Market Concentration, Bank Competition and Bank Efficiency in Emerging Asian Countries

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A thesis submitted in partial fulfilment of the requirements for the Degree of Doctor of Business Administration at the University of Western Sydney

September 2015
DBA thesis

Market Concentration, Bank Competition and Bank Efficiency in Emerging Asian Countries

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Acknowledgements

This thesis represents the culmination of a process during which I have learned a great deal and acquired important research skills. I am indebted to many people who have contributed to this process. Foremost is my supervisor panel. I would like to express my deepest gratitude to Associate Professor Kevin Daly, the principal supervisor, for his encouragement, guidance and support. His thoughtfulness, great vision, and analytical and critical thinking will remain lifelong treasures to me. I am deeply grateful to Doctor Linda (Qiongbing) Wu, the co-supervisor, for her continuous interest and helpful comments as well as suggestions in developing this thesis. I will never forget her thoughtfulness to me throughout the period of research and writing of this thesis. I also wish to express my sincere thanks to the other co-supervisor, Doctor Kathy Tannous, for her support throughout my candidature, especially in the early research period.

I would like to acknowledge the University of Western Sydney, Associate Professor Yi-Chen Lan, Professor Clive Smallman, Associate Professor Anneke Fitzgerald, Professor Terry Sloan, Professor George Lafferty, DBA lecturers and guest speakers for their instruction, kind support, useful and interesting lessons and the experience I gained in doing research. I also would like to thank the University of Western Sydney Library, International Office, Sydney Graduate School of Management and School of Business staff—Amanda Reed, Judy Foster, BecCampisi and Barbara Pinning—for their enthusiasm and kind help.

I would like to express my gratitude to the University of Economics Ho Chi Minh City, Vietnam (UEH), the UEH-International School of Business (UEH-ISB), Professor Nguyen Dinh Tho and Doctor Tran Ha Minh Quan for their guidance and support throughout my candidature. I would like to acknowledge the Ministry of Education and Training of Vietnam and the Vietnamese Government, who financially supported me during my journey to achieve this DBA. My special thanks to the Managerial Board of the University of Finance and Marketing and all of my colleagues in the Faculty of Finance and Banking for their continuous encouragement throughout my doctoral studies.
My special gratitude goes to my family. I wish to sincerely thank my parents, Mr Phan Trong Huyen and Mrs Nguyen Thi Dinh, and my sisters and brothers for all they have done for me, and for their unconditional love. I owe my loving thanks to my dear husband, Tran Quang Minh Chau, and my dear son, Tran Phan Minh Tuan. I want to say I love all of you, my wonderful family.
Statement of Authentication

The work in the thesis has been prepared by me to partially fulfil the requirements of the Doctor of Business Administration at the University of Western Sydney.

I hereby declare that the work is a result of my own research, except where due acknowledgement is made. It is an original work and I have not submitted this material, either in whole or in part, for a degree at this or any other institution.

Signed: [Signature]

Date: September 2015
Preface

Based on the research conducted in this thesis, I presented a paper at an international conference.

Conference

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<tr>
<td>2SLS</td>
<td>Two-stage least squares</td>
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<tr>
<td>3SLS</td>
<td>Three-stage least squares</td>
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<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
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<td>AR</td>
<td>Average revenue</td>
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<td>DEA</td>
<td>Data envelopment analysis</td>
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<td>DFA</td>
<td>Distribution-free approach</td>
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<td>ESH</td>
<td>Efficient structure hypothesis</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GDP</td>
<td>Gross domestic product</td>
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<td>GDPG</td>
<td>Real gross domestic product growth</td>
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<td>GFC</td>
<td>2008 global financial crisis</td>
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<td>IGH</td>
<td>Information generation hypothesis</td>
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<tr>
<td>IFS</td>
<td>International Financial Statistics</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>M&amp;A</td>
<td>Mergers and acquisitions</td>
</tr>
<tr>
<td>MC</td>
<td>Marginal cost</td>
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<tr>
<td>NEIO</td>
<td>New Empirical Industrial Organization</td>
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<tr>
<td>OLS</td>
<td>Ordinary least squares</td>
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<tr>
<td>PBT</td>
<td>Profit before tax</td>
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<td>QLH</td>
<td>Quiet life hypothesis</td>
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<tr>
<td>SCP</td>
<td>Structure conduct performance</td>
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<td>SFA</td>
<td>Stochastic frontier analysis</td>
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<td>SUR</td>
<td>Seemingly unrelated regression</td>
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<tr>
<td>TA</td>
<td>Total assets</td>
</tr>
<tr>
<td>TOC</td>
<td>Total operating cost</td>
</tr>
<tr>
<td>UK</td>
<td>The United Kingdom</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
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<tr>
<td>VIF</td>
<td>Variance inflation factor</td>
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<td>WTO</td>
<td>World Trade Organization</td>
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Abstract

Developing Asian economies have emerged as a new growth pole in the world economy and have played a crucial role in balanced and sustainable global growth. These countries have experienced bank privatisation, interest rate deregulation and financial liberalisation, mergers and acquisitions (M&A), and foreign bank entry. They also have initiated significant financial reforms in banking system that aim to improve the quality of bank management and increase bank performance.

This thesis examines the relationships between competition, concentration and X-efficiency in banking in six emerging Asian countries—Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam—over the period 2005–12.

First, we measure bank competition at industry level using the conduct parameter approach that is popular in recent empirical studies, and measure bank concentration using the conventional four-bank concentration ratio. The results showed that bank competition levels had a tendency to decrease for India and Indonesia, and to increase for Bangladesh, Malaysia and the Philippines. Degrees of competition in Vietnamese banking fluctuated frequently over a small range. Concentration levels in banking markets had a tendency to decrease for Bangladesh, India, Indonesia, and Vietnam; in contrast, the degree of bank market concentration had a tendency to increase slightly in Malaysia and the Philippines. The study also provides evidence to support the assumptions of the structure conduct performance (SCP) hypothesis: that there is a negative relationship between market concentration and bank competition across banking systems.

Second, the study estimates bank X-efficiency using the stochastic frontier analysis (SFA) approach and measures degrees of bank competition at the bank level using the Lerner approach. It was found that banks in these countries are highly efficient and competitive.

Finally, the research investigates the relationship between bank competition, market concentration and bank X-efficiency for the full sample and by country using both Tobit regression and two-stage least square regression. For the full sample, market concentration has a positive effect on X-efficiency, whereas competition has a negative effect on X-efficiency. Therefore, this study provides empirical evidence in
support of the information generation hypothesis (IGH) but not the quiet life hypothesis (QLH). Moreover, the effect of bank size on X-efficiency is positive, whereas the effect of liquidity risk on X-efficiency is negative. Gross domestic product growth (GDPG) has a positive influence on X-efficiency; however, the effect of inflation on X-efficiency is not clear. By country, the QLH is supported for banking in Bangladesh and Indonesia. In contrast, this hypothesis is rejected and the IGH is supported for banking in India, Malaysia, the Philippines and Vietnam.

The study makes three important contributions. First, this research empirically tested the QLH and the IGH in emerging Asian countries, along with the assumption of the SCP hypothesis of a negative relationship between competition and concentration. Second, the study provides new empirical evidence on the relationships between competition, market concentration and bank X-efficiency in six emerging Asian countries overall and by country. Third, the study has important policy implications for governments, policymakers and banks with respect to increasing X-efficiency of banking. For example, policy on M&A may encourage M&A of small-sized and weak financial banks as a means to improve their financial strength and soundness. Governments and policymakers are encouraged to allow increased foreign bank penetration and divestiture of state ownership in banking. Moreover, to increase X-efficiency, banks are motivated to diversify their activities and incomes, and establish better customer information systems. They consider also examining thoroughly sub-prime lending and relationship-based lending, try to increase their size and reduce their liquidity risk.
Chapter 1: Introduction

1.1 Background

The effect of competition and market concentration on efficiency in the banking sector remains controversial. In particular, debate on associations between competition, concentration and efficiency in banking has raised issues among researchers and policymakers. Four main hypotheses have been advanced to explain these relationships.

The efficient structure hypothesis (ESH) (Demsetz, 1973; Smirlock, 1985), which posits that more efficient banks can achieve lower costs, higher profits and larger market shares that result in higher market concentration. In this way, the ESH suggests there is a positive and indirect effect of bank efficiency on market concentration. Further, more efficient banks can gain a larger market share from less efficient banks in the market; therefore, they can exploit greater market power. Thus, this hypothesis also posits a positive (or negative) causality running from efficiency to market power (or competition).

The quiet life hypothesis (QLH) (Berger & Hannan, 1998; Hicks, 1935) postulates that banks in more concentrated markets are less efficient. Banks with higher market power have less incentive to maximise their efficiency in a more relaxed environment; therefore, increasing competition increases bank efficiency.

The information generation hypothesis (IGH) (Marquez, 2002) is similar to the ESH in that it proposes the existence of a negative relationship between competition and efficiency. This hypothesis states that competition among banks leads to a decline in the information-gathering capacity of banks, which increases the probability of ‘adverse selection’. Therefore, increasing competition decreases bank efficiency.

Finally, views on the relationships between competition, market concentration and performance are based on the structure conduct performance (SCP) hypothesis (Bain, 1951). This hypothesis suggests that market structure affects competition and the behaviour of banks in setting interest rates that in turn influence banks’ performance. This premise is based on an assumption that there is a negative
relationship between market concentration and bank competition in the banking industry.

Numerous empirical studies have determined that market concentration and bank competition are significant determinants of bank efficiency (e.g. Berger & Hannan, (1998); Casu and Girardone (2006); Chen (2009); Delis and Papanikolaou (2009); Delis & Tsionas (2009); Ferreira (2013); Hauner & Peiris (2005); Kirkpatrick, Murinde, and Tefula (2008); Ketter, Kolari & Spierdijk, (2008; 2012); Maudos & de Guevara (2007); Turk Ariss (2010); Williams, (2012)). However, the nature of the relationships between market concentration, competition and bank efficiency are controversial. The majority of studies in this field have been based on developed countries such as the United States of America (US) and European (EU) countries. Few studies have examined these relationships in developing economies (see Chen (2009); Fang, Hasan, and Marton (2011); Fu & Heffernan (2009); Kirkpatrick et al. (2008); Pruteanu-podpiera, Weill, and Schobert (2008); Turk Ariss (2010); Williams (2012)).

Developing Asian economies including those in East Asia, the Pacific region and South Asia have emerged as a new growth pole in the world economy, with a robust economic growth of 8.04%, in comparison with a global average gross domestic product growth (GDPG) of 2.5% over 2005–14.¹ These countries have played a crucial role in balanced and sustainable global growth. Emerging Asian countries have experienced bank privatisation, interest rate deregulation and financial liberalisation, M&A and foreign bank entry; and in recent decades have introduced significant financial reforms in banking that aim to improve the quality of bank management and increase bank performance. Competition, market concentration and efficiency in banking may have been modified in these countries as a result. However, only limited empirical studies have examined the relationships between competition, concentration and efficiency in the banking systems in these countries, especially after the 2008 global financial crisis (‘the GFC’).

1.2 Objectives of the Research

The study was conducted for six Asian countries of Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam over the period 2005–12. These

countries were chosen as they represent emerging Asian countries in South Asia and Southeast Asia that have experienced bank privatisation, M&A, foreign bank entry and financial reforms in banking over recent decades. The study period incorporates changes in market concentration, competition and efficiency in banking during the pre- and post-GFC periods.

The study has four objectives. Although emerging markets provide a rich laboratory in which to study competition in banking systems, the literature on competition in these regions, especially for Asian emerging markets, is limited. Thus the first objective is to fill this gap in the literature and to examine the changes in bank competition levels in emerging countries before and after the GFC. Therefore, this study aims to measure bank competition at the banking industry level for the six focal Asian countries during 2005–12.

Second, banking in the six Asian countries has been dramatically affected by M&A and banking industry restructuring, resulting in an altered market structure. This study therefore aims to investigate changes in market concentration and address the question of the relationship between bank competition and market concentration across these countries over the study period.

Third, the GFC has influenced economies as well as banking industries all over the world. The GFC has been acknowledged as affecting the behaviour and management of banks, given its origin and secondary effects. Nevertheless, very little research has been conducted to investigate these issues for emerging markets over the pre- and post-crisis period. Therefore, to understand the quality of management and competition among banks in the Asian region, this study measures efficiency and competition at the bank level for the six focal countries during 2005–12.

Finally, this study aims to examine the relationships between market concentration, bank competition and bank efficiency across the six emerging Asian economies over the period 2005–12, spanning the GFC.

1.3 Methodological Framework

Measuring competition levels is undertaken using structural and non-structural methods. The former approach employs market concentration as a measure of competition whereas the latter approach tries to estimate the level of competition directly. Market concentration in not very informative about the degree of competition
in banking, and according to Schaeck, Cihak, and Wolfe (2009), it is an inappropriate measure of bank competition. Therefore, non-structural approaches — or so-called New Empirical Industrial Organization (NEIO) approaches—have more advantages than structural approaches. These include that NEIO methods do not assume the existence of a negative relationship between the level of concentration and competition, instead they assume contestability in banking competition; they do not infer that banks in concentrated market are less competitive and do not identify a geographic market.

To estimate bank competition at the industry level for each country in the sample, a conduct parameter approach is employed following the framework suggested by Uchida and Tsutsui (2005), Delis and Tsionas (2009), and Soedarmono et al. (2011; 2013). For robustness checks of the results, the study uses two statistical methods: seemingly unrelated regression (SUR) and three-stage least squares (3SLS). To examine the relationship between competition and bank efficiency, bank competition at bank level is estimated using the Lerner index method. Both the conventional Lerner and efficiency-adjusted Lerner indices are used; the latter being employed to avoid bias when the implicit assumption of banks being fully efficient does not hold, or to account for the endogeneity bias due to competition–efficiency interrelationships.

The study estimates bank X-efficiency for emerging Asian countries using the stochastic frontier analysis (SFA) approach introduced by Aigner, Lovell, and Schmidt (1977), and Meeusen and Broeck (1977). X-efficiency measures how well a specific bank performs compares with the best-practice bank in the sample producing the same outputs under the same cost conditions. It reflects both allocative and technical efficiency of a bank. This approach was chosen to measure bank efficiency in numerous previous empirical studies in developing countries, including those of Dong, Hamilton, and Tippett (2014), Fang et al. (2011), Fu and Heffernan (2009), Fungáčová, Pessarossi, and Weill (2013), Mobarek and Kalonov (2014), Spulbár and Nițoi (2014), Turk Ariss (2010), Vu and Turnell (2010), and Williams (2012). Estimation is conducted for the frontier function separately for each country to derive individual inefficiency estimates. In addition, to examine the relationships between market concentration, bank competition and bank efficiency, Tobit regression is employed to take into account the censored nature of the efficiency. In addition, due to the
probability of causality running from bank efficiency to market concentration and bank competition under the efficient structure paradigm, two-stage least squares (2SLS) regression is used to address endogeneity problems and avoid associated biases.

1.4 Significance of the Research

This study makes three main contributions. First, it contributes to the literature on the relationship between market concentration, competition and efficiency in banking by empirically testing the QLH and the IGH in emerging Asian economies. Moreover, the study investigates the relationship between market concentration and bank competition across these banking systems, to test the SCP hypothesis that market concentration is negatively related to bank competition.

Second, this study provides new empirical evidence about the relationships between competition, market concentration and bank X-efficiency in emerging Asian countries using a sample of six such countries from two different regions in Asia: South and Southeast Asia. The research examines these relationships over the full sample and by country.

Third, the study has policy implications for governments, policymakers and banks with respect to increasing the X-efficiency of banking. For governments and policymakers, policy on M&A may encourage M&A of small-sized and weak financial banks as a means to improve their financial strength and soundness. Governments and policymakers are encouraged to allow increased foreign bank penetration and divestiture of state ownership in banking. Moreover, to increase X-efficiency, banks may diversify their activities and incomes (e.g. net interest income and non-interest income) instead of relying mainly on traditional activities (e.g. capital mobilisation and credit activities) and net interest incomes. Banks are motivated to establish better customer information systems to assess repayment capacity of their customers before lending to minimise the chance of adverse borrower selection. They consider also examining thoroughly sub-prime lending and relationship-based lending, and try to increase their size and reduce liquidity risk.
1.5 Thesis Structure

The remainder of the thesis is organised into four chapters as follows.

Chapter 2 investigates bank X-efficiency in the six emerging Asian countries before and after the GFC. The chapter reviews the literature on bank efficiency in terms of the concept of X-efficiency, measurement methods and results of empirical studies for the chosen countries; and presents the methodology to measure bank X-efficiency and the resulting estimates of bank X-efficiency for these countries. Section 2.2 introduces the concept of X-efficiency and presents some methods for measuring bank efficiency: the financial accounting ratio analysis approach, and frontier methods such as non-parametric and parametric techniques. This section reviews empirical studies on bank efficiency in developed and developing countries. Section 2.3 presents the data and the methodologies used to measure bank efficiency. Section 2.4 discusses the empirical results.

Chapter 3 examines the market concentration and competition in banking in the six emerging Asian countries that make up the study sample. Section 3.2 reviews the literature on market concentration and competition in the banking system. This section discusses the methods for measuring the degree of market concentration and bank competition, including structural and non-structural approaches, and reviews empirical studies on bank competition. Section 3.3 presents the data and a method to measure bank competition at the banking industry level using the conduct parameter approach suggested by Uchida and Tsutsui (2005). Section 3.4 provides the results of the estimation of concentration and competition levels, as well as their relationship.

Chapter 4 investigates the relationships between market concentration, bank competition and bank efficiency in emerging Asian countries. Section 4.2 presents an overview of the literature on the relationships between market concentration, bank competition and bank efficiency. This section also presents some hypotheses on the relationship between concentration, competition and bank efficiency, namely the ESH, the QLH and the IGH. Section 4.3 details the data, the method used to measure competition at the bank level using the two Lerner specifications (conventional and efficiency-adjusted), and the methodology for testing the relationships between market concentration, bank competition and bank efficiency across the focal countries. Section 4.4 discusses the estimates obtained using the Lerner indices and the
relationships between market concentration, competition and bank X-efficiency both for the full sample and by country.

Chapter 5 summarises the main findings of the research. Some potential limitations of this empirical research and directions for future research are provided, and policy implications are discussed.
Chapter 2: Bank Efficiency in Emerging Asian Countries

2.1 Introduction

Banks play an important role in a financial system, especially in developing countries with relatively underdeveloped capital markets, where they are the main providers of credit to the economy. Bank efficiency is considered one factor representing the quality of bank management (Maudos & de Guevara, 2007; Williams, 2012). As a measure of bank performance and a prerequisite for enhancing the quality of bank management, bank efficiency has been researched extensively.

The concept of X-efficiency reflects technical and allocative efficiency of banks. It refers to the closeness of a bank’s costs to a best-practice bank’s cost when producing the same outputs under the same cost conditions (Berger & Mester, 1997). Over recent decades, numerous studies have investigated the efficiency of banks, but the majority used a sample of developed countries such as the US and European countries (e.g. Ahmad & Luo (2010); Altunbas, Carbo, Gardener, & Molyneux (2007); Casu & Girardone (2006, 2009); Coccorese & Pellecchia (2010); Fiordelisi, Marques-Ibanez, & Molyneux (2011); Kooeter et al. (2008; 2012); Kwan & Eisenbeis (1997); Maudos & de Guevara (2007); Weill (2004); Williams (2004)).

In contrast to the vast literature on bank efficiency in developed countries, few studies have examined the quality of bank management in developing economies. However, recent years have seen an increasing number of empirical studies on bank efficiency in developing countries (Fang et al. (2011); Fu & Heffernan (2009); Mlambo & Ncube (2011); Ahmad Mokhtar, Naziruddin, & Alhabshi (2008); Turk Ariss (2010); Williams (2012)), which are predominantly focused on a single country.

Challenges for banks to control cost efficiency increased following the GFC, particularly in emerging Asian countries where banks focus on traditional activities such as capital mobilisation and credit activities. In recent years, emerging Asian countries have introduced significant financial reforms in banking that aim to improve the quality of bank management and increase bank performance. Therefore, an increasing number of researchers have raised concerns about bank efficiency in this region; for example Ahmad Mokhtar et al. (2008), Fu & Heffernan (2007, 2009),

The current study uses the SFA approach to examine X-efficiency of banks over the 2005–12 period (which incorporates the GFC) in the context of six emerging Asian countries: Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam. This research makes two major contributions. First, the study measures X-efficiency in banking using a sample of six emerging countries from two different regions in Asia: South Asia and Southeast Asia. Second, the estimates obtained for bank X-efficiency in these countries provide useful information for bank managers, investors and shareholders to evaluate banks’ abilities to control their costs and to find solutions for improving bank efficiency.

This chapter is organised as follows: the next section reviews the literature on bank efficiency in developed and developing countries. Section 2.3 discusses the methodology and the data. Section 2.4 presents an in-depth discussion of the empirical results. Finally, Section 2.5 provides a conclusion.

2.2 Bank Efficiency: Definition, Measurement Methods and Empirical Studies

2.2.1 Definition of Bank X-efficiency

The term ‘X-efficiency’ was first introduced by Liebenstein (1966) who suggested that X-efficiency can exist and is often more significant than allocative efficiency. X-efficiency reflects non-allocative efficiency that is the gap between actual efficiency and allocative efficiency.

The concept of X-efficiency in banking was proposed by Berger and Mester (1997) as a measure of how the actual costs of banks in a sample are minimised to align with best-practice banking. In other words, X-efficiency measures how well a specific bank in a sample performs compared with a best-practice bank producing the same outputs under the same cost conditions. X-inefficiency reflects both technical inefficiency due to employing too many inputs to produce the same outputs, and allocative inefficiency due to not reacting optimally to relative input prices.

A bank’s X-efficiency is calculated as the ratio of the predicted minimum cost outlaid by the best-practice bank in the sample and the predicted costs of the bank
under the same conditions of inputs and outputs. Therefore, X-efficiency is a relative measure of efficiency. X-efficiency ranges between 0 and 1, and the higher the figure, the more efficient the bank. A bank with X-efficiency of 1 is the most efficient bank—or the best-practice bank—in the sample. X-efficiency quantifies the percentage of cost the bank uses efficiently compared to the best-practice bank in the sample under the same conditions. For example, bank i’s X-efficiency ratio of 0.7 in term of costs means that bank i is 70% efficient, or 30% less efficient, compared to the best-practice bank under identical conditions.

2.2.2 Measurement Methods

2.2.2.1 The Financial Accounting Ratio Analysis Approach

Many approaches have been employed in the literature to measure bank efficiency. The first is the financial accounting ratio analysis approach that uses accounting ratios to estimate efficiency including return on equity, return on assets (Halkos & Salamouris, 2004), or ratio of operating expenses to gross income (Olson & Zoubi, 2011). Halkos and Salamouris (2004) summarised some advantages of this approach; for example, financial indicators are used to estimate bank performance and to compare performance of different sized banks as well as to compare financial ratios of a bank to some benchmark of the system by controlling for sector characteristics. However, this method has some limitations, with accounting ratios not reflecting a bank’s current market value and value-maximising behaviour (Kohers, Huang, & Kohers, 2000) and not controlling for the bank’s input price and output mix (Berger & Humphrey, 1992). Thus, two alternative approaches that measure frontier efficiency are used more widely in the academic literature, namely non-parametric and parametric techniques. Both approaches estimate frontiers, using linear programming techniques and econometric techniques, respectively. The main difference between these approaches is specification of the functional form of the frontier and assumptions with regard to random errors.
2.2.2.2 Non-parametric Approaches

Non-parametric techniques assume that the distance from the frontier is an inefficiency score. They explain the noise as inefficiency and do not allow for measurement error in the frontier’s estimation. Data envelopment analysis (DEA) is the most frequently used non-parametric approach. It estimates frontiers by using the linear programming methods developed by Charnes, Cooper, and Rhodes (1978). The DEA approach recognises best-practice frontiers by observing management practices in the sample. This approach has some advantages over parametric techniques, which are commonly referred to as the SFA approach. First, the DEA approaches do not require explicit specification of the functional form of the frontier, the component error term or assumptions related to distribution of the inefficiency term (Maudos, 1998). Second, this approach is straightforward and easy to use. Finally, the method can be appropriate and efficient for small sample sizes.

Compared to SFA, DEA assumes that the value of random errors is 0, meaning that it does not allow for any errors in the data. Any unfavourable effect beyond the control of a bank refers to inefficiency, whereas luck factors or under-measured costs can make banks more efficient. Hence, estimates of inefficiency by the DEA approach may be overestimated or upwardly biased when random errors (i.e. measurement errors and luck factors) are ignored. In summary, this non-parametric approach does not specify the functional form of the frontier explicitly and uses only inefficiency to explain deviation from the best-practice bank. Therefore, DEA suffers from several limitations: (1) random error (i.e. measurement errors and luck factors) can affect the shape and position of the frontier; (2) estimates of inefficiency may be biased when random errors are ignored; (3) the efficiency scores obtained are only relative to performance of the best-practice bank in the sample so it is inappropriate to compare efficiency scores among samples.

2.2.2.3 Parametric Approaches

Parametric approaches specify the functional form of the frontier and separate inefficiency from error terms. The SFA approach is a commonly used parametric technique, introduced by Aigner et al. (1977) and Meeusen and Broeck (1977), which specifies a standard cost function with input prices and output factors to estimate minimal cost and efficiency frontiers for the full sample. This technique assumes that
the error term contains random errors (which are symmetrical and reflect the frontier’s random variation across banks) and inefficiency (which accounts for inefficiency compared to the frontier). This method makes arbitrary distribution assumptions of inefficiency and random disturbance.

Three main problems need to be addressed when using the SFA approach: (1) SFA demands the specification of the specific functional form of the efficient frontier. However, estimated inefficiency may be overstated due to miss-specification of the functional form (Hauner & Peiris, 2005); (2) SFA assumes a specific distribution for inefficiency and a random disturbance. If these assumptions are miss-specified, the estimated efficiency will be biased; (3) The distributional assumptions of the error term’s components are arbitrary so when inefficiency scores are not constrained, they will follow symmetric normal distributions rather than half-normal distributions (Pruteanu-podpiera et al., 2008).

Nevertheless, SFA can overcome the major drawback of DEA whereas DEA assumes inefficiency as all deviations from the frontier, SFA considers random fluctuations as part of the error term due to circumstances not under the bank’s control (e.g. bad luck), which may avoid biased results for inefficiency (Ahmad Mokhtar et al., 2008).

To summarise, the main difference between SFA and DEA is that SFA specifies a functional form of the frontier to estimate the efficient frontier (i.e. the minimum cost) and posits that all deviations of a bank’s observed costs from the frontier are compound error terms that contain both inefficiency and random fluctuation due to circumstances not under the bank’s control (Maudos, 1998). These approaches each have advantages and disadvantages. The choice of the best efficiency estimation method has been controversial.

2.2.3 Empirical Studies on Bank Efficiency

2.2.3.1 Bank Efficiency in Developed Countries

A large body of literature has investigated bank efficiency in the US and in European countries rather than in emerging countries; for example Ahmad and Luo (2010), Altunbas et al. (2007), Casu and Girardone (2006, 2009), Coccorese and Pellecchia (2010), Ferreira (2013), Fiordelisi et al. (2011), Koetter et al. (2008; 2012),

Most empirical studies have used two prevailing techniques—the non-parametric (DEA) and the parametric approach (SFA)—to measure X-efficiency and cost efficiency. Casu and Girardone (2006) measured X-efficiency of banks in 15 European countries over 1997–2003 using the DEA approach. To ensure the benchmark bank was not influenced by other factors and had no extreme behaviour, the authors selected a bank or a cluster of banks that were the most efficient ones in the sample, and then re-identified the boundary for the rest of the data.

Ahmad and Luo (2010) examined bank efficiency in European countries by comparing technical efficiency, allocative efficiency and X-efficiency of Islamic banks and conventional banks in Germany, Turkey and the United Kingdom (UK), over 2005–08. The results of DEA estimation suggested that conventional banks are more cost X-efficient and allocative efficient but less technically efficient than Islamic banks in Europe. A study by Coccorese and Pellecchia (2010) of Italian banking reported different results for cost efficiency obtained from different SFA models. There was a clear decreasing trend in yearly averages of cost efficiency scores derived from the Battese–Coelli model (Battese & Coelli, 1992) but an inconstant trend in efficiency scores derived from the Aigner–Lovell–Schmidt model (Aigner et al., 1977) over 1992–2007.

Koetter et al. (2008; 2012) estimated both cost efficiency and profit efficiency of banking in the US using the SFA approach. Koetter et al. (2008) used a sample of bank holding companies during 1986–2006, whereas Koetter et al. (2012) examined commercial banks over the period 1976–2007, when historic deregulation changed competition and structure of the banking system dramatically. Both studies concluded that banks in the US were more cost efficient than profit efficient.

Maudos and de Guevara (2007) used the parametric SFA approach to measuring X-efficiency of banking in European countries. The authors observed that an estimated common efficiency frontier for all banks in the sample was necessary when comparing banks’ cost efficiency across nations. Moreover, they introduced into the cost function environmental variables, per capital income, population density, bank branches per capita, real gross domestic product growth and dummy variables for each
country, to reflect the effects of the economic environment on cost efficiency and to interpret the differences of cost efficiency across nations.

Weill (2004) showed that the common frontier for a full sample allows a comparison of efficiency levels across nations and considered the effect of environmental factors on efficiency. The drawbacks identified were the requirement for assuming similar technologies in all countries and difficulties in comparing results of efficiency for a specific country in a study with those reported by other country-specific studies. Although national frontiers do not permit a comparison of efficiency scores across nations in a sample, they are helpful for comparing the results of estimated efficiency scores with those estimated in other country-specific studies; it is not necessary to assume similar technologies in all countries. Therefore, to compare the results of efficiency frontier methods in the sample of European banking, Weill (2004) used national frontiers rather than a common frontier and employed three frontier techniques: the SFA, the DEA and the distribution-free approach (DFA). The results suggested no best frontier approach and a lack of robustness among methods.

Casu and Girardone (2009) investigated managerial ability of the largest five European banking markets (i.e. France, Germany, Italy, Spain and the UK) during 2000–05 using both a parametric (SFA) and a non-parametric approach (DEA). They estimated both country-specific frontiers and a common ‘EU-5’ frontier. The results showed differences between estimates from the two methods. Ferreira (2013) estimated cost efficiency of banks in 27 European countries over 1996–2008 using DEA. Ferreira (2013) found that banking in the UK was the most efficient while banking in Hungary was the least efficient during this period.

2.2.3.2 Bank Efficiency in Developing Countries

In contrast with the literature on bank efficiency in developed countries, empirical studies on cost efficiency and X-efficiency of banking in emerging countries are relatively few in number. The majority of the latter investigated bank efficiency in a single country rather than multiple countries.

Bank Efficiency for a Single Country

Mlambo and Ncube (2011) estimated various types of bank efficiency, including technical efficiency, allocative efficiency and cost efficiency, for banks in South Africa over 1999–2008 using DEA. The results show a gradual increase in
average efficiency during this period. In addition, the findings suggest that input misallocation of prevailing input prices on average is the cause of bank inefficiency in South Africa. By using a Bayesian dynamic frontier model, Barros and Wanke (2014) found that cost efficiency of Brazil banking showed the tendency to improve over the 1998–2010 period. Investigating banking in Ghana, a study by Kofi, Christopher, and Baiding (2014) reported that bank X-efficiency scores estimated by DEA were relatively low and unstable over 2001–10. However, the average efficiency score had remarkably improved since 2007.

In the Asian context, bank efficiency is one of the key concerns in country-specific studies. Ahmad Mokhtar et al. (2008) examined both X-efficiency and cost efficiency of Islamic banking in Malaysia by type and ownership over the period 1997–2003 using the non-parametric DEA approach. They found that conventional banks are the most efficient banks, followed by fully fledged Islamic banks. The ‘Islamic windows’ are the least efficient and foreign banks are more efficient than domestic banks.

The Vietnamese banking sector has changed substantially via banking reforms and restructuring programmes, financial deregulation and M&A. Many recent studies have paid attention to how efficiently banks in Vietnam operate. Nahm and Vu (2013), Minh, Long, and Hung (2013) and Ngo (2012) investigated profit efficiency and technical efficiency, whereas Vu and Turnell (2010) and Nguyen et al. (2014) examined X-efficiency of banking in Vietnam. Vu and Turnell (2010) measured cost X-efficiency during 2000–06 using SFA. They found that cost X-efficiency in the Vietnamese banking industry is relatively high but slightly decreased over the estimation period. Reasons for this declining X-efficiency may include increases in costs related to diverse activity management, expansion of branch networks and banking technology upgrades. Nguyen et al. (2014) used a DEA approach to measure cost and profit X-efficiency of banks in Vietnam over the 1995–2011 period. They reported an upward trend in bank efficiency, and suggested that banks are more cost efficient than profit efficient and state banks are more efficient than private commercial banks. Moreover, the results indicated that efficiency of Vietnamese banking was not affected by the GFC or the Asian financial crisis.

Numerous researchers have investigated bank efficiency in the context of China using the DEA model (e.g. Ariff & Can (2008); Chen, Skully, & Brown (2005);
Hou, Wang, & Zhang (2014); Luo, Yao, Chen, & Wang (2011); Sufian (2010); Sufian & Habibullah (2011); Yao, Han, & Feng (2008); Ye, Xu, & Fang (2012)). Other studies employed the SFA method to measure bank efficiency in China. For instance, Fu and Heffernan (2009) measured X-efficiency of Chinese banks during 1985–2002 when notable bank reform occurred, using the SFA approach. The authors reported a significant decrease in X-efficiency. Also using data from Chinese banks, Fungáčová et al. (2013) estimated cost efficiency scores using the SFA approach and showed an improvement of cost efficiency over 2002–11. Dong et al. (2014) estimated the consistency of bank cost efficiency in Chinese banking using two frontier approaches (DEA and SFA). They reported moderate consistency between results for the two methods over 1994–2007. They also recommended that a range of frontier techniques may be performed with methodological cross-checking for measuring efficiency.

**Bank Efficiency across Countries**

The more recent literature on the quality of management in banking has examined bank efficiency across countries. Using data from banks in 10 newly acceded European countries, Brissimis, Delis, and Papanikolaou (2008) chose the non-parametric DEA technique to estimate banks’ productive efficiency during 1994–2005. The results show that most countries improved their efficiency over the period. This may be due to significant changes in ownership structure, stable macroeconomic conditions and enhancements in operating cost management.

Fang et al. (2011) measured cost and profit X-efficiency in the transition South-Eastern European nations over 1998–2008 using the SFA approach. The results reveal that average profit X-efficiency was less than average cost X-efficiency. In addition, banks in these countries could improve their X-efficiency by increasing their market power and institutional development. Foreign banks gained higher profit X-efficiency but lower cost X-efficiency whereas Government-owned banks were less profit efficient than private banks.

Using data from Latin American banks over 1985–2010, Williams (2012) also employed the SFA approach to estimate both cost and profit efficiency. The results were consistent with findings reported by Turk Ariss (2010) that cost efficiency was higher than profit efficiency. Estimating both profit and cost efficiency by the parametric SFA method, Bonin, Hasan, and Wachtel (2005) compared the results of
these types of efficiency across four types of ownership (foreign, domestic, state-owned and private banks) over 1996–2000 in 11 transition countries. State-owned banks were found to be the least efficient banks, and foreign banks the most efficient. Mobarek and Kalonov (2014) compared technical efficiency scores for conventional banks with those of Islamic banks using two dominant frontier methods (SFA and DEA) for 18 Organization of Islamic Conference countries. The results indicated that conventional banks are more efficient than Islamic banks.

Within Asia, Chan, Karim, Burton, and Aktan (2014) measured cost efficiency and profit efficiency of banking using DEA for seven East Asian countries. They found that banks in this region have higher cost efficiency scores than profit efficiency scores over the period 2001–08. Also using a DEA model, Gardener et al. (2011) measured cost X-efficiency and technical efficiency of banking in Southeast Asia. A significant decrease in bank efficiency across Indonesia, Malaysia, the Philippines, Thailand and Vietnam over 1998–2004 suggested a negative effect of post-1997 financial crisis restructuring on bank efficiency in this region. Turk Ariss (2010) used the SFA approach to measure cost and profit X-efficiency in five regions (Africa; East/South Asia and Pacific; Eastern Europe and Central Asia; Latin America and Caribbean; and the Middle East) over 1999–2005. Cost efficiency was reported to be higher than profit efficiency for all countries in the sample. In the East/South Asia and Pacific region, estimates of cost X-efficiency indicate that banks in eight countries (Bangladesh, Cambodia, India, Indonesia, Malaysia, Nepal, Pakistan and Vietnam) were relatively cost efficient with average efficiency scores of ~80% over the period 1999–2005. Examining the context of transition countries, Spulbăr and Nițoi (2014) measured bank cost efficiency in Latin America, Central and Eastern Europe, and Southeast Asia over 2005–11 using the SFA approach. They found that banks in Brazil, India, Indonesia and Malaysia operated relatively efficiently with efficiency scores of almost 80% over the studied period. However, the results for efficiency need to be considered cautiously because number of banks in Southeast Asia used in the sample was rather small and thus may not be representative of banking in the region.

2.3 Methodology
2.3.1 Model Specification

To measure X-efficiency, this study uses the SFA approach, mainly because it (1) considers random fluctuation as part of the error term due to circumstances not under a bank’s control and can distinguish inefficiency from random errors, thus may avoid biased results for inefficiency; (2) provides estimates of marginal costs, frontier estimates of profit ($PBT$) and total operating cost ($TOC$) from the translog functional form for calculating conventional and efficiency-adjusted Lerner indices (see Chapter 4); (3) was used in recent studies on bank efficiency using a sample of banks in developing Asian countries (see Turk Ariss (2010); Spulbăr & Niţoi (2014)).

Both inputs and outputs of banks are specified in this study based on the intermediation approach that considers banks as financial intermediaries that collect deposits and then transfer them into loans and other earning assets (Sealey & Lindley, 1977). Total cost is expressed as a function of one output ($Q$), three input prices ($W$), two fixed netputs ($Z$) and technical change (trend). The output is total assets ($TA$). The three input prices are price of deposits ($W_1$), price of labour ($W_2$) and price of physical capital ($W_3$). Fixed assets ($Z_1$) and total equity ($Z_2$) are used as fixed netputs. Moreover, time trend variables take into account technical change that considers changes in the cost function over time. The trend variable ranges from 1 to 8, with 1 for the year 2005 and 8 for the year 2012. Fixed netputs and time trend are used as control variables to account for heterogeneity across banks.

Bank efficiency scores are estimated from the translog functional form:

$$
\ln TOC_{it} = \alpha_0 + \alpha_1 \ln Q_{it} + \frac{1}{2} \alpha_2 (\ln Q_{it})^2 + \sum_{m=1}^{3} \beta_m \ln W_{mit} \\
+ \sum_{m=1}^{3} \sigma_m \ln Z_{mit} + \frac{1}{2} \sum_{j=1}^{3} \sum_{m=1}^{2} \gamma_{mj} \ln W_{mit} \ln W_{jit} \\
+ \frac{1}{2} \sum_{m=1}^{2} \sum_{j=1}^{2} \alpha_{mj} \ln Z_{mit} \ln Z_{jit} + \sum_{m=1}^{3} \varepsilon_m \ln Q_{it} \ln W_{mit} \\
+ \sum_{m=1}^{3} \delta_m \ln Q_{it} \ln Z_{mit} + \sum_{m=1}^{2} \theta_{mj} \ln W_{jit} \ln Z_{mit} \\
+ \varphi_1 \text{Trend} + \frac{1}{2} \varphi_2 (\text{Trend})^2 + \varphi_3 \text{Trend} \ln Q_{it} \\
+ \sum_{m=1}^{3} \mu_m \text{trendln} W_{mit} + \sum_{m=1}^{2} \eta_m \text{trendln} Z_{mit} + \varepsilon_i
$$

(2.1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOC</td>
<td>Total operating cost</td>
</tr>
</tbody>
</table>
The stochastic frontier approach suggested by Aigner et al. (1977) and Meeusen and Broeck (1977) assumes that the error term ($\varepsilon$) or disturbance term contains two components: a two-sided random error term ($v$) capturing the effects of random noise and a non-negative inefficiency score ($u$) capturing inefficiency relative to the frontier. The stochastic frontier approach is employed using the model of Battese and Coelli (1992), which allows estimation of time-varying efficiency scores. In this model, the components of error terms are distributed independently; $v_{it}$ is assumed to be independent and identically distributed with mean 0 and variance $\sigma_v^2$ as a normal distribution, $N(0, \sigma_v^2)$; $u_{it}$ is assumed to be independent and identically distributed with mean $\mu$ and variance $\sigma_u^2$ as a truncated-normal distribution truncated at 0, $N^+(\mu, \sigma_u^2)$. The error term ($\varepsilon$) equals the sum of the random error term ($v$) and the non-negative inefficiency score ($u$).

To estimate time-varying cost inefficiency, $u_{it}$ is calculated as $u_{it} = u_i(\exp [-\eta (t-T_i)])$ (Battese & Coelli, 1992) where $t=1,...,T_i$; $T_i$ is the last period for bank $i$; and $\eta$ is the decay parameter. If $\eta>0$, the inefficiency of bank $i$ tends to decrease over time. If $\eta<0$, the inefficiency of bank $i$ tends to increase over time. If $\eta=0$, the inefficiency of bank $i$ is unchanged with time.

By the maximum likelihood technique, the frontier function is estimated to derive inefficiency scores. Some conditions are suggested for the translog cost function that is linearly homogeneous in input price:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q$</td>
<td>output</td>
</tr>
<tr>
<td>$W_1$</td>
<td>input price of deposits</td>
</tr>
<tr>
<td>$W_2$</td>
<td>input price of labour</td>
</tr>
<tr>
<td>$W_3$</td>
<td>input price of physical capital</td>
</tr>
<tr>
<td>$Z_1$</td>
<td>fixed netput 1</td>
</tr>
<tr>
<td>$Z_2$</td>
<td>fixed netput 2</td>
</tr>
<tr>
<td>Trend</td>
<td>Technical change</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>Error term ($v + u$)</td>
</tr>
<tr>
<td>$V$</td>
<td>Two-sided random error term</td>
</tr>
<tr>
<td>$U$</td>
<td>One-sided non-negative inefficiency score</td>
</tr>
</tbody>
</table>
\[
\sum_{m=1}^{3} \beta_m = 1, \sum_{m=1}^{3} \gamma_{mj} = 0 \quad (m = 1, 2, 3), \sum_{m=1}^{3} \delta_m = 0, \sum_{m=1}^{3} \mu_m = 0,
\]

\[
\sum_{j=1}^{3} \theta_{mj} = 0 \quad (m = 1, 2)
\]

By symmetry of the Hessian, \( \gamma_{mj} = \gamma_{jm} \), \( \pi_{mj} = \pi_{jm} \), \( \theta_{mj} = \theta_{jm} \).

Total costs and input prices are normalised by input price of physical capital \((W_3)\) to impose linear homogeneity in input prices. The translog cost function is rewritten as follows:

\[
\ln \left( \frac{TOC_{it}}{W_{3it}} \right) = \alpha_0 + \alpha_1 \ln Q_{it} + \frac{1}{2} \alpha_2 (\ln Q_{it})^2 + \sum_{m=1}^{3} \beta_m \ln \left( \frac{W_{mit}}{W_{3it}} \right) \\
+ \sum_{m=1}^{3} \sigma_m \ln Z_{mit} + \frac{1}{2} \sum_{m=1}^{3} \sum_{j=1}^{3} \gamma_{mj} \ln(W_{mit}/W_{3it}) \ln(W_{jit}/W_{3it}) \\
+ \frac{1}{2} \sum_{m=1}^{3} \sum_{j=1}^{3} \pi_{mj} \ln Z_{mit} \ln Z_{jit} + \sum_{m=1}^{3} \delta_m \ln Q_{it} \ln(W_{mit}/W_{3it}) \\
+ \sum_{m=1}^{3} \epsilon_m \ln Q_{it} \ln Z_{mit} + \sum_{j=1}^{3} \sum_{m=1}^{3} \theta_{mj} \ln(W_{jit}/W_{3it}) \ln Z_{mit} \\
+ \phi_1 \text{Trend} + \frac{1}{2} \phi_2 (\text{Trend})^2 + \phi_3 \text{Trend} \ln Q_{it} \\
+ \sum_{m=1}^{3} \mu_m \text{trend} \ln(W_{mit}/W_{3it}) + \sum_{m=1}^{3} \eta_m \text{trend} \ln Z_{mit} + \varepsilon_i
\]

\[(2.2)\]

According to Berger and Mester (1997), X-efficiency measures how close a bank’s costs are to a best-practice bank’s costs for producing the identical output bundle under the same conditions. Therefore, the X-efficiency of bank \( i \) is calculated as the ratio of the estimated minimum costs that would be used by the best-practice bank in the sample to produce the same output bundle under the same exogenous conditions to the estimated actual cost of bank \( i \).

Bank-specific X-efficiency is measured as follows:

\[
X-\text{Eff}_i = \frac{C_{\min}}{C_i} = \frac{\exp\left[ f(Q_i, w_i, Z_{i,trend}) \right] \times \exp(\ln \tilde{u}_{\min})}{\exp\left[ f(Q_i, w_i, Z_{i,trend}) \right] \times \exp(\ln \tilde{u}_i)} = \frac{\tilde{u}_i}{\tilde{u}_{\min}}
\]

\[(2.3)\]

X-efficiency ranges between 0 and 1, and equals 1 for the most efficient bank (the best-practice bank) in the sample. X-efficiency shows the percentage of cost the bank uses efficiently compared to the costs of the best-practice bank in the sample under the same conditions.
2.3.2. Data

The sample consists of commercial banks in emerging countries from two Asian regions: South and Southeast Asia. The countries are Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam. The data include bank-level financial statements for 2005–12, which were retrieved from the Bankscope Fitch-IBCA database. Banks that did have not enough data in more than two consecutive years and exhibited negative values for total equity and interest expenses were excluded from the sample. After elimination of these banks, the sample consisted of 212 commercial banks: 34 for Bangladesh, 50 for India, 40 for Indonesia, 32 for Malaysia, 24 for the Philippines and 32 for Vietnam. The data were checked thoroughly with appropriate treatment of missing values, inconsistencies and reporting errors. Table 2.2 provides a summary of descriptive statistics for variables used to estimate bank efficiency in stochastic frontier models for the six selected emerging Asian countries in the period 2005–12.
<table>
<thead>
<tr>
<th></th>
<th>Bangladesh</th>
<th>India</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total operating cost</strong></td>
<td>Mean</td>
<td>105.166</td>
<td>1571.080</td>
<td>389.407</td>
<td>414.410</td>
<td>236.345</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.612</td>
<td>2218.225</td>
<td>610.144</td>
<td>552.9745</td>
<td>288.167</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>570.370</td>
<td>19372.26</td>
<td>3234.484</td>
<td>3061.439</td>
<td>1400.102</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td>Mean</td>
<td>1338.848</td>
<td>24410.83</td>
<td>5627.517</td>
<td>12333.35</td>
<td>4551.026</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1391.333</td>
<td>0</td>
<td>9927.65</td>
<td>17639.85</td>
<td>5948.464</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>8472.234</td>
<td>217.427</td>
<td>290048.3</td>
<td>112008.90</td>
<td>30209.940</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>290048.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Input price of deposits</strong></td>
<td>Mean</td>
<td>0.070</td>
<td>0.058</td>
<td>0.053</td>
<td>0.026</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.017</td>
<td>0.012</td>
<td>0.019</td>
<td>0.018</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.173</td>
<td>0.028</td>
<td>0.006</td>
<td>0.001</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>0.112</td>
<td>0.116</td>
<td>0.252</td>
<td>0.065</td>
<td>0.178</td>
</tr>
<tr>
<td><strong>Input price of labour</strong></td>
<td>Mean</td>
<td>0.013</td>
<td>0.010</td>
<td>0.015</td>
<td>0.009</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.006</td>
<td>0.003</td>
<td>0.007</td>
<td>0.010</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.006</td>
<td>0.003</td>
<td>0.003</td>
<td>0.000</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>0.039</td>
<td>0.027</td>
<td>0.044</td>
<td>0.086</td>
<td>0.031</td>
</tr>
<tr>
<td><strong>Input price of physical capital</strong></td>
<td>Mean</td>
<td>0.930</td>
<td>1.154</td>
<td>2.367</td>
<td>3.121</td>
<td>1.826</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.574</td>
<td>0.872</td>
<td>2.437</td>
<td>3.296</td>
<td>1.900</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.133</td>
<td>0.178</td>
<td>0.141</td>
<td>0.131</td>
<td>0.291</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>3.027</td>
<td>9.606</td>
<td>16</td>
<td>22.222</td>
<td>17.531</td>
</tr>
<tr>
<td><strong>Fixed assets</strong></td>
<td>Mean</td>
<td>25.584</td>
<td>192.599</td>
<td>72.147</td>
<td>52.464</td>
<td>80.121</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>37.516</td>
<td>228.273</td>
<td>120.507</td>
<td>74.383</td>
<td>110.448</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.350</td>
<td>1.076</td>
<td>0.191</td>
<td>0.198</td>
<td>0.554</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>289.573</td>
<td>1297.226</td>
<td>658.170</td>
<td>394.271</td>
<td>432.726</td>
</tr>
<tr>
<td><strong>Total equity</strong></td>
<td>Mean</td>
<td>99.232</td>
<td>1670.163</td>
<td>599.792</td>
<td>1005.937</td>
<td>478.521</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>94.774</td>
<td>2432.665</td>
<td>1111.890</td>
<td>1513.593</td>
<td>609.674</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>685.282</td>
<td>18311.79</td>
<td>7306.225</td>
<td>12063.990</td>
<td>3622.572</td>
</tr>
<tr>
<td><strong>Technical change (Trend)</strong></td>
<td>Mean</td>
<td>4.541</td>
<td>4.500</td>
<td>4.500</td>
<td>4.523</td>
<td>4.489</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.287</td>
<td>2.294</td>
<td>2.295</td>
<td>2.289</td>
<td>2.306</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td></td>
<td>268</td>
<td>400</td>
<td>320</td>
<td>256</td>
<td>190</td>
</tr>
</tbody>
</table>

Source: Bankscope
Note: $W_1$ (input price of deposits) is the ratio of interest expenses to total deposits; $W_2$ (input price of labour) is the ratio of personnel expenditure to TA; $W_3$ (input price of physical capital) is the ratio of other operating costs to fixed assets. TOC, $Q$, $Z_1$, $Z_2$ are in 1 million USD.

### 2.4 Empirical Results

Table 2.3 reports the annual averaged estimates of bank X-efficiency scores for the six focal countries over 2005–12 using the SFA approach. In general, X-efficiency had a tendency to increase for banking in Bangladesh, Indonesia and the Philippines, suggesting that banks in these countries improved their technical and allocative efficiency levels. In contrast, X-efficiency of banks in India, Malaysia and Vietnam followed a downward trend; thus they need to consider their cost management thoroughly.

#### Table 2.1 X-efficiency of Banking in Six Asian Countries by Year and Country

<table>
<thead>
<tr>
<th>Year</th>
<th>Bangladesh</th>
<th>India</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0.730</td>
<td>0.928</td>
<td>0.881</td>
<td>0.953</td>
<td>0.934</td>
<td>0.958</td>
</tr>
<tr>
<td>2006</td>
<td>0.773</td>
<td>0.922</td>
<td>0.890</td>
<td>0.943</td>
<td>0.951</td>
<td>0.934</td>
</tr>
<tr>
<td>2007</td>
<td>0.818</td>
<td>0.915</td>
<td>0.899</td>
<td>0.937</td>
<td>0.965</td>
<td>0.909</td>
</tr>
<tr>
<td>2008</td>
<td>0.856</td>
<td>0.907</td>
<td>0.907</td>
<td>0.930</td>
<td>0.974</td>
<td>0.883</td>
</tr>
<tr>
<td>2009</td>
<td>0.890</td>
<td>0.900</td>
<td>0.915</td>
<td>0.922</td>
<td>0.982</td>
<td>0.854</td>
</tr>
<tr>
<td>2010</td>
<td>0.920</td>
<td>0.891</td>
<td>0.922</td>
<td>0.913</td>
<td>0.987</td>
<td>0.823</td>
</tr>
<tr>
<td>2011</td>
<td>0.948</td>
<td>0.882</td>
<td>0.928</td>
<td>0.903</td>
<td>0.991</td>
<td>0.789</td>
</tr>
<tr>
<td>2012</td>
<td>0.973</td>
<td>0.873</td>
<td>0.935</td>
<td>0.893</td>
<td>0.994</td>
<td>0.754</td>
</tr>
<tr>
<td>Average</td>
<td>0.863</td>
<td>0.902</td>
<td>0.910</td>
<td>0.924</td>
<td>0.972</td>
<td>0.863</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

Note: X-efficiency scores were estimated by the SFA approach. They show the percentage of cost that the bank uses efficiently compared to the best-practice bank in the sample under the same conditions. X-efficiency lies between 0 and 1, and equals 1 for the most efficient bank (i.e. the best-practice bank) in the sample.

Estimates in Table 2.3 indicate that averaged X-efficiency scores for banking systems in all countries of the sample are rather high. These scores are highest for the
Philippines (0.972), followed by Malaysia (0.924), Indonesia (0.910) and India (0.902). Bangladesh and Vietnamese banking systems achieve the same averaged X-efficiency score of 0.863. These results suggest that banks in the six emerging Asian countries operate quite efficiently compared to their best-practice bank for producing the same outputs under the same conditions.

Annual averaged X-efficiency scores for banks in the Philippines increased from 0.934 to almost 1. After the GFC, their X-efficiency scores almost reached the efficiency levels of the best-practice bank. Banking systems in Malaysia, Indonesia and India also operated efficiently with annual X-efficiency scores of around 0.9 over 2005–12.

Compared to other countries in the sample, Bangladesh and Vietnam experienced more dramatic changes in the yearly averaged efficiency levels of their respective banking systems. Banks in Vietnam operated very efficiently with X-efficiency scores >0.90 before the GFC but gradually declining to 0.754 in 2012. The possible reasons for the downward trend of X-efficiency in Vietnamese banking may be that during 2005–12 there was a decrease in GDP growth rates from 8.44% to 5.02%, while there was an increase in deposit interest rates from 8.4% to 11.5%, to around 13.5% in 2008 and 13.0% in 2011. Higher deposit interest rates may increase bank costs, thus decreasing the X-efficiency of banks in Vietnam.

In contrast, Bangladesh banks had a tendency to improve their X-efficiency on average, from 0.730 in 2005 to 0.973 in 2012. This improvement in the quality of management of banks in Bangladesh may be attributed to financial reforms in banking such as legal, policy and institutional reforms. A series of reforms was undertaken to increase efficiency of financial resource allocation, improve financial intermediation processes and enhance the competitiveness of the private sector.

2.5 Conclusions

The study investigates bank X-efficiency of six emerging countries (Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam) from two Asian regions (South and Southeast Asia) over the period 2005–12. X-efficiency is estimated by the SFA approach using the model of Battese and Coelli (1992).

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2 Source: Asian Development Bank (The Key Indicators for Asia and the Pacific 2013)
The results indicate that bank X-efficiency on average showed the tendency to improve for Bangladesh, Indonesia and the Philippines but decline for India, Malaysia and Vietnam over the study period. Therefore, banks in India, Malaysia and Vietnam need to consider their cost management to improve their X-efficiency. Banks in all countries in the sample achieve high X-efficiency scores, particularly the Philippines, Indonesia, and Malaysia. The average X-efficiency score of >0.86 suggests that banks in emerging Asian countries can control costs to attain high allocative and technical efficiency levels.
Chapter 3 Bank Concentration and Bank Competition in Emerging Asian Countries Pre- and Post-2008 Global Financial Crisis

3.1 Introduction

Over the last decades, emerging markets have experienced bank privatisation, interest rate deregulation and financial liberalisation while their banking structure has become more consolidated (Turk Ariss, 2010). Overall, banking across emerging markets has experienced increased competition from the presence of foreign banks where claimed efficiency advantages include advances in technological capabilities and superior management skills (Berger, DeYoung, Genay, & Udel, 2000; Jeon, Olivero, & Wu, 2011). As reported in studies on bank competition by Claessens and Laeven (2004), Jeon et al. (2011), Wu, Jeon, and Luca (2010), Yeyati and Micco (2007), and Yildirim and Philippatos (2007), foreign bank entry enhances competition in domestic banking markets. Further, Williams (2012) found that both foreign bank entry and privatisation have increased competition by restructuring domestic banking and consolidating troubled local banks, and have decreased the State’s role in banking. In general, emerging markets provide a rich laboratory to study the competitive structure of banking (Turk Ariss, 2010), as testified by several recent studies including Agoraki, Delis, and Pasiouras (2011), Beck, De Jonghe, and Schepens (2013), Fu, Lin, and Molyneux (2014), Marrouch and Turk-Ariss (2014), Nguyen, Skully, and Perera (2012), Soedarmono (2010), Soedarmono et al. (2011, 2013) and Tabak, Fazio, and Cajueiro (2012).

Asia has emerged as the world’s fastest growing region, with robust economic growth over 2005–14. In particular, East Asia, the Pacific and South Asia had averaged GDPG of 8.04%, compared with the world’s GDPG of 2.5%.3 Asian banking structures changed significantly after the 1997 Asian crisis due to the rapid development of banking consolidation as well as an increase in M&A. Since the early 1990s, Asian economies have experienced the vastly increased presence of foreign banks with better technological abilities and management skills (Jeon et al., 2011). The increase in

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foreign bank entry and changing market structures in emerging markets do raise concerns about competition in the region (Jeon et al., 2011; Turk Ariss, 2010). However, few studies have investigated bank competition in emerging Asian markets, with the exception of Beck et al. (2013), Fu et al. (2014), Nguyen et al. (2012), Soedarmono (2010), Soedarmono et al. (2011, 2013) and Turk Ariss (2010).

The current study investigates bank competition across emerging Asian markets including Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam, and focuses on how competition in these banking industries changed over the period 2005–12. The study’s innovation is to employ a conduct parameter approach following the framework suggested by Uchida and Tsutsui (2005) and Soedarmono et al. (2011, 2013). To check robustness of the results, both SUR and 3SLS are employed to estimate simultaneously the system of equations in the model. The study also examines the relationship between competition and market concentration over the study period.

This study contributes in several respects. First, it fills the gap in the banking literature by investigating bank competition across emerging markets over the GFC. Second, the study employs various statistical methods for robustness checks of the results. Third, the relationships between competition and market concentration in banking systems are investigated in the context of emerging Asian countries throughout the GFC.

This chapter is organised as follows: the next section reviews the literature on market concentration and competition across banking in developed and developing countries. Section 3.3 discusses the methodology and the data. Section 3.4 presents an in-depth discussion of the empirical results. Finally, Section 3.5 provides a conclusion.

3.2 Market Concentration and Bank Competition: An Overview

3.2.1 Market Concentration

Market concentration is usually considered as a proxy for market structure. Market concentration is also an indirect measure of market power based on traditional industrial organisation approaches that relate to banks’ behaviour and profitability (Casu & Girardone, 2006). The SCP hypothesis proposed by Bain (1951) suggests that greater profitability results from collusion between firms in a concentrated market. According to the SCP hypothesis, market structure affects competition and the
behaviour of banks in setting interest rates, which in turn influences bank performance. In highly concentrated markets, banks can set lower deposit rates and higher lending rates to get higher spreads that can increase their profitability. In other words, due to a lower cost of collusion between large banks under more concentrated markets, these banks obtain more market power to set price and earn supernormal profit. Hence, the traditional SCP hypothesis proposes that market concentration is an explanation for bank performance; that is, there exists a positive link between market structure and performance. The SCP hypothesis—which assumes that banks in a concentrated market collude to achieve higher profits—suggests that concentration and competition in banking is negatively related.

Some dominant pioneering empirical studies on banking lend support to the SCP hypothesis: for example, Heggestad and Mingo (1977), Lloyd-Williams, Molyneux, and Thornton (1994), Rhoades (1982), Rose and Fraser (1976), and Spellman (1981). In addition, Molyneux and Forbes (1995) tested the SCP hypothesis for European banking during the period 1986–89, reporting a positive and statistically significant relationship between market concentration and bank profitability. In the context of Asian banking, the SCP hypothesis was tested by Bhatti and Hussain (2010) and Fu and Heffernan (2009). Bhatti and Hussain (2010) confirmed a positive correlation between market concentration and profitability (using annual pooled data from 20 incorporated Pakistani commercial banks over 1996–2004) whereas Fu and Heffernan (2009) showed a significant negative relationship between market concentration and profitability in Chinese banking during their second stage of banking reform (1993–2002).

3.2.2 Bank Competition

3.2.2.1. Approaches to Measuring Bank Competition

The literature on the measurements of bank competition is very large and can be divided into two main streams: studies using the structural approach and those using the non-structural approach. The former employ market concentration as a measure of competition, whereas the later try to estimate the level of competition directly.

The structural approach uses market concentration as a measure of competition. Concentration is negatively related to competition based on the traditional SCP hypothesis (Bain, 1951) that presupposes banks in a highly
concentrated market have a tendency to collude and thus gain higher profits. This paradigm assumes that the more concentrated the market, the more market power banks attain. Therefore, the structural method is based on an assumption that there is a negative relationship between market concentration and bank competition in the banking industry (Fu & Heffernan, 2009). However, the structural approach does not consider differentiation strategies of banks, such as product differentiation. It reflects only the market share of banks, not their competitive behaviour (Beck, 2008). As a result, these indicators are viewed as a weak and poor estimate of bank competition (Berger, Demirgüç-Kunt, Levine, & Haubrich, 2004; Claessens & Laeven, 2004, 2005; de Guevara, Maudos, & Pérez, 2005; Joaquín & Fernández de Guevara, 2004; Klaus Schaeck & Cihak, 2010). The concern here is that market concentration tells us little about the degree of competition in banking and is, according to Schaeck et al. (2009), an inappropriate measure of bank competition.

The non-structural approach, the so-called NEIO approach, has become popular in recent bank studies because it has several advantages over the structural approach. For example, the non-structural approach does not assume the existence of a negative relationship between the level of concentration and competition; instead it assumes contestability in banking competition whereby the degree of potential competition, rather than the degree of actual concentration, is investigated. This method does not infer that banks in concentrated markets are less competitive because contestability does not necessarily depend on the concentration level but rather on the level of potential competition. In addition, it is not necessary to identify a geographic market because market power can be indicated by individual banks’ behaviours (Casu & Girardone, 2006). Therefore, instead of investigating the competitive environment via a structural approach, the NEIO approach attempts to measure and estimate the level of competition directly. These approaches evaluate the competitive conditions of the banking industry and market power via the pricing conduct of banks or observing banks’ behaviour, and via estimation of equations related to price and output determination (Coccorese, 2009). Due to the benefits of the NEIO approach, three techniques for measuring bank competition are often used in empirical studies: the Panzar–Rosse (P–R) H-statistic approach, the conduct parameter approach, and the Lerner index approach.

The Panzar–Rosse (P–R) H-statistic approach
This approach is based on the Panzar and Rosse (1987) model, which estimates a H-statistic to reflect the degree of competition. The H-statistic is also widely used in many empirical studies on bank competition (e.g. Casu and Girardone (2006); Chen (2009); Schaeck and Cihak, (2010); Mlambo and Ncube, (2011); Masood and Sergi (2011)). This technique aims to evaluate the effect of changes in input prices on banks’ revenues, and then calculates an H-statistic as the sum of the elasticities of a bank’s revenue with respect to all input prices, including price of funds, price of labour, and price of capital from a reduced form revenue equation. Hence, the H-statistic approach needs only information on revenue and factor prices for each bank in the sample rather than data on cost and specific assumptions about the market (e.g. product or geography) (Coccorese, 2009). However, a weakness of the Panzar–Rosse H-statistic is that its usefulness only applies when estimating the level of bank competition at the national level rather than at the specific individual bank level. Thus, it cannot be employed to evaluate individual bank-level decisions of banks (Turk Ariss, 2010).

Further, the H-statistic is considered as a continuous and long-run measure under the assumption of long-run equilibrium, which is a further limitation of this approach (Liu, Molyneux, & Nguyen, 2012; Klaus Schaeck & Cihak, 2010; S. Shaffer, 2004). There should be no statistical correlation between rates of return and input prices in long-run equilibrium. Hence, this statistic needs to be considered with some caution if the equilibrium test is rejected (Bikker & Bos, 2008).

**Conduct parameter approach**

To overcome the H-statistic test’s shortcomings, empirical studies have used another technique for calculating competition levels. This technique estimates a parameter that reflects bank conduct, such as the Conjectural Variation Coefficient (Iwata, 1974) or Conduct Parameter (Bresnahan, 1982; Lau, 1982). The advantage of this technique is that it estimates a direct measure of competition that is not based on market structure or the assumption of a long-run equilibrium.

The conduct parameter method reflects banks’ behaviour via an estimated parameter that represents their degree of market power through a mark-up test. The mark-up tests are based on the principle that profit-maximising banks in equilibrium will select prices at which marginal costs and perceived marginal revenue are equal. This test, therefore, estimates \( \theta \), which represents the degree of market power of a bank by calculating the deviation of a bank’s perceived marginal revenue schedule from its
demand schedule. This technique and its variants have been applied in bank competition studies by Uchida and Tsutsui (2005), Brissimis et al. (2008), Delis, Staikouras, and Varlagas (2008), Delis and Tsionas (2009), Soedarmono (2010), and Soedarmono et al. (2011, 2013).

A suggested approach by Uchida and Tsutsui (2005) on competition in the Japanese banking over the 1974–2000 period, referred to as the Cournot-type theoretical framework, provides yearly estimates of the degree of competition ($\theta$). After developing three equations for the cost, inverse demand, and first-order condition functions of profit maximisation, that study estimated simultaneously these equations by multivariate regression and 3SLS. Unlike the method of Bresnahan (1982) and Lau (1982), which estimates a long-run average competition level using time series data, one of the merits of Uchida and Tsutsui's (2005) estimation method is that it investigates short-term changes in the degree of competition by using panel data; thus this approach can reveal the trend in competition over a period. Moreover, this approach requires neither information on market structure, nor assumptions regarding market equilibrium.

**Lerner index approach**

A bank’s market power, defined as its ability to specify price above marginal cost (Lerner, 1934), is considered a proxy for its competitive behaviour. Estimation of the Lerner index, pioneered by Lerner (1934), has become one of the most widely used methods in academia to assess the degree of bank competition at both the industry and bank levels. The conventional Lerner index is calculated by the ratio of the disparity between price ($p$) and marginal cost (MC), to price ($p$). This standard indicator is based on information on costs and prices or average revenue (AR) and attempts to estimate banks’ conduct as well as their market power. This measure is considered a bank-level, time-varying proxy for market power (Angelini & Cetorelli, 2003; Coccorese & Pellecchia, 2010; Maudos & de Guevara, 2007). It is, therefore, more suitable than the H-statistic or conduct parameter for examining competition at bank level and its relationship with bank performance and bank efficiency.

In addition, the Lerner index approach can estimate market power in various markets such as the asset, loan and deposit markets. It is able to capture the effect of both market concentration and elasticity of demand. Koetter et al. (2008) found that
the efficiency-adjusted Lerner index can assess competitive behaviour in banking markets and other markets; thus it is useful for policies that seek to foster competition over time, and for regulators as well as policymakers to recognise efficient banks in providing bank products and services to customers (Klaus Schaeck & Cihak, 2010). However, Vives (2008) suggested that the Lerner index cannot measure the level of product substitutability. Moreover, the Lerner index will be biased if either of its two components (price and marginal cost) are not estimated exactly.

3.2.2.2. Empirical Studies on Bank Competition


In the context of emerging economies, many studies have estimated bank competition using the Panzar and Rosse (1987) H-statistic method; in Europe and Latin America (Gelos & Roldós, 2004), the Gulf Combined Countries (Al-Muharrami, Matthews, & Khabari, 2006), South-eastern Europe (Mamatzakis, Staikouras, & Koutsomanoli-Fillipaki, 2005), Sub-Saharan Africa (Chen, 2009), China (Masood & Sergi, 2011), South Africa (Mlambo & Ncube, 2011), emerging Asia and Latin America (Jeon et al., 2011), and Southeast Asia (Liu et al., 2012). Many such studies concluded that emerging banking markets were monopolistically competitive. Similar results were also reported in a study using Lerner indices by Turk Ariss (2010) for five emerging regions over the period 1999–2005. The author indicates that banks operate under conditions of monopolistically competitive markets in these emerging regions where there are conditions of relatively underdeveloped financial markets and where the essential role of banks is to provide credit. The findings here suggest that banking industries in two regions—namely East/South Asia and Pacific, and the Middle East—are less competitive.

In the context of the Latin American banking system, Williams (2012) used conventional Lerner indices for both loan and deposit markets, and efficiency-adjusted
Lerner indices for asset markets to estimate market power. The results showed that the banking system in Latin America was generally of the monopolistically competitive variety. Similarly, Fang et al. (2011) concluded that the banking systems of six South-eastern European transition nations operated under conditions of monopolistic competition in the decade 1998–2008. Pruteanu-podpiera et al. (2008) also employed Lerner indices to calculate bank competition levels in the Czech Republic, a transition economy. The results, however, indicate a downward trend as the main trend of banking competition during the transition period, rather than a strong development of competition. To investigate whether competition or regulations affects bank risk taking in transition countries, Agoraki et al. (2011) measured bank market power for a sample of Central and Eastern European banking systems over the period 1998–2005 using the conventional Lerner index. The results suggest that monopolistic competition is the best description for banking sectors in this region.

The growth of foreign bank entry and changing market structures in emerging Asian markets raises concerns about competition in banking (Jeon et al., 2011; Turk Ariss, 2010). Claessens and Laeven (2004) and Klaus Schaeck et al. (2009) used the Panzar and Rosse (1987) H-statistic to estimate the degree of bank competition in a sample of developed and developing countries. They found that the structure of banking sectors in some Asian emerging countries is characterised by monopolistic competition. Focusing solely on Asian banking markets, Soedarmono (2010) examined yearly average market power in 10 Asian countries between 1999 and 2007 using the Cournot-type theoretical framework suggested by Uchida and Tsutsui (2005). The study found that monopolistic competition is the best description of competitive structure in these banking industries for this period, with the exception of India, where marginal cost exceeds price. The findings also indicate an increase in market power (i.e. a decrease in competition level) in the Asian banking sector over this period. Soedarmono et al. (2013) estimated bank competition in 11 Asian industries over the period 1994–2009, covering both the 1997 Asian crisis and the GFC. They found that the competitive structure was monopolistic competition for most banking industries during 2005–09. The current study adds to the literature on banking in emerging Asian economies by investigating the changes in market concentration and bank competition as well as their relationship over the pre- and post-GFC periods.

3.3 Methodology
3.3.1 Measurement of Market Concentration and Bank Competition

To investigate competition across Asian banking and changes between 2005 and 2012, the period spanning the GFC, this study employs a non-structural approach based on explicit information with regard to cost and demand, to estimate bank behaviour. The level of banks’ market power is reflected via estimates of banks’ behaviour (Coccorese, 2009). The study follows the framework suggested by Delis and Tsionas (2009), Soedarmono et al. (2011, 2013), and Uchida and Tsutsui (2005) to measure competition across emerging markets. Based on the framework developed by Uchida and Tsutsui (2005), a bank is assumed to raise total deposit and short-term funding \((d_i)\) from its depositors, then invest it to total earning assets \((q_i)\) and government bonds \((b_i)\), and aim to maximise its profit function:

\[
\pi_i = P_t(q_i)q_i + r^{b}_{it}b_i - r^{d}_{it}d_i - C_i(q_i, d_i) \tag{3.1}
\]

Where \(\pi\) is the profit of bank \(i\) at time \(t\), \(P_t(q_i)\) is the inverse demand function for total earning assets, \(C_i(q_i, d_i)\) is the operating cost function. \(r^{b}_{it}\) and \(r^{d}_{it}\) are the yields for bonds and the deposit interest rate, respectively. The bank’s goal is to maximise profit:

\[
Max_{b_i, q_i, d_i} \pi_i \text{ s.t. } b_i + q_i = d_i. \tag{3.2}
\]

The first-order conditions of the profit maximisation are:

\[
P_t(1 - \frac{1}{\eta_t} \theta_i) = r^{b}_{it} + \frac{C_i(q_i, d_i)}{d_i} \tag{3.3}
\]

and

\[
r^{b}_{it} - r^{d}_{it} - \frac{\partial C_i}{\partial d_i} = 0 \tag{3.4}
\]

or

\[
r^{b}_{it} = r^{d}_{it} + \frac{\partial C_i}{\partial d_i} \tag{3.5}
\]

Where \(\eta_t = -(P_t/Q_t)(\partial Q_t/\partial P_t)\) measures the market demand elasticity for total earning assets; \(\theta_i = (q_i/Q_t)(\partial Q_t/\partial q_i)\) represents the competition degree of bank \(i\) at time \(t\); and \(\theta\) represents competition degree of banking industry at time \(t\).

Replacing \(r^{b}_{it}\) with \((r^{d}_{it} + \frac{\partial C_i}{\partial d_i})\) in Equation 3.3 results in:

\[
P_t(1 - \frac{1}{\eta_t} \theta_i) = r^{d}_{it} + \frac{C_i(q_i, d_i)}{d_i} + \frac{\partial C_i}{\partial q_i} \tag{3.6}
\]
\[ R_{it} = P_{it}q_{it} \] is defined as the total revenue of bank \( i \) at time \( t \). As in Brissimis et al. (2008), Soedarmono (2010) and Soedarmono et al. (2011, 2013), total revenue is the sum of the interest and non-interest revenue, and total expense is defined as the sum of interest and non-interest expense. These definitions show implicitly the role of both interest and non-interest activities in creating the profits of banks. The revenue of bank \( i \) generated by total earning assets is specified as:

\[
R_{it} = \frac{\theta_t}{\eta_t} R_{it} + r_{it} d_{it} q_{it} + \frac{\partial c_{it}}{\partial d_{it}} q_{it} + \frac{\partial c_{it}}{\partial q_{it}} q_{it} \tag{3.7}
\]

The translog cost function and the revenue function are assumed as follows:

\[
\ln C_{it} = b_0 + b_1 \ln q_{it} + \frac{1}{2} b_2 (\ln q_{it})^2 + b_3 \ln d_{it} + \frac{1}{2} b_4 (\ln d_{it})^2 + b_5 \ln w_{it} + \frac{1}{2} b_6 (\ln w_{it})^2 + b_7 (\ln q_{it})(\ln w_{it}) + b_8 (\ln q_{it})(\ln d_{it}) + b_9 (\ln d_{it})(\ln w_{it}) + e_{it}^C \tag{3.8}
\]

\[
R_{it} = \frac{\theta_t}{\eta_t} R_{it} + r_{it} d_{it} q_{it} + C_{it}(b_1 + b_2 \ln q_{it} + b_3 \ln w_{it} + b_4 \ln d_{it}) + C_{it}q_{it}(b_5 + b_6 \ln d_{it} + b_7 \ln q_{it} + b_8 \ln w_{it}) + e_{it}^S \tag{3.9}
\]

To reduce multicollinearity, variables with upper bars are calculated by deviations from their means in each period (Brissimis et al., 2008; Soedarmono et al., 2011; Uchida & Tsutsui, 2005).

\[ \eta_t \] is captured from the inverse loan demand function as follows:

\[
\ln P_{it} = g_0 - (1/\eta_t) \ln q_{it} + g_1 \ln GDP_t + g_2 \ln IR_t + g_3 \ln TA_{it} + e_{it}^P \tag{3.10}
\]

As in Delis and Tsionas (2009), macroeconomic variables used in Equation 3.10 are gross domestic product (GDP), instead of GDP due to the negative values of GDP for Malaysia in 2009.

According to this approach, \( \theta \) is defined as the conjectural variation elasticity for total banking industry outputs with respect to the \( i^{th} \) bank’s output, which provides a measure of annual market power. \( \theta \) is a proxy for bank competition at industry level. A higher (lower) \( \theta \) indicates a decrease (increase) in bank competition. In theory, values of \( \theta \) are bound by 0 and 1, where \( \theta = 0 \) implies perfect competition, \( \theta = 1 \) implies pure monopoly, and in-between values of \( \theta \) indicate monopolistic competition.
However, $\theta < 0$ implies that marginal cost is higher than price, possibly due to non-optimising behaviour of banks.

Table 3.2 Definition of Variables for Estimating $\theta$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C$</td>
<td>Total expenses</td>
</tr>
<tr>
<td>$Q$</td>
<td>Total earning assets</td>
</tr>
<tr>
<td>$D$</td>
<td>Total deposit and short-term funding</td>
</tr>
<tr>
<td>$W$</td>
<td>Total operating expenses to TA</td>
</tr>
<tr>
<td>$R$</td>
<td>Total revenue, equals sum of interest revenue and non-interest revenue</td>
</tr>
<tr>
<td>$r$</td>
<td>Ratio of interest expenses to total deposits</td>
</tr>
<tr>
<td>$P$</td>
<td>Ratio of total revenue to total earning assets</td>
</tr>
<tr>
<td>$IR$</td>
<td>Short-term interest rates</td>
</tr>
<tr>
<td>$TA$</td>
<td>Total assets</td>
</tr>
<tr>
<td>$GDP$</td>
<td>Real gross domestic product</td>
</tr>
<tr>
<td>$e$</td>
<td>Error term</td>
</tr>
</tbody>
</table>

Like Uchida and Tsutsui (2005) and Brissimis et al. (2008), the study employs both SUR and 3SLS to estimate simultaneously the system of equations 3.8–3.10. The SUR is able to take into account the correlation among error terms in equations of the system, so this method can estimate the system of equations with correlated error terms. However, SUR makes the assumption that the error term and explanatory variables in each equation are uncorrelated. Therefore, if each equation in the system has endogenous variables on both sides, this regression will give biased results when estimating such a system. For 3SLS, both the endogeneity of the variables on the left-hand side and the cross-equation restrictions are considered when systems of three equations are estimated simultaneously. Moreover, 3SLS regression handles possible correlation between variables on the right-hand side and the error terms, contemporary occurrence of heteroscedasticity, along with correlation between residuals (Coccorese, 2009).

For 3SLS, year dummy variables are used to estimate $\theta$, but time dummy variables for every two years are employed to estimate $\eta$, in both models due to linear
dependence of $\eta$ on GDP in Equation 3.10. The rank variables $q_{i,t}$, $d_{i,t}$, $r_{i,t}$, $C_{i,t}$, $P_{i,t}$ and $R_{i,t}$, and exogenous variables such as $IR_{i,t}$, $TA_{i,t}$, $w_{i,t}$, GDP, and year dummies are used as instrumental variables.

Based on traditional industrial organisation approaches that observe the market structure and connect it with bank behaviour and profitability (Casu & Girardone, 2006), market concentration is considered a proxy for market structure. To measure the degree of market concentration in emerging Asian banking industries, this study uses a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year.

### 3.3.2 Data

To investigate bank competition in emerging banking industries pre- and post-GFC, the study uses a sample of commercial banks only because these institutions have a tendency to be freer in choosing their mixture of business and can cope with similar limitations across countries (W. Soedarmono et al., 2011). The sample consists of commercial banks in six emerging Asian countries: Bangladesh (36 banks), India (46 banks), Indonesia (40 banks), Malaysia (25 banks), the Philippines (24 banks) and Vietnam (32 banks) over 2005–12.

The study uses panel data instead of time series data to estimate annual degree of competition, and thus reveals short-term changes in competition level. All yearly bank-specific data were retrieved from Bankscope Fitch-IBCA. For country-specific data, data for the real GDP were collected from the World Economic Outlook of the International Monetary Fund (IMF). IR is defined as short-term interest rates such as the inter-bank rate (for Bangladesh, India, Indonesia, Malaysia and the Philippines) or benchmark interest rate (for Vietnam) that was collected from the Asian Development Bank (ADB). Banks that provide insufficient data on the main variables for calculating competition level are excluded from the sample.

Descriptive statistics for all variables are shown in Table 3.2. In general, the interest rates in these emerging countries were very high, especially in Bangladesh and Vietnam. The average interest rates were highest in Bangladesh, followed by Vietnam (~9%). In contrast, Malaysia had the lowest average interest rates (~3%). Total expenses ($C$), total earning assets ($Q$), total deposit and short-term funding ($D$), total revenue (equals sum of interest revenue and non-interest revenue) ($R$), and TA were
highest for India, followed by Malaysia; they were lowest for Bangladesh. There were remarkable differences in real gross domestic product (GDP) among countries in the sample. GDP fluctuated from around 28 billion USD for Vietnam to over 983 billion USD for India.

Table 3.2 Descriptive Statistics for Variables used to Estimate Bank Competition

<table>
<thead>
<tr>
<th></th>
<th>Bangladesh</th>
<th>India</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>108</td>
<td>1,661</td>
<td>389</td>
<td>517</td>
<td>235</td>
<td>303</td>
</tr>
<tr>
<td>SD</td>
<td>93</td>
<td>2,286</td>
<td>610</td>
<td>582</td>
<td>287</td>
<td>507</td>
</tr>
<tr>
<td>Min</td>
<td>6</td>
<td>14</td>
<td>4</td>
<td>20</td>
<td>0.3</td>
<td>0.167</td>
</tr>
<tr>
<td>Max</td>
<td>570</td>
<td>19,372</td>
<td>3,234</td>
<td>3,061</td>
<td>1,400</td>
<td>3,252</td>
</tr>
<tr>
<td><strong>Q</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1,156</td>
<td>22,972</td>
<td>4,938</td>
<td>12,634</td>
<td>4,012</td>
<td>3,455</td>
</tr>
<tr>
<td>SD</td>
<td>1,042</td>
<td>31,861</td>
<td>8,643</td>
<td>16,218</td>
<td>5,406</td>
<td>5,313</td>
</tr>
<tr>
<td>Min</td>
<td>64</td>
<td>183</td>
<td>69</td>
<td>284</td>
<td>29</td>
<td>7</td>
</tr>
<tr>
<td>Max</td>
<td>5,860</td>
<td>262,787</td>
<td>53,663</td>
<td>100,411</td>
<td>28,453</td>
<td>28,021</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
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<td>4,611</td>
<td>12,736</td>
<td>3,673</td>
<td>3,243</td>
</tr>
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<td>4,870</td>
<td>4,955</td>
</tr>
<tr>
<td>Min</td>
<td>64</td>
<td>183</td>
<td>69</td>
<td>284</td>
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<td>7</td>
</tr>
<tr>
<td>Max</td>
<td>7,630</td>
<td>246,610</td>
<td>47,218</td>
<td>87,228</td>
<td>23,652</td>
<td>26,322</td>
</tr>
<tr>
<td><strong>W</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.024</td>
<td>0.018</td>
<td>0.033</td>
<td>0.017</td>
<td>0.035</td>
<td>0.015</td>
</tr>
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<td>0.013</td>
<td>0.011</td>
<td>0.013</td>
<td>0.005</td>
</tr>
<tr>
<td>Min</td>
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<td>0.007</td>
<td>0.007</td>
<td>0.005</td>
<td>0.012</td>
<td>0.003</td>
</tr>
<tr>
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<td>0.097</td>
<td>0.042</td>
<td>0.075</td>
<td>0.112</td>
<td>0.087</td>
<td>0.045</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>178</td>
<td>2,603</td>
<td>756</td>
<td>1025</td>
<td>463</td>
<td>444</td>
</tr>
<tr>
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<td>3,642</td>
<td>1,304</td>
<td>1,177</td>
<td>581</td>
<td>749</td>
</tr>
<tr>
<td>Min</td>
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<td>7</td>
<td>36</td>
<td>5</td>
<td>0.364</td>
</tr>
<tr>
<td>Max</td>
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<td>30,551</td>
<td>7,723</td>
<td>6,384</td>
<td>2,872</td>
<td>4,759</td>
</tr>
<tr>
<td><strong>r</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.068</td>
<td>0.057</td>
<td>0.053</td>
<td>0.026</td>
<td>0.032</td>
<td>0.074</td>
</tr>
<tr>
<td>SD</td>
<td>0.018</td>
<td>0.012</td>
<td>0.020</td>
<td>0.010</td>
<td>0.012</td>
<td>0.032</td>
</tr>
<tr>
<td>Min</td>
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<td>0.028</td>
<td>0.006</td>
<td>0.009</td>
<td>0.010</td>
<td>0.014</td>
</tr>
<tr>
<td>Max</td>
<td>0.173</td>
<td>0.109</td>
<td>0.116</td>
<td>0.101</td>
<td>0.065</td>
<td>0.178</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.156</td>
<td>0.116</td>
<td>0.152</td>
<td>0.095</td>
<td>0.131</td>
<td>0.122</td>
</tr>
<tr>
<td>SD</td>
<td>0.027</td>
<td>0.016</td>
<td>0.043</td>
<td>0.042</td>
<td>0.032</td>
<td>0.037</td>
</tr>
<tr>
<td>Min</td>
<td>0.078</td>
<td>0.085</td>
<td>0.045</td>
<td>0.042</td>
<td>0.053</td>
<td>0.026</td>
</tr>
<tr>
<td>Max</td>
<td>0.245</td>
<td>0.205</td>
<td>0.311</td>
<td>0.420</td>
<td>0.252</td>
<td>0.265</td>
</tr>
<tr>
<td><strong>IR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>9.324</td>
<td>6.542</td>
<td>6.687</td>
<td>3.113</td>
<td>5.620</td>
<td>8.873</td>
</tr>
<tr>
<td>SD</td>
<td>2.971</td>
<td>1.528</td>
<td>1.503</td>
<td>0.498</td>
<td>1.438</td>
<td>2.657</td>
</tr>
<tr>
<td>Min</td>
<td>4.824</td>
<td>3.608</td>
<td>4.037</td>
<td>2.233</td>
<td>4.025</td>
<td>5.917</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>India</td>
<td>Indonesia</td>
<td>Malaysia</td>
<td>Philippines</td>
<td>Vietnam</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>-------</td>
<td>-----------</td>
<td>----------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>Mean</td>
<td>1,380</td>
<td>25,639</td>
<td>5,628</td>
<td>15,332</td>
<td>4,512</td>
<td>3,883</td>
</tr>
<tr>
<td>SD</td>
<td>1,371</td>
<td>35,577</td>
<td>9,928</td>
<td>18,786</td>
<td>5,929</td>
<td>5,809</td>
</tr>
<tr>
<td>Min</td>
<td>87</td>
<td>217</td>
<td>75</td>
<td>492</td>
<td>34</td>
<td>9</td>
</tr>
<tr>
<td>Max</td>
<td>8,472</td>
<td>290,048</td>
<td>58,232</td>
<td>112,009</td>
<td>30,210</td>
<td>29,634</td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>68,139</td>
<td>983,132</td>
<td>226,672</td>
<td>192,034</td>
<td>118,068</td>
<td>28,024</td>
</tr>
<tr>
<td>SD</td>
<td>5,703</td>
<td>126,075</td>
<td>34,421</td>
<td>31,950</td>
<td>20,573</td>
<td>1,512</td>
</tr>
<tr>
<td>Min</td>
<td>59,389</td>
<td>767,047</td>
<td>178,109</td>
<td>143,804</td>
<td>84,446</td>
<td>24,694</td>
</tr>
<tr>
<td>Max</td>
<td>75,208</td>
<td>1,145,876</td>
<td>271,799</td>
<td>244,931</td>
<td>153,303</td>
<td>29,451</td>
</tr>
<tr>
<td><strong>Number of banks</strong></td>
<td>36</td>
<td>46</td>
<td>40</td>
<td>25</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>288</td>
<td>368</td>
<td>320</td>
<td>200</td>
<td>192</td>
<td>253</td>
</tr>
</tbody>
</table>

Source: Bankscope, ADB and IMF

*Note: R, C, Q, D, TA and GDP are in millions of USD; IR is in %; P, W, and r are ratios.*

### 3.4 Empirical Results

#### 3.4.1 Bank Competition and Market Concentration across Emerging Asian Countries

Tables 3.3–3.8 illustrate the degree of market concentration and competition in banking systems across the six focal countries over 2005–12 using a four-bank concentration ratio in terms of TA (CRTA4) and values of \( \theta \) obtained from simultaneous estimation of equations by SUR and 3SLS. \( \theta \) is defined as the conjectural variation elasticity for total banking industry outputs with respect to the \( i \)th bank’s output, which provides a measure of annual market power and a proxy for bank competition at industry level.

**Bangladesh**
Figure 3.1. Estimates of $\theta$ by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for Bangladesh banking.

Figure 3.1 illustrates that $\theta$ generally showed a downward trend over 2005–12. $\theta$ provides a measure of annual market power and a proxy for bank competition at industry level so $\theta$ is negatively related to bank competition. Therefore, competition in Bangladesh banking generally improved over this period. As shown in Table 3.3, most $\theta$ values are statistically significant with the exception of $\theta$ by SUR in 2006 and $\theta$ by 3SLS during 2006–08. $\theta$ by SUR decreased sharply over 2005–07 from 1.107 to –0.196. Therefore, banks in Bangladesh had a tendency to operate under conditions of a pure monopoly in 2005 and monopolistic competition in 2006; but the negative value of $\theta$ in 2007 implies that marginal cost was higher than price, possibly due to non-optimising behaviour of banks. $\theta$ increased and reached a peak of 0.172 in 2008, so banks in Bangladesh seemed to be monopolistic competitive when the GFC happened. However, $\theta$ decreased dramatically and took on negative values in the following years. One possible interpretation for the trend of competition is that financial reforms in the banking sector—such as the legal, policy and institutional reforms launched since 1990—enhance competitiveness among banks in the system. However, the recent GFC may have resulted in a slight decrease in the degree of competition among banks in the year the crisis occurred, and as a result of non-optimising behaviour of banks in later years.

Table 3.3 Bank Competition and Market Concentration in Bangladesh over 2005–12
<table>
<thead>
<tr>
<th>Year</th>
<th>SUR</th>
<th>3SLS</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1.107 ***</td>
<td>0.807 ***</td>
<td>44.732</td>
</tr>
<tr>
<td>2006</td>
<td>0.159</td>
<td>0.242</td>
<td>41.480</td>
</tr>
<tr>
<td>2007</td>
<td>–0.196 *</td>
<td>0.030</td>
<td>42.260</td>
</tr>
<tr>
<td>2008</td>
<td>0.172 *</td>
<td>0.142</td>
<td>38.890</td>
</tr>
<tr>
<td>2009</td>
<td>–0.195 **</td>
<td>–0.148 *</td>
<td>35.753</td>
</tr>
<tr>
<td>2010</td>
<td>–0.666 ***</td>
<td>–0.562 ***</td>
<td>33.887</td>
</tr>
<tr>
<td>2011</td>
<td>–0.394 ***</td>
<td>–0.336 ***</td>
<td>33.501</td>
</tr>
<tr>
<td>2012</td>
<td>–0.522 ***</td>
<td>–0.483 ***</td>
<td>30.883</td>
</tr>
</tbody>
</table>

$R^2$ 0.488 0.467

Source: Author’s calculations

Note: $\theta$ is a proxy for bank competition. Values of $\theta$ are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between $\theta$ and degree of competition, that is, a higher (lower) $\theta$ is associated with a lower (higher) competition level: $\theta = 0$, perfect competition; $\theta = 1$, pure monopoly; $0<\theta<1$, monopolistic competition; $\theta<0$, marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Estimated values of $\theta_t$ by 3SLS lie between 0 and 1 over 2005–08, implying that banks in Bangladesh had a tendency to be monopolistically competitive in this period. However, $\theta_t$ is statistically significant only in 2005. Similar to the results for SUR, all $\theta_t$ by 3SLS takes on negative values and is statistically significant over 2009–12, suggesting that banks in Bangladesh had higher marginal cost than price, possibly because they behaved in a non-optimised fashion under the effects of the GFC.

Table 3.3 shows that market concentration of the banking in Bangladesh decreased from 44.73% in 2005 to 30.88% in 2012. The growth of TA held by the four largest banks (~14%) is lower than the growth of TA for the whole banking system (~20%) over 2005-2012⁴. The four largest banks could not maintain their market

⁴Source: Author’s calculation based on Bankscope data.
shares of TA over this period because other smaller commercial banks competed to grab market shares from these banks gradually, and thus increased their market shares.

India

![Figure 3.1. Estimates of $\theta$ by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for Indian banking.](chart)

In contrast to the banking system in Bangladesh, Figure 3.2 shows that $\theta_t$ for Indian banking generally followed an upward trend, suggesting that there was a decrease in bank competition for this banking context over the studied period because $\theta$ provides a measure of annual market power and a proxy for bank competition at industry level so $\theta$ is negatively related to bank competition. In addition, Table 3.4 indicates that $\theta_t$ takes on negative values over 2005–08 and increased sharply in the first three years from around –1 to around – 0.3, but remained virtually constant when the crisis occurred. These results suggest that banks in India tended to operate at non-optimisation levels before the crisis because they had higher marginal cost than price. However, $\theta_t$ continued to increase and takes on positive values between 0 and 1 over 2009–12, thus implying that competition in Indian banking had a tendency to decrease, and that monopolistic competition is the best description of the competitive structure of Indian banking over this period. $\theta_t$ in 2009 is virtually 0 (0.014 by SUR; 0.017 by 3SLS), implying the banking system is rather perfectly competitive. However, this finding was not statistically significant. Table 3.4 shows that the estimated results for $\theta_t$ by SUR and 3SLS are similar. Most $\theta_t$ estimates are highly statistically significant at the 1% level, with the exception of $\theta_t$ in 2009.
Table 3.4 Bank Competition and Market Concentration in India over 2005–12

<table>
<thead>
<tr>
<th>Year</th>
<th>Bank competition ($\theta$)</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUR</td>
<td>3SLS</td>
</tr>
<tr>
<td>2005</td>
<td>-0.984 ***</td>
<td>-1.060 ***</td>
</tr>
<tr>
<td>2006</td>
<td>-0.670 ***</td>
<td>-0.704 ***</td>
</tr>
<tr>
<td>2007</td>
<td>-0.255 ***</td>
<td>-0.356 ***</td>
</tr>
<tr>
<td>2008</td>
<td>-0.240 ***</td>
<td>-0.363 ***</td>
</tr>
<tr>
<td>2009</td>
<td>0.014</td>
<td>0.017</td>
</tr>
<tr>
<td>2010</td>
<td>0.204 ***</td>
<td>0.176 ***</td>
</tr>
<tr>
<td>2011</td>
<td>0.175 ***</td>
<td>0.182 ***</td>
</tr>
<tr>
<td>2012</td>
<td>0.269 ***</td>
<td>0.276 ***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.621</td>
<td>0.589</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

\textbf{Note:} $\theta$ is a proxy for bank competition. Values of $\theta$ are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between $\theta$ and degree of competition, that is, a higher (lower) $\theta$ is associated with a lower (higher) competition level: $\theta = 0$, perfect competition; $\theta = 1$, pure monopoly; $0 < \theta < 1$, monopolistic competition; $\theta < 0$, marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

The four largest banks hold around one-third market share of the Indian banking sector. The financial sector reforms have allowed the entry of new private commercial banks and foreign banks since 1992. The establishment of new private banks became liberalised. As a result, market concentration decreased slightly during 2005–12.

\textit{Indonesia}
Figure 3.3 Estimates of $\theta$ by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for banking in Indonesia.

$\theta$ is negatively related to bank competition because $\theta$ provides a measure of annual market power. Figure 3.3 shows that $\theta_t$ generally increased gradually over 2005–12. Following a decrease during 2005–06, $\theta_t$ became larger until 2008, and then decreased slightly in 2009 before recovering in the remaining years. This result suggests that bank competition in Indonesia increased over 2005–06 but declined just before the GFC. Bank competition then increased in 2009 and decreased again over 2009–12.

Table 3.5 indicates that the estimates of $\theta_t$ by SUR are slightly higher than those by 3SLS. All $\theta_t$ are highly statistically significant at the 1% level. $\theta_t$ takes on small values from 0.05 to 0.18 over 2005–12, suggesting that banking in Indonesia became monopolistically competitive but competition was very strong over this period.

Market concentration of Indonesian banking showed a tendency to decrease over 2005–12. The four largest banks had over half of the total market share of banking. Therefore, banks in Indonesia operated in a rather highly concentrated market during the study period.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bank competition ($\theta$)</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUR</td>
<td>3SLS</td>
</tr>
<tr>
<td>2005</td>
<td>0.106 ***</td>
<td>0.089 ***</td>
</tr>
<tr>
<td>Year</td>
<td>$\theta$</td>
<td>$\theta$</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>2006</td>
<td>0.083 ***</td>
<td>0.053 ***</td>
</tr>
<tr>
<td>2007</td>
<td>0.138 ***</td>
<td>0.121 ***</td>
</tr>
<tr>
<td>2008</td>
<td>0.157 ***</td>
<td>0.149 ***</td>
</tr>
<tr>
<td>2009</td>
<td>0.142 ***</td>
<td>0.131 ***</td>
</tr>
<tr>
<td>2010</td>
<td>0.156 ***</td>
<td>0.158 ***</td>
</tr>
<tr>
<td>2011</td>
<td>0.167 ***</td>
<td>0.157 ***</td>
</tr>
<tr>
<td>2012</td>
<td>0.184 ***</td>
<td>0.177 ***</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

*Note: $\theta$ is a proxy for bank competition. Values of $\theta$ are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between $\theta$ and degree of competition, that is, a higher (lower) $\theta$ is associated with a lower (higher) competition level: $\theta = 0$, perfect competition; $\theta = 1$, pure monopoly; $0<\theta<1$, monopolistic competition; $\theta<0$, marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

**Malaysia**

In general, there was a downward trend in $\theta_t$ over 2005–12. Figure 3.4 shows a sharp decline in $\theta_t$ over 2005–07 and 2009–12; thus bank competition in Malaysia followed an upward trend in these periods because $\theta$ which provides a measure of annual market power is negatively related to bank competition. However, $\theta_t$ had a tendency to remain constant in the three years of 2007–09. This may be because banks in Malaysia focused on addressing their own problems to produce a stable banking system, rather than competing with each other, so they tended to avoid severe competition over the crisis period.
Figure 3.4. Estimates of $\theta$ by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for banking in Malaysia.

As shown in Table 3.6, the estimated values of $\theta_t$ by SUR and 3SLS are similar. Most $\theta_t$ are highly statistically significant at the 1% level. $\theta_t$ reached unity in 2005, implying that banking became a pure monopoly at that time. $\theta_t$ decreased gradually from ~0.6 to 0.3 over 2006–10, suggesting that banks in Malaysia operated under conditions of monopolistic competition during that period. In 2011, $\theta_t$ dropped to almost 0; however, this finding is not statistically significant. $\theta_t$ subsequently takes on a negative value, implying that banks in this country had higher marginal cost than price, possibly because that showed non-optimising behaviours in 2012.

Market concentration increased slightly from ~48% in 2005 to ~50% in 2012. However, the concentration levels had a tendency to decrease over 2006–11.

Table 3.6 Bank Competition and Market Concentration in Malaysia over 2005–12

<table>
<thead>
<tr>
<th>Year</th>
<th>Bank competition ($\theta$)</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUR</td>
<td>3SLS</td>
</tr>
<tr>
<td>2005</td>
<td>1.022 ***</td>
<td>1.017 ***</td>
</tr>
<tr>
<td>2006</td>
<td>0.655 ***</td>
<td>0.630 ***</td>
</tr>
<tr>
<td>2007</td>
<td>0.526 ***</td>
<td>0.442 ***</td>
</tr>
<tr>
<td>2008</td>
<td>0.455 ***</td>
<td>0.411 ***</td>
</tr>
<tr>
<td>2009</td>
<td>0.445 ***</td>
<td>0.438 ***</td>
</tr>
<tr>
<td>2010</td>
<td>0.324 ***</td>
<td>0.296 ***</td>
</tr>
<tr>
<td>2011</td>
<td>0.010</td>
<td>0.002</td>
</tr>
<tr>
<td>Year</td>
<td>( \theta ) (SUR)</td>
<td>( \theta ) (3SLS)</td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>2012</td>
<td>-0.347 ***</td>
<td>-0.375 ***</td>
</tr>
</tbody>
</table>

\( R^2 \) | 0.815 | 0.795 |

Source: Author’s calculations

Note: \( \theta \) is a proxy for bank competition. Values of \( \theta \) are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between \( \theta \) and degree of competition, that is, a higher (lower) \( \theta \) is associated with a lower (higher) competition level: \( \theta = 0 \), perfect competition; \( \theta = 1 \), pure monopoly; \( 0 < \theta < 1 \), monopolistic competition; \( \theta < 0 \), marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

The Philippines

![Graph](image)

Figure 3.5. Estimates of \( \theta \) by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for banking in the Philippines.

Similar to Malaysian banking, \( \theta_t \) in the Philippines generally decreased over the study period; therefore, competition in banking followed an upward trend during the period 2005–12 because \( \theta \) which provides a measure of annual market power is negatively related to bank competition. \( \theta_t \) declined gradually from \(~0.9\) to \(0.4\), suggesting that monopolistic competition is the best description of Philippines banking competitive structure in this period. All estimated values of \( \theta_t \) are highly statistically significant at the 1% level for both SUR and 3SLS estimations. Although \( \theta_t \) generally declined, there was a slight increase in \( \theta_t \) over 2008–09; thus, the recent financial crisis
seemed to decrease competition of banking in the Philippines. Market concentration generally followed an upward trend. Market shares of the four largest banks accounted for 56% in 2005, then increased to nearly 59% in 2012. Therefore, banks in the Philippines operated in a highly concentrated market.

Table 3.7 Bank Competition and Market Concentration in the Philippines over 2005–12

<table>
<thead>
<tr>
<th>Year</th>
<th>Bank competition (θ)</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUR</td>
<td>3SLS</td>
</tr>
<tr>
<td>2005</td>
<td>0.890 ***</td>
<td>0.852 ***</td>
</tr>
<tr>
<td>2006</td>
<td>0.762 ***</td>
<td>0.802 ***</td>
</tr>
<tr>
<td>2007</td>
<td>0.767 ***</td>
<td>0.773 ***</td>
</tr>
<tr>
<td>2008</td>
<td>0.616 ***</td>
<td>0.639 ***</td>
</tr>
<tr>
<td>2009</td>
<td>0.648 ***</td>
<td>0.658 ***</td>
</tr>
<tr>
<td>2010</td>
<td>0.549 ***</td>
<td>0.590 ***</td>
</tr>
<tr>
<td>2011</td>
<td>0.497 ***</td>
<td>0.528 ***</td>
</tr>
<tr>
<td>2012</td>
<td>0.385 ***</td>
<td>0.453 ***</td>
</tr>
<tr>
<td></td>
<td>*0.934</td>
<td>0.939</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

Note: θ is a proxy for bank competition. Values of θ are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between θ and degree of competition, that is, a higher (lower) θ is associated with a lower (higher) competition level: θ = 0, perfect competition; θ = 1, pure monopoly; 0<θ<1, monopolistic competition; θ<0, marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Vietnam

Figure 3.6 indicates a fluctuation of θt for Vietnamese banking over 2005–12. θ provides a measure of annual market power so θ is negatively related to bank competition. θt followed a V-shape over 2005–07, suggesting that bank competition increased over 2005-2006 but declined in 2007. Then, θt declined in 2008 and recovered over 2008–10; therefore, competition showed a tendency to improve before the 2008 crisis but decreased two years later. One possible interpretation of this trend
in competition is that banks in Vietnam became more vulnerable due to high ratios of non-performing loans, especially when the GFC happened. Hence, they had a tendency to focus on addressing their own problems rather than competing with each other. In this way they tended to avoid severe competition during the crisis period. $\theta$ reached a new bottom in 2011 before increasing slightly in 2012; thus bank competition improved in 2011 but decreased slightly in 2012.

![Graph](image)

*Figure 3.6.* Estimates of $\theta$ by seemingly unrelated regression (SUR) and three-stage least squares (3SLS) for banking in Vietnam.

Table 3.8 shows that estimated values of $\theta_i$ by SUR and 3SLS in 2005 are very different (−0.087 by SUR vs. 0.112 by 3SLS); however, neither value is statistically significant. All estimates of $\theta_i$ take on negative values and fluctuated over a small range from around −0.1 to around −0.3 during 2006–12 and are statistically significant, with the exception of $\theta_i$ by 3SLS in 2007. This result suggests that marginal cost was higher than price in Vietnamese banking, possibly because banks in Vietnam seem to operate at non-optimised levels.
Table 3.8 Bank Competition and Market Concentration in Vietnam over 2005–12

<table>
<thead>
<tr>
<th>Year</th>
<th>Bank competition (θ)</th>
<th>Market concentration (CRTA4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUR</td>
<td>3SLS</td>
</tr>
<tr>
<td>2005</td>
<td>−0.087</td>
<td>0.112</td>
</tr>
<tr>
<td>2006</td>
<td>−0.199 ***</td>
<td>−0.266 **</td>
</tr>
<tr>
<td>2007</td>
<td>−0.099 ***</td>
<td>−0.111</td>
</tr>
<tr>
<td>2008</td>
<td>−0.219 ***</td>
<td>−0.240 ***</td>
</tr>
<tr>
<td>2009</td>
<td>−0.173 ***</td>
<td>−0.143 ***</td>
</tr>
<tr>
<td>2010</td>
<td>−0.156 ***</td>
<td>−0.131 ***</td>
</tr>
<tr>
<td>2011</td>
<td>−0.204 ***</td>
<td>−0.245 ***</td>
</tr>
<tr>
<td>2012</td>
<td>−0.166 ***</td>
<td>−0.229 ***</td>
</tr>
<tr>
<td></td>
<td>$R^2$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations

Note: θ is a proxy for bank competition. Values of θ are obtained from simultaneous estimation of equations by SUR and 3SLS. There is a negative relationship between θ and degree of competition, that is, a higher (lower) θ is associated with a lower (higher) competition level: θ = 0, perfect competition; θ = 1, pure monopoly; 0<θ<1, monopolistic competition; θ<0, marginal cost is higher than price. CRTA4 is a four-bank concentration ratio in terms of TA, defined as the ratio of the TA of the four largest banks to the TA of all the banks in a given year. CRTA4 is in %.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Among countries in the sample, Vietnam had the most highly concentrated banking market in the first two years, with concentration ratios >72%. However, from the year 2007, these ratios decrease dramatically. There are several main potential reasons for these changes. First, the Vietnamese banking system has witnessed a dramatic increase in the number of banks, mainly due to a remarkable increased presence of foreign banks, especially since 2007 when Vietnam became a member of the World Trade Organization (WTO). Due to the global integration of Vietnam and its WTO commitments, the banking system is now more open to foreign investment, and has removed many barriers to foreign banks. Since 1 January 2011, the playing field for both domestic and foreign banks has been levelled because of the similar treatment of foreign banks’ branches as domestic banks, for example with respect to deposit and lending rules and provision of the same services (Ho & Baxter, 2011).
Second, strong competition between joint stock commercial banks and state-owned commercial banks to capture market share led to a dramatic change in concentration levels.

### 3.4.2 The Relationship between Market Concentration and Bank Competition

Of interest in the research is the nature of the relationship between market concentration and bank competition. Hence, a model is developed to examine the influence of concentration and other factors on competition in the six focal countries, which can be expressed as:

\[ \theta_{kt} = f (\text{Concentration}_{kt}, \text{GDP Growth}_{kt}, \text{Inflation}_{kt}, \text{Crisis}_{kt}, \text{LOANDEP}_{kt}) \] (3.11)

where \( \theta \) is a proxy for bank competition in country \( k \) at time \( t \). A higher \( \theta \) depicts a lower level of competition and vice versa. Concentration is a four-bank concentration ratio in terms of TA. GDP growth and inflation are the growth of real GDP and the inflation rate both derived from International Financial Statistics (IFS) data from the IMF. Crisis is a dummy variable set at 1 for the year 2008 and 0 otherwise. LOANDEP is the ratio of loans to deposits. Total deposits and total loans are in million USD and were obtained from the IMF.

Table 3.9 Descriptive Statistics for Variables Used to Examine the Relationship Between Competition and Concentration in Banking

<table>
<thead>
<tr>
<th></th>
<th>( \theta_{SUR} )</th>
<th>( \theta_{3SLS} )</th>
<th>Concentration</th>
<th>GDP growth</th>
<th>Inflation</th>
<th>Crisis</th>
<th>LOANDEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.125</td>
<td>0.121</td>
<td>48.828</td>
<td>6.090</td>
<td>7.123</td>
<td>0.125</td>
<td>0.784</td>
</tr>
<tr>
<td>STD</td>
<td>0.447</td>
<td>0.439</td>
<td>11.050</td>
<td>2.028</td>
<td>4.118</td>
<td>0.334</td>
<td>0.153</td>
</tr>
<tr>
<td>Min</td>
<td>-0.984</td>
<td>-1.060</td>
<td>30.883</td>
<td>-1.513</td>
<td>0.597</td>
<td>0</td>
<td>0.392</td>
</tr>
<tr>
<td>Max</td>
<td>1.107</td>
<td>1.017</td>
<td>77.927</td>
<td>11.228</td>
<td>23.120</td>
<td>1</td>
<td>1.005</td>
</tr>
<tr>
<td>Number of observations</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Note: Concentration, inflation and GDP growth are in %
Table 3.10 The Relationship between Bank Competition and Concentration across Six Emerging Asian Countries

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable: $\theta_{\text{SUR}}$</th>
<th>Dependent variable: $\theta_{\text{3SLS}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>$P$-value</td>
</tr>
<tr>
<td>Concentration</td>
<td>0.011</td>
<td>0.037</td>
</tr>
<tr>
<td>GDP growth</td>
<td>-0.063</td>
<td>0.037</td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.026</td>
<td>0.099</td>
</tr>
<tr>
<td>Crisis</td>
<td>0.084</td>
<td>0.649</td>
</tr>
<tr>
<td>LOANDEP</td>
<td>-0.434</td>
<td>0.255</td>
</tr>
<tr>
<td>Constant</td>
<td>0.472</td>
<td>0.303</td>
</tr>
</tbody>
</table>

Note: $\theta_{\text{SUR}}$ and $\theta_{\text{3SLS}}$ are $\theta$ (a proxy for bank competition) estimated by SUR and 3SLS. A higher (lower) $\theta$ is associated with a lower (higher) competition level.

The estimation results for the model are presented in Table 3.10. $\theta$ provides a measure of annual market power and a proxy for bank competition at industry level so $\theta$ is negatively related to bank competition. The coefficient for concentration is significantly positive, suggesting that the relationship between market concentration and $\theta$ is positive. This result implies that competition among banks across the six countries in the studied sample becomes greater when market concentration decreases. A negative association between market concentration and bank competition in these countries can be explained by the SCP hypothesis that suggests banks in concentrated markets can collude to achieve higher profits. Thus, when a market is less concentrated, banks will decrease their collusion and be more competitive. Therefore, this result provides evidence to support the assumptions of the SCP hypothesis regarding a negative relationship between concentration and competition in banking.

The coefficient for GDP growth is significantly negative at the 5% level. Similarly, the coefficient for inflation is negative but this finding is significant only when considering $\theta$ by SUR as a dependent variable. Thus, GDP growth and inflation promoted bank competition. The lack of significance of the coefficients for crisis and LOANDEP suggests these factors had no significant effect on the degree of competition.
3.5 Conclusions

This study describes changes in market concentration and competition in banking throughout the world’s fastest economic growing region over the recent GFC. In general, there was a downward trend in concentration levels for the banking markets of Bangladesh, India, Indonesia and Vietnam over 2005–12, while the degree of market concentration had a tendency to grow slightly for banking in Malaysia and the Philippines. Market concentration levels are rather high in Indonesia, Malaysia, the Philippines and Vietnam, with concentration ratios of ~50% for Malaysia, and over half of the whole market shares being held by the four largest banks in each of the remaining countries. Of all countries in the sample, Bangladesh and India had the least concentrated markets, with concentration ratios of >30%.

The study also investigates the changes in bank competition across the six emerging Asian countries before and after the GFC. Monopolistic competition seems to be the best description of the competitive structure of banking in Indonesia, Malaysia and the Philippines. In contrast, Vietnamese banking had higher marginal cost than price, suggesting that banks in Vietnam were able to operate at non-optimised levels. For Indian banking, marginal cost was higher than price during 2005–08, whereas monopolistic competition is the best description of competitive structure of Indian banking during 2010–12. Bangladesh banking had the tendency to operate under conditions of pure monopoly in 2005 and monopolistic competition in 2008, whereas this banking had higher marginal cost than price in 2007 and during 2009–12. In addition, bank competition levels had a tendency to decrease in India and Indonesia, and to increase in Bangladesh, Malaysia and the Philippines. In the case of Vietnamese banking, competition levels fluctuate frequently over a small range.

The study reveals a negative association between market concentration and bank competition across these banking systems. This result provides evidence in support of the assumptions of the SCP hypothesis regarding a negative relationship between market concentration and bank competition. GDP growth and inflation promoted bank competition. However, crisis conditions and the ratio of loans to deposits did not affect the degree of competition significantly.
Chapter 4: Market Concentration, Bank Competition and Bank Efficiency in Emerging Asian Countries

4.1 Introduction

The determinants of bank efficiency are discussed in the vast literature on banking. Numerous studies have found that market concentration and bank competition are significant determinants of bank efficiency; for example, Berger and Hannan (1998), Casu and Girardone (2006), Chen (2009), Delis and Papanikolaou (2009), Delis and Tsionas (2009), Ferreira (2013), Hauner and Peiris (2005), Kirkpatrick et al. (2008), Koetter et al. (2008; 2012), Maudos and de Guevara (2007), Turk Ariss (2010) and Williams (2012). However, evidence for the influence of increased market concentration due to M&A on bank efficiency is conflicting (Berger & Humphrey, 1992; Pilloff, 1996). Moreover, Demirgüç-Kunt and Levine (2000) indicated that evidence is ambiguous regarding a link between concentration and bank efficiency, and competition–efficiency relationships are not straightforward (Casu & Girardone, 2006, 2009). In addition, the numerous empirical studies on the relationship between competition and efficiency have reported contradictory results; including Casu and Girardone (2006, 2009), Chen (2009), Fang et al. (2011), Fu and Heffernan (2009), Kirkpatrick et al. (2008), Koetter et al. (2008; 2012), Maudos and de Guevara (2007), Pruteanu-Podpiera et al. (2008), Schaeck and Cihak (2008), Turk Ariss (2010) and Williams (2012).

The relationships between market concentration, competition and bank efficiency are interpreted by three main hypotheses: the QLH, the IGH and the ESH. According to the QLH (Berger & Hannan, 1998; Hicks, 1935), market concentration (or market power) is negatively associated with bank efficiency because market power allows banks to enjoy a ‘quiet life’ (i.e. to have freedom from competition in a more relaxed environment), which reduces bank managers’ effort to maximise their bank efficiency. Therefore, there is a negative relationship between concentration and efficiency and a positive association between competition and efficiency. In contrast, the IGH (Marquez, 2002) proposes a negative relationship between competition and efficiency. This hypothesis suggests that competition among banks leads to a decline in their information-gathering capacity and increases the probability of adverse
borrower selection and thus increases bank inefficiency. The ESH (Demsetz, 1973; Smirlock, 1985) proposes a positive (or negative) causality running from efficiency to market concentration (or bank competition).

The majority of studies on banking have tested these hypotheses in the context of developed countries such as the US and European countries. In comparison with the vast literature on the relationship between concentration, competition and bank efficiency in developed countries, few studies have examined these relationships in developing economies. Moreover, the relationships between market concentration, bank competition and bank efficiency are considered separately. The empirical literature on banking concentrates on the effect of either concentration or competition on efficiency. Limited research has investigated effects of both concentration and competition on bank efficiency, particularly in the context of emerging Asian countries pre- and post-GFC.

The emerging Asian banking structure changed significantly after the 1997 Asian crisis due to the rapid development in banking consolidation brought about by M&A. General banking across emerging markets has experienced a significant increase in competition from the presence of foreign banks and privatisation. An important issue to examine is the effects of market concentration and bank competition on bank efficiency in emerging Asian countries. To address this, the current research examines the relationships between concentration, competition and X-efficiency in banking across the six focal countries during 2005–12.

Degrees of bank competition are here estimated using two Lerner indices: the conventional and the efficiency-adjusted Lerner. Tobit regression is performed to take into account the censored nature of the efficiency for examining the relationships between market concentration, bank competition and bank efficiency. Moreover, 2SLS is used to address endogeneity problems and avoid associated bias due to the probability of causality running from bank efficiency to market concentration and bank competition under the efficient structure paradigm.

This study makes three main contributions. First, previous studies have examined the market concentration–bank efficiency and bank competition–bank efficiency relationships separately. Therefore, this research develops five models to examine the relationship between market concentration and efficiency, the relationship
between bank competition and efficiency, and the relationship between market concentration, bank competition and bank efficiency in emerging Asian countries pre- and post-GFC. In addition, testing is undertaken of the QLH and the IGH in these economies. Second, competition levels of banks are measured using two Lerner specifications: the conventional and the efficiency-adjusted Lerner. This increases the robustness of the analysis of the relationships between competition and efficiency. Third, the study investigates the relationship between market concentration, bank competition and bank efficiency both for the full sample of six countries, and separately by country.

This chapter is organised as follows: the next section reviews the relevant literature on the relationships between market concentration, bank competition and bank efficiency. Section 4.3 discusses the data and methodology. Section 4.4 presents the estimation results for the two Lerner specifications and provides an in-depth discussion about the effects of both market concentration and competition on X-efficiency for the full sample and by country, along with tests for multicollinearity. Section 4.5 provides a conclusion.

4.2 Market Concentration, Bank Competition and Bank Efficiency: An Overview

4.2.1 Related Hypotheses

4.2.1.1 The Efficient Structure Hypothesis

In the literature on efficiency, one of the well-known hypotheses on the relationship between market concentration, competition and efficiency is the ESH proposed by Demsetz (1973). This hypothesis posits that more efficient firms can lower costs of production and thus gain both higher profits and larger market shares. The market, therefore, is more concentrated. The ESH is supported by Smirlock’s (1985) study on banking, which showed that concentration does not explain American banks’ profitability. His assumption was that market concentration is not a random event but is an outcome of leading banks’ superior efficiency in gaining a higher market share. Efficient banks with comparative advantage in product can achieve a large market share that results in higher market concentration levels. Therefore, the ESH proposes a positive influence of bank efficiency on concentration of the market indirectly.
Moreover, Smirlock (1985) proposed that the most efficient banks can gain the larger market shares from other less efficient banks in the market. Thus, the market becomes more concentrated and banks can exploit greater market power. The greater the market power of banks, the less their competition levels. As a result, the ESH posits positive (negative) causality running from efficiency to market power (competition).

4.2.1.2 The Quiet Life Hypothesis

The QLH was first suggested by Hicks (1935). In the first study on the link between efficiency and market structure, Hicks found that ‘The best of all monopoly profits is the quiet life’ (Hicks, 1935, p. 8). In other words, market power allows firms to enjoy a ‘quiet life’ (i.e. to have freedom from competition in a more relaxed environment), but such a life reduces firm managers’ effort to maximise their firm efficiency.

Based on the pioneering study of Hicks (1935), Berger and Hannan (1998) were the first to study QLH in the banking industry. The authors suggested that managers can exercise market power of banks to gain supernormal profits without making efforts to work or control cost to increase bank efficiency. Thus, increased monopoly power results in a decrease in efficiency whereas competition fosters bank efficiency.

4.2.1.3 The Information Generation Hypothesis

Similar to the ESH, the IGH theorises on ‘a negative relationship between competition and efficiency’. The IGH, first proposed by Marquez (2002), states that fierce competition among banks may result in lower bank efficiency. IGH is based on the view that banks are ‘special’ intermediaries because they can access borrowers’ information to collect and analyse inside information, and thus they are able to reduce their adverse borrower selection to a minimum level, due to the ability to generate superior information compared to their peers (Koetter et al., 2008). However, in growing competitive markets, each bank owns specific information about a small pool of borrowers, so this dispersion of information can cause a decline in banks’ screening capabilities, increasing the chance of having loans for low-quality borrowers, and thus increasing bank inefficiency. Moreover, when competition increases, banks will offer customers lower charges to attract them. This may lead to easier switches of customers from their current bank to another bank that provides them with more benefits.
Therefore, a reduction in a bank’s information-gathering capacity due to customer switches also causes bank inefficiency (Marquez, 2002). To summarise, competition among banks leads to a decline in their information-gathering capacities that results in a higher probability of adverse borrower selection and thus higher bank inefficiency.

4.2.2 The Relationship between Market Concentration, Competition and Efficiency in Banking: Empirical Results

Berger and Hannan (1998) tested the QLH in the banking industry by examining the relationship between market concentration, measured by the Herfindahl–Hirshman index, and cost X-efficiency in the US banking system. They found that more concentrated markets reflect lower competition and cause higher cost inefficiency for banks due to lax management. Hence, the negative relationship between market concentration and bank efficiency provides evidence in support of the QLH. For a robustness check of this finding, Berger and Hannan (1998) used multiple samples (ownership and full sample), various approaches to estimate cost X-efficiency (DFA and SFA) and two regression analyses (ordinary least squares (OLS) and 2SLS) to examine the concentration–efficiency relationship. These authors also suggested that banks in concentrated markets can exploit market power in setting price, and greater cost rather than greater profits is much of the benefit they gain from this power. Although managers exercise market power in pricing and allow an increase in cost rather than profit maximisation, they can still enjoy supernormal profits. Thus, if bank owners can only see the results of bank operations and not observe managerial behaviours, they may not be aware that supernormal profit results from market power rather than managers’ efforts.

To explain the negative effects of market concentration, as a proxy for market power, on bank efficiency, Berger and Hannan (1998) suggested some reasons relating to manager behaviour and monopoly power. First, when banks operate in a higher concentration market, they are able to set a higher price than marginal cost. Thus, managers can benefit from this price and earn economic rent without expending any effort on cost minimisation. This reduces their motivation for working hard to keep expenses under control, thus causing a decrease in bank efficiency. As a result, monopoly power decreases managers’ efforts in working and in controlling costs to increase bank efficiency. Second, banks with high market power can permit their managers to pursue objectives other than profit maximisation. For example, they can
outlay more costs to expand staff or utility-increasing inputs beyond cost levels for profit maximisation, or reduce risk below the level that is required by shareholder for their value maximisation. Third, bank managers may spend their resources on obtaining and maintaining market power. Although they can earn higher profits, bank costs would be increased, and thus cost efficiency would decline. Fourth, the weak discipline in concentrated markets decreases managers’ efforts to keep costs under control. Based on the price ‘cushion’ that is created from market power, managers can persist without managerial effort and pursuit of other goals.

Also testing the QLH in US banking, Koetter et al. (2008) examined the relationship between competition and efficiency over the period 1986–2006. The authors realised that most previous studies focused on X-efficiency (i.e. allocative and technical efficiency) in cost rather than in profit, and did not explain their findings from the perspective of the IGH (Marquez, 2002). In addition, the proxies for competition used by Berger and Hannan (1998) and efficiency are not derived from the same structural model, thus can cause endogeneity problems. Therefore, Koetter et al. (2008) estimated both efficiency and competition simultaneously from an identical model to address simultaneity problems. Both cost and profit efficiency are estimated by the SFA approach for the sample period and different sub-periods. The two abovementioned Lerner specifications are used here as direct measures of competition instead of market concentration as used by Berger and Hannan (1998). Koetter et al. (2008) tested two competing hypotheses, the QLH and the IGH, for US banks using various regression model specifications and sub-periods. They found a significantly negative effect of competition on cost efficiency and profit efficiency, which argues against the QLH. However, increasing market power precedes increasing efficiency, which implies that US banks under low competitive pressure have superior capabilities to screen their borrowers, thus supporting indirectly the IGH.

Similarly, Koetter et al. (2012) tested the QLH in a sample of US banks using both cost and profit efficiency, as well as two Lerner specifications (the efficiency-unadjusted and the efficiency-adjusted Lerner). However, the authors tested the QLH under historic geographic deregulation and examined the effect of liberalised banking markets on this hypothesis in US banking over the period 1976–2007. Moreover, to account for possible endogeneity problems, Koetter et al. (2012) introduced various other instrumental variables for market power instead of only the lagged Lerner values.
used by Koetter et al. (2008). The authors found a negative effect of competition on cost efficiency, thus rejecting the QLH. However, the QLH is supported when considering profit efficiency because market power, measured by the efficiency-adjusted Lerner index, is negatively related to profit efficiency.

Investigating the determinants of bank efficiency in the context of European countries, Delis and Papanikolaou (2009) provided evidence to support the QLH for banking systems in 10 newly acceded European Union banks during 1994-2005, covering their banking sector reform process. The authors found a negative relationship between three-bank concentration ratios and productive efficiency scores, suggesting market concentration is a significantly negative determinant of bank efficiency.

Using a sample of 15 EU countries (EU-15), Maudos and de Guevara (2007) examined the relationship between bank cost X-efficiency and market power during 1993–2002. The authors used market concentration as a measure of market power and a first proxy variable for competition. Following Berger and Hannan (1998), market concentration is measured by the Herfindahl–Hirshman index in terms of TA. Moreover, Maudos and de Guevara (2007) investigated different effects of concentration on efficiency in various types of banking products (e.g. loan and deposit). They found that the association between concentration in terms of TA and bank cost efficiency is negative but not significantly so. However, the negative coefficient for this concentration variable agrees with the result of Berger and Hannan (1998) that provides support for the QLH. They found concentration to be positively associated with cost efficiency in the loan market but negatively related to cost efficiency in the deposit market. These results are statistically significant at the 1% level. Therefore, banks in more concentrated markets are less efficient in deposit markets but more efficient in loan markets. These findings support the QLH for the deposit market but provide evidence against this hypothesis for the loans market.

Maudos and de Guevara (2007) used an alternative indicator, the Lerner index, as a direct measure of competition in deposit and loan markets, due to limitations of using market concentration as a proxy for bank competition. They found that bank competition is a significantly negative determinant of cost X-efficiency in both markets, rejecting the validity of the QLH with respect to European banking. To explain the negative influence of competition on bank cost X-efficiency in European
countries, several reasons are proposed. First, the monopolistic power of banks due to their location advantages decreases their cost of monitoring and transacting with companies. Second, banks may have cost advantages in screening borrowers due to market power obtained from geographical and technological specialisation. Third, banks with market power may enjoy higher profit so they behave prudently and select less risky activities to lower the cost of monitoring, thus increasing their cost efficiency. Fourth, greater market power allows banks to decrease their operating costs because of less pressure to enhance the quality of banking services, thereby improving their cost efficiency.

Also examining banking systems in the context of European countries, Casu and Girardone (2006) investigated factors affecting competitive conditions over the period 1997–2003. They found a significant negative relationship between bank efficiency and bank competition measured by the Panzar–Rosse H-statistic. This result favours the ESH, which postulates that the most efficient banks can attain larger market shares, thus exploit greater market power. The most cost efficient banks attempt to increase profitability and acquire less efficient peers to expand their market power. Therefore, increased efficiency did not make European banking more competitive. Nevertheless, the authors indicated that pro-competition deregulation applied to the European banking sector increased degrees of bank efficiency and competition in the early stages. Hence, Casu and Girardone (2006) suggested that competition may foster bank efficiency but increased efficiency makes banks less competitive in EU banking systems. Therefore, competition–efficiency relationships are not straightforward. These findings are in line with those reported by Casu and Girardone (2009).

Casu and Girardone (2009) investigated whether competition leads to cost efficiency using the Granger causality test for the sample of European banks over the period 2000–05. The authors found that a positive causality runs from market power, proxied by the Lerner index, to cost efficiency measured by both SFA and DEA approaches, possibly because banks with higher market power enjoy lower financial and operating costs. The influence of monopoly power on efficiency may be positive if this power makes banks lower their costs. This result argues against the QLH. Moreover, Granger causality tests can only show that an increase in market power precedes an increase in efficiency, rather than establishing causality between these
variables. Therefore, in line with results reported by Maudos and de Guevara (2007), Casu and Girardone (2009) suggested that a positive relationship between market power and efficiency is not necessarily informative about their causal relationship. The authors also examined the causality running from efficiency to competition. Granger causality tests, however, provide no proof that increases in efficiency forego increases in market power. As a result, they agreed with findings of Casu and Girardone (2006) that the relationships between competition and efficiency are not straightforward.

Schaeck and Cihak (2008) also used Granger causality tests to examine the influence of competition on bank efficiency, reporting a positive influence of competition on profit efficiency for a large sample of European and US banks during 1995–2005, providing evidence in support of the QLH. Moreover, the findings for the US sample also confirm the hypothesis that competition increases cost efficiency. On this basis, Schaeck and Cihak (2008) suggested that banks can attain higher efficiency levels in both cost and profit under competitive pressure. The QLH is also supported by Delis and Tsionas (2009) who found a negative relationship between market power and efficiency in the Economic and Monetary Union banking system by establishing a framework for the joint estimation of market power and efficiency.

Recent studies of banking in developing countries also provide evidence for complex relationships between competition and efficiency. Some studies support the QLH, which posits a positive relationship between competition and efficiency, while others reject this hypothesis by providing evidence for a negative association between these variables or finding no proof to support the paradigm. For instance, the findings of Kirkpatrick et al. (2008) provide support for the QLH for banking systems across nine Sub-Saharan African countries over 1992–99. The authors report a significant positive relationship between market concentrations measured by the Herfindahl–Hirshman index and cost X-inefficiency. Also investigating the context of Sub-Saharan African countries, Chen (2009) proposed that a higher degree of bank competition pushed cost efficiency for the 2000–07 period.

In contrast, some studies provide evidence against the QLH, and support the IGH. Using data on Czech banks over the transition period of 1994–2005, Pruteanu-podpiera et al. (2008) examined the relationship and causality between bank competition and bank cost X-efficiency in a transition country. The authors used a direct individual measure of competition, Lerner index, and estimated X-efficiency in
loan market using the DFA approach. The empirical results of their study indicate that
greater competition reduces cost efficiency in banking due to a rise in monitoring cost
and the appearance of economies of scale. Indeed, the result of Granger causality test
favors a negative causality from competition to efficiency of Czech banks over the
transition period of 1994–2005. Also investigating the determinants of bank efficiency
in the context of transition economies, Fang et al. (2011) reported a positive association
between market power and efficiency, including both cost and profit efficiency, in
banking systems across six transition countries of South-eastern Europe during 1998–
2008. These results are in line with the IGH.

With respect to the QLH in different markets and for different types of
efficiency, studies provide varying results on the relationship between competition and
(2012) investigated the relationship between market power and bank efficiency in
different markets (loan, deposit and assets markets) during the full period and sub-
periods including the pre-restructuring (1985–1997) and post-restructuring (1998–
2010) periods. Like Koetter et al. (2008), Williams estimated both cost and profit
efficiency using the SFA approach for the sample period and sub-periods and
employed two Lerner specifications for robustness purposes. Following Berger and
Hannan (1998), the QLH was tested by the OLS and 2SLS statistical techniques. The
empirical results of Williams (2012) reveal significant positive associations between
market power and efficiency in the assets market, thus the QLH was rejected. In
contrast, Latin American banks seem to enjoy a ‘quiet life’ in the deposits market in
each sub-period and the full period. Using data from banks in 60 developing countries
between market power and cost efficiency. However, the results indicated that market
power is positively associated with profit efficiency, thus the QLH was rejected for
those countries.

In the Chinese banking study of Fu and Heffernan (2009), on the other hand,
there was no evidence to support the QLH. To examine the effects of bank reforms on
market structure and performance in the Chinese banking sector, Fu and Heffernan
(2009) investigated the relationship between market structure and cost X-efficiency of
Chinese banks over the 1985–2002 period when various notable reforms were
implemented in this sector. Following Berger and Hannan (1998), the authors
employed market concentration as a proxy for market power and used SFA to estimate
cost X-efficiency. They found no evidence in favour of the QLH in this system and
suggested that the failure of state banks with greater market power to earn monopolistic
rents was due to strict controls on interest rates rather than higher market
concentration.

4.3 Data and Methodology

4.3.1 Data

Bank-specific data were retrieved from the Bankscope Fitch-IBCA database
for the six chosen countries for 2005–12. Country-specific data, such as growth of real
gross domestic product (GDPG) and inflation rate, were derived from the International
Financial Statistics (IFS) data of the IMF. After excluding banks that have missing
data in more than two consecutive years and observations with negative values for total
equity, interest expenses and total revenue, the data consist of 1,685 observations from
212 commercial banks in emerging countries: Bangladesh (34 banks), India (50
banks), Indonesia (40 banks), Malaysia (32 banks), the Philippines (24 banks) and
Vietnam (32 banks). An unbalanced panel dataset was used due to M&A, entry and
exit of banks, and exclusion of inappropriate observations. The data were checked
thoroughly and data problems such as missing values, inconsistencies and reporting
errors were handled as appropriate.

4.3.2 Estimation Methodology: Bank Competition

Consistent with studies by Turk Ariss (2010), Koetter et al. (2008; 2012) and
Williams (2012) on the relationship between competition and efficiency in banking,
the competition at bank level was estimated here using the Lerner index approach.
Lerner indices reflect the degree of market power; therefore, the higher the Lerner
index value, the lower the degree of competition. First, the conventional Lerner index
was calculated to measure competition levels of banks with the implicit assumption
that banks are fully efficient. However, endogeneity bias can appear in estimates of
bank competition if both competition level and efficiency are not derived from a single
structural model. Therefore, for the robustness check of the results for competition
levels and to account for the interrelationship between competition and efficiency, the
efficiency-adjusted Lerner index was employed.

The conventional Lerner index is calculated as:
\[ L = \frac{p - MC}{p} = \frac{AR - MC}{AR} \quad (4.1) \]

Here, price \( p \) is defined as AR, which is measured as the ratio of total revenue to total asset, whereas total revenue equals sum of profit before tax (PBT) and TOC. Marginal cost (MC) is derived from the translog cost function (Equation 2.1) in Chapter 2 by taking derivatives with respect to TA \( Q \). Marginal cost is calculated as follows:

\[
MC = \frac{TOC_{it}}{Q_{it}} [\alpha_1 + \alpha_2 \ln Q_{it} + \sum_{m=1}^{3} \delta_m \ln W_{mit} + \sum_{m=1}^{2} \varepsilon_m \ln Z_{mit} + \varphi_3 \text{Trend}] 
\]

\[(4.2)\]

As for the conventional Lerner index, banks are assumed to be fully efficient. For calculating marginal cost, the coefficients of Equation 2.1 are estimated using OLS regression.

Unlike the conventional Lerner index, the efficiency-adjusted Lerner index can account for endogeneity bias via simultaneous estimation of both market power degree and efficiency from a single structural model. To consider possible cost inefficiencies of banks, a SFA approach and maximum likelihood were used to calculate frontier estimates of TOC \( \hat{TOC} \) and PBT \( \hat{PBT} \). The SFA approach using the model of Battese and Coelli (1992) allows estimation of the frontiers of TOC \( \hat{TOC} \) and of PBT \( \hat{PBT} \), as well as time-varying efficiency scores. This model assumes that the disturbance term has two components including an idiosyncratic error \( v \) and inefficiency term \( u \)—a non-negative component. \( v_{it} \) is assumed to be independent and identically distributed with a normal distribution \( N(0, \sigma_v^2) \), whereas \( u_i \) is assumed to be independent and identically distributed and have a truncated-normal distribution \( N^*(\mu, \sigma_u^2) \).

Humphrey and Pulley (1997) suggested an alternative profit function to calculate frontier estimates of PBT \( \hat{PBT} \) when assumptions of a perfectly competitive market are not satisfied. Moreover, Berger and Mester (2003) postulated that the alternative profit function is more appropriate and favoured over the standard profit function when the sample has an international dimension. The alternative profit function is similar to the cost function in Equation 2.1 in Chapter 2 with TOC replaced by PBT as the dependent variable and the error term \( \varepsilon \) being equal to \( v - u \). Average revenues are calculated as the sum of average profits and average costs. As for the
countries that have negative values of PBT, a constant \((\varphi)\) is added to the PBT of each bank to ensure that values of PBT are positive before taking their logarithm. Following Berger and Mester (1997), a constant \((\varphi)\) equals the absolute minimum value of PBT divided by the input price of physical capital \((W_3)\) in the same year for all banks plus 1; that is, \(\varphi = \left| \frac{PBT}{W_3} \right|_{\text{min}} + 1\). A calculation for \(\varphi\) is carried out for each country in the sample.

The efficiency-adjusted Lerner index is calculated as follows:

\[
L_{\text{adjusted}} = \left( \frac{PBT}{Q} + \frac{TOC}{Q} \right) - \bar{MC} \left( \frac{PBT}{Q} + \frac{TOC}{Q} \right)
\]  (4.3)

Here, frontier estimates of PBT \((\hat{PBT})\) and of TOC \((\hat{TOC})\) are derived from the alternative profit and TOC function, respectively. \(\bar{MC}\) is marginal cost derived from the translog cost function using SFA, and \(Q\) is TA.

4.3.3 Methodology

4.3.3.1 Model Specifications

First, this study develops Model 1 to examine the effect of market concentration on bank X-efficiency:

**Model 1:**

\[
\text{EFF}_{i,t} = \alpha_0 + \alpha_1 \text{CON}_{i,t} + \Sigma_{i=2}^{n} \alpha_i \text{CONTROL}_{i,t} + e_{i,t}
\]  (4.4)

Then, the effect of competition on bank X-efficiency is examined using Models 2 and 3 as follows:

**Model 2:**

\[
\text{EFF}_{i,t} = \beta_0 + \beta_1 \text{Lerner}_{i,t} + \Sigma_{i=2}^{n} \beta_i \text{CONTROL}_{i,t} + e_{i,t}
\]  (4.5)

**Model 3:**

\[
\text{EFF}_{i,t} = \gamma_0 + \gamma_1 \text{Lerner-adj}_{i,t} + \Sigma_{i=2}^{n} \gamma_i \text{CONTROL}_{i,t} + e_{i,t}
\]  (4.6)

Models 2 and 3 present the association between bank competition and X-efficiency using two specifications of Lerner as proxies for bank competition: the conventional Lerner (‘Lerner’) and the efficiency-adjusted Lerner (‘Lerner-adj’), respectively.

Finally, the relationship between market concentration, bank competition and bank efficiency across the six emerging Asian countries is investigated using Models 4 and 5 as follows:

\[
\text{EFF}_{i,t} = \eta_0 + \eta_1 \text{CON}_{i,t} + \eta_2 \text{Lerner}_{i,t} + \Sigma_{i=3}^{\eta} \eta_i \text{CONTROL}_{i,t} + e_{i,t}
\]  (4.7)
\[ \text{EFF}_{i,t} = \mu_0 + \muCON_t + \muLerner-adj_{i,t} + \sum_{n=3}^{\mu} \mu_{\text{CONTROL}_{i,t}} + \epsilon_{i,t} \] (4.8)

Models 4 and 5 reflect the effects of both bank competition and market concentration on X-efficiency using the two specifications of Lerner.

Here, the dependent variable \( \text{EFF}_{i,t} \) measures the X-efficiency of bank \( i \) at time \( t \). Two main independent variables are market concentration (CON) and bank competition (Lerner and Lerner-adj). Market concentration is calculated as CRTA4, the ratio of the TA of the four largest banks to the TA of all the banks in a given year. Bank competition is measured by the two specifications of Lerner. A higher (lower) Lerner index is related to a lower (higher) competition level. Control variables (CONTROL\(_{i,t}\)) for bank level and market level consist of some bank-specific characteristics and macroeconomic conditions. Bank-specific characteristics include bank size, credit risk and liquidity risk. Bank size is measured by a natural logarithm of TA. Bank risk includes credit risk (measured as a ratio of loans to assets) and liquidity risk (measured as a ratio of deposits to assets). Macroeconomic conditions are used to account for the effects of economic development (proxied by GDPG) and economic stability (proxied by inflation rate) on efficiency. Finally, \( \epsilon_{i,t} \) is an error variable for each bank \( i \) at time \( t \).

This study examines the relationship between competition, market concentration and X-efficiency for the full sample and by country. These models are used to test whether the QLH is favoured in the six emerging Asian countries. If the coefficients for market concentration and/or Lerner are significantly negative, this would suggest that emerging Asian banking enjoys a ‘quiet life’. However, if the coefficients are significantly positive, the results will argue against the QLH and support the IGH.

Table 4.1 provides a description of the variables used in the research model. The dependent variable, X-efficiency, is estimated in the first stage in Chapter 2. The two main independent variables of interest are market concentration (calculated in Chapter 3) and bank competition (proxied by the two specifications of Lerner index and calculated in Section 4.4.1).

Table 4.1 Definitions of Variables for Examining the Relationship between Market Concentration, Bank Competition and Bank Efficiency
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Technical and allocative efficiency scores are calculated from a cost function by the SFA approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-efficiency (EFF)</td>
<td>The ratio of the TA of the four largest banks to the TA of all the banks in a given year</td>
</tr>
<tr>
<td>Independent variables</td>
<td></td>
</tr>
<tr>
<td>Market concentration (CON)</td>
<td>Conventional Lerner</td>
</tr>
<tr>
<td>Lerner</td>
<td>Efficiency-adjusted Lerner</td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
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<tr>
<td>Bank-specific characteristics</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>A natural logarithm of TA</td>
</tr>
<tr>
<td>Credit risk</td>
<td>The ratio of loans to assets</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>The ratio of deposits to assets</td>
</tr>
<tr>
<td>Macroeconomic conditions</td>
<td></td>
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<tr>
<td>Economic development (GDP growth)</td>
<td>Real Gross domestic product growth</td>
</tr>
<tr>
<td>Economic stability (inflation)</td>
<td>Inflation rate</td>
</tr>
<tr>
<td>Instrumental variables</td>
<td></td>
</tr>
<tr>
<td>Industry size</td>
<td>TA of banking system</td>
</tr>
<tr>
<td>Lags of Lerner</td>
<td>One-period lags of the conventional Lerner</td>
</tr>
<tr>
<td>Lags of Lerner-adj</td>
<td>One-period lags of the efficiency-adjusted Lerner</td>
</tr>
</tbody>
</table>

According to Kumbhakar and Lovell (2000), when the value of a dependent variable lies between 0 and 1, this variable must be transformed before estimation, or Tobit regression must be used to estimate a limited dependent variable. Greene (2005) supported the suggestion that a Tobit model should be applied in the case of a dependent variable obtained from a first-stage regression. Consistent with banking literature on efficiency and competition (e.g. Coccorese & Pellecchia (2010); Koetter et al. (2008); Turk Ariss (2010)), a Tobit regression model, also called a censored regression model, is used here to examine the relationship between concentration, competition and bank efficiency in the context of emerging Asian countries.
First, the Tobit regression is run to account for the censored nature of the dependent variable, X-efficiency. Due to the probability of ‘reverse causation’ under the efficient structure paradigm, meaning that bank efficiency may affect market concentration and bank competition, the Wald test is employed to test for the exogeneity of market concentration and/or competition. The null hypothesis is that market concentration and competition (measured by the Lerner index) are exogenous variables. For each country, industry size measured by the TA of the banking system is used as an instrumental variable for market concentration. Since market concentration is calculated as the ratio of TA of the biggest four banks and TA of all banks, market concentration is negatively associated with industry size. An increase in industry size may be due to an increase in the number of banks and an increase in size of banks in the system. Therefore, it is difficult for the biggest banks to increase their market share in a more crowded market and larger banking system. This may explain the negative relationship between market concentration and industry size. In addition, industry size does not affect bank efficiency directly so it satisfies the conditions for an instrumental variable. Following Koetter et al. (2008; 2012) and Williams (2012), one-period lags of Lerner are used as instrumental variables for Lerner indices. If the Wald test statistic is significant, the null hypothesis of exogeneity is rejected, suggesting that concentration and competition (measured by the Lerner index) are treated as endogenous variables. In this case, Tobit estimation can cause a bias. The instrumental variables technique (2SLS) is used here to address any endogeneity problems and avoid associated bias. The presence of multicollinearity is determined using the variance inflation factor (VIF). Multicollinearity is confirmed when the VIF of a variable is >10.

4.4 Empirical Results

4.4.1 Estimates of the Lerner Index

The Lerner index was calculated based on two components, average revenue and marginal cost, as shown in Table 4.2. Estimates of the conventional Lerner index rely on price (p) and marginal cost derived from the translog cost function using OLS (MC-OLS). The specification of the efficiency-adjusted Lerner index is based on average revenue [(\(\hat{P}_{BT} + \hat{T}_{OC})/Q\)] and marginal cost (MC-SFA) derived from the translog cost function using SFA. The figures in Table 4.2 indicate the differences
between the averaged values of marginal cost estimated by OLS and SFA regressions for the six Asian countries are not significant.

Table 4.2 Average Revenue and Marginal Cost on Average by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Average Revenue</th>
<th>Marginal Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( P )</td>
<td>( \frac{(\bar{PBT} + \bar{TOC})}{Q} )</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.107</td>
<td>0.196</td>
</tr>
<tr>
<td>India</td>
<td>0.080</td>
<td>0.074</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.097</td>
<td>0.121</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.052</td>
<td>0.096</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.075</td>
<td>0.097</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.088</td>
<td>0.068</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

Note: Price (\( p \)) is calculated as the ratio of total revenues to TA, and total revenue is the sum of PBT and TOC. \( \bar{PBT} \) and \( \bar{TOC} \) are frontier estimates of PBT and TOC. \( Q \) is TA. Marginal cost is derived from the translog cost function using OLS (MC-OLS) and SFA (MC-SFA).

Table 4.3 provides the yearly average estimates of the degree of market power based on the two Lerner specifications for the six focal countries’ banking systems. A higher (lower) Lerner index is associated with a lower (higher) bank competition level.

The figures in Table 4.3 indicate that annual averaged values of Lerner indices are between 0 and 1, so banks in Bangladesh, India, Indonesia, Malaysia and the Philippines seem to have operated under monopolistic competition over the 2005–12 period. In the case of Vietnam, the annual average values of the conventional Lerner index also lie between 0 and 1, but the annual average values of the efficiency-adjusted Lerner index are negative for the year 2008 and during 2010–12. This suggests that with respect to endogeneity bias due to interrelatedness of bank competition and efficiency for Vietnamese banks, their marginal cost seems to be higher than price, possibly due to non-optimising behaviour of banks in the system in 2008 and 2010–12.
Table 4.3 Values for the Conventional Lerner Index (Lerner) and Efficiency-adjusted Lerner Index (Lerner-adj)

<table>
<thead>
<tr>
<th></th>
<th>Bangladesh</th>
<th></th>
<th>India</th>
<th></th>
<th>Indonesia</th>
<th></th>
<th>Malaysia</th>
<th></th>
<th>Philippines</th>
<th></th>
<th>Vietnam</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Lerner</td>
<td>Lerner-adj</td>
<td>Lerner</td>
<td>Lerner-adj</td>
<td>Lerner</td>
<td>Lerner-adj</td>
<td>Lerner</td>
<td>Lerner-adj</td>
<td>Lerner</td>
<td>Lerner-adj</td>
<td>Lerner</td>
<td>Lerner-adj</td>
</tr>
<tr>
<td>2005</td>
<td>0.324</td>
<td>0.571</td>
<td>0.279</td>
<td>0.251</td>
<td>0.302</td>
<td>0.415</td>
<td>0.273</td>
<td>0.724</td>
<td>0.385</td>
<td>0.519</td>
<td>0.271</td>
<td>0.162</td>
</tr>
<tr>
<td>2006</td>
<td>0.307</td>
<td>0.442</td>
<td>0.258</td>
<td>0.237</td>
<td>0.261</td>
<td>0.328</td>
<td>0.280</td>
<td>0.585</td>
<td>0.384</td>
<td>0.516</td>
<td>0.264</td>
<td>0.111</td>
</tr>
<tr>
<td>2007</td>
<td>0.217</td>
<td>0.326</td>
<td>0.214</td>
<td>0.190</td>
<td>0.283</td>
<td>0.336</td>
<td>0.319</td>
<td>0.446</td>
<td>0.405</td>
<td>0.536</td>
<td>0.294</td>
<td>0.094</td>
</tr>
<tr>
<td>2008</td>
<td>0.300</td>
<td>0.280</td>
<td>0.199</td>
<td>0.161</td>
<td>0.257</td>
<td>0.302</td>
<td>0.300</td>
<td>0.352</td>
<td>0.368</td>
<td>0.506</td>
<td>0.172</td>
<td>-0.059</td>
</tr>
<tr>
<td>2009</td>
<td>0.307</td>
<td>0.345</td>
<td>0.175</td>
<td>0.153</td>
<td>0.253</td>
<td>0.298</td>
<td>0.435</td>
<td>0.406</td>
<td>0.440</td>
<td>0.513</td>
<td>0.259</td>
<td>0.034</td>
</tr>
<tr>
<td>2010</td>
<td>0.349</td>
<td>0.453</td>
<td>0.206</td>
<td>0.132</td>
<td>0.296</td>
<td>0.361</td>
<td>0.451</td>
<td>0.371</td>
<td>0.521</td>
<td>0.542</td>
<td>0.239</td>
<td>-0.016</td>
</tr>
<tr>
<td>2011</td>
<td>0.272</td>
<td>0.534</td>
<td>0.157</td>
<td>0.071</td>
<td>0.306</td>
<td>0.409</td>
<td>0.435</td>
<td>0.346</td>
<td>0.528</td>
<td>0.530</td>
<td>0.167</td>
<td>-0.164</td>
</tr>
<tr>
<td>2012</td>
<td>0.039</td>
<td>0.699</td>
<td>0.133</td>
<td>0.028</td>
<td>0.326</td>
<td>0.471</td>
<td>0.415</td>
<td>0.395</td>
<td>0.533</td>
<td>0.533</td>
<td>0.102</td>
<td>-0.250</td>
</tr>
<tr>
<td>Average</td>
<td>0.264</td>
<td>0.456</td>
<td>0.203</td>
<td>0.153</td>
<td>0.286</td>
<td>0.365</td>
<td>0.364</td>
<td>0.453</td>
<td>0.445</td>
<td>0.524</td>
<td>0.221</td>
<td>-0.011</td>
</tr>
</tbody>
</table>

Source: Author’s calculations

*Note:* Lerner indices are calculated as the ratio of disparity between price and marginal cost to price. L and L-adj are the conventional Lerner index and the efficiency-adjusted Lerner index, respectively. A higher (lower) Lerner index is associated with a lower (higher) bank competition level.
4.4.2 Market Concentration, Bank Competition and Bank Efficiency across Six Emerging Asian Countries

4.4.2.1 The Relationship between Market Concentration, Bank Competition and X-Efficiency for the Full Sample

Table 4.4 provides the Tobit regression and 2SLS regression test results for the relationship between market concentration, bank competition and bank X-efficiency in the full dataset. The Wald tests show that exogeneity for market concentration and bank competition is rejected at the 1% level for all models. Therefore, Tobit estimation seems to be less appropriate than instrumental variable estimation (2SLS). This result is consistent with the finding of Koetter et al. (2008) that the instrumental variables technique should be used. The relationships between market concentration, bank competition and bank X-efficiency are analysed in detail below.

The values in Table 4.4 indicate that market concentration has a significant influence on X-efficiency across all models. Indeed, the coefficients for market concentration are significantly positive at the 1% level for both Tobit and 2SLS estimations. This shows that an increase in market concentration results in an increase in bank X-efficiency, thus arguing against the QLH in these Asian countries. Thus, an increasing market concentration level can help banks in the system to improve their quality of management in terms of both allocative and technical efficiency. These findings are in line with those for EU banking in the loans market but contrast with results for the deposits market reported by Maudos and de Guevara (2007), and also are not consistent with those for banking in Sub-Saharan Africa reported by Kirkpatrick et al. (2008).
Table 4.4 The Relationship between Market Concentration, Bank Competition and Bank X-efficiency across Six Emerging Asian Countries

<table>
<thead>
<tr>
<th>Dependent variable: X-efficiency</th>
<th>Tobit</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Concentration</td>
<td>0.002</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Lerner</td>
<td>–</td>
<td>0.008</td>
</tr>
<tr>
<td>Lerner-adj</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Size</td>
<td>0.014</td>
<td>0.004***</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Credit risk</td>
<td>–0.006</td>
<td>–0.014</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>–0.060</td>
<td>–0.045**</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>GDP growth</td>
<td>0.004</td>
<td>0.004***</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>–0.002</td>
<td>–0.003***</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.723</td>
<td>0.902***</td>
</tr>
<tr>
<td></td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Wald test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chi² (2)</td>
<td>38.40</td>
<td>17.72</td>
</tr>
<tr>
<td>Prob&gt;chi²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculation
Note: results from Tobit and 2SLS regressions for the relationship between market concentration, bank competition and bank X-efficiency. X-efficiency levels are calculated from a cost function by the SFA approach. The degree of competition is proxied by the Lerner index with higher values of Lerner indicating a lower degree of bank competition level. Both the conventional Lerner index (Lerner) and efficiency-adjusted Lerner index (Lerner-adj) are reported. Concentration represents the four-bank concentration ratio by TA; Size is the natural logarithm of TA; Credit risk is loan to asset ratio accounts; Liquidity risk is deposit to asset ratio; GDP growth is real gross domestic products growth; inflation is inflation rate. Industry size and one-period lags of the Lerner index are used as instrumental variables for market concentration and Lerner when 2SLS estimation is performed. The Wald test is used to test for the exogeneity of market concentration and/or competition, under the null hypothesis that these are exogenous variables.

*, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively.
According to the results from Tobit regressions, the relationship between the conventional Lerner index and X-efficiency is positive (but not significantly so) when excluding market concentration from the research model (Model 2) but is negative (but not significantly so) when considering concentration and competition as key variables of interest (Model 4). The association between the conventional Lerner index and X-efficiency is significantly positive for both Models 2 and 4 using 2SLS regression. These findings suggest rejection of the QLH, which postulates that banks require less effort to maximise their efficiency in a more relaxed environment and thus that increasing competition fosters X-efficiency of banks in the system. The significantly negative association between competition and X-efficiency supports the IGH.

A negative relationship between competition and bank efficiency is strongly supported when considering the effect of the efficiency-adjusted Lerner index on X-efficiency. The coefficients for the efficiency-adjusted Lerner index are all significantly positive at the 1% level using both Tobit and 2SLS regression. This suggests that banks with higher competition levels cannot reduce costs to attain higher levels of X-efficiency. Therefore, the findings lead to rejection of the QLH, as discussed above, whereas they provide evidence in support of the IGH, which proposes that bank competition decreases bank efficiency. These findings are in line with those reported by Maudos and de Guevara (2007) and Schaeck and Cihak (2008) for Europe; Pruteanu-Podpiera et al. (2008) for the Czech Republic; and Fang et al. (2011) for six transition countries in South-eastern Europe. There are two possible reasons to explain this result. First, competition among banks results in an increased mobilizing interest rates. The banking systems in these emerging countries concentrate mainly on two traditional activities: capital mobilising activity and credit activity. Banks compete fiercely to capture market share and attract bank depositors by increasing their mobilising interest rates, thus increasing costs and decreasing X-efficiency. Second, in more competitive markets, bank can increase costs for monitoring and treating non-performing loans. As suggested by the IGH, when competition increases, the screening and information-gathering capacities of banks can decrease due to a dispersion of information about their borrowers; thus low-quality borrowers have more chance to acquire bank loans, and banks’ probability of adverse borrower selection increases. To prevent non-performing loans, banks need to expend more resources (e.g. personnel)
for monitoring their borrowers and dealing with non-performing loans. As a result, bank X-efficiency can decrease. Therefore, competition can result in lower bank X-efficiency.

The values in Table 4.4 indicate that bank size has a highly significant effect on X-efficiency. The coefficients for bank size are significantly positive for all models by Tobit regression and 2SLS regression. Thus larger banks are able to attain higher levels of X-efficiency. This finding is in line with the result for developing countries reported by Turk Ariss (2010).

Turning to bank risk variables, although the signs of the coefficients for credit risk vary between research models, the coefficients for this variable are insignificant for all models. The coefficients for liquidity risk are not significant in models considering the efficiency-adjusted Lerner index as a measure of competition. The significantly negative relationship between liquidity risk and X-efficiency holds for Models 1, 2 and 4 by both Tobit and 3SLS regression. This suggests that liquidity risk has a significant negative effect on allocative and technical efficiency of the banking systems of the six study countries over 2005–12. Therefore, banks in these countries may decrease their liquidity risk to improve their X-efficiency.

Macroeconomic conditions have significant effects on X-efficiency for banks in the sample. The coefficients for economic development (GDP growth) are significantly positive across all models by Tobit regressions and 2SLS regressions. Therefore, economic development is positively related to X-efficiency. This indicates that banks can improve their allocative and technical efficiency levels when they operate under conditions of more rapid growth in GDP. Moreover, the effect of economic stability (inflation) on X-efficiency is negative across all models by Tobit regression, although the signs of the coefficients for inflation vary among models with 2SLS regression. The coefficients for inflation by 2SLS are significantly positive for only Model 5 when considering the efficiency-adjusted Lerner and concentration as key variables of interest but they are negative for the remaining models. Therefore, the influence of inflation on allocative and technical efficiency in these emerging Asian countries is not clear.
4.4.2.2. The Relationship between Market Concentration, Bank Competition and X-efficiency by Country

Exogeneity in concentration and bank competition are rejected at the 1% level for all countries in the sample based on the Wald test results. This suggests it is necessary to perform the instrumental variables technique. Therefore, both Tobit and 2SLS regression are used here.

Table 4.5 reports the relationships between market concentration, bank competition and bank X-efficiency by Tobit and 2SLS regression for each country in the dataset. Banking systems in Bangladesh and Indonesia show evidence to support the QLH whereas this hypothesis is rejected for the other banking systems over the study period.
Table 4.5 The Relationship between Market Concentration, Bank Competition and Bank X-efficiency by Country: Tobit and 2SLS Estimations

<table>
<thead>
<tr>
<th>Country</th>
<th>Bangladesh Tobit</th>
<th>Bangladesh 2SLS</th>
<th>India Tobit</th>
<th>India 2SLS</th>
<th>Indonesia Tobit</th>
<th>Indonesia 2SLS</th>
<th>Malaysia Tobit</th>
<th>Malaysia 2SLS</th>
<th>Philippines Tobit</th>
<th>Philippines 2SLS</th>
<th>Vietnam Tobit</th>
<th>Vietnam 2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>−0.015 ***</td>
<td>−0.017 ***</td>
<td>0.011 ***</td>
<td>−0.005 ***</td>
<td>−0.006 ***</td>
<td>0.006 ***</td>
<td>0.034 ***</td>
<td>0.012 ***</td>
<td>0.086 ***</td>
<td>0.003 ***</td>
<td>0.005 ***</td>
<td></td>
</tr>
<tr>
<td>Lerner-adj</td>
<td>−0.033 ***</td>
<td>−0.049 ***</td>
<td>0.040 ***</td>
<td>0.077 ***</td>
<td>−0.010</td>
<td>−0.033 *</td>
<td>0.072 ***</td>
<td>−0.001</td>
<td>−0.022</td>
<td>0.001</td>
<td>0.109 ***</td>
<td>0.127 ***</td>
</tr>
<tr>
<td>Size</td>
<td>0.010 ***</td>
<td>−0.004</td>
<td>−0.0004</td>
<td>0.004 **</td>
<td>0.015 ***</td>
<td>0.014 ***</td>
<td>−0.011 ***</td>
<td>0.021 ***</td>
<td>0.031 ***</td>
<td>0.004 **</td>
<td>−0.001</td>
<td>0.0002</td>
</tr>
<tr>
<td>Credit risk</td>
<td>−0.014</td>
<td>−0.042 ***</td>
<td>−0.010</td>
<td>−0.016 *</td>
<td>0.028 **</td>
<td>0.026 *</td>
<td>0.036 **</td>
<td>−0.037</td>
<td>0.003</td>
<td>0.001</td>
<td>−0.001</td>
<td>0.009</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>−0.117 ***</td>
<td>−0.228 ***</td>
<td>−0.007</td>
<td>−0.010</td>
<td>−0.032 **</td>
<td>−0.054 ***</td>
<td>0.030 *</td>
<td>−0.096</td>
<td>−0.161</td>
<td>−0.124</td>
<td>0.008</td>
<td>−0.023</td>
</tr>
<tr>
<td>GDP</td>
<td>−0.027 ***</td>
<td>−0.027 ***</td>
<td>0.0003 ***</td>
<td>−3.73e−06</td>
<td>−0.006 ***</td>
<td>−0.007 ***</td>
<td>−0.001 *</td>
<td>−0.0002</td>
<td>−0.002</td>
<td>−0.010</td>
<td>0.015 ***</td>
<td>0.008 ***</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.009 ***</td>
<td>0.009 ***</td>
<td>0.002 ***</td>
<td>0.002 ***</td>
<td>−0.001 ***</td>
<td>−0.001 ***</td>
<td>0.004 ***</td>
<td>0.006 ***</td>
<td>−0.001</td>
<td>−0.003</td>
<td>0.001 ***</td>
<td>0.001 ***</td>
</tr>
<tr>
<td>Constant</td>
<td>1.586 ***</td>
<td>1.859 ***</td>
<td>0.519 ***</td>
<td>0.474 ***</td>
<td>1.162 ***</td>
<td>1.241 ***</td>
<td>0.657 ***</td>
<td>−0.910</td>
<td>0.180 **</td>
<td>−3.942</td>
<td>0.561 ***</td>
<td>0.513 ***</td>
</tr>
</tbody>
</table>

Wald test

<table>
<thead>
<tr>
<th></th>
<th>Chi² (2)</th>
<th>Prob&gt;chi²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>87.07</td>
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<tr>
<td></td>
<td>243.7</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>10.21</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>134.42</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>83.91</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>1745.14</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Source: Author’s calculations
Note: Results from Tobit and 2SLS regression show the relationship between market concentration, bank competition and bank X-efficiency. X-efficiency levels are calculated from a cost function by the SFA approach. The degree of competition is proxied by the Lerner index, with higher values indicating a lower degree of bank competition level. Lerner-adj is efficiency-adjusted Lerner index. Concentration represents the four-bank concentration ratio by TA; Size is the natural logarithm of TA; Credit risk is the loan to asset ratio accounts, Liquidity risk is the deposit to asset ratio; GDP growth is real gross domestic products growth; inflation is inflation rate. The Wald test is used to test for the exogeneity of market concentration and/or Lerner. The null hypothesis is that market concentration and/or Lerner are exogenous variables. Industry size and one-period lags of the Lerner index are used as instrumental variables for market concentration and Lerner when 2SLS estimation is performed.

*, ** and*** denote statistical significance at the 10, 5 and 1% levels, respectively.
Evidence to Support the Quiet Life Hypothesis: Bangladesh and Indonesia

In Bangladesh banking, market concentration and the efficiency-adjusted Lerner index are highly significantly and negatively related to X-efficiency. This finding seems to support the QLH, which posits that banks with higher market power require less effort to maximise efficiency in a relaxed environment. Therefore, increasing competition can result in an improvement of X-efficiency in the Bangladesh banking system.

The relationship between bank size and X-efficiency indicated by the Tobit regression results is positive and highly significant at the 1% level, suggesting that larger banks can achieve higher X-efficiency levels. However, the 2SLS estimates indicate that bank size has an insignificant negative effect on X-efficiency.

The coefficients for credit risk and liquidity risk are negative but only insignificant so for credit risk by Tobit regression. Hence, banks in Bangladesh are able to reduce their credit risk and liquidity risk to gain higher X-efficiency. In addition, the effects of macroeconomic conditions (including GDP growth and inflation) on X-efficiency are highly significant (1% level). GDP growth has a negative relationship with X-efficiency whereas inflation is positively related to X-efficiency.

The Indonesian banking system also seems to fit the QLH. The association between market concentration and X-efficiency is negative and highly significant for all regressions. Banks operating in more concentrated markets cannot control cost efficiently, thus they are less efficient. Moreover, the relationships between Lerner indices and X-efficiency are negative and only significant for 2SLS estimations. Therefore, banks with higher market power or those operated under less competitive pressure can be less efficient. The coefficients for bank size and credit risk are significantly positive whereas those for liquidity risk, GDP growth and inflation are significantly negative for all regressions. Thus, banks with larger size and credit risk can achieve higher X-efficiency. In contrast, a higher liquidity risk for banks can reduce their X-efficiency. Macroeconomic conditions such as GDP growth and inflation have negative effects on X-efficiency.

Evidence to Reject the Quiet Life Hypothesis: India, Malaysia, Philippines and Vietnam

India
In contrast to the cases of Bangladeshi and Indonesian banking, significantly positive coefficients for concentration and Lerner indices in both Tobit and 2SLS regressions provide evidence against the QLH and seem to support the IGH for the Indian banking system. The coefficients for bank size estimated by Tobit and 2SLS regression vary in sign, but are significant only for 2SLS estimation. Results estimated by 2SLS regression indicate that Indian banks with larger TA can achieve higher X-efficiency. Credit risk and liquidity risk have negative effects on X-efficiency, but only significantly so for 2SLS estimates for the relationship between credit risk and bank efficiency. The signs and significance of the coefficients for GDP growth from Tobit and 2SLS regressions are contrasting: they are positive and significant for Tobit regression but negative and insignificant for 2SLS regression. The coefficients for inflation are significantly positive for all regressions, suggesting that inflation has a positive impact on X-efficiency.

Malaysia

For Malaysian banking, the coefficients for market concentration are positive and significant at the 1% level for all regressions. In addition, the coefficient for the efficiency-adjusted Lerner index is significantly positive for the Tobit estimate (although negative and insignificant for the 2SLS regression estimate). The apparent positive relationship between concentration and X-efficiency argues against the QLH in Malaysian banking. The influence of bank size on X-efficiency is significantly negative for Tobit regression. Nevertheless, the coefficient for size by 2SLS regression is significantly positive, suggesting that larger banks in Malaysia are more efficient than their smaller peers. Both liquidity risk and credit risk are significantly positively related to X-efficiency for Tobit estimates. However, the 2SLS results indicate that the coefficient for credit risk is insignificantly negative and that for liquidity risk is negative and significant at the 1% level. Therefore, banks with higher liquidity risk may be less efficient. In addition, both the Tobit and 2SLS estimates suggest that GDP growth has a negative influence on X-efficiency, although only the Tobit coefficients are significant. X-efficiency of banks under effects of higher inflation can be improved for Malaysian banks.

The Philippines

For the Philippines banking system, the results for both Tobit and 2SLS regressions indicate that concentration is significantly and positively related to X-
efficiency, providing evidence to reject the QLH. Similarly, the relationship between bank size and X-efficiency are significantly positive; thus banks with larger size can achieve higher X-efficiency. Both liquidity risk and GDP growth have significant negative effects on X-efficiency. All coefficients for inflation are negative but significantly so only with 2SLS regression. This suggests that higher inflation can decrease X-efficiency of banks in the Philippines. The coefficients for Lerner indices and credit risk are not statistically significant; therefore, bank competition and credit risk have no significant effect on X-efficiency in the Philippines.

**Vietnam**

The coefficients for concentration and Lerner-adj are positive and significant at the 1% level, suggesting that the QLH be rejected for Vietnamese banking. Similarly, the effects of macroeconomic conditions on X-efficiency are highly significant (1% level). The coefficients for GDP growth and inflation are significantly positive, indicating that higher GDP growth and higher inflation rates can improve X-efficiency of Vietnamese banks. Size, credit risk and liquidity risk have insignificant effects on X-efficiency.

**4.4.3 Tests for Multicollinearity**

Multicollinearity was tested for the models using VIF. The figures in Table 4.6 show that VIF is highest for the efficiency-adjusted Lerner index in Model 5 (1.42) and lowest for size in Model 2 (1.05). Therefore, multicollinearity is not a concern in all models when examining the relationship between competition, market concentration and X-efficiency for full sample.

Table 4.7 shows that VIF for bank concentration is highest for India (6.84) and VIF for credit risk is lowest for Philippines (1.04). Overall, multicollinearity is not a concern when examining the relationship between competition, market concentration and X-efficiency by country in the sample.
### Table 4.6 Variance Inflation Factor (VIF): Checking for Multicollinearity for the Full Sample

<table>
<thead>
<tr>
<th>VIF</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>1.28</td>
<td>–</td>
<td>–</td>
<td>1.32</td>
<td>1.29</td>
</tr>
<tr>
<td>Lerner</td>
<td>–</td>
<td>1.15</td>
<td>–</td>
<td>1.18</td>
<td>–</td>
</tr>
<tr>
<td>Lerner-adj</td>
<td>–</td>
<td>–</td>
<td>1.41</td>
<td>–</td>
<td>1.42</td>
</tr>
<tr>
<td>Size</td>
<td>1.21</td>
<td>1.05</td>
<td>1.12</td>
<td>1.21</td>
<td>1.29</td>
</tr>
<tr>
<td>Credit risk</td>
<td>1.16</td>
<td>1.13</td>
<td>1.12</td>
<td>1.16</td>
<td>1.16</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>1.12</td>
<td>1.15</td>
<td>1.17</td>
<td>1.15</td>
<td>1.17</td>
</tr>
<tr>
<td>GDP growth</td>
<td>1.09</td>
<td>1.06</td>
<td>1.07</td>
<td>1.09</td>
<td>1.10</td>
</tr>
<tr>
<td>Inflation</td>
<td>1.08</td>
<td>1.15</td>
<td>1.31</td>
<td>1.15</td>
<td>1.33</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>1.15</td>
<td>1.11</td>
<td>1.20</td>
<td>1.18</td>
<td>1.25</td>
</tr>
</tbody>
</table>

*Note:* VIF is used to check for multicollinearity. Multicollinearity is a concern when VIF for a variable is >10. Lerner and Lerner-adj represent the conventional Lerner index and the efficiency-adjusted Lerner index, respectively. Concentration is the four-bank concentration ratio in terms of TA; Size is the natural logarithm of TA; Credit risk is the loan to asset ratio; Liquidity risk is the deposit to asset ratio; GDP growth is real gross domestic products growth; Inflation is inflation rate.

### Table 4.7 Variance Inflation Factor (VIF): Checking for Multicollinearity for Each Country

<table>
<thead>
<tr>
<th>VIF</th>
<th>Bangladesh</th>
<th>India</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>2.41</td>
<td>6.84</td>
<td>3.38</td>
<td>1.05</td>
<td>1.34</td>
<td>3.06</td>
</tr>
<tr>
<td>Lerner-adj</td>
<td>1.81</td>
<td>2.11</td>
<td>1.82</td>
<td>1.29</td>
<td>1.89</td>
<td>1.79</td>
</tr>
<tr>
<td>Size</td>
<td>2.52</td>
<td>1.21</td>
<td>1.18</td>
<td>1.95</td>
<td>1.71</td>
<td>1.82</td>
</tr>
<tr>
<td>Credit risk</td>
<td>1.10</td>
<td>1.42</td>
<td>1.14</td>
<td>2.11</td>
<td>1.04</td>
<td>1.06</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>1.10</td>
<td>1.33</td>
<td>1.85</td>
<td>1.52</td>
<td>1.60</td>
<td>1.34</td>
</tr>
<tr>
<td>GDP growth</td>
<td>1.30</td>
<td>1.29</td>
<td>1.85</td>
<td>1.17</td>
<td>1.18</td>
<td>2.69</td>
</tr>
<tr>
<td>Inflation</td>
<td>1.35</td>
<td>5.48</td>
<td>2.09</td>
<td>1.17</td>
<td>1.36</td>
<td>1.14</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>1.66</td>
<td>2.81</td>
<td>1.90</td>
<td>1.47</td>
<td>1.45</td>
<td>1.84</td>
</tr>
</tbody>
</table>

*Note:* VIF is used to check for multicollinearity, which is a concern when VIF of a variable is >10. Lerner-adj represents the efficiency-adjusted Lerner index. Concentration is the four-bank concentration ratio in terms of TA; Size is the natural logarithm of TA; Credit risk is the loan to asset ratio; Liquidity risk is the deposit to asset ratio; GDP growth is real gross domestic products growth; Inflation is inflation rate.
4.5 Conclusions

This chapter analysed the relationships between market concentration, bank competition and bank efficiency for the six emerging Asian countries pre- and post-GFC. Using data for 212 banks in these countries from 2005–12, the degree of competition was estimated at bank level using two Lerner specifications: the conventional and efficiency-adjusted Lerner indices.

The study used five models to test the QLH and the IGH. Model 1 demonstrates the market concentration–bank X-efficiency relationship; Models 2 and 3 examined competition–bank X-efficiency associations using the conventional and efficiency-adjusted Lerner indices, respectively; Models 4 and 5 reflect the influence of both bank competition and market concentration on bank X-efficiency, also using the two Lerner indices.

The study examined the relationship between competition, concentration and X-efficiency in banking for the full sample and by country. For the full sample, it was shown that market concentration has a significantly positive effect on X-efficiency, providing evidence against the QLH for these six Asian countries. Moreover, the findings provide evidence for significantly positive relationships between Lerner indices and X-efficiency, leading to rejection of the QLH, which postulates that increasing competition fosters X-efficiency levels of banks because banks require less effort to maximise their efficiency in a more relaxed environment. On the other hand, the significantly positive associations between Lerner indices and X-efficiency suggest that competition is negatively associated with X-efficiency, in line with the IGH. Two possible reasons for this are that banks compete fiercely to capture market share and attract bank depositors by increasing their mobilising interest rates, thus increasing costs and decreasing X-efficiency; and second in more competitive markets, banks’ probability of adverse borrower selection increases and they need to expend more resources to monitor their borrowers and treat non-performing loans, thus decreasing X-efficiency.

Bank size has a highly significant positive effect on X-efficiency, suggesting that larger banks are able to attain higher levels of X-efficiency. Liquidity risk is significantly negatively related to X-efficiency, thus banks with higher liquidity risk experience decreased X-efficiency. Economic development (GDP growth) positively
influences bank X-efficiency, suggesting that banks can improve their allocative and technical efficiency levels under conditions of rapid GDP growth. However, the effect of economic stability (inflation) on X-efficiency is unclear. Inflation is significantly positively related to X-efficiency only for Model 5, which considers the efficiency-adjusted Lerner and concentration as key variables of interest; the relationship is negative in the remaining models. Credit risk has no significant effect on X-efficiency in all research models.

The study examined the relationship between market concentration, bank competition and bank X-efficiency for each country in the research sample. It found that the QLH is supported for the banking in Bangladesh and Indonesia but this hypothesis is rejected and the IGH is supported for banking in India, Malaysia, the Philippines and Vietnam.
Chapter 5: Conclusions

5.1 Summary of the Research

In recent years, banks in emerging countries have introduced many financial reforms and restructuring that resulted in changes in market concentration and competition in banking. Given that banks in these countries play an important role in the financial system as the main financial institutions providing credit to the economy in relatively underdeveloped capital markets, an analysis of bank efficiency and its determinants is of importance and significance to bank managers, bank investors and policymakers.

The primary objectives of this study were to (1) investigate market concentration and competition in six emerging Asian countries of Bangladesh, India, Indonesia, Malaysia, the Philippines and Vietnam over 2005–12, spanning the GFC; (2) measure X-efficiency of banking systems in these countries; (3) examine the relationships between market concentration, bank competition and bank efficiency in these countries pre- and post-GFC.

The first step to pursue these objectives was to undertake a literature review on bank efficiency and determine the methodology to be used to measure it in the current study. These aspects and the estimation results for bank efficiency for the six countries were presented in Chapter 2. Chapter 3 examined market concentration and competition and their relationship in banking of these countries. This was followed in Chapter 4 by an analysis of the relationship between market concentration, bank competition, and bank efficiency in the focal countries. The contributions of this study were discussed in Chapters 2 to 4.

The study investigated market concentration and competition levels of banking using a sample of six emerging Asian countries over a period spanning the 2008 GFC. The significant and important results emerging from this study are summarised as follows.

In general, there were different trends for market concentration in banking systems in these countries over the study period. Concentration levels in banking systems followed a downward trend for Bangladesh, India, Indonesia and Vietnam but
had a tendency to increase slightly for Malaysia and the Philippines. Market concentration ratios for banking were rather high in Indonesia, Malaysia, the Philippines and Vietnam, and less so in Bangladesh and India.

With regard to competition in banking systems, the study employed the conduct parameter approach following the framework suggested by Uchida and Tsutsui (2005), Delis and Tsionas (2009) and Soedarmono et al. (2011; 2013) to measure bank competition at industry level. To obtain values of \( \theta \) to measure bank competition and to perform robustness checks, the study used two statistical techniques: SUR and 3SLS. The results pointed to various competitive structures and trends in competition in banking in the study sample. Monopolistic competition seems to be the best description of the competitive structure of banking in Indonesia, Malaysia and the Philippines. However, in Vietnam, the marginal cost was higher than price, possibly due to non-optimising behaviour of banks. In India also, marginal cost was higher than price over 2005–08, but banks in this country operated under monopolistic competition during 2010–12. Bangladesh banking showed a tendency to operate under conditions of pure monopoly in 2005 and monopolistic competition in 2008, whereas marginal cost was higher than price in 2007 and during 2009–12. The degree of bank competition followed a downward trend for India and Indonesia, and an upward trend for Bangladesh, Malaysia and the Philippines. Vietnamese banking competition levels fluctuated frequently over a small range.

The study investigated factors affecting bank competition across these countries. It found that market concentration had a negative association with bank competition, providing evidence to support the SCP hypothesis. GDP growth and inflation promoted bank competition, whereas neither crisis conditions nor the ratio of loans to deposits had an effect on the degree of competition.

Another issue addressed was the relationship between competition, concentration and bank efficiency in the six Asian countries. Although previous studies focussed on the effect of either market concentration or bank competition on bank efficiency, the present study examined the relationships between bank competition, market concentration and bank efficiency pre- and post-GFC using five research models. Model 1 demonstrated market concentration–bank efficiency relationships; Models 2 and 3 considered competition–bank efficiency associations
using Lerner indices; Models 4 and 5 examined the effects of both bank competition and market concentration on bank efficiency, also using Lerner indices.

The SFA approach was employed using the model of Battese and Coelli (1992), which allowed the estimation of time-varying efficiency scores. The frontier function was estimated separately for each country to derive individual inefficiency estimates using the maximum likelihood technique. Two Lerner specifications were used to measure competition at the bank level. The results suggested that monopolistic competition is the best description for most banking systems in the sample. The relationship between competition, concentration and X-efficiency was examined for the full sample and by country via both Tobit and 2SLS regressions.

For the six countries in the sample period, market concentration was significantly positively related to X-efficiency while competition had a negative impact on X-efficiency. These results provide evidence against the QLH for these Asian countries. Rather, the negative effect of competition on bank X-efficiency supports the IGH. This finding can be explained as follows. First, banks in emerging Asian countries compete fiercely to capture market share and attract bank depositors by increasing their mobilising interest rates, thus increasing costs and decreasing X-efficiency. Second, when bank competition increases, banks face a higher likelihood of adverse borrower selection, so they must expend more resources on monitoring their borrowers and dealing with non-performing loans, thus decreasing their X-efficiency. Moreover, bank size was found to have a significantly positive effect on X-efficiency suggesting that larger banks were able to control their costs to attain higher levels of X-efficiency. Credit risk had no significant effect on X-efficiency because the relationship between credit risk and X-efficiency was statistically insignificant. Banks with higher liquidity risk experienced decreased X-efficiency. GDP growth positively influenced bank X-efficiency but the effect of inflation on X-efficiency was not clear. Inflation was significantly positively related to X-efficiency only for the model that considered the efficiency-adjusted Lerner and concentration as key variables of interest, the relationships between inflation and X-efficiency were negative for the remaining models.

The relationship between market concentration, bank competition and bank X-efficiency was examined for each country in the research sample using the efficiency-adjusted Lerner index as a proxy for competition. The results provided evidence to
support the QLH for banking in Bangladesh and Indonesia, and the IGH for banking in India, Malaysia, the Philippines and Vietnam.

5.2 Policy Implications

This study investigated bank competition, market concentration and bank efficiency in emerging Asian countries that have performed a number of financial reforms and restructuring in banking systems. On the basis of the empirical findings, some recommendations can be made for increasing bank efficiency in the context of emerging countries.

For government and policymakers, several policy implications arise from the study. First, policy on M&A need encourage M&A of small and weak banks as a means to improve their financial strength and soundness. Second, as demonstrated by some previous studies (e.g. Claessens and Laeven (2004); Jeon et al. (2011); Yeyati and Micco (2007); Yildirim and Philippatos (2007); Wu et al. (2010)), foreign bank entry be promoted as this enhances competition by restructuring domestic banking sectors and encouraging troubled local banks to change their governance as well as decreasing the state’s role in banking markets. Generally, the encouragement of foreign bank penetration and divestiture of state ownership in banking can heighten competitive pressures in the banking sector. Thus, the main policy lessons drawn from the study are that competitive conditions may be further enhanced by easing regulatory impediments and, in the long run, allowing more foreign bank participation in an attempt to spur competitive conduct in banking.

Some policy implications are also suggested for banks to increase their X-efficiency. The negative relationship between competition and efficiency may be explained by the fact that banks compete fiercely to capture market share from their peers. They raise their mobilising interest rates and invest more in banking promotions and bonuses to attract new customers to sign up for new accounts and to retain existing customers, thus increasing their costs and decreasing X-efficiency. Further, when bank competition increases, a bank’s probability of adverse borrower selection increases. Therefore, banks experience increased costs of monitoring their borrowers and treating non-performing loans, thus decreasing X-efficiency. Thus, to increase bank X-efficiency, banks aim to diversify their activities and income (e.g. net interest income and non-interest income) rather than continuing to rely largely on traditional
activities (e.g. capital mobilisation and credit activities) and net interest incomes, to avoid a race to increase interest among banks. Additionally, banks consider establishing better customer information systems to access, collect, store and transmit customer information to their peers. In this way, they can assess repayment capacity of their customers before lending, to avoid adverse borrower selection. Banks also need to thoroughly examine sub-prime lending and relationship-based lending.

The second important implication of the current results for banks is that bank size has a positive effect on X-efficiency. Therefore, to increase bank X-efficiency, banks aim to increase their size and TA via privatisation and attracting capital from shareholders and investors through the securities market. They are encouraged to attract deposits from customers and other banks by diversifying their deposit products and introducing new products to their existing and potential clients as well as supplying the best quality of service to their customers. Small and weak financial banks may be able to increase their size via M&A to improve their financial strength and X-efficiency.

The third recommendation for banks is that they can increase their X-efficiency by reducing their liquidity risk. Banks can raise liquidity of their assets by increasing their liquid assets and matching cash-flows of both assets and liabilities. Moreover, it is necessary to build very close cooperation and strong relationships among banks in the system, so that a bank facing the risk of a funding crisis or a sudden demand for liquid funds can receive prompt support from its peers. In addition, banks endeavour to strengthen customer belief and build customer loyalty to promote a strong relationship between them and their customers.

5.3 Limitations of this Thesis and Suggestions for Future Research

This study reported many interesting findings and makes a positive contribution to the limited literature on bank competition, market concentration and bank efficiency in emerging Asian countries over pre- and post-GFC periods. Nevertheless, like other empirical research, this study has some limitations, and some directions for future research are suggested.

First, the study only focuses on cost X-efficiency, which provides a measure of how close the actual costs of a bank are to the minimum costs that would be used by the best-practice bank in the sample to produce a given bundle of outputs.
Therefore, future research may examine profit efficiency of banking in emerging Asian countries.

Second, the study measures X-efficiency using the SFA approach only. Interesting further research might use other methods, such as the DEA, DFA and thick frontier approach to estimate bank efficiency.

Third, this study was limited in relation to the number of observations in the sample. As a result, future research consider using a larger sample of countries and extend the study time period to provide a more comprehensive analysis of banking in the context of emerging countries. Further, as this study investigated market concentration, competition and bank efficiency of only emerging Asian countries, an interesting future study would involve samples from both developed and developing countries to compare the degrees of concentration, competition levels and bank efficiency levels between these groups of countries.

Finally, two Lerner specifications were used to measure competition at bank level. Unlike the conventional Lerner index, the efficiency-adjusted Lerner index can account for competition–efficiency inter-relationships; however, neither index excludes funding cost from the translog cost function to obtain a ‘raw’ proxy for pricing power. To avoid biased findings due to the effect of market power that may be captured by price of deposits in the cost function, future research consider employing the funding-adjusted Lerner index along with the other specifications.
References


