | 0.2180 | -1.9600 | 0.0519** |
| Beta 2 | 7.0000 | 1.0200 | 6.8400 | 0.0001**** |
| Beta 3 | -0.0339 | 0.0599 | -0.5660 | 0.5719 |
| Beta 4 | -2.1000 | 0.4540 | -4.6200 | 0.0001**** |
| Beta 5 | 0.0033 | 0.0211 | 0.1580 | 0.8746 |
| sigma-squared | 0.0057 | 0.0010 | 6.0400 | |
| gamma | 0.8910 | 0.0333 | 26.7000 | |
| log likelihood function = 370.281 | | | | |

Applying operating expenses (*Opex*) to the same equation (6.5) to investigate the impacts of the explanatory variables on *Opex* creates the regression results presented in Table 6.15. The regression results in Table 6.15 point out similar findings to those presented in Table 6.14. In Table 6.15, 11 coefficients are statistically significant with the dependent variables (*Opex*). There are 7 coefficients of endogenous variables and 3 coefficients of environmental variables are statistically significant in terms of explaining *Opex*. The endogenous variables that have a statistically significant relationship with *Opex* are $priceDEP (\alpha_1)$, $Sdep (\alpha_3)$, $PriceCAP_{it} * PriceDEP_{it} (\alpha_6)$, $Sdep_{it} * PriceDEP_{it} (\alpha_9)$, $Credit_{it} * PriceCAP_{it} (\alpha_{12})$, $Feeincome_{it} * PriceDEP_{it} (\alpha_{13})$, $(Credit_{it})^2 (\alpha_{16})$ and $(Feeincome_{it})^2 (\alpha_{17})$. Furthermore, as in Table 6.14, in Table 6.15 the coefficients of

the environmental variables of $\beta_1(Size_{it})$, $\beta_2(Quality_{it})$ and $\beta_4(CAR_{it})$ also significantly explain the changes of operating expenses (*Opex*).

Hence, in this case, once more the null Hypothesis H3 of the thesis mentioned in Chapter 4 should be accepted. Following the empirical evidence from the case of *Opex*, it is confirmed that the individual explanatory variables, namely *priceDEP*, *Sdep*, *Credit*, *Feeincome*, *Size*, *Quality* and *CAR*, positively improve the allocative efficiency of VBARD branches. Hence, it is suggested that the same conclusion for commercial banks in Vietnam should be investigated by the main study at the bank level in Chapter 7.

The empirical evidence for the cases of both *Topex* and *Opex* shows no evidence to support null Hypothesis H4 mentioned in Chapter 4. The *Location* variable in both cases does not have a statistically significant impact on *Topex* and *Opex*. It means there is no statistical relationship between *Location* and the cost efficiency of VBARD branches.

6.7. Suggestions for the main study

The empirical findings of the pilot study are solid evidence for the main study conducted for the commercial banks in Vietnam in the next chapter – Chapter 7. The findings of the pilot study suggest relevant evidence for the research questions, research hypothesis and research methodology of the main study. Generally, the pilot study provides solid evidence to support the acceptance of null Hypothesis H3, while it suggests rejecting null Hypotheses H0 and H2. Hence, the pilot study helps to pave the way for applying the analytical framework to the main study of Vietnamese commercial banks in Chapter 7.

As a result, in the next chapter of the thesis, the thesis applies the same analytical framework developed and applied for the pilot study on a data set of Vietnamese commercial banks to measure and investigate their technical efficiency. Comparing the empirical findings between the pilot study and main study is also an interesting area for further debate and exploration in the next chapters.

The empirical findings of the pilot study are relevant evidence to confirm the validity of the research methodology and research framework intended to be applied for commercial banks in Vietnam. Because of the data constraints of the Vietnamese commercial banks, as described later in Chapter 7, in that chapter the main empirical studies on the technical efficiency of Vietnamese banks focus on using the DEA method of the *basic model* rather than the parametric method. Because the input prices data is unavailable for the banks in

Vietnam, the parametric methods used for the pilot study cannot be applied for the Vietnamese banks. Consequently, in the *two-stage model* applied for Vietnamese banks, the technical efficiency scores estimated by the *basic model* using the DEA method are deeply investigated by other explanatory determinants by using the Tobit model.

CHAPTER 7: EMPIRICAL STUDY ON VIETNAMESE BANKING EFFICIENCY

Following the pilot study, in this chapter the thesis investigates the technical efficiency of the Vietnamese banking sector in the period 2002–2012 at the bank level, as follows.

- i. The thesis presents the empirical studies on technical efficiency of Vietnamese banks for the sub-period of 2002–2005.
- ii. The thesis presents the empirical studies on technical efficiency of Vietnamese banks for the sub-period of 2006–2012.
- iii. The thesis compares the empirical results from the two above-mentioned sub-periods to investigate the impacts of financial liberalisation on the technical efficiency of Vietnamese banks during the whole period 2002–2012. The final conclusion and policy recommendations after comparing the outcomes of the two sub-periods should be presented for Vietnamese banks' efficiency during the period.³²

The whole study period (2002–2012) is decomposed into two sub-periods, namely 2002–2005 and 2006–2012, because of the changes in policy implemented by the Vietnamese authorities and the changes in the global financial landscape. These changes have significantly influenced the strategic moves and business strategy of Vietnamese banks including but not limited to changes in corporate governance, organic developments and M&A movements. Consequently, the technical efficiency of Vietnamese banks has been strongly questioned during the whole period, accordingly.

7.1. Data description

The data sources for the main study of the thesis at bank level are mainly based on the data of commercial banks in Vietnam collected and provided by the Investigation and

³² Because of the characteristics of the data collected from the Vietnamese banks but, more importantly, because of the suggestions of the pilot study, the entire study period 2002–2012 of the thesis is divided into two sub-periods, namely 2002–2005 and 2006–2012. As the pilot study suggests in Chapter 6, the year 2006 is the breaking point for the impacts of the financial liberalisation process on the efficiency of VBARD branches. Hence, it is important that the main study be anchored to the acceptably empirical basis tested by the pilot study. In other words, the main study intends to find the same empirical evidence on the breaking point of the year 2006 for the whole banking system in Vietnam, as in the findings for the case of VBARD branches.

Supervisory Department of the SBV and the Management Information System (MIS) of Vietcombank.³³ Furthermore, the data for the main study is collected from the other data resource, which is extracted from the audited annual reports issued by the Vietnamese commercial banks.

The data of the thesis is in the format of panel data combined by cross-sectional format and time-series format. The thesis also bases on the other data resources to collect data for the endogenous and exogenous variables as described by the *two-stage model* in Chapter 5 of the thesis.³⁴

In the first period, 2002–2005, the data is extracted from the audited annual reports of the Vietnamese commercial banks. The data for 2002 consists of 11 commercial banks, of which 3 are SOCBs and 8 are non-state-owned, 6 of them headquartered in the north and the remainder in the south of Vietnam. Meanwhile, data for 3 SOCBs and 29 non-state-owned banks was collected for the sample for 2003, of which 18 banks were headquartered in the south and the rest in the north. For the year 2004, there are 35 Vietnamese commercial banks: 21 from the south and the rest from the north, of which 2 are SOCBs and the rest are non-state-owned banks. In 2005, data was collected for 19 banks, 7 headquartered in the north and the remaining 12 in the south. Again, almost all of them are non-state-owned banks, while only 2 SOCBs are in the sample.

In the second period, 2006–2012, data is also extracted from the audited annual reports of the Vietnamese commercial banks and the MIS of Vietcombank. The 2006 data consists of 53 commercial banks and other non-bank credit institutions; 14 of them are SOCBs and other state-owned credit institutions (all of them are finance companies or leasing companies owned by SOCBs). Meanwhile, 47 commercial banks and other non-bank credit institutions were collected for the sample for 2010, 6 of which are SOCBs and other state-owned credit institutions. For the year 2011, there are 49 Vietnamese

³³ On 20 November 2014, the SBV issued Circular 36/2014/TT-NHNN ('Circular 36') regulating prudential ratios for the operations of onshore commercial banks. This amended and supplemented Circular 13/2010/TT-NHNN dated 20 May 2010 ('Circular 13'). Circular 13 (replaced by Circular 36) helps to strengthen the quality of banking operations through setting and monitoring important prudential ratios applicable for banking operations; and requests banks to report those ratios and their balance sheets daily to the Investigation and Supervisory Department of the SBV. All information collected from Circular 13 and Circular 36 is then shared by the Investigation and Supervisory Department of the SBV with each individual bank through the wired-connection MIS between the SBV and individual commercial banks. Consequently, the data for the main study is collected by the author through the MIS of Vietcombank.

³⁴ Similarly to the thesis, other studies on banking efficiency in Vietnam briefly reviewed in Chapter 3 – namely Hung (2007), Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a), Vu and Nahm (2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015) – collected the data for their empirical studies, especially the data for endogenous and exogenous variables, from the same audited annual reports issued by those commercial banks in Vietnam.

commercial banks and other non-bank credit institutions, of which 6 are SOCBs and other state-owned credit institutions. For 2012, the data is from 33 commercial banks and other non-bank credit institutions, 5 of which are SOCBs and other state-owned credit institutions.

7.1.1. Data for the DEA model

As developed and tested in the pilot study, two DEA models based on two different outputs are programmed to compute technical efficiency scores for Vietnamese banks in this chapter. Subsequently, comparisons of the findings of the two DEA models will be made to judge and identify relevant suggestions for further studies in the next sections of this chapter. If there is a considerable variance of the two DEA models, then judgement will be presented to define which result is more suitable for the case of Vietnam. Consequently, the efficiency scores of the better model will be used in the *two-stage model* to run the Tobit regression that decomposes the factorial effects of environmental variables on Vietnamese banks' technical efficiency levels.

For the first period, 2002–2005, the two DEA models use the same inputs, namely *interest expenses, labour, capital* and *fixed assets*. *Interest expenses* are the accrued interest paid for depositors. Because of the constraints involved in collecting the number of staff in the banks, *total labour cost* is used as a proxy for *labour*. Capital is the *equity capital*. *Fixed assets* are booked at cost less accumulated depreciation.

All the data extracted from the balance sheets of the commercial banks in Vietnam is based on the Vietnamese Accounting Standards. Outputs used in the first DEA model are *interest income* and *non-interest income*. *Profit before tax* is used as an output in the second DEA model. All these input and output data are measured in thousand VND. For foreign banks whose financial statements were presented in US dollars, the data is converted into VND at the official exchange rate quoted by the SBV.³⁵

The statistical information for all banks for the first period, 2002–2005, is summarised in Appendix 4.1. There is a significant variation among the observations in almost all variables over the period. In particular, the variable *capital* has substantially diversified; in the year 2005 the maximum capital of all observed banks is nearly 900 billion VND, while the minimum is only above 1 billion VND. In 2004, profits in observations range

³⁵ More information about the official exchange rate of VND/USD in Vietnam during the study period can be found in Appendix 1.1.

from VND643 million up to VND1.7 trillion. In 2002, interest income varies from VND9.3 billion to over VND9 trillion.

As for the first stage (2002–2005), the same two DEA models will be applied to measure and investigate the technical efficiency scores for Vietnamese banks during the second period, 2006–2012.

The two DEA models in the second period, 2006–2012, use different inputs but the same outputs as the two DEA models conducted for the first period, 2002–2005. Accordingly, the two DEA models in the second period use the inputs *Total outstanding credit, Total deposits, Inter-bank funding, Securities holdings, Total provisions, Equity*. Meanwhile, the outputs used for the two DEA models in the second period are *Net interest income* and *Profit before tax*. The statistical information for all banks in the second period is summarised in Appendix 4.2. As in the first period, 2002–2005, in the second period there is a significant variation among the observations. The underlying reason for the variation is the significantly different size between banks in Vietnam.

7.1.2. Data for Malmquist index computation

It is critical to investigate the change in technical efficiency of the Vietnamese commercial banks over the first period, 2002–2005; however, this is impossible because of a lack of balanced panel data. Using the modest panel data of 6 banks during this first period, the thesis measures the Malmquist TFP index and decomposed productivity change. Appendix 4.3 describes the statistical summary of those variables. The 6-bank sample for the first period 2002–2005 consists of SOCBs and JSCBs, of which the 2 SOCBs are BIDV and Vietcombank, and the 4 JSCBs are Sacombank, ACB, NamA Bank and Western Bank.

As for the first period, over the second period (2006–2012) the thesis faces a lack of balanced panel data. However, the number of balanced panel data in the second period has significantly increased to 23 banks, compared with 6 banks in the first period.

Appendix 4.4 describes the statistical summary of those variables for the second period.

The sample of 23 banks in the period 2006–2012 consists of SOCBs and JSCBs, of which 4 are SOCBs with some state-owned finance or leasing companies that are wholly owned by SOCBs, and the remainder are major JSCBs.

7.1.3. Data for Tobit regression in the *two-stage model*

There are more than 90 observations in the data sample for Tobit regression with two dummy variables, *d1* representing *ownership* and *d2* representing *geography*. These dummy variables have values either 0 or 1. In terms of *ownership*, *d1* = 1 if the bank is an SOCB; otherwise, *d1* = 0. In terms of *geography* *d2* = 1 if the bank is headquartered in the south, while *d2* = 0 if the bank is headquartered in the north. The other variables in the model also have the censored values of (0, 1]. An executive summary of the explanatory variables for the first period 2002–2005 is shown in Table 7.1.

Table 7.1: Statistical values of environmental variables, 2002–2005

| Variables | No. Observations | Min | Frequency | Percentage | Max | Frequency | Percentage |
|--------------|------------------|-------|--------------------|------------|-------|-----------|------------|
| d1 | 91 | 0.000 | 11 | 12.1% | 1.000 | 80 | 87.9% |
| d2 | 91 | 0.000 | 39 | 42.9% | 1.000 | 52 | 57.1% |
| Variables | No. Observations | Mean | Standard Deviation | Min | Max | | |
| eta | 91 | 0.108 | 0.123 | 0.020 | 0.950 | | |
| total assets | 91 | 0.145 | 0.277 | 0.000 | 1.000 | | |
| lk | 91 | 0.089 | 0.073 | 0.002 | 0.460 | | |
| lk2 | 91 | 0.013 | 0.030 | 0.000 | 0.212 | | |
| capital | 91 | 0.141 | 0.252 | 0.001 | 1.000 | | |

A correlation matrix between explanatory variables, namely the equity–total assets ratio (*eta*), the labour–capital ratio (*lk*), the equity capital score (*capital*) and total assets (*total assets*), shown in Table 7.2, also reaffirms a pre-test for the Tobit regression. The detection of multicollinearity of the Tobit regression is presented by the correlation matrix as described in Table 7.2 as well as the variance inflation factors as mentioned in Appendix 9. As a result, the Tobit regression should be executed for overall technical efficiency, pure technical efficiency and scale efficiency. In the Tobit model, the efficiency scores (dependent variables) are derived from the estimated findings of two DEA models.

Table 7.2: Correlation between independent variables in Tobit regression, 2002–2005

| | eta | total assets | lk | lk2 | capital |
|--------------|---------|--------------|--------|--------|---------|
| eta | 1.000 | | | | |
| total assets | -0.2578 | 1.000 | | | |
| lk | -0.3043 | 0.4709 | 1.000 | | |
| lk2 | -0.1722 | 0.5003 | 0.9176 | 1.000 | |
| capital | -0.2362 | 0.9433 | 0.4139 | 0.4895 | 1.000 |

181 observations in the data sample of the second period 2006–2012 are found with two similar dummy variables $d1$ and $d2$. The other censored variables in the model are also valued (0, 1]. The statistical summary of those explanatory variables for the second period 2006–2012 is shown in Table 7.3.

Table 7.3: Statistical values of environmental variables, 2006–2012

| Variables | No. Observations | Min | Frequency | Percentage | Max | Frequency | Percentage |
|--------------|------------------|-------|--------------------|------------|-------|-----------|------------|
| d1 | 181 | 0.000 | 156 | 86.2% | 1.000 | 25 | 13.8% |
| d2 | 181 | 0.000 | 112 | 61.9% | 1.000 | 69 | 38.1% |
| Variables | No. Observations | Mean | Standard Deviation | | Min | Max | |
| eta | 181 | 0.157 | 0.174 | | 0.000 | 0.944 | |
| total assets | 181 | 0.132 | 0.217 | | 0.001 | 1.000 | |
| pk | 181 | 0.065 | 0.078 | | 0.000 | 0.523 | |
| pk2 | 181 | 0.010 | 0.030 | | 0.000 | 0.273 | |
| capital | 181 | 0.178 | 0.235 | | 0.000 | 1.000 | |

A correlation matrix between explanatory variables, such as the equity–total assets ratio (eta), the provision–capital ratio (pk), the equity capital score ($capital$) and total assets ($total\ assets$), is shown in Table 7.4. This statistical description in Table 7.4 as well as the variance inflation factors as mentioned in Appendix 9 is a detection of multicollinearity of the Tobit regression. Consequently, all measures of efficiency in terms of overall technical efficiency, pure technical efficiency and scale efficiency should be applied in the Tobit regression.

Table 7.4: Correlation between independent variables in Tobit regression, 2006–2012

| | eta | total assets | pk | pk2 | capital |
|--------------|--------|--------------|-------|-------|---------|
| eta | 1.000 | | | | |
| total assets | -0.382 | 1.000 | | | |
| pk | -0.271 | 0.646 | 1.000 | | |
| pk2 | -0.186 | 0.604 | 0.929 | 1.000 | |
| capital | -0.167 | 0.903 | 0.617 | 0.567 | 1.000 |

7.2. Empirical results of technical efficiency in the *basic model*

7.2.1. General results of estimated efficiency

As described in the previous sections of the thesis, because of the high CAGR of the whole banking sector, Vietnamese banks tend to expand their business to sustain market share rather than shrinking their operations and cutting down their inputs. In these circumstances, an output-oriented approach to measure efficiency is a rational approach. Consequently, the DEA method chosen is the output-oriented approach. The CCR-O model proposed by Charnes, Cooper and Rhodes (1978) provides overall technical efficiency based on the assumption of constant returns to scale. Meanwhile, the BCC-O model developed by Banker, Charnes and Cooper (1984) measures pure technical efficiency based on the assumption of variable returns to scale. Because the balanced panel data during the study period is unavailable, this section applies the time-invariant efficiency approach.

7.2.1.1. Technical efficiency estimated with the first DEA model

In this section, the technical efficiency of Vietnamese banks is measured using the inputs of *labour*, *equity capital*, *fixed assets* and *interest expenses*, while the outputs are *interest income* and *non-interest income*. Detailed findings for all banks in the periods 2002–2005 and 2006–2012 are presented in Appendix 5. The estimated findings for the first DEA model are presented in Table 7.5.

The efficiency scores of the Vietnamese commercial banks during the period are considerably convergent. Findings from the first DEA model show that the average scale, pure technical and overall technical efficiency levels of Vietnamese commercial banks in the period 2002–2005 remain extremely high, at 97%, 92% and 90%, respectively. Compared with the estimated findings implemented by Hung (2007) for 13 Vietnamese commercial banks over the period 2001–2003, it can be seen the significantly consistent in terms of the technical efficiency scores. In the Hung (2007) study, the same outputs *interest income* and *non-interest income* were used, while inputs were *total labour expenses*, *physical capital* and *deposits*. Furthermore, Hung (2007) found that overall technical efficiency, pure technical efficiency and scale efficiency were high at 92%, 96% and 95%, respectively.

However, the average scale, pure technical and overall technical efficiency levels of Vietnamese commercial banks in the second period, 2006–2012, as shown in Table 7.5,

have been significantly reduced to 83%, 73% and 61%, respectively compared to the same indicators measured in the first period 2002–2005. These findings are similar to the conclusion of the pilot study conducted in Chapter 6. The empirical evidence helps to draw an important conclusion that the technical efficiency of commercial banks in Vietnam has been significantly reduced over the period 2002–2012. Hence, by this conclusion it is also suggested that null Hypothesis H2 of the thesis should be rejected.

This critical finding can be explained by the following main reasons: (i) because the sample (number of observations) in the first period 2002–2005 is much smaller than in the second period 2006–2012, it may not precisely represent the entire banking sector in Vietnam; (ii) the competitive pressures make the Vietnamese banks during the whole period of 2002–2012 focus on massively expanding scale and market share rather than on efficiency improvement (the CAGR of the Vietnamese banking sector in the last decade is more than 15%). This conclusion is also drawn in Chapter 4, which reconfirms the paradox in the Vietnamese banking sector for the so-called ‘*over-banking*’ in terms of number of banks but ‘*under-banking*’ in terms of quality of service. Naturally, this phenomenon not only introduces the threats to force the banks to implement restructuring and consolidating process but also brings great M&A opportunities to the banking sector in Vietnam. The next findings present empirical evidence to bring more food for thought for this conclusion.

Table 7.5: Summary of technical efficiencies in first DEA model

| Sample | No. of Banks in the Sample | No. of Banks with Inappropriate Data | No. of Evaluated Banks | Types of Technical Efficiency | Mean | Standard Deviation | Min | Max | No. of Efficient Banks |
|------------------------------|----------------------------|--------------------------------------|------------------------|-------------------------------|--------|--------------------|--------|-----|------------------------|
| 2002 | 11 | 0 | 11 | CRSTE | 0.9334 | 0.1892 | 0.3373 | 1 | 8 |
| | | | | VRSTE | 0.9382 | 0.1745 | 0.3885 | 1 | 8 |
| | | | | SCALE | 0.9870 | 0.0420 | 0.8680 | 1 | 8 |
| 2003 | 32 | 0 | 32 | CRSTE | 0.8978 | 0.1842 | 0.3427 | 1 | 17 |
| | | | | VRSTE | 0.9086 | 0.1761 | 0.3436 | 1 | 18 |
| | | | | SCALE | 0.9850 | 0.0330 | 0.8910 | 1 | 17 |
| 2004 | 35 | 0 | 35 | CRSTE | 0.8831 | 0.1624 | 0.2988 | 1 | 13 |
| | | | | VRSTE | 0.9256 | 0.1411 | 0.3027 | 1 | 22 |
| | | | | SCALE | 0.9530 | 0.0890 | 0.6120 | 1 | 13 |
| 2005 | | | | CRSTE | 0.9321 | 0.1205 | 0.4887 | 1 | 10 |
| | | | | VRSTE | 0.9426 | 0.1079 | 0.5429 | 1 | 11 |
| | | | | SCALE | 0.9870 | 0.0260 | 0.9000 | 1 | 10 |
| 2006 | 52 | 0 | 52 | CRSTE | 0.555 | 0.3123 | 0.069 | 1 | 10 |
| | | | | VRSTE | 0.748 | 0.2947 | 0.071 | 1 | 23 |
| | | | | SCALE | 0.746 | 0.2648 | 0.186 | 1 | 10 |
| 2010 | 47 | 0 | 47 | CRSTE | 0.708 | 0.285 | 0.060 | 1 | 15 |
| | | | | VRSTE | 0.775 | 0.297 | 0.091 | 1 | 23 |
| | | | | SCALE | 0.904 | 0.124 | 0.508 | 1 | 15 |
| 2011 | 49 | 0 | 49 | CRSTE | 0.620 | 0.310 | 0.052 | 1 | 13 |
| | | | | VRSTE | 0.687 | 0.309 | 0.099 | 1 | 20 |
| | | | | SCALE | 0.895 | 0.164 | 0.272 | 1 | 14 |
| 2012 | 33 | 0 | 33 | CRSTE | 0.582 | 0.303 | 0.016 | 1 | 6 |
| | | | | VRSTE | 0.727 | 0.297 | 0.085 | 1 | 12 |
| | | | | SCALE | 0.783 | 0.225 | 0.052 | 1 | 6 |
| Average for period 2002–2005 | | | | CRSTE | 0.9000 | | | | |

| | | | | | | | | | |
|--|--|--|--|-------|--------|--|--|--|--|
| | | | | VRSTE | 0.9200 | | | | |
| | | | | SCALE | 0.9700 | | | | |
| Average for period 2006–2012 | | | | CRSTE | 0.617 | | | | |
| | | | | VRSTE | 0.735 | | | | |
| | | | | SCALE | 0.834 | | | | |
| Note: overall technical efficiency (<i>crste</i>), pure technical efficiency (<i>vrste</i>) and scale efficiency (<i>scale</i>) | | | | | | | | | |

Furthermore, Table 7.5 also suggests that a major portion of the commercial banks during the period had been operating under constant returns to scale (63%). It also suggests that those banks would not need to change their output levels because any change in output would not bring about any efficiency improvement. Meanwhile, 22% of the whole sample has been operating under decreasing returns to scale. These findings suggest that those banks having decreasing returns to scale should reduce their outputs (or reduce market share) if efficiency improvement is their focus. The remaining 15% is the best banks with increasing returns to scale that could expand their business (market shares) for efficiency enhancement.

In the whole period, scale efficiency scores are always higher than pure technical efficiency scores. It is helpful to conclude that the overall technical inefficiency of the banks is more attributable to pure technical inefficiency. It suggests that many of those banks have not used the most efficient available technology for their operations. In other words, their technical efficiency will be improved should those banks boost technology advancement. This is the underlying reason to explain why the banking sector in Vietnam is under-banking in terms of quality of service. In the next section, the technical efficiency scores of Vietnamese commercial banks are estimated with a different model where profit is used as output while input variables remain unchanged.

7.2.1.2. Technical efficiency estimated with the second DEA model

Table 7.6 shows an executive summary of overall technical efficiency, scale efficiency and pure technical efficiency scores of the commercial banks for the whole study period 2002–2012. The efficiency scores of the banks are similar to each other, although the number of observations in the second DEA model is significantly different from year to year. The annual findings are close to the average technical efficiency levels.

The findings from the second DEA model are significantly different from those of the first DEA model. On average, the overall technical efficiency of all banks is 65%, pure technical efficiency is 75% and scale efficiency is 87%. In the second DEA model, four observations were skipped because their indicators are inappropriate for the DEA program. One observation in the year 2002 (VPBank) and three others in the year 2003

(Exim Bank, MSB, VPBank) were skipped in the DEA program because they had no profit.

Table 7.6: Summary of technical efficiencies in second DEA model

| Sample | No. of Banks in the Sample | No. of Banks with Inappropriate Data | No. of Evaluated Banks | Types of Technical Efficiency | Mean | Standard Deviation | Min | Max | No. of Efficient Banks |
|-------------------------------------|----------------------------|--------------------------------------|------------------------|-------------------------------|--------|--------------------|--------|-----|------------------------|
| 2002 | 11 | 1 | 10 | CRSTE | 0.6962 | 0.3288 | 0.1621 | 1 | 8 |
| | | | | VRSTE | 0.8158 | 0.3108 | 0.1865 | 1 | 4 |
| | | | | SCALE | 0.8440 | 0.2094 | 0.4700 | 1 | 6 |
| 2003 | 32 | 0 | 32 | CRSTE | 0.6768 | 0.2788 | 0.0031 | 1 | 5 |
| | | | | VRSTE | 0.7503 | 0.2797 | 0.0035 | 1 | 10 |
| | | | | SCALE | 0.8914 | 0.1457 | 0.5087 | 1 | 5 |
| 2004 | 35 | 0 | 35 | CRSTE | 0.6006 | 0.2635 | 0.0846 | 1 | 5 |
| | | | | VRSTE | 0.7384 | 0.2607 | 0.1314 | 1 | 11 |
| | | | | SCALE | 0.8265 | 0.2196 | 0.0846 | 1 | 5 |
| 2005 | | | | CRSTE | 0.6877 | 0.2289 | 0.3489 | 1 | 4 |
| | | | | VRSTE | 0.7259 | 0.2269 | 0.3668 | 1 | 5 |
| | | | | SCALE | 0.9418 | 0.0490 | 0.8406 | 1 | 4 |
| 2006 | 53 | 0 | 53 | CRSTE | 0.505 | 0.301 | 0.084 | 1 | 4 |
| | | | | VRSTE | 0.744 | 0.293 | 0.272 | 1 | 12 |
| | | | | SCALE | 0.699 | 0.326 | 0.084 | 1 | 4 |
| 2010 | 47 | 0 | 47 | CRSTE | 0.621 | 0.293 | 0.209 | 1 | 9 |
| | | | | VRSTE | 0.720 | 0.290 | 0.258 | 1 | 14 |
| | | | | SCALE | 0.859 | 0.155 | 0.383 | 1 | 10 |
| 2011 | 49 | 0 | 49 | CRSTE | 0.533 | 0.341 | 0.065 | 1 | 8 |
| | | | | VRSTE | 0.619 | 0.343 | 0.107 | 1 | 12 |
| | | | | SCALE | 0.858 | 0.223 | 0.315 | 1 | 8 |
| 2012 | 33 | 0 | 33 | CRSTE | 0.332 | 0.374 | 0.009 | 1 | 4 |
| | | | | VRSTE | 0.410 | 0.351 | 0.037 | 1 | 5 |
| | | | | SCALE | 0.776 | 0.268 | 0.038 | 1 | 4 |
| Average for period 2002–2005 | | | | CRSTE | 0.652 | | | | |
| | | | | VRSTE | 0.748 | | | | |
| | | | | SCALE | 0.872 | | | | |
| Average for period 2006–2012 | | | | CRSTE | 0.511 | | | | |
| | | | | VRSTE | 0.643 | | | | |
| | | | | SCALE | 0.797 | | | | |

Note: overall technical efficiency (*crste*), pure technical efficiency (*vrste*) and scale efficiency (*scale*)

Contrary to the findings of the first DEA model, in the second DEA model the proportions of banks operating under constant, increasing and decreasing returns to scale are sharply different. A paltry 31% out of the whole sample is operating under constant returns to scale. These banks should not change their output or input levels, since such a change would not help them to achieve any improvement in technical efficiency scores. Nearly half of the 93 observations in the second DEA model are found to be operating under increasing returns to scale. Meanwhile, one-fifth of the whole sample is operating under decreasing returns to scale, suggesting those banks should reduce their outputs and size to achieve efficiency improvements.

It is found in the second DEA model that the scale and the efficiency scores are higher than pure technical efficiency scores. These findings reconfirm that the overall technical inefficiency of the banks is more attributable to pure technical inefficiency. Hence, if those banks used more efficient available technology for their operations, their overall technical efficiency would be much higher.

The same conclusion about the downward trend of efficiency during the whole period 2002–2012 is found in the second DEA model. The average scale, pure technical and overall technical efficiency levels of Vietnamese commercial banks in the second period 2006–2012, as shown in Table 7.6, have been significantly reduced to 79%, 64% and 51% respectively from the equivalent levels of 87%, 74% and 65% in the first period 2002–2005. Consequently, as for the conclusion of the first DEA model, this evidence of the second DEA model repeatedly suggests rejecting null Hypothesis H2 mentioned in Chapter 4 of the thesis.

7.2.2. Comparing the findings of the two DEA models

The wide variance between the estimated results of the two DEA models implies that the choice of variables has a vital impact on the findings of the thesis. It affirms the conclusion of the literature synthesis that choosing the appropriate model is a critical success factor for study in this field.

Many variables can be chosen to form different models to measure the technical efficiency levels of Vietnamese commercial banks. However, due to the modest and limited size of data, only two DEA models are tested to measure technical efficiency levels. In the first period 2002–2005, the findings of the second DEA model are more appropriate for Vietnamese commercial banks because of the following factors.

- Firstly, the Vietnamese banking sector is still in its infancy; hence the estimated technical efficiency scores amounting to over 90% (scale efficiency is up to 97%) are suspiciously high.
- Secondly, when taking the CAR level of the Vietnamese commercial banks into account, the choice of interest income and non-interest income as outputs in the DEA model imposes an extremely high risk to the accuracy of efficiency estimation. As equity capital levels of commercial banks are limited and modest, banks have to use external sources of funds to finance their loans and other investments. In the fierce competitive environment, banks' costs of external capital are increasing. Consequently, NIM is significantly down due to a large portion of interest income that must be used to pay interest expenses. In that sense, the first DEA model is likely to provide less accurate technical efficiency results than the second DEA model.

The estimated findings of the two models are widely different. For the first model, figures from four years show that a majority of banks had high scale efficiency, pure technical efficiency and overall technical efficiency. Many of them were operating under constant returns to scale. In contrast, the results of the second model show that on average banks can improve their overall technical efficiency by 35%. There is a small number of the banks who used the most efficient technology for their operation. In both models, scale efficiency scores were always higher than pure technical efficiency scores, suggesting that overall technical inefficiency is more attributable to pure technical inefficiency. The results reveal that an adoption of better technology would help to improve the overall technical efficiency of those banks.

However, the results of the second period 2006–2012 show a different conclusion from that of the first period 2002–2005. Accordingly, the first DEA model is more appropriate for Vietnamese commercial banks. As competition is sharply increasing in the market, it leads to low productivity of the banks, and there remains a high correlation between some variables in the first DEA model. In that sense, the second DEA model is likely to provide less accurate technical efficiency results than the first model.

Furthermore, from the measures of both DEA models it helps to reaffirm the conclusion of Hung (2007). According to the estimated findings presented in Appendix 5, Vietcombank had measured efficiency scores of 1 during the study period. Hence, theoretically, Vietcombank is among the most efficient and most competitive banks in Vietnam. In other words, in terms of competitiveness and efficiency, Vietcombank is considered as a benchmark for other banks in Vietnam. The findings of the thesis again cement the conclusion of Hung (2007) that is briefly summarised in Chapter 3 and Chapter 4 of the thesis. This evidence is also helpful to suggest accepting null Hypothesis H1 mentioned in Chapter 4 of the thesis.

In summary, the DEA approach is adopted to estimate the technical efficiency of commercial banks in Vietnam for the whole period 2002–2012. In the first model, interest expense, equity capital, labour cost, and fixed assets are used as inputs, while interest income is the output. In the second model, while the input variables remain unchanged compared with the first model, profit is used as the ultimate output of commercial banks. The estimated results of the two DEA models are slightly different. As for the first period 2002–2005, in the second period 2006–2012 the scale efficiency scores in both DEA models were always higher than the pure technical efficiency scores.

In both DEA models, the scale efficiency scores were always higher than the pure technical efficiency scores, meaning that overall technical inefficiency is more attributable to pure technical inefficiency. The results reveal that an adoption of better technology would be helpful to improve the overall technical efficiency of those banks. As for the first period 2002–2005, in the second period 2006–2012, because of the low CAR of the banking sector, the results of the second DEA model tend to reflect the real efficiency status of the Vietnamese commercial banks better than the first model.

Last but not least, both DEA models simultaneously suggest:

- accepting null Hypothesis H1 confirming that Vietcombank is the benchmarked bank in Vietnam in terms of efficiency;
- accepting a new null hypothesis suggested by the empirical evidence of the pilot study that the year 2006 is considered as a breaking point for the financial liberalisation process in Vietnam. Accordingly, the empirical evidence simultaneously found by both pilot study and main study predicts that the cost efficiency and technical efficiency of branches and technical efficiency of banks declined after 2006;³⁶
- rejecting null Hypothesis H2 that the financial liberalisation process and deregulation policy in Vietnam significantly enable Vietnamese banks to improve their efficiency.

7.2.3. Technical efficiency in terms of region

As the pilot study suggested, the geographical factor has significantly influenced the efficiency of Vietnamese commercial banks. As a result, in this section of the thesis the sample of Vietnamese commercial banks is also decomposed into two groups, the south-oriented and non-south-oriented banks. Based on the two DEA approaches mentioned in the previous Sections 7.2.2 and 7.2.3, it suggests that the DEA model with profit as output provides better estimated findings. Hence, the following section applies this DEA model to estimate and compare the technical efficiency scores of commercial banks in terms of

³⁶ To further investigate the validity of the breaking point at the year 2006, it is necessary to apply more advanced econometric techniques. Among the relevant econometric techniques applied to test the breaking point at the year 2006 is the *Chow-test* invented by the economist Gregory Chow in 1960. In econometrical time series analysis, the *Chow-test* is used to test for the presence of a structural break when there is an unexpected shift in a time series leading to substantial forecasting errors and unreliability of the model. However, this is outside the scope of the thesis; hence it is suggested for future studies on the banking efficiency in Vietnam to test the hypothesis.

geography for each individual year during the period. The detailed findings of the DEA program are presented in Appendix 6.

Table 7.7: Summary of efficiency scores for southern vs. non-southern banks

| Year | Southern Banks | | | | | Non-Southern Banks | | | |
|--|----------------|--------------|--------------|--------------|--|--------------------|--------------|--------------|--------------|
| | no. obs. | crste | vrste | Scale | | no. obs. | crste | vrste | Scale |
| 2002 | 5 | 0.847 | 0.951 | 0.839 | | 5 | 0.620 | 0.688 | 0.901 |
| 2003 | 18 | 0.775 | 0.834 | 0.921 | | 13 | 0.637 | 0.861 | 0.752 |
| 2004 | 21 | 0.577 | 0.724 | 0.813 | | 14 | 0.728 | 0.868 | 0.821 |
| 2005 | 12 | 0.728 | 0.782 | 0.929 | | 7 | 0.746 | 0.840 | 0.882 |
| Average | | 0.719 | 0.811 | 0.889 | | | 0.688 | 0.837 | 0.821 |
| In the first DEA Model | | | | | | | | | |
| Year | Southern Banks | | | | | Non-Southern Banks | | | |
| | no. obs. | crste | vrste | Scale | | no. obs. | crste | vrste | Scale |
| 2006 | 21 | 0.539 | 0.786 | 0.686 | | 31 | 0.694 | 0.809 | 0.845 |
| 2010 | 31 | 0.716 | 0.769 | 0.920 | | 15 | 0.842 | 0.870 | 0.965 |
| 2011 | 31 | 0.617 | 0.724 | 0.849 | | 18 | 0.730 | 0.760 | 0.939 |
| 2012 | 20 | 0.500 | 0.682 | 0.670 | | 13 | 0.735 | 0.936 | 0.793 |
| Average | | 0.608 | 0.742 | 0.802 | | | 0.767 | 0.831 | 0.882 |
| In the second DEA Model | | | | | | | | | |
| Year | Southern Banks | | | | | Non-Southern Banks | | | |
| | no. obs. | crste | vrste | Scale | | no. obs. | crste | vrste | Scale |
| 2006 | 23 | 0.542 | 0.764 | 0.715 | | 29 | 0.675 | 0.828 | 0.811 |
| 2010 | 32 | 0.630 | 0.733 | 0.855 | | 15 | 0.645 | 0.725 | 0.892 |
| 2011 | 30 | 0.565 | 0.697 | 0.814 | | 18 | 0.629 | 0.686 | 0.889 |
| 2012 | 20 | 0.306 | 0.392 | 0.718 | | 13 | 0.692 | 0.860 | 0.818 |
| Average | | 0.530 | 0.665 | 0.787 | | | 0.661 | 0.779 | 0.847 |
| Note: overall technical efficiency (<i>crste</i>), pure technical efficiency (<i>vrste</i>) and scale efficiency (<i>Scale</i>) | | | | | | | | | |

The numbers of southern banks and non-southern banks are balanced in the sample; hence it is significant to compare the findings of the two groups. Table 7.7 suggests that the average overall technical efficiency and scale efficiency of the non-southern banks are lower than those of the southern banks in the first period, 2002–2005; while, average pure technical efficiency scores are higher for the non-southern banks. On average, banks headquartered in the southern areas and in non-southern areas achieved only 89% and 82% of their potential outputs, respectively.

In the year 2002, 60% of both southern banks and non-southern banks are operating at constant returns to scale. Meanwhile, 40% of non-southern banks are operating at decreasing returns to scale. However, 40% of southern banks are operating at increasing returns to scale, suggesting that their technical efficiency levels could be improved if they increased output.

In the year 2003, 42% and 29% of the non-southern banks and southern banks respectively are operating at constant returns to scale. The findings suggest that those banks do not need to change their inputs and outputs. The remaining 71% of southern banks are operating at increasing returns to scale. In contrast, 25% of non-southern banks are operating under decreasing returns to scale.

For the year 2004, 38% and 36% of the banks in the south and in the non-south are operating at constant returns to scale. Meanwhile, 38% and 34% are operating at increasing returns to scale, respectively. The remaining 24% and 20% are at decreasing returns to scale. In 2005, 42%, 16% and 42% of the southern banks are under constant, increasing and decreasing returns to scale respectively; meanwhile 100% of non-southern banks are running at constant returns to scale.

Entirely different conclusions for the banks in the second period, 2006–2012, have been drawn. The average overall technical efficiency score, average pure technical efficiency score and average scale efficiency score of non-southern banks are higher than for southern banks in both DEA models. These interesting findings suggest further evidence to enhance and cement the general conclusion that, due to fierce competitive pressures during the second period, Vietnamese banks (especially southern banks having more commercial-oriented decision-making processes) have been sacrificed and traded off the efficiency for the business expansion in terms of asset size and market share.

Furthermore, all the empirical evidence suggests that in the whole period the northern banks are generally more efficient than the southern banks. As a result, this conclusion suggests that null Hypothesis H4, which stated that commercial banks with business oriented in the north of Vietnam are more efficient than the southern-oriented commercial banks, should be accepted.

7.2.4. Technical efficiency in terms of ownership

The state-owned and non-state-owned banks have different characteristics that may impact on their technical efficiency scores; different frontiers for the two groups of

commercial banks are used in order to compare these studied observations. Because the second DEA model is more appropriate to compute banks' efficiency, this model is used to measure the efficiency scores of the banks in terms of the two ownership groups. The estimates of efficiency scores are done separately for each year, as shown in Table 7.8 and Appendix 7.

Table 7.8: Summary of efficiency scores for SOCBs vs. non-state-owned banks

| Year | SOCBs | | | | Non-State-Owned Commercial Banks | | | |
|--|----------|--------------|--------------|--------------|----------------------------------|--------------|--------------|--------------|
| | no. obs. | crste | vrste | Scale | no. obs. | crste | vrste | Scale |
| 2002 | 3 | 0.638 | 1.000 | 0.638 | 7 | 0.771 | 0.936 | 0.810 |
| 2003 | 3 | 0.784 | 1.000 | 0.784 | 29 | 0.696 | 0.780 | 0.895 |
| 2004 | 2 | 0.725 | 1.000 | 0.725 | 33 | 0.609 | 0.764 | 0.822 |
| 2005 | 2 | 0.736 | 1.000 | 0.736 | 17 | 0.735 | 0.798 | 0.920 |
| Average | | 0.719 | 1.000 | 0.719 | | 0.676 | 0.791 | 0.864 |
| In the first DEA Model | | | | | | | | |
| Year | SOCBs | | | | Non-State-Owned Commercial Banks | | | |
| | no. obs. | crste | vrste | Scale | no. obs. | crste | vrste | Scale |
| 2006 | 14 | 0.782 | 0.968 | 0.805 | 38 | 0.641 | 0.815 | 0.777 |
| 2010 | 6 | 0.971 | 0.993 | 0.978 | 40 | 0.699 | 0.742 | 0.932 |
| 2011 | 6 | 0.938 | 0.938 | 1.000 | 43 | 0.591 | 0.688 | 0.857 |
| 2012 | 5 | 0.876 | 0.880 | 0.993 | 28 | 0.475 | 0.655 | 0.688 |
| Average | | 0.864 | 0.953 | 0.907 | | 0.611 | 0.729 | 0.825 |
| In the second DEA Model | | | | | | | | |
| Year | SOCBs | | | | Non-State-Owned Commercial Banks | | | |
| | no. obs. | crste | vrste | Scale | no. obs. | crste | vrste | Scale |
| 2006 | 13 | 0.868 | 0.923 | 0.942 | 40 | 0.574 | 0.726 | 0.786 |
| 2010 | 6 | 0.837 | 0.838 | 0.994 | 41 | 0.593 | 0.700 | 0.850 |
| 2011 | 6 | 0.748 | 0.765 | 0.945 | 43 | 0.519 | 0.657 | 0.805 |
| 2012 | 5 | 0.605 | 0.796 | 0.764 | 28 | 0.261 | 0.378 | 0.642 |
| Average | | 0.794 | 0.853 | 0.923 | | 0.506 | 0.635 | 0.782 |
| Note: overall technical efficiency (<i>crste</i>), pure technical efficiency (<i>vrste</i>) and scale efficiency (<i>Scale</i>) | | | | | | | | |

The significant difference in the number of observations for each group in terms of ownership makes the comparison difficult. In addition, since the sample size for the SOCB group is limited, the results from this DEA estimation are highly sensitive. During the first period 2002–2005, the average overall technical efficiency and pure technical efficiency of the SOCBs are 4% and 21% respectively, which are higher than the indicators of their counterparts. However, the average scale efficiency of the non-state-owned banks is 15% higher than the scores of the SOCBs. Meanwhile, the pure technical efficiency levels of the SOCBs remain at the highest level of 1 over the first period 2002–2005. It is important to recall that, because of the small number of SOCBs in the sample, the estimated findings suggest that the SOCBs are fully efficient. These estimated results may not reflect real efficiency levels. The same trend is also prolonged in the second period 2006–2012 that the SOCBs in Vietnam are generally more efficient than the non-state-owned banks.

This conclusion seems a strange and unexpected outcome because it is not the same as almost all the studies described in the literature review. However, this conclusion is similar to other studies implemented for the case of the Chinese and Indian banking sectors. The question of whether the SOCBs in Vietnam are more efficient than the non-state-owned banks requires further investigation to make the validity adjustment. The following underlying factors should be brought into review for the efficiency of Vietnamese commercial banks.

- The interest rate (both deposit and lending) and exchange rate in Vietnam during the period 2002–2012 (especially the period 2010–2012) were still heavily controlled by the local authority (the SBV). During the period, the SBV applied a lot of administrative policies and instruments on the pricing process of commercial banks in Vietnam, including the floor and ceiling for the interest rate and exchange rate. Lack of competitive environment, the non-state-owned banks are absolutely less competitive than the SOCBs.
- SOCBs benefit not only from the uncompetitive market structure as mentioned above but also from cheap national resources. The land, building and even the human resources are inputs of SOCBs that are subsidised by government and significantly under-booked against their fair values. Meanwhile, the non-state-owned banks have to book marked-to-market those assets and resources as their true fair values.

Hence, all empirical evidence of this analysis suggests that null Hypothesis H5 of the thesis, which stated that the SOCBs are more efficient than the non-state-owned commercial banks and the branches of foreign banks, should be accepted.

7.3. Productivity improvement

Because the balanced panel data are available for six banks in the whole period 2002–2012, evaluation of the productivity change of those six banks based on the Malmquist TFP index is allowed. The all banks in the sample over the period do not reflect the productivity movement.

As discussed in the previous section, regarding the efficiency of the Vietnamese commercial banks, the second DEA model is better than the first DEA model. Based on this fundamental conclusion, the thesis computes and decomposes the productivity change of the six banks based on the second DEA model. For calculating the Malmquist index, the year 2002 is pegged as the base year. As a result, the indices are relatively calculated against the previous year and presented in Appendices 4.3 and 4.4. Summary findings of the Malmquist index and the productivity change in the whole period are shown in Table 7.9.

Table 7.9: Malmquist index summary

| MALMQUIST INDEX SUMMARY OF ANNUAL MEANS | | | | | | MALMQUIST INDEX SUMMARY OF BANKS MEANS | | | | | |
|---|-------|--------|-------|-------|--------|--|-------|--------|-------|-------|--------|
| year | effch | techch | pech | sech | tfpch | Bank | effch | techch | pech | sech | tfpch |
| | | | | | | 1 | 1.000 | 1.070 | 1.000 | 1.000 | 1.070 |
| 2003 | 1.011 | 1.341 | 1.042 | 0.971 | 1.356 | 2 | 1.234 | 1.042 | 1.308 | 0.944 | 1.285 |
| 2004 | 1.074 | 0.810 | 1.013 | 1.060 | 0.870 | 3 | 0.769 | 1.097 | 0.758 | 1.015 | 0.844 |
| 2005 | 0.925 | 1.362 | 0.903 | 1.024 | 1.260 | 4 | 0.887 | 1.080 | 0.917 | 0.967 | 0.958 |
| | | | | | | 5 | 1.000 | 1.252 | 1.000 | 1.000 | 1.252 |
| | | | | | | 6 | 1.198 | 1.325 | 1.000 | 1.198 | 1.587 |
| mean | 1.002 | 1.139 | 0.984 | 1.018 | 1.141 | mean | 1.002 | 1.139 | 0.984 | 1.018 | 1.141 |
| | | | | | | 1 | 0.955 | 0.736 | 0.960 | 0.994 | 0.702 |
| 2010 | 1.401 | 1.906 | 1.076 | 1.302 | 2.670 | 2 | 0.537 | 1.272 | 0.898 | 0.598 | 0.683 |
| 2011 | 0.712 | 0.096 | 0.894 | 0.796 | 0.068 | 3 | 0.840 | 1.736 | 1.086 | 0.774 | 1.459 |
| 2012 | 1.002 | ***** | 1.124 | 0.861 | ***** | 4 | 0.840 | 1.295 | 0.845 | 0.995 | 1.089 |
| Mean | 0.988 | 49.160 | 1.027 | 0.963 | 48.577 | 5 | 1.261 | 1.235 | 1.082 | 1.166 | 1.557 |
| | | | | | | 8 | 1.000 | 1.159 | 1.000 | 1.000 | 1.159 |
| | | | | | | 9 | 1.135 | 1.287 | 1.000 | 1.135 | 1.461 |
| | | | | | | 11 | 1.147 | 1.508 | 0.903 | 1.271 | 1.730 |
| | | | | | | 12 | 1.099 | 1.405 | 1.014 | 1.084 | 1.544 |
| | | | | | | 13 | 1.072 | 1.343 | 1.023 | 1.048 | 1.439 |
| | | | | | | 16 | 1.666 | 1.497 | 1.504 | 1.107 | 2.494 |
| | | | | | | 17 | 1.436 | 1.276 | 1.160 | 1.237 | 1.832 |
| | | | | | | 19 | 1.519 | 1.306 | 1.228 | 1.237 | 1.983 |
| | | | | | | 23 | 1.000 | 1.502 | 1.000 | 1.000 | 1.502 |
| | | | | | | 24 | 1.812 | 1.802 | 1.646 | 1.101 | 3.264 |
| | | | | | | 25 | 0.765 | 1.279 | 0.783 | 0.977 | 0.979 |
| | | | | | | 26 | 0.497 | 1.318 | 0.824 | 0.603 | 0.654 |
| | | | | | | 29 | 0.949 | 0.916 | 0.949 | 1.000 | 0.870 |
| | | | | | | 31 | 1.107 | 1.103 | 1.052 | 1.052 | 1.221 |
| | | | | | | 32 | 0.431 | 1.250 | 0.981 | 0.439 | 0.538 |
| | | | | | | 33 | 1.136 | 1.480 | 1.042 | 1.091 | 1.682 |
| | | | | | | 34 | 1.000 | 1.404 | 1.000 | 1.000 | 1.404 |
| | | | | | | 36 | 0.843 | ***** | 0.982 | 0.859 | ***** |
| | | | | | | Mean | 0.988 | 49.160 | 1.027 | 0.963 | 48.577 |

| MALMQUIST INDEX SUMMARY OF ANNUAL MEANS | | | | | | MALMQUIST INDEX SUMMARY OF BANKS MEANS | | | | | |
|--|-------|--------|-------|-------|--------|---|-------|--------|-------|-------|--------|
| Year | effch | techch | pech | sech | tfpch | Bank | effch | techch | pech | sech | tfpch |
| | | | | | | 1 | 0.955 | 0.736 | 0.960 | 0.994 | 0.702 |
| 2010 | 1.401 | 1.906 | 1.076 | 1.302 | 2.670 | 2 | 0.537 | 1.272 | 0.898 | 0.598 | 0.683 |
| 2011 | 0.712 | 0.096 | 0.894 | 0.796 | 0.068 | 3 | 0.840 | 1.736 | 1.086 | 0.774 | 1.459 |
| 2012 | 1.002 | ***** | 1.124 | 0.861 | ***** | 4 | 0.840 | 1.295 | 0.845 | 0.995 | 1.089 |
| Mean | 0.988 | 49.160 | 1.027 | 0.963 | 48.577 | 5 | 1.261 | 1.235 | 1.082 | 1.166 | 1.557 |
| | | | | | | 8 | 1.000 | 1.159 | 1.000 | 1.000 | 1.159 |
| | | | | | | 9 | 1.135 | 1.287 | 1.000 | 1.135 | 1.461 |
| | | | | | | 11 | 1.147 | 1.508 | 0.903 | 1.271 | 1.730 |
| | | | | | | 12 | 1.099 | 1.405 | 1.014 | 1.084 | 1.544 |
| | | | | | | 13 | 1.072 | 1.343 | 1.023 | 1.048 | 1.439 |
| | | | | | | 16 | 1.666 | 1.497 | 1.504 | 1.107 | 2.494 |
| | | | | | | 17 | 1.436 | 1.276 | 1.160 | 1.237 | 1.832 |
| | | | | | | 19 | 1.519 | 1.306 | 1.228 | 1.237 | 1.983 |
| | | | | | | 23 | 1.000 | 1.502 | 1.000 | 1.000 | 1.502 |
| | | | | | | 24 | 1.812 | 1.802 | 1.646 | 1.101 | 3.264 |
| | | | | | | 25 | 0.765 | 1.279 | 0.783 | 0.977 | 0.979 |
| | | | | | | 26 | 0.497 | 1.318 | 0.824 | 0.603 | 0.654 |
| | | | | | | 29 | 0.949 | 0.916 | 0.949 | 1.000 | 0.870 |
| | | | | | | 31 | 1.107 | 1.103 | 1.052 | 1.052 | 1.221 |
| | | | | | | 32 | 0.431 | 1.250 | 0.981 | 0.439 | 0.538 |
| | | | | | | 33 | 1.136 | 1.480 | 1.042 | 1.091 | 1.682 |
| | | | | | | 34 | 1.000 | 1.404 | 1.000 | 1.000 | 1.404 |
| | | | | | | 36 | 0.843 | ***** | 0.982 | 0.859 | ***** |
| | | | | | | Mean | 0.988 | 49.160 | 1.027 | 0.963 | 48.577 |

Note:

- Effch: technical efficiency change;
- Sech: scale efficiency change; and
- Tfpch: total factor productivity change.
- Techch: technical or technological change;
- Pech: pure technical efficiency change;

Table 7.9 suggests that in both 2003 and 2005 there is an overall productivity improvement by all six studied banks with values of 35.6% and 26% respectively. However, there was a 13% decline in total factor productivity in 2004 because of adverse technological movement among those six banks.

The average productivity change is supported by both SOCBs and non-state-owned bank groups. Improvement in all efficiency indicators is presented by BIDV and Vietcombank (banks no. 2 and 5 respectively in the list) that suggests their positive contribution to the average TFP. These findings again reconfirm the conclusion of Hung (2007) summed up in Chapter 2. This evidence not only confirms Vietcombank as a benchmark for the whole banking system because of its highest efficiency scores of 1 year by year, but also establishes the efficiency improvement of Vietcombank over the period. Consequently, this is helpful evidence to suggest accepting null Hypothesis H1 of the thesis, which stated that Vietcombank is considered as a benchmark for other Vietnamese commercial banks in terms of efficiency and competitiveness.

However, within the non-state-owned bank group there is contradicting productivity movement. Among them, ACB and Western Bank (banks no. 1 and 6 respectively) had improved productivity, while NamA Bank and Sacombank (banks no. 3 and 4 respectively) presented a decline trend in their productivity over the period.

7.4. Factorial effects on technical efficiency by the *two-stage model*

In this section, the technical efficiency of Vietnamese commercial banks previously measured by the DEA models is decomposed into factorial effects (environmental variables) using the *two-stage model* Tobit regression. Relevant regressions are executed to investigate whether the environmental variables might have statistically significant impacts on overall technical efficiency (*crste*), pure technical efficiency (*vrste*) and scale efficiency (*scale*). Because of the different types of data collected during the two sub-periods (2002–2005 and 2006–2012), the Tobit models used to decompose factorial effects on efficiency of banks are slightly different.

The measured efficiency scores from the two DEA models in the two sub-periods were used to run the Tobit regression. Consequently, two sets of Tobit regressions were run separately for the measured efficiency scores obtained from the first and second DEA models for both sub-periods, as described below.

The Tobit model for the first period (2002–2005):

$$TE_i = \alpha_0 + \alpha_1 d1_i + \alpha_2 d2_i + \alpha_3 eta_i + \alpha_4 total\ asset_i + \alpha_5 lk_i + \alpha_6 lk2_i + \alpha_7 capital + \varepsilon_i \quad (7.1)$$

| | |
|--|--|
| <i>TE</i> : | Technical efficiency level |
| Ownership (<i>d1</i>): | <i>d1</i> =1 for non-state-owned banks <i>d1</i> =0 for state-owned banks |
| Geography (<i>d2</i>): | <i>d2</i> =1 for banks in the south <i>d2</i> =0 for non-southern banks |
| <i>eta</i> : | Share of assets financed by shareholders |
| Total assets score (<i>total assets</i>): | Represented by the score as described above |
| Labour/capital ratio (<i>lk</i>): | Equals total labour cost divided by capital |
| Squared labour/capital ratio (<i>lk2</i>): | The square of labour/capital ratio |
| <i>capital</i> : | Score of capital as described above |

The Tobit model for the second period (2006–2012):

$$TE_i = \alpha_0 + \alpha_1 d1_i + \alpha_2 d2_i + \alpha_3 eta_i + \alpha_4 total\ asset_i + \alpha_5 pk_i + \alpha_6 pk2_i + \alpha_7 capital + \varepsilon_i \quad (7.2)$$

| | |
|--|--|
| <i>TE</i> : | Technical efficiency level |
| Ownership (<i>d1</i>): | <i>d1</i> =1 for non-state-owned banks <i>d1</i> =0 for state-owned banks |
| Geography (<i>d2</i>): | <i>d2</i> =1 for banks in the south <i>d2</i> =0 for non-southern banks |
| <i>eta</i> : | Share of assets financed by shareholders |
| Total assets score (<i>total assets</i>): | Represented by the score as described above |
| Provision/capital ratio (<i>pk</i>): | Equals total provision cost divided by capital |
| Squared labour/capital ratio (<i>pk2</i>): | The square of provision/capital ratio |
| <i>capital</i> : | Score of capital as described above |

Based on the methodology for the *two-stage model* described in Chapter 5, the measured efficiency scores from the two DEA models executed in Section 7.2 are used as dependent variables to run the Tobit regressions. Consequently, two sets of Tobit models were regressed separately based on those measured efficiency scores for both sub-periods.

All multicollinearity tests for the explanatory variables in the first DEA model and second DEA model used to run the Tobit regression in Equations 7.1 and 7.2 are presented in Appendix 9. The multicollinearity tests presented in Appendix 9 suggest running the Tobit regression equations (7.1) and (7.2) by the ML - Censored Normal (TOBIT) (Quadratic hill climbing) method rather than the normal OLS method. As a result, all empirical Tobit regressions of the thesis are run by the ML - Censored Normal (TOBIT) (Quadratic hill climbing) method.

Furthermore, homoscedasticity is a critical assumption in Tobit regression. Hence, to test for the null hypothesis of no heteroscedasticity for the Tobit regressions in this chapter, firstly those Tobit regressions are run by the OLS method, and then the White's general heteroscedasticity test is applied for those OLS Tobit regressions. Appendix 10 presents

the findings of White's general heteroscedasticity test for those OLS Tobit regressions. Appendix 10 presents the White's general heteroscedasticity test for the first DEA model in the 2002–2005 period presenting the case of SCALE that suggests rejecting the null hypothesis of no heteroscedasticity. Meanwhile, in the second period of 2006–2012, it suggests rejecting the null hypothesis of no heteroscedasticity for the case of CRSTE, VRSTE and SCALE for the first DEA model and rejecting the null hypothesis of no heteroscedasticity for the case of CRSTE and VRSTE for the second DEA model.

Because of the existence of evidence for rejecting the null hypothesis of no heteroscedasticity, instead of the OLS method the thesis runs the entire Tobit regressions by the ML - Censored Normal (TOBIT) (Quadratic hill climbing) method. The graphs of estimated squared residuals for the Tobit regressions based on the ML - Censored Normal (TOBIT) (Quadratic hill climbing) method are presented in Appendix 11. The graphs of estimated squared residuals suggest accepting the null hypothesis of no heteroscedasticity in the Tobit regressions based on the ML - Censored Normal (TOBIT) (Quadratic hill climbing) method.

7.4.1. Factorial effects on technical efficiency from the first DEA model

The factorial effects on measured technical efficiency of the first DEA model in which the interest income is used as output are summed up in Table 7.10. The empirical findings for the period 2002–2005 indicate a positive linkage between levels of overall technical efficiency and pure technical efficiency with *total assets*. These findings suggest that the banks in this period 2002–2005 could achieve higher technical efficiency levels by increasing their total assets. Table 7.10 proves that the coefficients of the variable *lk* are statistically significant and different from 0 for all dependent variables namely, *crste*, *vrste* and *scale* at the 5% level of significance. The signs of linear and quadratic coefficients of the labour–capital ratio present a convex function of this ratio only for the case of overall technical efficiency. This suggests that there is a statistically significant correlation between overall technical efficiency and the labour–capital ratio. The findings from this Tobit regression are also helpful to verify the inverse relationship between overall technical efficiency and pure technical efficiency with *capital*.

Meanwhile, the empirical findings for the period 2006–2012 present insignificant linkage between levels of all efficiency indicators (*crste*, *vrste* and *scale*) and *total assets*. It means in the period the banks could not increase total assets (or market share) in order to achieve efficiency improvement. In other words, in the period 2006–2012, banks in

Vietnam have not reached economies of scale and economies of scope. This critical conclusion has been proved and cemented by various pieces of evidence in previous sections. However, as for the period 2002–2005, the coefficients of the variables pk , $pk2$ and $ownership$ are statistically significant and different from 0. The signs of linear and quadratic coefficients of the provision–capital ratio also present a convex function of this ratio only with the case of overall technical efficiency. The findings from this Tobit regression in the period 2006–2012 also suggest that there is a positive and inverse relationship between scale with location ($d2$) and share of assets financed by shareholders (eta).

Table 7.10: Summary of factorial effects (efficiency scores from first DEA model)

(Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing))

| The First Period 2002–2005 | | | | | | | | | |
|-----------------------------|-------------|--------|----------|-------------|--------|----------|-------------|--------|----------|
| Variables | CRSTE | | | VRSTE | | | SCALE | | |
| | Coefficient | z | p-value | Coefficient | z | p-value | Coefficient | z | p-value |
| d1 | -0.202 | -0.800 | 0.428 | -0.166 | -0.580 | 0.561 | -0.063 | -0.660 | 0.513 |
| d2 | -0.047 | -0.660 | 0.509 | -0.064 | -0.770 | 0.442 | -0.005 | -0.200 | 0.845 |
| eta | -0.334 | -1.180 | 0.242 | -0.232 | -0.720 | 0.473 | -0.166 | -1.530 | 0.130 |
| total assets | 1.063 | 1.710 | 0.091** | 1.618 | 2.190 | 0.032** | 0.096 | 0.500 | 0.619 |
| lk | -5.189 | -2.400 | 0.019*** | -5.054 | -2.020 | 0.047** | -1.844 | -2.300 | 0.024** |
| lk2 | 16.656 | 1.790 | 0.078** | 16.889 | 1.600 | 0.114 | 5.370 | 1.600 | 0.114 |
| capital | -1.490 | -2.790 | 0.007*** | -1.961 | -3.100 | 0.003*** | -0.236 | -1.470 | 0.144 |
| cons | 1.578 | 5.400 | 0.000*** | 1.604 | 4.850 | 0.000*** | 1.214 | 10.860 | 0.000*** |
| The Second Period 2006–2012 | | | | | | | | | |
| Variables | CRSTE | | | VRSTE | | | SCALE | | |
| | Coefficient | z | p-value | Coefficient | z | p-value | Coefficient | z | p-value |
| d1 | 0.293 | 3.465 | 0.000*** | 0.248 | 3.016 | 0.003*** | 0.090 | 1.500 | 0.134 |
| d2 | 0.025 | 0.541 | 0.588 | -0.019 | -0.447 | 0.655 | 0.055 | 1.712 | 0.087* |
| eta | 0.017 | 0.091 | 0.928 | 0.294 | 1.572 | 0.116 | -0.339 | -2.484 | 0.013*** |
| total assets | 0.231 | 0.873 | 0.383 | 0.170 | 0.662 | 0.508 | 0.065 | 0.344 | 0.731 |
| pk | -2.185 | -3.100 | 0.002*** | -1.432 | -2.091 | 0.036** | -0.905 | -1.808 | 0.071** |
| pk2 | 4.241 | 2.473 | 0.013*** | 3.080 | 1.847 | 0.065* | 1.401 | 1.149 | 0.251 |
| capital | -0.103 | -0.460 | 0.643 | -0.076 | -0.349 | 0.727 | -0.028 | -0.177 | 0.859 |
| cons | 0.652 | 1.261 | 0.000*** | 0.717 | 1.425 | 0.000*** | 0.893 | 2.428 | 0.000*** |

Hence, these findings suggest investigating and concluding the null Hypothesis H3 of the thesis as follows:

- (i) Contrary to the conclusion of the pilot study in Chapter 6, the results suggest that in the first period (2002–2005) the variables, namely ownership, location and share of assets, have no statistically significant impact on technical efficiency levels of the banks. However, the other variables, namely total assets, labour and capital, have statistically significant effects on the technical efficiency indicators of the Vietnamese banks. Hence, for the period 2002–2005 it is suggested that null Hypothesis H3, in terms of the variables of total assets, labour and capital, should be accepted, while null Hypothesis H3, in terms of the variables of ownership, location and share of assets, should be rejected.

(ii) Meanwhile, for the period 2006–2012, the findings are differentiated. There are two explanatory variables that are not statistically significant related to the technical efficiency levels of the banks, namely total assets and capital. The other variables, namely location, ownership, share of assets and provision–capital ratio, are partially or fully significantly related with one or all measures of technical efficiency of those banks. Consequently, the findings suggest that null Hypothesis H3, in terms of the variables of total assets and capital, should be rejected; however, null Hypothesis H3, in terms of location, ownership, share of assets and provision–capital ratio, should be accepted.

7.4.2. Factorial effects on technical efficiency from the second DEA model

The empirical findings of Tobit regression based on the measured efficiency scores resulting from the second DEA model are reported in Table 7.11.

Table 7.11: Summary of factorial effects (efficiency scores from second DEA Model)

(Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing))

| The First Period 2002–2005 | | | | | | | | | |
|-----------------------------|-------------|--------|----------|-------------|--------|----------|-------------|--------|----------|
| Variables | CRSTE | | | VRSTE | | | SCALE | | |
| | Coefficient | z | p-value | Coefficient | z | p-value | Coefficient | z | p-value |
| d1 | 0.237 | 0.830 | 0.407 | 0.170 | 0.520 | 0.603 | 0.147 | 0.820 | 0.413 |
| d2 | 0.164 | 2.090 | 0.040** | 0.225 | 2.460 | 0.016*** | 0.042 | 0.850 | 0.396 |
| eta | -0.220 | -0.700 | 0.486 | -0.042 | -0.110 | 0.912 | -0.114 | -0.570 | 0.572 |
| total assets | 0.434 | 0.840 | 0.404 | 0.421 | 0.700 | 0.484 | 0.115 | 0.350 | 0.724 |
| lk | -3.610 | -2.670 | 0.009*** | -5.810 | -3.070 | 0.003*** | -0.660 | -0.770 | 0.441 |
| lk2 | 6.241 | 1.990 | 0.049** | 15.781 | 2.520 | 0.014*** | -0.361 | -0.180 | 0.855 |
| capital | -0.158 | -0.390 | 0.700 | -0.137 | -0.290 | 0.775 | -0.023 | -0.090 | 0.928 |
| cons | 0.600 | 1.920 | 0.059* | 0.827 | 2.280 | 0.025** | 0.804 | 4.070 | - |
| The Second Period 2006–2012 | | | | | | | | | |
| Variables | CRSTE | | | VRSTE | | | SCALE | | |
| | Coefficient | z | p-value | Coefficient | z | p-value | Coefficient | z | p-value |
| d1 | -0.079 | -0.907 | 0.364 | 0.255 | 2.996 | 0.003*** | -0.322 | -4.881 | 0.000*** |
| d2 | -0.105 | -2.266 | 0.023** | -0.075 | -1.663 | 0.096* | -0.036 | -1.026 | 0.305 |
| eta | 0.045 | 0.227 | 0.821 | 0.527 | 2.718 | 0.007** | -0.379 | -2.529 | 0.011*** |
| total assets | -0.302 | -1.113 | 0.265 | -0.287 | -1.088 | 0.277 | -0.034 | -0.166 | 0.868 |
| lk | -2.344 | -3.264 | 0.001*** | -1.967 | -2.814 | 0.005*** | -0.672 | -1.243 | 0.214 |
| lk2 | 5.931 | 3.355 | 0.001*** | 4.375 | 2.542 | 0.011*** | 2.333 | 1.754 | 0.079* |
| capital | 0.407 | 1.777 | 0.075* | 0.180 | 0.807 | 0.420 | 0.282 | 1.640 | 0.101 |
| cons | 0.620 | 1.160 | 0.000*** | 0.655 | 1.258 | 0.000*** | 0.885 | 2.199 | 0.000*** |

In Table 7.11, the thesis briefly sums up the main empirical evidence of the Tobit regression. This table enables some different conclusions between two Tobit regressions to be made, as follows.

- (i) For both periods of 2002–2005 and 2006–2012 the variable of location (*d2*) significantly influenced overall technical efficiency and pure technical efficiency. Hence, this evidence suggests that null Hypothesis H3, for the case of location, should be accepted.

- (ii) The results of this regression do not suggest any positive linkage between total assets and any technical efficiency measures (*crste*, *vrste* and *scale*), as suggested in the previous Tobit model (the Tobit regression based on the measured efficiency scores resulting from the first DEA model). This evidence again suggests that null Hypothesis H3, for the case of total assets, should be rejected.
- (iii) There is no significant correlation between any types of technical efficiency measure with capital, except the case of *crste* in the period 2006–2012. This evidence also suggests that null Hypothesis H3, in terms of capital, should be rejected.
- (iv) However, the relationships between the labour–capital ratio and provision–capital ratio with technical efficiency scores have been confirmed by this Tobit regression. Table 7.11 suggests that coefficients of the variables, namely *lk*, *lk2*, *pk* and *pk2*, are statistically significant and different from 0. Coefficients of the variables *lk* and *pk* suggest that there is a convex function between this ratio and efficiency. As a result, it is suggested that null Hypothesis H3, in terms of the environmental variables labour–capital ratio and provision–capital ratio, should be accepted. The sign of those environmental variables also suggests some interesting conclusions:
- The negative sign of the labour–capital ratio suggests that the Vietnamese commercial banks should reduce the labour–capital ratio to improve their technical efficiency. In other words, the evidence suggests that the banks in Vietnam should pay more for labour (higher salary payment) rather than increase capital expenditures. This conclusion is also found by some empirical studies conducted for the Chinese and Indian banking sectors, which share the same low salary system as Vietnam. Furthermore, some other empirical studies on banking efficiency in Vietnam – namely Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a), Vu and Nahm (2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015) – suggest the same conclusion.
 - Meanwhile, the negative sign of the provision–capital ratio also suggests that the banks in Vietnam must strongly focus on solutions for the NPLs. The higher the NPLs in the balance sheet, the higher the financial expenditure for the provision of a bank. Consequently, if the banks do not have efficient solutions to collect the bad debt and the NPLs, then the banks could not write off the financial provision.

That is one of the critical underlying reasons to explain the negative sign of provision–capital ratio in the Tobit regression.

- (v) Table 7.11 also reinforces the findings that the environmental variables of ownership and share of assets do not significantly influence any types of technical efficiency during the period 2002–2005. However, in the second period 2006–2012, there is a statistically significant relationship between those environmental variables and technical efficiency. In the second set of Tobit regressions, the model does not find any environmental variables towards scale efficiency of those banks in the first period 2002–2005. However, in the second period 2006–2012 the findings show a statistically significant impact of the environmental variables ownership, location and $pk2$ on scale efficiency.

7.5. Concluding remarks

In the empirical studies in this chapter, the overall technical efficiency ($crste$), pure technical efficiency ($vrste$) and scale efficiency ($scale$) scores of Vietnamese commercial banks are measured using two DEA models that aim to compare the results and choose the most appropriate model for Vietnam. In the first DEA model, with interest expenses, labour, capital and fixed assets used as inputs, and interest income and non-interest income used as outputs, overall technical efficiency, pure technical efficiency and scale efficiency, on average, are found to be significantly decreasing from 90%, 92% and 97% in the period 2002–2005 to 61.7%, 73.5% and 83.4% in the period 2006–2012, respectively. In the second DEA model, with the same inputs as for the first DEA model, and with profit used as the ultimate output, the evidence suggests that the commercial banks could improve their overall technical efficiency, pure technical efficiency and scale efficiency by 35%, 25% and 13% for the period 2002–2005 and by 49%, 36% and 21% for the period 2006–2012, respectively.

A material difference between the estimated results of the two DEA models shows that a thorough review of the literature and a careful selection of variables for an analytical framework are key success factors for further studies in this field. Since the CAR of Vietnamese commercial banks is low, a major part of their income must be used to pay for interest expense. Consequently, in the first DEA model the input variable ‘interest expense’ and the output variable ‘interest income’ are highly correlated. This likely leads to inaccuracy of efficiency estimation. For this reason, the estimated results in the second

DEA model are believed to better reflect the real efficiency scores of Vietnamese commercial banks.

The second DEA model in this chapter provides better estimated results than its counterpart that was adopted in separate efficiency estimations for the banks of different ownership and location. The empirical results show that over both periods of 2002–2005 and 2006–2012, on average, the SOCBs are more overall technically and pure technically efficient than the rest. In contrast, SOCBs had lower scale efficiency than their counterparts.

In terms of location, the studied banks in the south had lower efficiency scores compared with their counterparts. These findings also suggest the same conclusion as those of the pilot study conducted in the previous chapter. Nevertheless, it is important to note that due to a difference in number of observations in terms of ownership and location, this simple comparison should be further investigated. The observed variance in this sample may not reflect the real relationship between all groups.

To identify determinants of technical efficiency of Vietnamese commercial banks, the thesis links the efficiency scores measured by the two DEA models with some relevant variables by applying a Tobit regression. Two separate sets of Tobit regression are executed for the technical efficiency levels from the two DEA models. Ownership and share of equity out of total assets do not show significant impacts on the technical efficiency levels of the studied banks over the periods of 2002–2005 and 2006–2012. There is a convex relation between labour–capital ratio and efficiency scores of the studied banks, suggesting that after passing the worst level of labour–capital ratio, the higher labour–capital ratio, the better banks' technical efficiency. However, the two sets of regression suggest some inconsistent findings about the impact of capital, location and total assets (bank size) on technical efficiency of the studied commercial banks. In the first set of Tobit regression, total assets is found to have a positive impact on overall technical efficiency and pure technical efficiency, while capital adversely influences these two types of technical efficiency. In contrast, the results of the second Tobit regression set asserted that there is no correlation between capital and total assets with the two efficiency types. The first Tobit regression does indicate that location is associated with technical efficiency, while the second regression indicates that location impacts on pure technical efficiency and overall technical efficiency.

Consequently, the critical empirical evidence of Chapter 7 is a solid base to test the hypotheses mentioned in Chapter 4 and to validate the main conclusions drawn out by the pilot study in Chapter 6 as well as by the studies conducted by Hung (2007), Ngo (2012), Vinh (2012), Minh *et al.* (2013), Nguyen and Stewart (2013), Vu and Nahm (2013a), Vu and Nahm (2013b), Matousek *et al.* (2014), Nguyen *et al.* (2014), and Nguyen and Simioni (2015). The empirical evidence of Chapter 7 suggests the main following conclusions.

- (i) Null Hypothesis H1 that Vietcombank should be considered as a benchmark for the Vietnamese banking sector in terms of efficiency and competitiveness should be accepted.
- (ii) Over the financial liberalisation period of 2002–2012 it can see the significant change in efficiency of Vietnamese commercial banks. However, the impacts of financial liberalisation on the efficiency of Vietnamese commercial banks are unexpected because these impacts are different from the literature review in Chapter 2. The evidence of the main study reaches the same conclusions as the pilot study. Both studies (pilot and main studies) suggest that the efficiency scores of banks and branches in Vietnam have been significantly reduced during the financial liberalisation process. Furthermore, both studies suggest that the year 2006 is considered as a breaking point for the financial liberalisation process in Vietnam in terms of efficiency improvement. Hence, based on both studies, it is suggested that null Hypothesis H2 mentioned in Chapter 4 of the thesis should be rejected.
- (iii) The efficiency scores of commercial banks in Vietnam have been significantly influenced by environmental variables (equity, total assets, ownership, location, labour, asset utilisation, liquidity position, provision, profitability ratios, and capital adequacy), especially in the second period of the study (2006–2012) when the financial liberalisation process in Vietnam is strengthened. However, the sign and the magnitude of impacts of those environmental variables on the efficiency of Vietnamese banks are differentiated. Generally, it is dependent on case-by-case basis in terms of each individual environmental variable; the empirical evidence of the thesis suggests accepting null Hypothesis H3. Hence, to improve the efficiency of Vietnamese commercial banks, it is necessary to deepen the reform of the banking business environment that aims to facilitate the positive impacts and mitigate the negative impacts of those variables on the efficiency of Vietnamese commercial banks. One of the key areas for the reform to facilitate the positive impacts of those

environmental variables is to change the constitutional environment and corporate governance in the Vietnamese banking sector, as briefly summed up in the next chapter of the thesis.

- (iv) The evidence of the thesis suggests accepting null Hypothesis H4, which stated that the commercial banks with business oriented in the north of Vietnam are more efficient than the southern-oriented commercial banks. Furthermore, the empirical evidence of the main study also suggests accepting null Hypothesis H5, which stated that the SOCBs are more efficient than the non-state-owned commercial banks and the branches of foreign banks.

- (v) Based on the findings and conclusions from the main study at the bank level in Chapter 7, it suggests rejecting null Hypothesis H0 that the financial liberalisation process in Vietnam significantly forces Vietnamese banks to streamline their operations and ownership to improve the efficiency of the banking sector. During the entire period of 2002–2012 it shows a mixed trend in efficiency scores of Vietnamese banks. There is an efficient improvement during the first sub-period 2002–2005 but declining efficiency during the second sub-period 2006–2012. This mixed trend of efficiency of banks in the whole period 2002–2012 is not enough to reach a clear conclusion to reject null Hypothesis H0. This is not only because of the unbalanced panel data of the thesis for the period but also because of the competitive pressures for local banks to compete with foreign entrants after 2006. Due to such competitive pressures the main business strategy of the local banks in the period 2006–2012 is to focus on size (market share) rather than on efficiency improvement. Consequently, further studies are necessary to test null Hypothesis H0 by expanding the time period for those studies as well as using more observations (more banks) in each individual year. Further studies could use a better data sample to investigate the strategic moves and trade-off decisions of local banks between size and efficiency. As a result, the null Hypothesis H0 should be investigated in more detail based on the further studies.

CHAPTER 8: CONCLUSIONS AND IMPLICATIONS FOR FURTHER STUDY

8.1. Concluding remarks

In the thesis, parametric and non-parametric methods are applied to estimate the technical efficiency of Vietnamese banks and the allocative efficiency of VBARD branches. The findings from the pilot study at branch level of the biggest bank in Vietnam in terms of total assets (VBARD) have produced empirical evidence to validate the research questions and hypotheses of the thesis. However, in contrast to the thesis hypotheses, the estimates from both DEA models and the *second-stage* model for the main study at bank level show that the technical efficiency scores of Vietnamese banks over the period 2002–2012 were not modest. The technical efficiency scores of the Vietnamese banks during the period suggest the following conclusions.

- (i) The efficiency scores of Vietnamese banks are significantly influenced by financial liberalisation in Vietnam and the global financial landscape, but in an inconsistent manner. The impacts of financial liberalisation on the technical and allocative efficiency scores of banks and branches respectively are very inconsistently presented by the changes in Malmquist index as well as the decomposition analysis on factorial effects over the two sub-periods of before 2006 and after 2006. Hence, the empirical evidence of the thesis shows that there are no prolonged and sustainable economies of scale and economies of scope in the Vietnamese banking sector.
- (ii) With the limited data sample, the thesis suggests that there is a mixed correlation between the openness of the banking sector in Vietnam and the efficiency of the banks. The empirical evidence of the thesis favours the negative correlation rather than the positive correlation. This conclusion is supported by the general evolution of efficiency scores of commercial banks and the deterioration of the average Malmquist index during the study period 2002–2012. The paradox is the outcome of a poor banking system where there is large number of bank with very low banking services provided. Hence, to improve the efficiency of Vietnamese banks there is no other way than to restructure and consolidate the banking sector to facilitate those banks to merge with each other. M&A in the banking sector in Vietnam to reduce

the number of banks in the system is the relevant way to help Vietnamese banks achieve sustainable efficiency and competitiveness. This conclusion is also recommended by other studies for the cases of Malaysian, Chinese and Indian commercial banks, as reviewed in Chapter 2.

Consequently, the empirical evidence from both the pilot study and the main study suggests that null hypotheses H1, H3, H4 and H5 should be accepted and that (i) Vietcombank is the benchmarked bank in Vietnam in terms efficiency; (ii) generally, each individual explanatory variable of equity, total assets, ownership, location, labour, asset utilisation, liquidity position, provision, profitability ratios, and capital adequacy contributes to the improvement of the efficiency of Vietnamese commercial banks; (iii) furthermore, during the financial liberalisation process, the northern banks in Vietnam are more efficient than the southern banks; (iv) meanwhile, SOCBs are more efficient than the non-state-owned commercial banks and the branches of foreign banks. From the acceptance of null Hypotheses H1, H3, H4 and H5, the significant impacts of the financial liberalisation process on banking efficiency in Vietnam are confirmed. However, the magnitude of those impacts is still questionable. The empirical evidence of the thesis points out the mixed impacts of financial liberalisation on the efficiency of Vietnamese banks during the period 2002–2012. As a result, null Hypotheses H0 and H2 are not supported by the empirical evidence of the thesis. Based on the results of the thesis, there are some main conclusions and suggestions on the thesis hypotheses, as follows.

Firstly, in accordance with the conclusion drawn by Hung (2007), the thesis again confirms that the Bank for Foreign Trade of Vietnam (Vietcombank) should be considered as a benchmark for banks in Vietnam for improving their efficiency and competitiveness.

Secondly, ownership seems to have statistically significant effects on the technical efficiency of the Vietnamese banks over the period 2002–2012. The Tobit regression in the thesis provides evidence for the hypothesis that the studied SOCBs are more efficient than their counterparts (the joint stock commercial banks and the foreign bank branches). The findings suggest that the financial liberalisation and reform policies conducted by the SBV and the government should be focused on an ownership-oriented reform approach to create a level playing field for all banks. This conclusion is also found in the banking sectors of China and India. Cautious consideration of this conclusion is required because of the limited data of the thesis (the unbalanced panel data sample of the thesis). During

the study period the market share of SOCBs significantly reduced from more than 80% to around 60%; however, the oligopoly of the Vietnamese banking sector, dominated by four major SOCBs, is a solid basis for those SOCBs to take advantage of economies of scale and economies of scope to compete with private and foreign banks. In addition, under the VN-US BTA framework and the commitments of Vietnam to the WTO, more foreign financial institutions are due to penetrate the Vietnamese banking market, and they will be entitled to full national treatment in 2018. In this context, further studies in this field with a broader sample, particularly including a greater number of foreign bank/joint-venture bank observations, might show different evidence about the relationship between ownership and technical efficiency. Furthermore, the complex ownership structure and cross-ownership at multiple levels of the banking system also influence the transparency in banking operations and corporate governance. That is why, in the restructuring scheme, the SBV recently tackled the ownership problems and violations arising from Circular No.36/2014/TT-SBV issued by the SBV and dated 30 November 2014 with stricter provisions on the legal mechanisms to manage cross-ownership. Policy implications relating to ownership type might change accordingly.

Thirdly, the outcomes of the Tobit regression using the efficiency scores and the estimates of efficiency for two separate regional groups (northern banks and southern banks) together assert that the location of a bank's headquarters has a significant impact on the technical efficiency score of that bank. In principle, under the fair competition condition, unlike the market distortion environment, the studied banks headquartered in the south of Vietnam are found to be less overall technically and pure technically efficient than their counterparts. It should be noted that, in the region where a bank has its headquarters, the bank often has a majority of its branches there. The efficiency difference might be attributable to a more conducive and competitive business environment in the south. This variance can be argued because of customer behaviour/preference and higher economic development levels in several key provinces in the south. Southern businesses and individuals tend to use and request more sophisticated banking products and services than their northern counterparts. Therefore, this may lead to a higher market penetration rate and higher operation cost for the southern banks. Following this argument, it is suggested that measures should be taken to change customers' behaviour in the north, pushing a higher proportion of their transactions into the banking system, and to reduce the number of transactions in cash. Nevertheless, more data should be included to reinforce the evidence for this finding. Further investigation

into the reasons why northern banks can be more technically efficient is also necessary so as to draw lessons for southern banks to improve their efficiency levels.

Supporting the thesis hypotheses, the results of the Tobit regressions show that enlarging the share of equity in total assets of the studied commercial banks would help to improve their technical efficiency. Although these findings could be challenged on the basis of data shortcomings, there is a policy implication that efforts to raise the equity–total assets ratio might be an effective measure to achieve technical efficiency improvements for those banks.

The thesis hypothesises that the labour–capital ratio and provision–capital ratio are correlated with technical efficiency scores. This relationship is affirmed by the results of both Tobit regressions for all technical efficiency scores obtained from two DEA models. The labour–capital ratio and provision–capital ratio are found to have a convex relation with the technical efficiency of the studied banks. These findings suggest that the government and banks' senior management should take measures to improve the labour–capital ratio and provision–capital ratio within the banks to improve their efficiency. The banks can increase their spending on staff training to improve the quality of their human resources. They might boost the appointment of professional managers and banking experts in order to adopt the appropriate policies to allow them to better utilise their capital and human resources. Vietnamese banks, particularly SOCBs, can consider and apply more flexible salary scales to attract skilful staff, and offer more attractive remuneration packages to keep their key personnel. In the context of the increasingly competitive banking market and the scarce talent human resources in Vietnam, the implications of this finding could be interesting for domestic banks. These solutions can lead to higher labour productivity and, in turn, help to improve technical efficiency of those banks.

The results of the Tobit regressions do not show consistently that an increase in total assets is a driving factor for higher technical efficiency. It is interesting to note that in the second set of Tobit regressions where the technical efficiency scores of the better DEA model are used, the independent variable *total assets* is found to have no significant impact on technical efficiency. It implies that the government should cautiously consider the recent M&A trends among some large banks and giant state-owned corporations in Vietnam just for the purpose of increasing size but not for the purpose of reforming corporate governance. One of the key purposes behind these arrangements is to accumulate total assets for new entities. Though these initiatives might be helpful for

banks and corporations to achieve different targets, they do not seem to be effective solutions in terms of improving the technical efficiency of banks.

Findings from the Tobit regressions also show the inconsistent effect of capital on the technical efficiency of banks. Because of the difference in the regression results, it is not possible to draw strong policy implications in terms of the impact of capital on the efficiency of banks in Vietnam. This result is due to the various ranges of banks in terms of capital in the sample, from very small banks to giant banks. The very different sizes of capital and total assets among the banks lead to different management codes of conduct and corporate governance that those banks apply in their routine operations. As a result, the impacts of capital on the efficiency scores of those banks are inconsistent during the study period.

8.2. Recommendations and policy implications

The Vietnamese banking sector recorded strong CAGR in profit and size during the study period of 2002–2012, despite a very tough macroeconomic environment. Over the period, credit is still the key driver for revenue creation because the increase in capital and other government interventions led banks to extremely high lending growth. For the non-interest income activities, the JSCBs are performing better than the SOCBs.

The banking sector has to face the uncertainty in policy of the local authorities, namely compulsory requirements for capital increase, removal of interest rate ceilings, limits on branch opening and bank mergers. Despite efforts to increase capital by nearly 23% annually in recent years, the CAGR of the banking sector of 15% requires the Vietnamese banks to continuously increase their capital base.

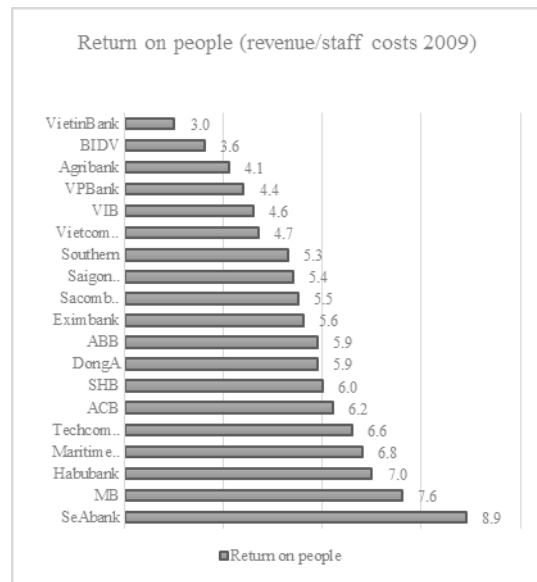
With the slowdown of efficiency in recent years, as mentioned in the thesis, it is necessary for industry rationalisation to be put in place as soon as is practical. The efficiency slowdown and reduced competitive advantage of Vietnamese banks as analysed in the thesis is a result of some of the following bottleneck factors to which the banks and local authorities in Vietnam need to pay attention.

- For the current size of the economy there are too many banks in Vietnam.
- The banking sector is both heavily concentrated and highly fragmented.

- Compulsory requirements from the authorities for enhancing capital adequacy may force the banks to conduct hostile merging with other banks provided that capital raising becomes more difficult and expensive.
- Increased competitive pressures push banks to develop economies of scale to protect and enhance their competitiveness both domestically and soon regionally. This trend pushes JSCBs to take market share from SOCBs.

A consequence of excessively aggressive lending growth is serious problems in the system in terms of bad debts. As recently announced by the Governor of the SBV at the end of 2011, the NPL in the banking system is around 10%; consequently it makes the capital of banks wiped out. Meanwhile, wage payment has been up twice to face the talent shortage in the banking sector. However, labour productivity is entirely diversified between banks, as Figure 8.1 shows.

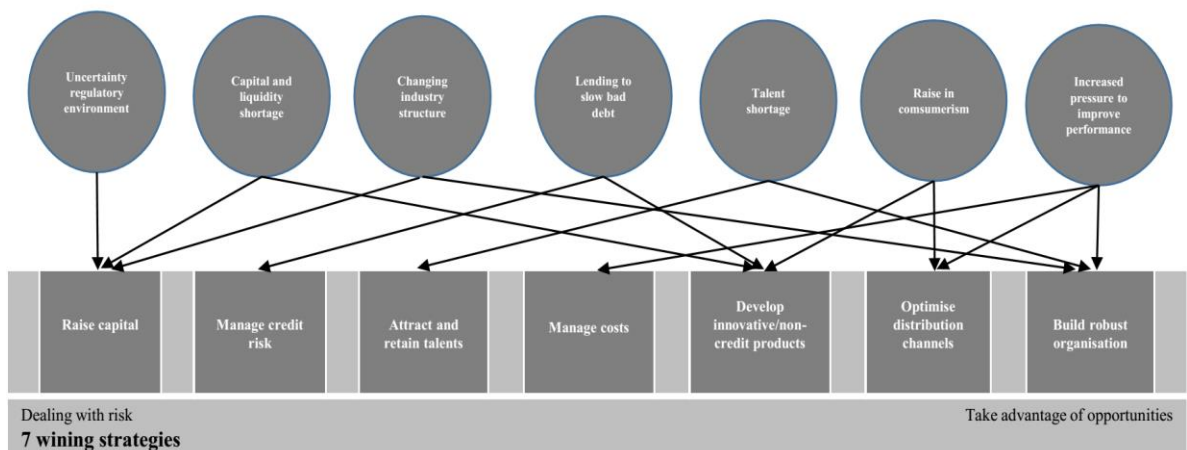
Figure 8.1: Labour productivity



Source: PricewaterhouseCoopers (2010: 36).

With the constraints described above, the thesis strongly recommends that the banks in Vietnam follow up and implement the advice of PricewaterhouseCoopers (2010) in order to enhance their competitiveness and efficiency. PricewaterhouseCoopers (2010) suggests that Vietnamese banks should focus on implementing seven themes, as described in Figure 8.2, to achieve sustainable competitiveness and efficiency.

Figure 8.2: Themes to improve sustainable competitiveness and efficiency



Successful implementation of the seven themes advised by PricewaterhouseCoopers (2010) requires Vietnamese banks to focus on the following key drivers.

- (i) To meet the minimum capital requirements requested by the SBV – minimum CAR of 9% – banks have to consider alternative funding sources rather than the traditional sources from the local stock markets or the strategic foreign investors, of which M&A is a relevant way out. This suggestion is consistent with the empirical evidence of the thesis about the effect of capital on efficiency improvement. The thesis implies that over-banking in terms of the number of banks in Vietnam, combined with low CAR, is a key factor in the low technical efficiency of Vietnamese banks. Consequently, M&A is a way out of both bottlenecks: too many banks with too low CAR. The SBV continues to show strong determination towards the restructuring of the Vietnamese banking system by aiming to reduce the number of commercial banks to just 14–17 by 2017. In regard to the SOCBs, the SBV has approved restructuring plans of the three main SOCBs, namely Vietcombank, VBARD and BIDV. These plans aim to enhance the financial capacity and risk management practices of those SOCBs. Particularly, Vietcombank and BIDV made proposals to reduce government shares to 65% by the end of 2015, while VBARD will have equity structure unchanged with 100% stake owned by the state by 2017. With respect to the JSCBs, the SBV has received restructuring plans from 24 out of 25 banks, and has approved 18 of them. The governing body of the banking system had proposed the overall plan to the government. M&A is still the SBV's favourite option for restructuring the weak commercial banks. Some recently approved M&A deals included JSC Sai Gon Thuong Tin Bank's acquisition of JSC Southern Bank, and JSC Vietnam Maritime Bank's acquisition of JSC Mekong Development Bank.³⁷
- (ii) To catch up with the CAGR of 15% in order to keep the competitiveness in a very fast industry like banking in Vietnam, the Vietnamese banks must keep sustainable credit growth. The empirical evidence of the thesis from both the pilot and the main study suggests that interest income is the most critical

³⁷ Combine the restructuring of the Vietnamese banking systems and finance companies, in that scheme, commercial banks recently acquire the finance companies to enable them to focus on consumer lending. Based on the most recent statistics, five out of seventeen finance companies in Vietnam have been purchased or are waiting for the acquisition plan from the banks. Of the twelve companies left, seven of them belong to other SOEs. With 2015 the due date for SOEs to divest capital from non-core business by the request of Vietnamese prime minister, these finance companies would be potential M&A targets for commercial banks in the coming time.

factor contributing to profitability in particular and efficiency in general. Hence, if the interest income down because of low credit growth, it is challenge for the banks to sustain their efficiency. However, the banks in Vietnam have experienced the bad lessons of high credit growth without asset quality control, leading to the high NPL ratio of 10% as the SBV Governor stated. Consequently, banks must make sure an adequate credit risk management framework is in place, as suggested by PricewaterhouseCoopers (2010).

- (iii) Reforming corporate governance is necessary, with the focus on setting up strategic risk management systems that concentrate on risk allocation over risk surveillance. This recommendation is backed up by the empirical findings of the thesis. During the study period of 2002–2012, the empirical analysis suggests that the strategic move of Vietnamese banks is to increase their size to maintain the market share. At the same time, banks ignore efficiency and risk. It shows transparent evidence that almost all banks in Vietnam have accepted the trade-off between size (market share) and efficiency and risk. Hence, adapting the international code of conduct for risk management for the banks in Vietnam is a critical success factor to enable those banks to maintain sustained efficiency. As a result, the SBV recently requested that the 10 biggest banks in Vietnam fully apply Basel II in their daily operations by 2018.
- (iv) Attracting and retaining talent through branding, training and performance-oriented evaluation are key success factors for the banks to achieve sustained efficiency and competitiveness. This suggestion is cemented by the Tobit regression in Chapter 7 with the statistically significant relationship between variables lk (labour–capital ratio), lk^2 and the efficiency score. Coefficient of the variable lk suggests that there is a convex function between this ratio and efficiency. Hence, to improve efficiency, it is necessary for the banks in Vietnam to maintain a competitive salary scheme to keep and recruit talent as well as create incentives to facilitate the productivity improvement of the labour force.
- (v) Strategic cost management requests to align operational costs and corporate strategy throughout managing the value chain. The banks also need to set up cost management systems that make sure costs are taken out without impact

on sustainable business growth. This conclusion is based on the stochastic cost frontier models run for the pilot study of the thesis. Based on the empirical regression evidence of the stochastic cost frontier models, the cost efficiency of branches is statistically significant with the variables priceDEP, Sdep, priceCAP, Credit, Feeincome, Size, Quality and CAR. Hence, this significant relationship between cost efficiency and these variables suggests the existence of horizontal and vertical integration in the value chain of the bank. The explanatory variables in the stochastic cost frontier models are the key values in both the production stage and the intermediate stage of the banking business that are briefly summarised in the two-stage banking model in Chapter 2.

- (vi) Developing services and products via the non-traditional distribution network must be prioritised by Vietnamese banks in their business strategy. This driver helps the banks access new markets with new technology that helps enhance the economies of scale and scope of banks. This recommendation is one of the key strategic moves for Vietnamese banks in the long run. In fact, the key driver of income and profit of the banks in Vietnam comes from the interest income. As concluded in the thesis, the non-interest income (fee income) contributes a minority portion in the total income of Vietnamese banks, but the efficiency of those banks, especially the private banks, is significantly dependent on the fee income. Hence, in addition to the traditional credit business, the banks should focus on expanding other fee-based services and products. Furthermore, the empirical evidence of both the pilot and the main study also suggests the following comments.
 - a. As a result of Vietnam's golden population structure (70% of the population is under 30 years old), the demand from the young generation for a non-traditional distribution network is high. Consequently, instead of developing the physical branch network, banks in Vietnam should focus much more on the non-traditional distribution network, such as internet banking, mobile banking, bancassurance and other high-technology-oriented products. In terms of the number of banks in Vietnam, as concluded in the thesis, Vietnam is over-banking, and so one recommendation is to restructure and consolidate the banking system by M&A to reduce the number of banks. As a result, should the banks focus

on developing the physical branch network, it could lead to a burden of cost without any efficiency improvement or increase in the client base.

- b. The banking sector in Vietnam is strongly affected by location. The southern banks are more business-oriented but less efficient than the northern banks. This phenomenon can be attributed not only to the banks but also to the clients. As pointed out, people in the south request costly and sophisticated banking services more frequently than those in the north. The number of accounts opened by people in the south is larger than in the north. The shortcomings of the Vietnamese banking sector suggest a potential opportunity for banks to develop new services and products via the non-traditional distribution network to enable them to approach to the potential existing client base.

8.3. Suggestions for further study

Since balanced panel data were not available for all studied commercial banks in the thesis for the period 2002–2012, annual growth of the Malmquist TFP index could not be measured for the whole sample. If more panel data were available, the findings on productivity change of commercial banks in the thesis would be more reliable and would suggest some more useful policy implications.

In addition, because data on input prices was not available, allocative efficiency could not be estimated to compute the overall efficiency of Vietnamese commercial banks, even though allocative efficiency is applied in the pilot study at branch level.

Although it would be interesting to compare the technical efficiency of existing foreign banks with that of domestic banks in Vietnam, the thesis could not do this because of a limited data set of foreign banks in the sample.

Other unobservable variables should be included in the Tobit regression to decompose factorial effects on commercial banks' efficiency more significantly. In addition, if the number of observations had been larger, time-variant and cross-sectional dummy variables could have been included in the regression model.

Some limitations of the main study in the thesis come from the DEA approach itself. Firstly, statistical errors are not taken into account by the DEA approach. Errors in technical efficiency computation from DEA models could lead to inaccurate conclusions.

Secondly, the DEA run does not allow 'extreme' observations where there are several studied banks in the sample having non-positive output (zero profit or loss recorded in their disclosed financial statements). Those observations should have been included in the estimation to fully reflect the efficiency level of the banking sector. Moreover, the DEA estimate results are highly sensitive to sample size. Because of the limited number of SOCBs in the sample, the technical efficiency scores tend to be close 1 when DEA was executed separately for the SOCBs group. For the above-mentioned reasons, different methods could also be adopted to estimate technical efficiency of commercial banks to challenge the results by the DEA approach.

Last but not least, should the number of observations is larger especially for the balanced panel data at the bank level of the main study, then it is highly recommended the other studies in this field in the future to conduct the data mining in order to investigate the impacts of financial liberalisation on banking efficiency through the bootstrapping methods. To further test the influences of financial liberalisation on the efficiency of Vietnamese banks, it is also necessary to find out the confidence intervals for efficiency terms. As a result, the bootstrapping method – a statistical re-sampling method used to perform inference – is highly recommended for further studies in this area. Based on the recommendation, the other studies in this field in the future should use of bootstrapping method developed by Löthgren and Tambour, which is based on the data generating process underlying the observed data to calculate the sampling distributions of the estimator by applying the empirical distribution of re-sampled estimates gained from a Monte Carlo re-sampling simulation. Should the distribution of efficiency scores be independently distributed, then the bootstrapping method is followed up the method of Simar and Wilson.

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