THE EFFICIENCY OF ISLAMIC AND CONVENTIONAL BANKS

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The aim of the thesis is to compare the efficiency of Islamic banking relative to conventional banks, highlighting the impact of operational characteristics on efficiency, and to determine factors influencing their productivity. Translog cost and output distance functions are employed to compare the efficiency of Islamic banking relative to conventional Malaysian banks during 1996-2002. The study first focuses on the impact of operating characteristics as well as the measurement of efficiency and productivity performance of Islamic banking relative to conventional banks. Alternative net and gross efficiency estimates both demonstrate that differences in operating characteristics explain much of the difference in costs and output between Malaysian banks. Productivity change is decomposed into efficiency, technical, and scale change using a generalised Malmquist Productivity Index. The results show that Islamic banks have higher costs and reduced outputs relative to conventional banks. Conventional banks with Islamic windows have poorer gross efficiency than those without Islamic windows and merged banks have experienced significantly lower productivity change relative to unmerged banks mainly due to the lower efficiency change of merged banks that have Islamic banking windows. A translog output distance function approach is also employed to measure the efficiency of Islamic banks relative to conventional banks in countries operating Islamic banking during 1996-2002. The findings demonstrate statistically significant differences in efficiency across countries even after controlling for specific environmental characteristics and Islamic banking. Islamic banks are found to have reduced potential output and experience moderately higher returns to scale than conventional banks. The latter suggests that Islamic banks may benefit from increased scale. Identifying and overcoming the factors that cause Islamic banks to have relatively high input requirements will therefore be the key challenge for Islamic banking in the coming decades.

Keywords: bank efficiency; bank productivity; Islamic banking; stochastic frontier analysis; Malmquist index

In loving memory of my mother

In the name of Allah, the Most Gracious, Most Merciful

Read! In the name of thy Lord and Cherisher, Who created.
Created man, out of a (mere) clot of congealed blood.
Read! And thy Lord is Most Bountiful,
He Who taught (the use of) the pen,
Taught man that which he knew not.

Sura Al-'Alaq: 1-5

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2. Aston Business School Working Paper (RP 0720), 2007

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AAOIFI	Accounting and Auditing Organization for Islamic Financial Institution
ATM	Automated Teller Machine
BIMB	Bank Islam Malaysia Berhad
BNM	Bank Negara Malaysia/ Central Bank of Malaysia
BvD	Bank Van Dijk
CAS	Capital Adequacy Standard
CDRC	Corporate Debt Restructuring Committee
CECA	Confederacion Espanola De Cajas Ahorros
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DFA	Distribution Free Approach
DRS	Decreasing Returns to Scale
EU	European Union
FOMNBs	Foreign-Owned Multinational Banks
GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Products
GCC	Gulf Cooperation Countries
GCIBFI	General Council for Islamic Banks and Financial Institutions
GDF	Global Development Finance
GIIs	Government Investment Issues
GNI	Gross National Income
IBU	Islamic Banking Unit
IBD	Islamic Banking Division
IBF	Islamic Banking Fund
ICCS	Islamic Cheque Clearing System
IDB	Islamic Development Bank
IFS	International Financial Statistics
IIFM	Inter-Bank Financial Market
IIRA	International Islamic Rating Agency
IFSB	International Financial Standard Board
IBS	Islamic Banking Scheme

IFRS	International Financial Reporting Standard
IMF	International Monetary Fund
INCEF	International Centre for Education in Islamic Finance
IRS	Increasing Returns to Scale
JIB	Jordan Islamic Bank for Finance And Investment
MYR	Malaysian Ringgit
MLE	Maximum-Likelihood Estimation
MNBs	Multinational banks
MOBs	Minority owned banks
NMOB	Non-minority owned bank
NPLs	Non-Performing Loans
OLS	Ordinary Least Square
PPF	Production Possibility Frontier
ROA	Return on Asset
ROE	Return on Equity
SFA	Stochastic Frontier Analysis
TEC	Technical Efficiency Change
TC	Technical Change
SCE	Scale Change Effects
TFA	Thick Frontier Approach
TFP	Total Factor Productivity
TFPC	Total Factor Productivity Change
UAE	United Arab Emirates
USA	United States of America
WDI	World Development Indicators

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

In the Muslim belief system which follows *shariah* (the legal code of Islam), interest is prohibited. Therefore, during the glory days of the Islamic civilisation and centuries thereafter, the system of mobilising resources to finance productive activities and consumer needs was free from interest and it was quite effective (Iqbal and Molyneux 2005). In addition, during the 12th and 13th centuries, in the Mediterranean region, partnership and profit-sharing formed the basis of commerce and trading activities instead of interest-based borrowing and lending (Goitein 1971; Iqbal and Molyneux 2005). However, as the focus of the world's economic activities for some centuries shifted to the Western world, Western financial institutions and practices which rely on interest rates became more influential while Islamic practices became dormant (Iqbal and Molyneux 2005).

As a result, Muslim people have avoided dealing with interest-based commercial banks, as this is an inherent contradiction to their values and Islamic scholars have expressed their reservations regarding the financial intermediation model of commercial banking (Wilson 2007). This has called for an alternative mechanism to function as financial intermediation in Muslim societies and began with theoretical and model discussions among Muslim economists and banks. After the Second World War and independence of most Muslim countries from colonial rule, *shariah* compliant financing

began being practised on a small scale before expanding into formal banking institutions in many countries in the Middle East and Asia regions (Wilson 2007).

In the early 1980s, as Islamic banks grew and required tools for managing liquidity, a number of banks in London offered *shariah* compliant deposits through mark-ups generated from short-term trading transactions[1] at the London Metal Exchange (Wilson 2007). At the same time, European banks dealing with Gulf Islamic banks that were involved in imports from Europe started to learn Islamic finance in order to understand the working mechanism (Wilson 2007). Although Islamic banking is sometimes perceived as a limiting choice, it is actually broadening the banking choice. Compared to conventional banking, Islamic banking activities are limited within the scope of *shariah* hence, the mechanism involved in Islamic banking is different from interest-based banking, but this gives bank customers an alternative to interest-based banking. In addition, Islamic banking is not viewed as threatening the existing business instead, open opportunity for new business as its operation is within the scope of socially responsible banking activities (Wilson 2007). Consequently, multinational and domestic conventional banks have opened *shariah* compliant windows in meeting demand from the Muslim communities as well as an alternative to the interest-based banking for both Muslim and non-Muslim customers particularly in countries with a mixed environment such as Malaysia.

As Islamic banking has been in operation for over 30 years, the performance of its operations needs to be evaluated. Moreover, as an alternative to the well-established interest-based banking, it is logical to compare the performance of Islamic banks to the conventional banks. Although the nature of *shariah* compliant banking is different from interest-based banking, it is worth finding a common ground in order to compare their performance.

Furthermore, as Islamic banking is part of the banking system of a country, its performance may affect the soundness and stability of the banking system. Moreover, for conventional banks with Islamic banking windows, the performance of these windows has certain influence on the performance of conventional banks. Therefore, the determination of the relative performance of Islamic to conventional banks will assist policy makers in

[1] The real trading in managing liquidity remains costly as compared to conventional treasury bills and progress to develop other *shariah* compliant tools is slow due to problems associated with the legality of debt trading (Wilson 2007).

devising a strategy to improve the performance of a banking system in a country and help managers in the conventional banks that choose to have Islamic banking windows besides conventional banking to improve bank performance.

In addition, the increasing number of Islamic banks has heightened the competition between full-fledged Islamic banks and conventional banks. Hence, the determination of the relative performance will encourage both full-fledged Islamic and conventional bank managers to improve their bank performance in order to compete with each other.

Given the above issues, how Islamic banks perform relative to conventional banks is important and needs to be investigated. Performance can be measured through efficiency and productivity. Malaysia, being one of the countries that operate Islamic banking side by side but separately from conventional banking, would be the appropriate sample country because it has full-fledged Islamic banks, conventional banks with Islamic banking windows and fully conventional banks. Therefore, the first sub-research question is: what is the efficiency and determinants of productivity change for Islamic banking relative to conventional banking in Malaysia? Having answered this question, the research will further verify the results in other countries which operate Islamic banking. Therefore, the second sub-research question is: what is the efficiency of Islamic banking compared to conventional banking internationally?

1.2 AIMS AND OBJECTIVES OF THE STUDY

Given the above research questions, the research aim is to compare the efficiency of Islamic banking relative to conventional banks, highlighting the impact of operational characteristics on efficiency, and to determine factors influencing their productivity. In particular, the first objective is to measure the efficiency of Islamic banking relative to conventional banks in Malaysia, emphasising the impact of operating characteristics as well as to find out the productivity performance of Islamic banking relative to conventional banks. The second objective of the study is to measure the efficiency of Islamic banks relative to conventional banks in countries operating Islamic banking emphasising the impact of operating characteristics. The following section will elaborate the structure of the thesis as summarised in Figure 1.1 and give an overview of the methodology adopted in attaining the previously mentioned two objectives of the research as shown in Figure 1.2.

1.3 STRUCTURE OF THE THESIS

This thesis is divided into seven major chapters. Following this introduction, chapter 2 provides a detailed background of Islamic banking, the main characteristics of the financial system in Malaysia and a brief exploration of countries involved in the research. The background of Islamic banking is discussed, focussing on its legal basis, definition, origin and typical operational model of how Islamic banks source out funds and acquire assets. The background of the Malaysian financial system describes its structure, investigates the development of Islamic banking in Malaysia and analyses the trend and changes in the Malaysian banking system. The final section tries to picture the diverse socio-economic background of the countries included in the study.

Chapter 3 presents the reader with a critical review of the existing conventional and Islamic bank efficiency and productivity literature. Within the area of relative performance of Islamic banks in comparison with conventional banking, a wider overview of previous research using various techniques is presented to provide a basic understanding of how this relative performance has been measured and to critically review how the literature has been dominated by financial ratio and non-parametric techniques. The discussion proceeds with the concepts of efficiency measurement followed by the stochastic frontier analysis (SFA) and the returns to scale. Following that, there is a review of research on how environmental factors have been considered in single and cross-country bank efficiency studies with the objective to model a function in order to measure the efficiency of Islamic and conventional banks. This information is useful in order to choose an appropriate function suitable with the sample banks and to decide how to take into account differences in operating characteristics when measuring efficiency of banks with different characteristics and in different regions. Productivity decompositions and particularly the parametric approach are then reviewed in order to highlight how productivity change has been previously measured and decomposed. Finally, the chapter discusses the various approaches to define bank outputs.

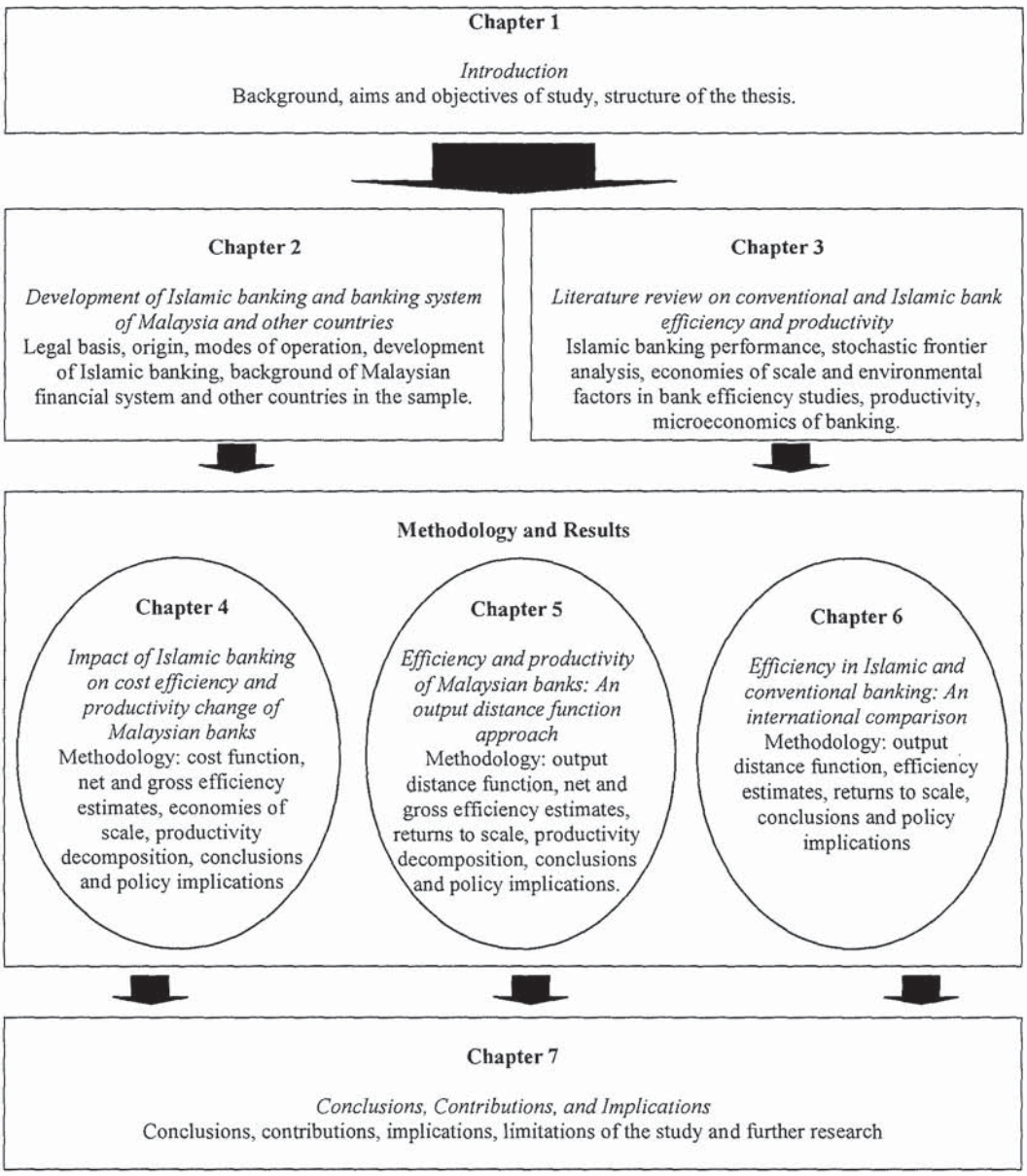


Figure 1.1: Structure of the study

The methodology and results are presented in chapter 4, 5 and 6. Chapter 4 focuses on the application of a cost function to Malaysian commercial banks over 1996-2002 in investigating the first issue. The cost function assumes input prices of labour, financial capital and physical capital to produce bank outputs. The chapter starts with a brief overview of Islamic banking development in the Malaysian banking system and the

methodology, followed by the findings of the relative performance of Islamic to conventional banks. Net and gross cost efficiency estimates, economies of scale as well as productivity change and its decomposition into technical change, cost efficiency change and scale change effect using the generalised Malmquist Productivity Index are analysed based on foreign, domestic, merged and unmerged bank categories. The chapter ends with a summary of the key findings and policy implications. This chapter concludes that Islamic banks have higher input requirements. However, Islamic banks which were initially costly to operate, managed to eliminate their cost disadvantages. Poorer gross efficiency of conventional banks with Islamic windows coupled with their modest productivity change seem to have less potential for these banks to overcome cost disadvantages associated with Islamic banking. In addition, the merged banks have experienced significantly lower productivity change relative to the unmerged banks mainly due to the lower efficiency change of merged banks that have Islamic banking windows.

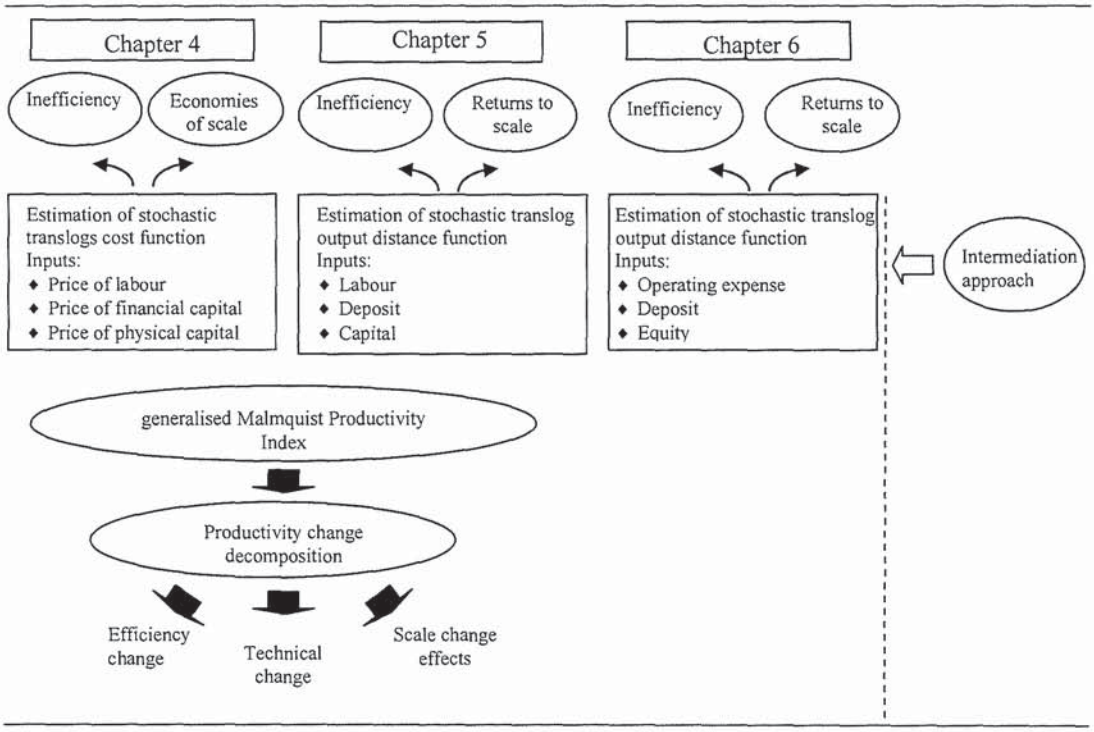


Figure 1.2: Research methodology

Chapter 5 provides an alternative technique to that of chapter 4 in investigating the first issue of the current research by applying an output distance function to Malaysian commercial banks over 1996-2002. This output-oriented approach which defines bank output using input quantities of labour, deposits and physical capital is used to check the consistency of results with the previous cost function approach. The chapter begins with a brief review of studies employing output distance function and a Malmquist Productivity Index. Output efficiency is then estimated followed by the analysis on net and gross efficiency estimates, and returns to scale. The generalised Malmquist Productivity Index is then employed to measure the productivity change which can be decomposed into efficiency change, technical change and scale change effects. The chapter ends with a summary of the main findings, and comparison of results with chapter 4 and recommendations for policy makers. Chapter 5 concludes that both full-fledged Islamic banks and conventional banks with Islamic banking windows require significantly higher input. In addition, merged banks suffer from significantly lower productivity change relative to unmerged banks mainly attributed to lower efficiency change of merged banks which have Islamic banking windows. Islamic banks experience modest output growth and suffer from output disadvantages reflected by the gross efficiency. Finally, poor performance of conventional banks with Islamic banking windows compared to those without Islamic banking windows are found in merged, unmerged and foreign categories but, they are equally efficient in the domestic category.

In examining the second issue of the research, the relative efficiency of Islamic to conventional banks is investigated internationally in chapter 6. The output efficiency of banks in 10 countries that operate Islamic banking is empirically analysed over 1996-2002 using an output-oriented distance function which defines bank outputs to be produced from quantities of operating expenses, deposits and equity. The chapter begins with a succinct review of the parametric approach of cross-country bank efficiency studies before discussing the output distance function estimates and further analysing the efficiency estimates and returns to scale. The chapter ends by outlining the major findings. Islamic banks are found to have lower potential output. In addition, they have a remarkable higher average inefficiency relative to the conventional banks which is partly attributed to the poor country specific inefficiency estimates for Sudanese and Yemeni banks. Even after having controlled for country-specific environmental conditions, country effects play

important roles in explaining efficiency distributions between countries and several significant differences in efficiency distributions have been found between countries.

Finally, the concluding chapter (chapter 7) summarises the main findings of the thesis and presents the conclusions. The implications of the study are then offered for both academic and practitioner audiences before pointing out the limitations of the study and suggesting directions for potential research. It is concluded that full-fledged Islamic banks have higher input requirements compared to the conventional banks and conventional banks with Islamic windows have poorer gross efficiency relative to those without Islamic windows. Besides that, merged banks have been found to experience significantly lower productivity change relative to unmerged banks mainly due to the lower efficiency change of merged banks that have Islamic banking windows. In addition, country effects play significant roles in explaining efficiency distributions between countries, even after having controlled for country-specific environmental conditions. The conclusion of the thesis is ultimately a value judgement in the sense that if one believes that the tenets of *shariah* are legitimate, Islamic banking is associated with higher input requirements which can be interpreted as "true inefficiency" because it fulfils the requirements of *shariah* which increases potential costs or reduces potential output. On the other hand, the increased cost or reduced output for compliance with *shariah* is more likely to be interpreted as inefficiency if one rejects the legitimacy of *shariah.* The finding of higher input requirements associated with Islamic banking suggests that policy makers involved in Islamic banking and Islamic bank managers will have to identify and overcome factors leading to these higher input requirements. Furthermore, they must aggressively work to create a more encouraging banking environment for Islamic banking, if they plan to further expand this *shariah* compliant banking.

CHAPTER 2
DEVELOPMENT OF ISLAMIC BANKING AND BANKING SYSTEM OF MALAYSIA AND OTHER COUNTRIES

2.1 INTRODUCTION

The chapter aims to provide the basic concept of Islamic banking and the background of the sample countries involved in this research. It explains the legal basis of Islamic banking, defines Islamic banking and its objectives, discusses the origin of Islamic banking and describes the modes of operation as well as traces the development of Islamic banking. Furthermore, the chapter investigates the structure and main features of the financial system in Malaysia as well as briefly discusses the socio-economic background of countries under study namely, Sudan, Bangladesh, Tunisia, Jordan, Lebanon, Yemen, Indonesia, Bahrain and Iran.

2.2 SHARIAH (LEGAL CODE OF ISLAM)

A Muslim is expected to lead their life according to the *shariah*. This law is derived mainly from the *Quran* (the Muslim holy book) and the *sunna* (sayings and deeds of Prophet Muhammad). It has been more than 1400 years since the Qur'an was revealed. In the Muslim belief system, the message from the Qur'an is applicable to all people and times. Besides the above two main sources of *shariah*, there are *ijma* (the consensus among Islamic scholars) and *qiyas* (reasoning by taking analogy). Islam does not distinguish spiritual from worldly affairs, hence business is considered as ethics and is

also subject to *shariah*. Therefore, Islamic banking is governed by the *shariah* besides the regulations set up by the host country (Karim 2001).

Interest is prohibited under the Quranic teaching, hence payment and receipt of interest is prohibited in Islam.[1] Interest, which is the pre-determined return on a financial transaction required by the lender from the borrower over and above the principal amount being lent, is forbidden but not the uncertain rate of return on the transaction which is represented by profit (Muhammad Abu al-Su'ud 1957; Khan and Mirakhor 1990).

2.3 ISLAMIC BANKING: DEFINITION

An Islamic bank can be defined as a financial institution with the objectives to implement the economic and financial principles of Islam in banking (Hassan 1999). Hamid (1999) noted that an Islamic bank can be a business or development financial institution. As a business firm, it seeks to maximize profit in order to give good returns to its shareholders and depositors. As a development financial institution, a bank helps economic development as well as ensures justice and kindness in the society including mobilizing savings, maintaining sectoral balance of the economy, developing labour skills through training, mobilizing non-human resources such as *sadaqah* (Islamic voluntary contribution) and *zakah* (Islamic wealth tax), maintaining equitable income and wealth distribution, and providing efficient banking services. An example that an Islamic bank tries to establish an equitable income distribution is the availability of interest-free loans for the needy, in which the customer has to pay only the principal amount and the administrative costs. Although the contribution of interest-free loans to total financing of the Islamic banking operation is very minimal, still the reason behind the establishment of an Islamic bank is not solely to maximize profit or revenue. The main features of Islamic banking are to avoid interest in all transactions and not involve in unethical activities such as prostitution, gambling and alcoholism. Therefore, the dual objectives of Islamic banking are to maximise returns for shareholders and depositors and to fulfil social obligations.

In this thesis, the Islamic bank is interchangeably referred to as the full-fledged Islamic bank. The Islamic banking scheme (IBS), which is also known as the Islamic

[1] The practice of interest has also been condemned by foremost thinkers in human history (Muhammad Anwar 1987) and by some religions such as Judaism and Christianity (Iqbal and Molyneux 2005).

banking window, is a *shariah* compliant banking operation, undertaken by conventional banks but financially separated from the conventional banking operation. In addition, Islamic banking represents the operation of both Islamic banks and IBS. Finally, Islamic financial services refer to financial services offered by both banking and non-banking financial institutions which comply with *shariah*.

2.4 ORIGIN OF ISLAMIC BANKING

In the 1890s, the first branch of a commercial bank established in the Muslim countries was Barclays Bank in Cairo (IFSB 2007b). This had invited the first critique on bank interest and then spread to the Arab region and Indian sub-continent (IFSB 2007b). In the 1930s-1950s, Islamic economists initiated discussion on the prohibition of interest and attempted to propose an alternative in the form of *mudharaba* (profit-sharing) before offering a theoretical model of Islamic banking and finance. The applications of this model have started with the setting-up of the *Mitghamr* Saving Association in Egypt during 1963-1967 (Iqbal and Molyneux 2005) and a saving institution in Malaysia for Muslims who wish to perform pilgrimage in Mecca known as *Tabung Haji* in 1962 (IFSB 2007b). Many Islamic banks were then established following the set-up of the Nasser Social Bank in Egypt and Dubai Islamic bank in UAE in 1971 and 1975 respectively (Iqbal and Molyneux 2005) followed by the Kuwait Finance House in 1977 and Bahrain Islamic Bank in 1978 (IFSB 2007b). The banks have employed *shariah* compliant services including trade financing with European banks in importing goods from Europe (Wilson 2007). While more Islamic banks started to operate in 1980s, countries like Iran, Sudan and Pakistan expressed their intention to transform their whole financial systems into systems that comply with *shariah* (Iqbal and Molyneux 2005).

During the period, some governors and monetary authorities of countries involved have called for strengthening regulations and supervision of Islamic banks. While research institutions and the International Monetary Fund (IMF) have produced articles and working papers on Islamic banking, non-banking Islamic financial institutions emerged to support the existing Islamic banks in the middle of the 1980s. While conventional banks and large international entities started to operate Islamic banking window in the 1990s, Dow Jones and Financial Times Islamic Indices were also launched.

Besides public policy interest in some countries, systemic concerns, rules, supervision and risk management related to Islamic banking were rising issues (IFSB 2007b).

2.5 ISLAMIC BANKING: MODES OF OPERATION

A variety of Islamic banking models have been proposed and adopted. As mentioned in Khan and Mirakhor (1990), generally the operation of a typical Islamic banking model has the following features:

2.5.1 Sources of funds

The sources of funds for the banks are deposits, capital and equity. Deposits can be divided into transaction deposits or investment deposits which are respectively equivalent to current and fixed deposit accounts in conventional banking. In the former, banks act as the safe-keeper which promises the nominal value of the transaction deposits but does not guarantee returns on this liability and is known as *wadiah*. In the latter, depositors are not guaranteed nominal value nor paid with a fixed return. Instead, depositors are considered as shareholders, hence share profits or losses from the investment account with the bank. In addition, the proportion of the profits or the loss to be distributed is pre-determined and agreed by both parties. The ratio of this *mudharaba* transaction is also fixed throughout the contract unless with mutual agreement. However, Islamic bank depositors are not entitled to share the profit and losses of banks because the customers are not buying equity capital of the banks, unlike in investment companies (Karim 2001). Furthermore, the majority of Islamic banks mixes their investment accounts' funds with shareholders' funds and invest them under the bank's management in the same investment portfolio which subsequently reports these investments in the balance sheet and income statement. In addition, Islamic banks apply the *mudharaba* contract for their shareholders' funds (Karim 2001).

2.5.2 Asset Acquisition

The banks can acquire assets through two equity principles modes of transactions, namely *mudharaba* and *musharaka* (profit-and-loss sharing). Under *mudharaba*, the bank (which acts as investor) allows the customer (as entrepreneur) to use the funds for running an agreed project. The profit from the project is spread according to the pre-determined

ratio. If the project is unsuccessful, the investor bears all the losses (if not due to the negligence of the entrepreneur). On the other hand, the entrepreneur loses his or her time, as well as effort because human capital and financial capital are treated in par in the Islamic economy. However, the entrepreneur is liable if the losses are due to his negligence. Finally, it is common to apply the *mudharaba* principle on short- to medium-term investment projects (Khan and Mirakhor 1990).

In the second equity principle, which is *musharaka*, both bank and customer invest their funds on an agreed ratio into a project, and jointly manage it. Profit from the project is distributed according to an agreed pre-determined ratio but if the project is unsuccessful, the loss is distributed according to the ratio of their financial capital contribution (Aggarwal and Yousef 2000). Furthermore, this principle is frequently applied to long-term investment projects. Both equity principles discussed above are regarded as the essence of Islamic banking which fosters entrepreneurship, promoting new business and fosters private investment activities (IFSB 2007b).

Other modes of financing can be applied to transactions where the above principles are not applicable such as *murabaha* (cost-plus financing), *ijarah* (leasing), and *qardh* (benevolent) loan. With *murabaha*, the bank buys a particular good and resells it to the customer at a pre-determined price that covers the original price plus a negotiated profit margin. In addition, the customer may delay the payment to the bank; lump sum or by installment. Furthermore, the bank keeps the ownership of the product until all payments are made by the customer. Under *ijarah*, the bank lets the customer use a particular product with a pre-determined charge and for a specific period of time. In addition, the customer may also opt to own the asset at the end of the lease period. Thus, besides the lease sum, the payment includes the final acquisition and the ownership hand over of the product. However, both *murabaha* and *ijarah* has been critiqued by some Islamic banking scholars as debt-like financing. On the other hand, *qardh* loan is granted to those in need with zero rate of return and the customer may have to pay an administrative fee and repay the principal amount.

The list of the modes of financing is not restricted to the above as the choice of contract under *shariah* gives flexibility to parties involved to exploit various forms of transactions and instruments. Furthermore, there is no limit to create any contractual form

as long as it does not have the element of interest and each party involved in the deal is fully informed of the details (Khan & Mirakhor, 1990).

2.6 DEVELOPMENT OF ISLAMIC BANKING

According to the existing interpretation of *shariah*, Islamic banks are expected to emphasize on equity principles such as the *mudharaba* and *musharaka* principles rather than debt-like principles such as *murabaha* and *ijarah*. It is the *mudharaba* and *musharaka* principles that make Islamic banking distinct from conventional banks. In acquiring funds, the Islamic bank usually applies the equity principle particularly in investment accounts. However, in practice most financing provided by Islamic banks is not dominated by equity principles, due to factors such as agency problems,[2] but use much in the form of debt-like instruments (Aggarwal and Yousef 2000). In addition, Muhammad Anwar (2000) noted that *murabaha* financing is the most utilized among other modes of financing although the proportion between debt-like and equity financing instruments vary among banks and countries.

The existence of differences in the operation of Islamic banking between countries is partly attributed to differences in the approach of regulating Islamic banks and differences in the interpretation of the *shariah* related to financial transactions by different schools of Islamic jurisprudence. Given Islamic banking was only formalised in recent times, governments in which Islamic banks operate have different approaches of setting-up the regulatory frameworks. Karim (2001) has categorized these countries into three; the first group of countries (e.g., Malaysia, Iran, Turkey Sudan, and Yemen) has enacted Islamic banking law, the second group (e.g., Bahrain, Saudi Arabia, Jordan, Egypt, Qatar) has not enacted any law related to Islamic banking, instead Islamic banks operate under laws which focus on commercial banking that govern all banks in the country and the final group (e.g., Lebanon) has not enacted Islamic banking law but is governed by their fiduciary law[3].

The lack of common understanding on unique characteristic of Islamic banking has led to different regulatory approaches taken by regulatory bodies in different countries. For example, depending on under which act Islamic banks are regulated in their

[2] Conflict of interests between the bank and the customer such as the latter put less effort into the project.
[3] Islamic bank holds a trust to act for the customer's benefit within the prescribed scope.

countries by the regulatory authorities, different treatments are given to investment account. In the first group of countries, Islamic banks report investment accounts under liability as conventional banks do but the second group of countries report it as an off-balance sheet item[4] and the third group of countries report this account as equity (Karim 2001). Therefore, legal frameworks of countries in which Islamic banks operate influence the financial reporting method if not the operation.

An appropriate legal framework is necessary for a sound financial system. Similar to the conventional law system, commerce related Islamic law provides its own framework for the implementation of the Islamic financial contract. Nevertheless, the existing laws in most countries, are not appropriate for the enforcement of Islamic banking contracts (IFSB 2007b). Besides banking law, other related laws such as property law need to be modified in order to have a good framework for Islamic financial contracts similar to conventional contracts (IFSB 2007b). For example, an asset-based financing contract in Islamic banking in most countries currently requires two stamp duties, that when the lender buys the asset and when the bank sells it to the customer, as compared to only one stamp duty payment in conventional banking which leads to higher costs in Islamic banking (FSA 2002).[5] Furthermore, in the absence of Islamic banking law, Islamic banking agreements require extra costs and efforts in order to enforce them in court under conventional banking limits.

Besides the regulatory framework, different supportive Islamic non-banking institutions exist in different countries. For example, Malaysia has *shariah* compliant stock-broking companies, *takaful* (insurance) and unit trust institutions but Jordan does not have such comprehensive non-banking institutions operating parallel to the conventional system. Appropriate regulatory framework, good supervisory and comprehensive supporting financial institutions may help Islamic banking operate competitively with conventional banking.

Furthermore, a secondary market for Islamic financial instruments in most countries is lacking hence, Islamic financial institutions tend to face higher risk of excess liquidity (e.g., Hassan 1999; Al-Hallaq 2005). Maintaining minimum prescribed level of

[4] Off-balance sheet items are items which are neither assets nor liabilities of banks, and are not in the balance sheet.

[5] However, in some countries (e.g., United Kingdom and Singapore) the double stamp duties on some Islamic banking products has been abolished (IFSB 2007b).

liquidity is a regulatory requirement to safeguard the depositors especially for contingency purposes. However, retaining high level of liquidity will put banks in a disadvantaged position for not having the chance of gaining returns, which might affect bank competitiveness. Unlike *shariah* compliant securities, treasury bills and repos which are frequently used by conventional banks to manage the liquidity are widely traded in the secondary market. Therefore, Bahrain has established an Islamic inter-bank financial market (IIFM) in order to encourage cross-border trading of *shariah* compatible products. This non-profit international organization which was established in 2002 aims to develop an active secondary market and produce guidelines for market participants in issuing instruments and standardising of documentations for secondary market trading. The main products of IIFM are *shariah* endorsement of existing and new Islamic financial products offered by various institutions including Islamic financial institutions as well as conventional banks with Islamic bank subsidiaries and windows. With this *shariah* endorsement, the IIFM aims to achieve uniformed Islamic products and instruments in order to have global spread and recognition (Iqbal and Molyneux 2005).

Non-uniformity in *shariah* interpretations of certain banking issues exist attributed to different interpretations by different schools of Islamic jurisprudence. It is however, important to mention that while synchronization of procedures and documentations are emphasized in regulating Islamic banking, diversity of *shariah* opinions are protected in Islamic legal history hence, remains a characteristic of the market (KPMG 2007). Therefore, divergence in *shariah* opinions prevails among countries and especially regions.

Differences in the interpretations have not only affected the operation of banks including the products and services offered, but also influenced bank financial reporting. Therefore, some Islamic banks and interested parties have privately established an organization for the purpose of preparing and propagating accounting, auditing, and governance standards based on *shariah* on Islamic financial institutions, called the Accounting and Auditing Organization for Islamic Financial Institution (AAOIFI). In order to put this standard into practice, it extensively involves the collaboration of national bank regulators in countries where these institutions operate. Despite this effort, different accounting frameworks have been adopted by Islamic banks besides AAOIFI, such as the International Financial Reporting Standard (IFRS), which is adopted by many

international financial institutions, local central bank guidelines and the combination of these three frameworks (KPMG 2007).

In addition to the previously mentioned organisations in synchronising the operation of Islamic financial institutions, the International Financial Standard Board (IFSB) has been set up to encourage and improve the reliability and stability of the Islamic financial services industry by delivering universal prudential standards and guiding principles for the industry, generally defined to include sectors such as banking, capital markets and insurance sectors. The IFSB, whose members are regulatory authorities, Islamic financial institutions from different countries, the IMF, World Bank and Islamic Development Bank (IDB) was established in 2002. As the characteristics of Islamic financial institutions' assets are often different from the conventional banks, the IFSB has issued two standards; Guiding Principles of Risk Management and Capital Adequacy Standard (CAS) guidance on requirements for minimum capital adequacy in 2005 to cover for risks of Islamic financial institutions.[6] Furthermore, it has released prudential regulations on corporate governance to be adopted by various countries operating Islamic banking and drafts on transparency and the supervisory review process (IFSB 2007a).

Market discipline is important in order to have a stable and efficient financial system hence the financial strength of an institution is of concern to the rating agency. However, even if the Islamic financial institutions are financially strong, not complying with *shariah* can seriously lead to systemic instability. In order to cater for this need, in 2002 an International Islamic Rating Agency (IIRA) was incorporated in Bahrain with the aim to examine the *shariah* aspect of financial institutions and their products to give a higher degree of confidence and acceptability among players in the industry (Iqbal and Molyneux 2005).

Bank customers and bankers may get confused with Islamic banking which is a relatively new way of banking compared to conventional banking. Therefore, a non-profit organisation based in Bahrain called the General Council for Islamic Banks and Financial Institutions (GCIBFI) was set-up to increase the understanding of Islamic banking by

[6] Currently the international standard that bank regulators adopt when creating regulations on the amount of capital to protect from risk is Basel II. However, Islamic banks claimed that the calculations put them in a disadvantaged position because they have different risk requirements. Therefore Islamic banks are working to develop a different capital adequacy standard but at the same time maintain prudential banking (IFSB 2007a).

hosting conferences and seminars. Membership is open to any registered Islamic banks and financial institutions from all over the world. In addition, the GCIBFI acts as a resource for its members by providing technical assistance, training and conferences (Iqbal and Molyneux 2005).

Iqbal and Molyneux (2005) noted that in 2002, there were 69 Islamic banks and the GCIBFI reported that there are 284 Islamic financial institutions operating in 38 countries managing USD200 billion excluding Islamic window operations in 2005 (IFSB 2007b). Furthermore, Islamic window operation only was estimated to manage about USD250 billion in 2005 (IFSB 2007b). Based on these figures and given only two banks which were initially established in Egypt and Dubai respectively by 1975, Islamic banking has grown rapidly. Besides Sudan and Iran, Islamic banks are concentrated in Gulf Cooperation Countries (GCC), South and South-East Asia and other Middle East countries. While Arab countries constitute about 60 percent of the shares in the number of banks, the GCC which is part of the Arab countries, accounts for 85 percent of Islamic banks' assets (Iqbal and Molyneux 2005). In addition, two major international holding companies, Dar al-Mal al-Islami and Al-Baraka control the bulk of Islamic banks and finance companies (Iqbal and Molyneux 2005). Some of them operate outside the Middle East and are owned by Middle Eastern people (Iqbal and Molyneux 2005).

Western countries, which had Islamic financial services offered by only foreign entities have now both foreign and local *shariah* compliant banking institutions. In the United Kingdom, besides the Islamic Bank of Britain serving the local retail market and the European Islamic Investment Bank, which are authorised to operate Islamic banking, starting in 2004 (FSA 2006) and 2006 (Wilson 2007) respectively, leading conventional banks serving the local retail market such as HSBC and Lloyds TSB have also offered *shariah* compliant deposits and financing facilities (Wilson 2007). Irrespective of the rapid growth of Islamic banking however, trained Islamic bankers are lacking in the industry and this affects all regions because the supply of qualified Islamic bankers has not kept pace with the growth of the industry. Islamic bankers need to be well versed in both conventional and Islamic banking particularly if they work in a mixed environment such as in Malaysia. Unlike conventional banks which hold assets in a fixed interest instrument, Islamic banks' financed assets such as a share in a joint venture are difficult to value hence the need for experienced accountants to value the assets (Karim 2001). In

reaction to the scarce supply of Islamic bankers, the Central Bank of Malaysia (BNM) has set-up an International Centre for Education in Islamic Finance (INCEF) with the objective to provide expertise to the industry internationally and the Bahrain Central Bank with the cooperation of some Islamic financial institutions has set up an Islamic Finance Education Scheme in 2006 (KPMG 2007).

In summary, despite a number of successes, Islamic banking faces many challenges including the lack of emphasis on equity principles (*mudharaba* and *musharaka*), the standardization of financial reporting, good regulatory framework and supervisory standards, regulatory capital, *shariah* interpretations convergence and human capital. Moral hazard problems have hindered further growth of *mudharaba* and *musharaka* despite its potential as an alternative for debt-like financing. In addition, an incomprehensive Islamic financial system either due to the absence of dedicated Islamic banking law or supportive non-banking financial institutions such as *shariah* compliant money market and *takaful,* has adversely affected the operation of Islamic banks. For a country to operate Islamic banking, a sound Islamic banking regulatory and good supervisory framework, as well as comprehensive Islamic financial institutions are needed, to be integrated into the existing system. Due to the different operational nature of Islamic banks from conventional banks, differences in the involved risks require different regulatory capital. Hence, standardizing financial reporting is important to measure the regulatory capital and facilitate risk management of Islamic banks. Furthermore, problems resulting from differences in *shariah* interpretations need to be addressed. Besides the above challenges, trained Islamic bankers need to be increased in order to keep pace with the fast growing industry.

As the main focus of the thesis is on the Malaysian commercial banks, the following section will provide some background on the financial system in Malaysia, including the structure of the Malaysian financial system, the development of Islamic banking in Malaysia, as well as the trend and changes in the system.

2.7 BACKGROUND OF THE MALAYSIAN FINANCIAL SYSTEM

2.7.1 Structure of the Malaysian financial system

The Malaysian financial system includes both financial institutions and financial markets. Financial institutions can generally be divided into banking system and non-bank financial intermediaries. The banking system is further made up of monetary and non-monetary institutions (see Table 2.1). The former is referred as the institutions whose principal liabilities are accepted as money, which are the BNM, the sole issuer of currency in the country, and the commercial banks (including the Islamic banks), the only institutions allowed to operate current accounts and authorised to deal in foreign exchange. The banking system also covers the representative offices of foreign banks and the offshore banks in the International Offshore Financial Centre in Labuan, East Malaysia. The Central Bank is responsible for the regulation and supervision of the banking system except for offshore banks operating in Labuan as these banks are regulated by the Labuan Offshore Financial Services Authority. Finally, commercial banks are the largest component of the financial system, accounting for 50 to 70 percent of the total banking assets.

The non-monetary institutions consist of finance companies, merchant banks and discount houses whose liabilities are generally accepted as near money (Central Bank of Malaysia 1999a). However, finance companies which have decreasing shares in the banking system overtime started to merge with commercial banks in 2003 and the exercise was completed in 2006. These activities are reflected in the decreasing amount of finance companies' assets from MYR142.0 billion (2003) to MYR68.4 billion (2004) and MYR26.9 billion (2005), and the upsurge of commercial banks' assets during the period.

Table 2.1
Assets of Malaysian banking institutions (MYR, billion)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Monetary institutions													
Central Bank of Malaysia	92.8	88.5	96.7	109.0	125.0	147.0	149.0	150.0	162.0	200.8	284.9	295.0	323.8
Commercial banks [a]	243.0	296.0	362.0	486.0	459.0	483.0	514.0	530.0	563.0	629.6	737.1	842.0	1,025.3
Non-monetary institutions													
Finance companies	73.5	91.9	120.0	152.0	124.0	116.0	109.0	122.0	131.0	142.0	68.4	26.9	[b]
Merchant banks	23.6	27.1	34.1	44.3	39.2	39.2	36.9	41.1	41.3	44.1	42.2	46.6	60.3
Discount houses	9.4	12.8	17.2	21.0	20.0	18.6	21.1	23.8	27.4	30.2	31.9	26.0	[c]
Total	442.0	516.0	630.0	812.0	767.0	804.0	830.0	866.0	925.0	1,046.7	1,189.9	1,280.8	[c]

Notes:
[a] Include Islamic banks
[b] Finance companies started to merge with commercial banks in 2003 and completed in 2006.
[c] not available
Source:
Central Bank of Malaysia Annual Report (Various issues); The Central Bank and The Financial System in Malaysia: A decade of Change 1989-1999 (1999).

Table 2.2 demonstrates that the commercial banks which can be foreign-owned or domestic-owned have generally decreased in number overtime from 37 in 1994 to 24 in 2003 despite increasing assets and market shares in the banking system due to merger of mainly domestic banks as shown in Table 2.1. The BNM encouraged financial institutions to merge with the objectives to increase the capital base of the banking group in order to have better risk management, more resilience, reduce costs and increase competitiveness of domestic financial institutions (Ariff, et al., 2001).[7] The 1997-1998 Asian financial crisis has given the BNM the opportunity to accelerate the consolidation process and in 1999, the BNM announced the plan to reduce the number of domestic financial institutions from 58 (21 commercial banks[8], 25 finance companies, 12 merchant banks) to 6 banking groups, with each group including a commercial bank. The merger programme was completed by 2003 with 10 domestic banking groups rather than the 6 groups previously aimed at by the BNM (Central Bank of Malaysia 2003).

These mergers have resulted in the shrinking of the number of domestic-owned banks from 23 to 10 hence, the number of domestic conventional banks with the IBS from 19 to 9 in 1994 and 2003, respectively (see Table 2.2). However, the number of foreign-owned banks including those with the IBS remains almost unchanged. Therefore, the share of foreign-owned banks in terms of the number of banks in the total banking system has increased from less than 40 percent in 1994 to about 50 percent in 2006.

While the IBS is provided by 80 to 91 percent of domestic banks over 1994-2003, about 30 percent of foreign-owned banks have been offering the IBS. There was initially one full-fledged Islamic bank in 1983 before another Islamic bank was set-up in 1999. This was further expanded to 11 with the establishment of 3 foreign-owned Islamic banks and the conversion of 8 IBS domestic-owned conventional banks into Islamic bank subsidiaries in 2006. The conversion of the IBS into full-fledged Islamic bank subsidiaries has resulted in the increased number of total banks from 25 in 2004 to 33 in

[7] Danamodal was established in 1998 to capitalise weak but viable banking institutions by injecting funds. In line with improved economy in 2000 and a merger programme for domestic banking institutions, some banking institutions had repaid their loans to Danamodal. Being the major shareholder in those banking institutions, Danamodal played an active role in leading the merger negotiations and wound-down its operation at the end of 2003 (Ariff, et al., 2001).

[8] By end 1999, the number has fell to 20 as in Table 2.2.

Table 2.2
Number of Malaysian Commercial Banks, 1994-2006

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Foreign banks	*14*	*14*	*14*	*13*	*13*	*13*	*14*	*14*	*13*	*13*	*14*	*15*	*16*
Conventional banks with IBS [a]	2	3	4	4	4	4	4	4	4	4	4	4	4
Conventional banks without IBS	12	11	10	9	9	9	10	10	9	9	10	9	9
Islamic banks [b]	-	-	-	-	-	-	-	-	-	-	-	2	3
Domestic banks	*23*	*23*	*23*	*22*	*22*	*20*	*17*	*11*	*11*	*10*	*11*	*14*	*17*
Conventional banks with IBS	19	20	21	20	21	18	16	10	10	9	8	7	2
Conventional banks without IBS	4	3	2	2	1	2	1	1	1	1	1	3	6
Islamic banks	1	1	1	1	1	2	2	2	2	2	2	4	8
Total banks	*37*	*37*	*37*	*35*	*35*	*33*	*31*	*25*	*24*	*23*	*25*	*29*	*33*

Notes:
[a] IBS, Islamic Banking Scheme
[b] Foreign-owned Islamic banks start operation in 2005
Source:
Central Bank of Malaysia Monthly Statistical Bulletin (Various issues); Annual Reports (Various issues).

2006 and raised the number of conventional banks without IBS from only one in 2004 to 6 in 2006.

Approximately, four domestic-owned banks have 50 percent or more of government shares directly or indirectly through government investment holding arms and agencies namely *Khazanah Nasional Berhad*, *Amanah Raya Berhad*, Employees Provident Funds and *Permodalan Nasional Berhad* in each year at least from 1996 to 2002.

2.7.2 Islamic banking development in Malaysia

A major development in the Malaysian banking system was the introduction of Islamic banking. The first Islamic bank, *Bank Islam Malaysia Berhad* (BIMB) was established in 1983. Similar to other licensed banks, BNM was vested with powers under separate legislation called the Islamic Banking Act 1983 (IBA)[9] to supervise Islamic banks. As in the IBA, the Islamic bank carries out normal banking business as other commercial banks do but along with the principles of *shariah*. The Islamic bank also offers deposit-taking products and financing facilities. Deposit-taking products are current deposits and savings deposits under the concept of *wadiah* and *mudharaba*, respectively. Financing facilities are working capital financing under *murabahah*, house financing through *bai' bithaman ajil* (deferred payment sale), leasing under *ijarah*, and project financing under the concept of *musharaka*. Based on the IBA, an Islamic bank must establish a *shariah* advisory body to assist the bank on any *shariah* operational and related issues (Central Bank of Malaysia 1999a, 1999b). Furthermore, it has to adhere to similar regulations as the conventional banks such as maintaining a statutory reserve account with the central bank. BIMB's initial paid-up capital of MYR79.9 million in 1983 was subsequently increased to MYR563 million in 2000 to support the asset growth (Bank Islam Malaysia Berhad 2003).

The long term objective of BNM is to have a comprehensive Islamic banking system operating side by side but separately from conventional banking hence this raised the need to increase the number of Islamic banks. Moreover, being the only Islamic bank in the country, the BIMB was not able to fulfill the needs of the population to provide

[9] Under this act, an Islamic bank is allowed to operate based on equity participation such as *musharaka*, which is similar to the activity of merchant banks and debt-like financing such as *murabaha* and *ijarah*, which are similar to the activities of commercial banks.

Islamic banking services due to limited resources such as the number of branches and employees (Central Bank of Malaysia 1999b).

In order to achieve the mentioned objective with minimum costs and shortest time as well as reaching a wider population, the BNM has introduced the IBS in 1993. Banking institutions were then allowed to offer Islamic banking products with specific guidelines through the IBS, which started with 3 commercial banks before expanding to other commercial banks, finance companies and merchant banks. Irrespective of the voluntary participations in the IBS, banking institutions must comply to the requirements of the scheme such as to have an Islamic Banking Unit (IBU) headed by an experienced Muslim banker, to appoint a *shariah* consultant for advice on daily operations, to create an Islamic Banking Fund (IBF) with minimum allocation of MYR1 million, to have a current account for Islamic banking operations with the BNM, to observe separate cheque clearing systems for Islamic banking and to have a separate general ledger for Islamic banking operations. These requirements are to ensure that the Islamic banking operation is financially separated from the conventional banking operation.

The Islamic money market was set-up in January 1994 mainly to facilitate the Islamic financial institutions to adjust their portfolios in the short-term. It involves the trading of Islamic financial instruments, profit-sharing inter-bank investments and the Islamic cheque clearing system (ICCS). With this Islamic money market, Islamic and IBS banks can trade in their Islamic financial instruments such as Islamic bonds and Islamic Accepted bills among themselves and the surplus IBS or Islamic banks may invest in the deficit IBS or Islamic banks (Central Bank of Malaysia 1999b).

In order to increase the number of Islamic banking market players further and as part of the financial restructuring in Malaysia, the IBS assets of 2 conventional banks (*Bank Bumiputra Malaysia Berhad* and *Bank of Commerce*) and a finance company (*BBMB Kewangan Berhad*) have been merged to form a new Islamic bank (*Bank Muamalat Malaysia Berhad).* This second Islamic bank commenced its operation on 1st October 1999 with paid-up capital of MYR300 million (Central Bank of Malaysia 1999b).

Since the establishment of the first Islamic bank in 1983 and having a full-fledged Islamic banking system operating side by side with the conventional banking system, Malaysia now has a comprehensive Islamic financial landscape encompassing the Islamic banking system, non-bank Islamic financial intermediaries and Islamic financial markets.

The non-bank Islamic financial intermediaries are comprised of *takaful* companies, savings institutions, development financial institutions and other financial intermediaries that offer banking services such as the housing credit institutions. One of the co-operative credit institutions, *Bank Rakyat* starting in 1993 accepts deposits and provides financing facilities to its members through nationwide branches based on the Islamic principles. Moreover, some of the development finance institutions offer Islamic banking services on a window basis, namely *Bank Industri, Bank Pembangunan dan Infrastruktur Malaysia* and the Agriculture Bank of Malaysia, which are recipients of IDB financing facilities. Finally, the government treasury housing loan division provides a house financing facility to civil servants based on the Islamic principles since 1996 (Central Bank of Malaysia 1999a).

Focusing on the Islamic capital market which is supervised by the Securities Commission, it comprises of the primary market and the secondary market. While the former offers new issues of Government Islamic securities and Islamic corporate securities, the latter trades the existing papers and securities. Within the Government Islamic securities market, two instruments are available; Government Investment Issues (GIIs) and the Islamic principle Malaysian Savings Bonds. Under the Government Investment Act 1983, the government is allowed to issue government papers based on the *qardh* principle to the public. As GIIs is considered as a liquid asset, Islamic and IBS banks can purchase GIIs to meet their liquidity requirement and to temporarily park their idle funds. On the other hand, the Malaysian Savings bond was initially issued to provide the retirees a reasonable return on investment during the economic slowdown in 1999 (Central Bank of Malaysia 1999a).

Finally, the Islamic corporate securities market is comprised of the Islamic debt securities market and Islamic equity market. While the former includes medium-term Islamic bonds and short-term Islamic commercial papers, the latter is a group of organizations that are involved in Islamic stock-broking including Islamic unit trusts and permissible counters in the Kuala Lumpur Stock Exchange issued by the Securities Commission (Central Bank of Malaysia 1999a) (The development of Islamic banking in Malaysia will be discussed further in section 4.1).

2.7.3 Trend and changes in the Malaysian banking system

As shown in Table 2.3, the Malaysian economy was growing at 10 percent in 1996, before the Asian financial crisis. The crisis had resulted in Gross Domestic Products (GDP) to fall by 7.4 in 1998. After the crisis, the growth rate has improved to 6.1 percent and 8.3 percent in 1999 and 2000, respectively. However, global economic slow down in 2001 resulted in weak external demand for Malaysian export products which produced a growth rate of 0.3 percent. Nevertheless, the economic growth has improved to 4 to 7 percent after 2001. Economic situations have directly and indirectly affected the ability of borrowers to repay their loans, of which the trend in the NPL-to-loans by bank size and year can be seen in Table 2.4 (Ministry of Finance Malaysia 2001).

Table 2.3
Malaysian real Gross Domestic Product (GDP) growth rate, %

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Real GDP Growth Rate	9.8	10.0	7.3	-7.4	6.1	8.3	0.3	4.1	5.3	7.1	5.2	5.8

Source:
Economic Report Malaysia (Various issues)

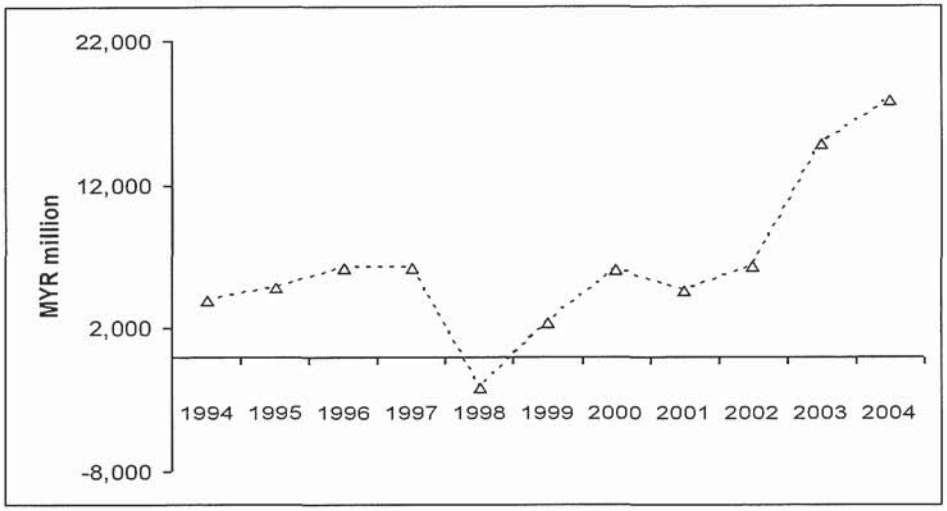
Table 2.4
Malaysian banks NPL/ loans by bank size, %

Assets Range (MYR '000 millions)	1996	1997	1998	1999	2000	2001	2002
0.53 - 5.14	4.10	7.67	14.53	25.29	22.06	16.61	15.60
5.15 - 10.64	3.49	5.67	17.31	17.14	23.10	22.21	24.00
10.65 - 20.16	3.80	5.00	12.45	13.55	10.98	16.02	19.31
20.17 -114.76	1.12	5.11	12.03	12.63	11.20	14.85	10.84

Source:
BankScope database and author's calculations.

Figure 2.1 demonstrates the trend in pre-tax profit of Malaysian conventional commercial banks including the IBS. Some commercial banks experienced lower profit and even losses during the Asian financial crisis which resulted in overall pre-tax loss of MYR2.2 billion for the conventional banks in 1998. Banks recorded high profit after the financial crisis but this declined slightly in 2001 due to the unfavourable economic condition.

Figure 2.1
Pre-Tax Profit: Malaysian Commercial Banks (MYR million)



Source:
Central Bank of Malaysia Annual Report (Various issues)

Focussing on innovations among Malaysian banks, the innovative capability relates to the Malaysian banking experience on several product developments such as the use of the Automated Teller Machine (ATM), the widespread use of internet banking and ATM, traditional products evolved into more sophisticated ones, and banking products combined with other products within a financial group. Figure 2.2 has shown that the ATM network increases drastically especially after the financial crisis and the number of branches remain almost unchanged at about 1,500 despite bank mergers over 1997-2002.

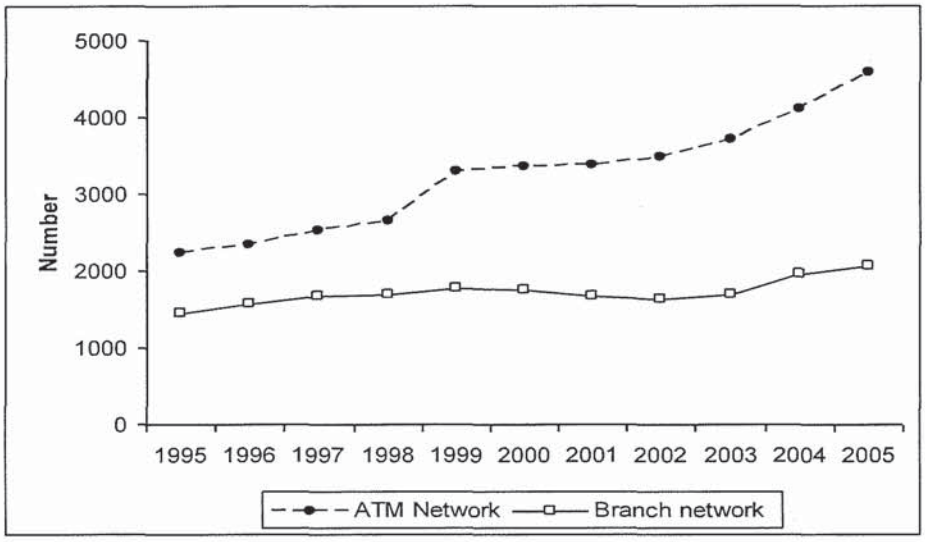
From only 10 percent of domestic commercial banks offering internet services in 2000, it increased to 32 percent in the following year and reached 50 percent in 2002[10]. Furthermore, almost 90 percent of domestic commercial banks offered internet banking in 2006 (Central Bank of Malaysia 2006) as compared to 75 percent in 2001 (Central Bank of Malaysia 2003). Foreign banks were also allowed to provide such services starting in 2002 (Central Bank of Malaysia 2003).

The financial crisis has brought about an important transformation in banks' activities. In particular, the quality of Malaysian banks' lending activities began to deteriorate from 1997 and onwards which can be seen through the increasing trend of non-performing loans (NPLs)-to-loan ratio during the period. The increase is obvious over 1997-1998 but slightly declined in mid 1999 following the sales of commercial bank's

[10] These figures exclude full-fledged Islamic banks.

loans to Danaharta[11] (Central Bank of Malaysia 1999a). Moreover, as the economic growth was stronger over 1999-2000, borrowers were able to repay their loans which were delayed due to high interest rates and slow economic growth during the financial crisis. In addition, selected NPLs were restructured by the Corporate Debt Restructuring Committee (CDRC)[12] and were exempted from NPL classification.

Figure 2.2
Automated teller machine and office networks of Malaysian commercial banks [a]



Notes:
[a] Excluding Islamic banks
Source:
Central Bank of Malaysia Annual Report (Various issues)

However, unfavourable economic condition and the slow global economy in 2001 had a negative effect on the ability of companies and borrowers paying back their loans. Danaharta has also completed acquiring NPLs from the financial sector and exemption for NPL classification discontinued in 2001. These have resulted in high NPLs in 2001 and 2002 (Central Bank of Malaysia 2001, 2002). Table 2.4 reports the ratio of NPLs-to-loans

[11] Danaharta which has unwound in 2005 was set-up to purchase NPLs from banking institution over 1998-2001 to ensure that NPLs of the banking system are under control and to reduce the burden of banking institutions in managing NPLs (Central Bank of Malaysia 1999a).
[12] CDRC is a facilitator in bringing creditors and debtors to the negotiating table in sorting out an agreeable and workable loan restructuring exercise. Some cases have been transferred to Danaharta. For certain industries, besides financial restructuring, CDRC also facilitates corporate restructuring such as changing the management of the companies and the sale of non-core assets of borrower (Ariff, et al., 2001). It ceased operation in August 2002.

for different sizes of banks. Generally, large-sized banks have a lower NPLs-to-loans ratio.

Table 2.5 shows bank equity-to-assets ratio by banks' size. While very small banks have the highest equity-to-assets ratio, other bank size categories have almost similar composition of equity-to-assets.

Table 2.5
Malaysian banks equity/ total assets by bank size, %

Assets Range (MYR '000 million)	1996	1997	1998	1999	2000	2001	2002
0.53 - 5.14	10.48	11.24	12.92	12.04	12.81	15.82	18.92
5.15 - 10.64	8.62	9.33	9.75	9.28	8.20	7.73	6.70
10.65 - 20.16	8.27	8.75	8.49	9.50	8.29	8.43	8.43
20.17 -114.76	7.42	7.59	0.90	7.81	8.27	8.01	8.65

Source:
Bank Scope database and author's calculations.

Besides Malaysia, the thesis also employs data of banks from other countries namely, Sudan, Bangladesh, Tunisia, Jordan, Lebanon, Yemen, Indonesia, Bahrain and Iran. Therefore, the following section will provide a brief socio-economic background of these countries although not exhaustive, with the objective to give ideas on the existence of diversity among them.

2.8 SOCIO-ECONOMIC BACKGROUND OF SELECTED COUNTRIES OPERATING ISLAMIC BANKING

2.8.1 Sudan

Agriculture is the main activity of the Sudanese economy but only 12 percent of this largest country in Africa is agricultural land. Therefore, the economic condition is vulnerable to climate condition and primary commodity market (Hussein 2004). The first Islamic bank in Sudan, Faisal Islamic bank was established in 1977. At the end of 1970s, the economy was in a difficult situation and there was political instability including deteriorating infrastructure, drought, famine, income and resource disparity between districts, and continuous civil war. These problems contributed to high default cases in bank financing (Saaid, Rosly, Ibrahim, and Abdullah 2003). Later in 1983, a decision was

made to transform the banking system into Islamic banking which is regulated by the Central Bank of Sudan (Hussein 2004). Since then, many Islamic banks including foreign-owned banks started to operate in Sudan.

The early 1980s was still characterised by political and environmental crisis. During the downfall of the government 1985-1989, many traditional banks reverted back to interest-based banking. Drought, government policy failures, high foreign debt and trade deficit, and devaluation of local currency have impacted on the banking system. Furthermore, the economy continued to deteriorate because of high inflation and government directive measure to finance priority sectors (Bashir 1999). Although the whole economy was transformed into being *shariah* compliant in 1989, only by 1992 was the operation of the whole financial sector compliant to *shariah* (Hussein 2004). Hence, banks were governed by Islamic banking law and each bank is required to have a *shariah* committee besides *shariah* board at central bank level. In complying with local regulations, multinational banks also operate Islamic banking. However, most shares in the banking market are controlled by the government (Hussein 2004). Iqbal and Molyneux (2005) noted that it is not very clear whether Sudan complies with the Basel standards of capital adequacy. Moreover, the Sudanese bank capital adequacy ratio is always below the international standard (Hussein 2004).

Irrespective of previously mentioned problems, the Sudanese government has engaged in economic reforms. Besides removing taxes on agricultural products, banks were directed to allocate 50 percent of the financing to the agricultural sector. As a result, the agricultural production as a percentage of GDP has increased from 28.7 percent in 1990 to 46.4 percent in 2000 (Hussein 2004).

However, both saving and investment, as well as their contributions to the GDP were very low. Demand deposits have dominated the total deposits of Sudanese banks, which suggest the failure of banks to provide instruments suitable with potential depositors, individual preference of instant cash on hands, or that depositors have lost confidence in the banking institutions. The higher inflation compared to the profit rates received from the deposits may have diverted customers to invest in real estate (Hussein 2004). While the low financing is possibly due to high costs of borrowing for customers and less access of opportunities from abroad, the low banking profit is possibly due to low

efficiency in asset management, high NPL, low labour productivity, absence of good governance, small bank size and slow access to the latest technology (Hussein 2004).

Moreover, banks have been found to over-utilise their capital by expanding the operation through new branches, although not profitable. This may possibly be due to their inabilities to get new technologies such as ATMs as a result of economic sanctions imposed by the United States of America (USA) and United Nations, hence they are unable to train their personnel with new technology skills and export their agricultural products (Saaid, et al. 2003). However, banks continue to increase in size and maintain considerable profits (Saaid, et al. 2003).

2.8.2 Bangladesh

Since independence in 1971, Bangladesh has been seen to move from a highly interventionist regime to substantially liberalised economic regime. In the 1990s, the Central Bank of Bangladesh has made radical changes to regulate and monitor the banking and insurance sectors by adopting several policies such as monetary, fiscal, bank rate and human resource based on the Company Act 1991. The financial sector that contributes 9 percent of the GDP consists of nationalised commercial banks, government-owned specialised banks, domestic banks, foreign-owned banks and non-bank financial institutions, insurance companies, stock exchange and co-operative banks. In addition, more than 50 percent of the number of banks are private-owned (Ahmad 2007). Besides the reduced gap between deposits and loan rates, the banks have introduced new technologies such as internet banking and ATMs (Ahmad 2007), hence the good performance of financial sector has led to structural transformation in the economy in such a way that the economy which was previously dominated by the agriculture sector has now shifted to services sector. Moreover, compared to after independence in 1970s, the contribution of the industry sector to the economy has doubled to 20 percent and the share of the agricultural sector has shrunk to almost 30 percent in 1990 (Ahmad 2007).

Islamic banking was introduced in 1983 with the establishment of Islami Bank Bangladesh Limited and by 1999 about 5 Islamic banks had been set-up, most of which started operation in 1995 (Hamid 1999). However, due to lack of dedicated law in Islamic banking, all disputes related to Islamic banking transactions have recourse to interest-based law. Furthermore, the lack of *shariah* compliant government securities and non-

existence of a money market for the Islamic bank to hold their liquid funds has led Islamic banks to have surplus funds and difficultly in managing their liquidities (Hassan 1999).

2.8.3 Tunisia

The commercial banking system in Tunisia began to restructure in 1987 in order to increase competition, mobilise savings and allocate resources more efficiently. The reforms have been done through liberalising interest rates, credit allocation, new indirect monetary policy, strengthening prudential regulation and opening the financial sector to foreign investors (Naceur 2003). However, labour input in Tunisian banks has been found to be more inefficiently used relative to capital, over 1980-1992 (Chaffai 1997). Amendments to the banking law have been introduced in 1993 and 1994 in order to fully integrate the development bank into the banking system hence, become a direct competitor to the commercial bank, as well as to improve prudential regulations (Cook, Hababou, and Liang 2005).

Private-owned banks are increasingly dominating commercial banks after the government privatised some of the banking assets although development banks are still largely owned by the public (IMF 1998; Grais and Kantur 2002). In addition, the government in its Economic Development Plan (1997-2001) has given priority to modernise the payment system as well as customer information, improve the regulatory framework, and strengthen the capital base of banks because most banks are small in size (IMF 1998). Irrespective of the above efforts, the compliance of Tunisian banks to Basel capital adequacy is still not clear (Iqbal and Molyneux 2005) and only one foreign-owned Islamic bank has been in operation (Reille and Lyman 2005) although European banks have been allowed to open branches in Tunisia since 2001 (Cook, et al. 2005).

2.8.4 Jordan

Unlike Arab countries which are mostly oil-based, the Jordanian economy is well diversified, which is reflected by the contribution of the services sector and finance, real estate and business to the GDP of 72 percent and 21 percent, respectively as of 2001. The economic crisis of devaluation in the Jordanian Dinar and the country's huge debt in 1988-1989, lead to an IMF stabilisation program which was aimed to boost the state revenues by reducing state expenditures through various measures such as privatisation,

new taxes and lifting state subsidies. Despite interruptions during the Gulf war in 1991, this government-dominated economy has slowly been restructured by privatising some of its key state enterprises (Isik, Gunduz, and Omran 2005).

On the other hand, the banking sector grew very fast from 1979s to early 1990s because the government aimed to have a banking-driven economy (Saleh and Zeitun 2006). In being cautious during the rapid banking sector expansion, bank regulations were improved including the increase in minimum capital requirements in the 1980s (Saleh and Zeitun 2006). Furthermore, the authorities have taken several steps to further improve the sector such as adopting new securities and banking laws over 1999-2002 (Saleh and Zeitun 2006).

Focussing on Islamic banking, the first Islamic bank in Jordan was established in 1979 and was known as the Jordan Islamic Bank for Finance and Investment (JIB). The growth of total assets, deposits and financing were extremely high during the initial period of operation because individuals who previously kept their money outside the formal banking sector to avoid interest have placed their money in this bank (Al-Hallaq 2005). However, the Islamic bank faced problems in managing its liquidity because it cannot utilise the central bank's lender of last resort which does not comply with *shariah*. Hence, the Islamic bank holds high liquidity to deal with unforeseen needs and confines most financing to short and medium terms (Al-Hallaq 2005). In addition, the lack of variety in financial instruments such as bonds as well as customers taking advantage of no penalty for late payment are among the problems faced by the Islamic banks.

Irrespective of the above obstacles, it managed to record growth and success which invited another Islamic bank, The International Arab Islamic bank to become a real competitor to JIB starting in 1996 (Al-Hallaq 2005). This country which operates a dual banking system had 14 commercial banks, 8 foreign banks, 2 Islamic banks and 4 specialised credit institutions by the end of 2004 (Saleh and Zeitun 2006). In addition, the Islamic banks which are regulated by the Central bank of Jordan have a dedicated Islamic banking law and are required to set-up a *shariah* committee as well as adopt international accounting standards.

2.8.5 Lebanon

The Lebanese currency is exchangeable freely with other currencies and similar to most countries, banks operating in the country are subject to secrecy law which prevents the employees disclosing information of the clients to another party. Starting in 1994, all revenues and interest earned on all types of accounts opened in Lebanese banks are exempted from income tax (Banque Du Liban 2007). It is also noted that most banks in Lebanon are privately-owned (Grais and Kantur 2002).

With regard to Islamic banking, the country initially acted as host to a subsidiary of the foreign Islamic bank and allowed an Islamic banking window to operate under existing regulations which was initially aimed for conventional banks (Banque Du Liban 2007). Several applications to set-up Islamic banks were at first pending because the Central bank of Lebanon took some time to consider several laws relating to Islamic banking (Banque Du Liban 2007). Only in 2004, a law to regulate Islamic banking transactions was passed which allowed Islamic banks to undertake commercial and investment activities without being subject to limitations as in traditional banks (Banque Du Liban 2007; Meouchi, Rizkallah, Badri, and Meouchi 2007). Since then, a series of guidelines on specific Islamic banking transactions have been released (Banque Du Liban 2007).

2.8.6 Yemen

The banks are regulated by the Central Bank of Yemen and its Yemeni Rial exchange rate has been floating freely since 1996, hence foreigners are free to bring any amount of foreign currency (Central Bank of Yemen 2007). The Yemeni banking sector is comprised of commercial banks, specialised banks and Islamic banks. While commercial banks are mainly private-owned, the rest of the banks are state-owned specialised banks with the aim to develop certain sectors.

The main features of the financial system are short term deposit and loan contracts, as well as loans concentration in certain sectors or regions. Furthermore, the activities of financial intermediaries in the country are influenced by uncertainty faced by market participants on the future of the country's economic development, limited investment opportunities offered by the public sector and the small scale industry, as well as the lack of confidence in the local legal institutions (Breitschopf 1999). Moreover, the population

relies more on the micro or small-enterprise sector and informal financial market which is due to their cultural traditions and social habits (Breitschopf 1999).

On the other hand, the downside of the banking sector are high NPL and its provisions, weak prudential supervision, limited bank investment opportunities, low equity and low savings rates. It is worth mentioning that the civil war between the north and south regions which started in 1994 was due to two different political and economic systems that were unified in 1990 (Breitschopf 1999).

With regard to Islamic banking, Yemen has introduced a dedicated Islamic banking law which specifies that Islamic banks may perform both banking and investment business (Karim 2001). Following that, the central bank is considering having a separate supervisory department for Islamic banks under its supervision (Iqbal and Molyneux 2005). As the country practises a dual banking system, the main policies are applicable to both conventional and Islamic banks (Karim 2001).

2.8.7 Indonesia

Some form of Islamic non-bank financial institutions have been operating before the legal foundation for Islamic banking was formally passed in 1992 which reflects the need for such a form of banking by the society. Therefore, 78 Islamic rural banks and one Islamic commercial bank have been in operation since 1998. A new act was later passed to allow for the central bank to operate based on *shariah* (Central Bank of Indonesia 2002). Besides at bank level, a *shariah* committee exists at national level to standardise the *shariah* interpretations on banking (Grais and Pellegrini 2006). During the Asian financial crisis, the NPLs of Islamic banks were much lower and improved faster than conventional banks, and the loan-to-deposits ratio for the former were also higher (Central Bank of Indonesia 2002). This may indicate that Islamic banking, which do not rely on interest rates, managed to face economic fluctuations better than conventional banks (Central Bank of Indonesia 2002).

By 2001, there was one additional Islamic commercial bank which was transformed from a conventional bank, 3 Islamic banking windows and 3 Islamic rural banks (Central Bank of Indonesia 2002). However, Islamic banking accounts for only 0.26 percent of the assets of the total banking system although the asset growth rate of Islamic banks increased by 74 percent over 1998-2001 (Central Bank of Indonesia 2002).

The central bank has the expectation that Islamic banking in Indonesia will grow further hence, has set out objectives of having a sound, prudent and efficient *shariah* banking system that applies equity-based financing in order to benefit society (Central Bank of Indonesia 2002).

2.8.8 Bahrain

Most bank financings in Bahrain are in personal, trade, manufacturing and construction sectors. The first Islamic bank in Bahrain, the Bahrain Islamic bank was established in 1979 and since then, the industry has been growing rapidly. Bahrain has become a country with the highest number of Islamic banks not only in the Middle East but also in the world (Iqbal and Molyneux 2005). Since 1992, all Bahraini banks are required to adopt International Accounting Standard (IAS) and starting from 1997, they are expected to comply with Accounting and Auditing Organization for Islamic Financial Institution (AAOIFI) and need to be published in addition to the audited financial statements. On the other hand, foreign banks are required to either comply with United Kingdom (UK) or USA Generally Accepted Accounting Principles (GAAP) or to comply with IAS (M. Islam 2003).

In 2000, the Central bank of Bahrain, Bahrain Monetary Agency has set a comprehensive prudential set of regulations, which includes capital adequacy, asset quality, management of investment accounts, corporate governance and liquidity management in ensuring Islamic financial institutions have comparable standards to conventional banks. This regulatory framework has attracted confidence among the investors and customers of Islamic banking in Bahrain, hence the industry enjoys sustainable growth, product innovation and an expanding market (Iqbal and Molyneux 2005).

2.8.9 Iran

The transformation of the banking system into a *shariah* compliant system in Iran has been done in three phases. In the first phase (1979-1982), efforts were made towards nationalisation, restructure, and reorganisation of the banking system. The second phase (1982-1986) saw adoption of legislative and administrative steps in which Islamic banking law had been passed in August 1983. While banks were given a year to transform their

deposits into being *shariah* compliant, the total banks' operations were allowed to take up to 3 years. The final phase (1986-current) defines the role of Islamic banking as part of the government instruments for policies in social and economic development, as a result of various political debates within the country.

Furthermore, banking policies were designed to restructure the economy which has heavily relied on services and consumption sectors into a production based economy (Hassan 2003). This has been done by reducing the credit to services sector, but increasing the financing in the agricultural sector in order to improve production, creating incentives for the cooperative sector in agriculture, industry and trade, and financing large industrial projects in partnership with government (Hassan 2003). In addition, in compliance with local regulations, multinational banks operate based on *shariah* principles (Hussein 2004).

2.9 CONCLUSIONS

The chapter has shown the existence of diversity in Islamic banking and in the financial sector of countries which have Islamic banking in operation. Although Islamic banking has generally similar features across countries, the implementation and the practice in terms of modes of operation, *shariah* interpretations, regulatory and accounting frameworks are different. In minimising the differences, several international organisations have been set-up such as AAOIFI, the International Islamic Rating Agency (IIRA) and Inter-Bank Financial Market (IIFM). In addition, the IIFM provides opportunities for international market players to channel their surplus funds through the *shariah* compliant secondary market as well as standardise the Islamic financial products. Certain organisations have also moved forward to reduce the gaps in human capital for Islamic banks, and promote understanding of Islamic banking among bankers and customers. Furthermore, countries which operate Islamic banking range from less developed to developed economies and they have both different socio-economic and political backgrounds. While most countries are lacking in terms of support for Islamic banking, certain countries such as Malaysia have a supportive legal structure and non-bank financial institutions for both conventional and Islamic banking.

CHAPTER 3
LITERATURE REVIEW ON CONVENTIONAL AND ISLAMIC BANK EFFICIENCY, AND PRODUCTIVITY

3.1 INTRODUCTION

This chapter starts with the review of studies on performance of Islamic banks and its comparison with conventional banks ranging from financial ratios to more sophisticated techniques. Furthermore, it defines efficiency, stochastic frontier analysis (SFA) and returns to scale, discusses the applications of costs and output distance functions on single country studies as well as the treatment of how environmental conditions are employed in measuring bank efficiency in both single and cross-country studies. It further discusses total factor productivity (TFP) change and reviews techniques to decompose productivity change, particularly the Malmquist Productivity Index. The chapter ends with the discussion on the approaches to define bank output.

3.2 THE MEASUREMENT OF ISLAMIC BANKING PERFORMANCE

Methods used in the literature on Islamic banking performance range from financial ratios which are based on certain financial indicators, to more advanced techniques such as Data Envelopment Analysis (DEA) and SFA. The studies which will be reviewed are divided into Islamic banking performance relative to conventional banks, performance of the IBS to conventional banks, performance of fully-fledged Islamic banks relative to the IBS and performance within Islamic banks across countries (Please refer to

Appendix I for summary of selected Islamic and conventional bank comparative efficiency studies).

3.2.1 The Islamic and Conventional Bank: Performance Measurement using Financial Ratios, Regression, SFA, DEA and Productivity

Performance of full-fledged Islamic banks relative to conventional banks has been studied using financial ratios, linear regression, DEA and SFA. This section will discuss the studies based on the mentioned techniques including returns to scale and productivity.

3.2.1.1 Financial ratios

Using financial ratios, their relative performance varies according to the measured financial indicators. Samad (2004) found that on average, 6 Islamic banks in Bahrain are doing as well as their 15 conventional counterparts in terms of profitability and liquidity, and even exhibit better credit performance, using financial ratios after the Gulf War over 1991-2001. Moreover, Islamic banks were found to be exposed less to liquidity risks due to high liquidity as a result of restricted *shariah* compliant investment opportunities, have short term loans and investments as well as more conservative in lending.

Likewise, employing financial ratio, Samad and Hassan (1999) discovered that the pioneer Malaysian Islamic bank was more liquid and less risky than 8 conventional banks over the period 1984-1997. They found the Islamic bank to face less risk because of high equity-to-asset ratio and greater investment in government securities. However, they did not find any statistically significant difference in managerial performance, as measured by both Return on Asset (ROA) and Return on Equity (ROE). The profitability performance of the Malaysian Islamic bank was found to be significantly lower than conventional banks because of smaller opportunity set for the Islamic bank in stocks and securities due to religious constraints.

Hassan and Bashir (2003) also found Islamic banks to perform better in terms of asset quality and capital adequacy but are less liquid compared to conventional banks[1]. Using financial ratio, the author compared Islamic banks in 21 countries with

[1] Each aspect of assets quality, capital, operations and liquidity is measured by various ratios.

conventional banks in the same countries with similar deposits and total assets for the period 1994-2001.

Similarly, Iqbal (2001) found that Islamic banks do not suffer from excess liquidity but are not cost effective (cost to income ratio). The author compared 12 private Islamic banks from various countries with conventional banks from the same countries using financial ratios and concluded that Islamic banks comparatively have higher growth rate in terms of equity, deposits, investment and total assets, better use of resources and have higher profitability in terms of Return on Investment and ROE.

In another study, Hamid (1999) evaluated an Islamic bank with two conventional private banks in Bangladesh using financial ratios. Islamic banks were found to perform better in terms of profitability, liquidity and overall productivity (total income to total expenditure). However, they generate less income per unit of personnel expenditure as well as suffered from excess liquidity due to lack of *shariah* compliancy in the Central Bank's investment opportunities. Moreover, as the Islamic banks are relatively new and hire experienced bankers from the conventional banks, they incur higher cost of labour. On the contrary, Nienhaus (1988) who compared 7 Islamic banks from 4 countries in the Middle East, Bahrain, Egypt, Jordan and Kuwait with 26 conventional banks from the same countries using financial ratio over the period 1980-1986 found that generally Islamic banks are equally, if not less performed than the conventional banks in terms of total assets, profit and capital although they can be operational and profitable.

3.2.1.2 Regression Analysis

Using regression analysis and in contrast to the above findings, Metwally (1997) found that there is no significant difference between Islamic banks and conventional banks in terms of their profitability and efficiency. The author evaluated the performance of 15 conventional banks and 15 Islamic banks from all over the world for the period of 1992-1994 by testing for structural difference between the two groups. Differences in efficiency (operating expense to assets ratio), profitability (income to assets ratio) and credit risks (loans directed for financing durable) are not statistically significant between the two groups. However, Islamic banks have higher cash to deposits ratio, face more

difficulties in attracting deposits, tend to be more conservative in utilising funds for lending and are disadvantaged in terms of investment opportunities compared to the conventional banks.

Using linear regression technique also, Hassoune (2002) found that ROE of Islamic banks are less volatile compared to conventional banks because the latter relies on the interest rate fluctuations. The author compared an Islamic bank to six conventional banks in Saudi Arabia that have a similar balance sheet structure over the period 1994-2001. In addition, Islamic banks' profitability (ROE) is found to be higher than conventional banks when extending the sample to Qatar, Saudi Arabia and Kuwait over 2000-2001.[2]

3.2.1.3 Stochastic Frontier Analysis and Data Envelopment Analysis

Employing more sophisticated techniques of SFA, Islamic banks are found to be the most cost and profit efficient compared to conventional commercial and investment banks in GCC countries namely Bahrain, Saudi Arabia, Kuwait, Oman, Qatar and The United Arab Emirates (UAE) (Alshammari 2003). This was also found in studies on Bahrain, Egyptian, Jordanian, and Saudi Arabian banks (Al-Jarrah and Molyneux 2005). Controlling for loan quality and capital in both cost and profit functions, Alshammari (2003) modelled bank types and country dummy to directly influence inefficiency. Moreover, the author found Bahraini banks to be the most cost efficient and Oman to be the least efficient. Similarly, Al-Jarrah and Molyneux (2005) also found that Bahraini banks are the most efficient in both cost and profit functions by geographic location. They have modelled for bank types, country dummy, assets, liquidity, concentration ratio, and market share to directly influence inefficiency but no environmental variables are assumed to influence the cost frontier. However, when using profit function, loan quality, capital and time are assumed to directly influence the frontier.

Using the same dataset, while El-Gamal and Inanoglu (2005) employed cost function to measure efficiency, Alpay and Hassan (2006) apply DEA to measure the efficiency of Turkish banks. Both studies agreed that on average, Islamic banks are equally, if not more efficient relative to conventional banks despite limited *shariah*

[2] No information on the number of samples provided.

compliant investment opportunities. However, unlike conventional banks, productivity and technical efficiency of Islamic banks decrease over time.

On the other hand, Mokhtar, et al. (2006) found no significant difference between Islamic banks and finance companies or merchant banks using cost function and between Islamic banks and all conventional banking institutions using profit function. This Malaysian banking study however, does not assume any environmental factors to neither influence the function nor modelling it to directly influence the inefficiency.

3.2.1.4 Economies of Scale and Productivity

Concentrating on economies of scale, differences between Islamic banks, conventional commercial banks and merchant banks were found to have no effect on scale (Alshammari 2003). In addition, the productivity growth and technical change of Turkish Islamic banks fell although they improved in efficiency over 1990-2000 using the non-parametric Malmquist Productivity Index, which is in contrast to the conventional counterparts (Alpay and Hassan 2006).

In conclusion, using financial ratios and regression techniques, mixed results are found in the relative performance of Islamic to conventional banks. Furthermore, by employing more sophisticated techniques such as DEA and SFA, Islamic banks are found to be equally (Abdul-Majid, Mohammed Nor, and Said 2005; Mokhtar, et al. 2006) if not more (Alshammari 2003; Al-Jarrah and Molyneux 2005) efficient to conventional banks. Although bank output quality and equity capital have been controlled for in certain studies (Alshammari 2003; Al-Jarrah and Molyneux 2005), none of these studies have controlled for differences in operating characteristics particularly *shariah* compliant banking, in the frontier estimation hence, the location of the frontier. This implies that the studies have assumed Islamic banks to have the same technology with conventional counterparts. In addition, only Al-Jarrah and Molyneux (2005) and Alshammari (2003) have assumed that *shariah* compliant banking have directly influenced inefficiency. Furthermore, there have been a relatively limited number of studies on Malaysia, and in particular no studies have used SFA to evaluate efficiency and productivity differences between Islamic banks, conventional banks with IBS, and fully conventional banks.

Malaysian banking studies in chapter 4 and 5 of the thesis will therefore, investigate relative efficiency of Islamic to conventional banks in both; when differences

in operating environment influence frontier estimation, and when operating environments directly influence inefficiency. On the other hand, cross-country research in chapter 6 will examine the relative efficiency of Islamic to conventional banks assuming differences in the operating environment influence the frontier. In view of the mixed results in the relative performance of Islamic to conventional banks and the limited studies that have employed sophisticated techniques, the thesis will employ SFA to investigate these issues further in Malaysia and in a wider sample involving 10 countries that have Islamic banking in operation.

3.2.2 The IBS and Conventional Bank Performance: Financial Ratio and SFA Approaches

Relative to conventional banks, the IBS has higher profitability measured through ROA but lower asset utilization and investment margin ratio over the period 1996-1999 in Malaysia (Rosly and Bakar 2003). The relatively higher ROA may be the result of IBS using existing overheads such as computer systems, security systems and ATMs maintained by its conventional parent bank. On the other hand, employing SFA through both cost and profit functions over 1997-2003 on Malaysian banks, Mokhtar, et al. (2006) found that conventional parent banks are more efficient than the IBS for domestic-owned banks but vice versa for foreign-owned banks.

In view of IBS operation sharing the same non-financial resources with its conventional parent bank, the thesis in chapter 4 and 5 will improve the model specification by including a dummy for conventional banks that operate IBS and conventional banks that do not have IBS operation instead of comparing IBS directly with conventional banks.

3.2.3 The Full-fledged Islamic Bank and IBS Performance: Financial Ratio, DEA and SFA Approaches

Performance comparison between the IBS from 9 conventional banks and a full-fledged Islamic bank over 1996-1999 in Malaysia using financial ratios found that the former performs better in terms of capital structure, assets, deposit structure and profitability (Hamid, S. A. and Ahmad 2002). The authors also discovered that IBS makes more money per Malaysian Ringgit (MYR) invested compared to the full-fledged

Islamic bank. Moreover, despite IBS remarkable growth during the financial crisis, the profitability of the full-fledged Islamic bank was badly affected. They also found that this pioneer Islamic bank was not fully utilising its resources to generate more income towards strengthening shareholder's funds. Likewise, Batchelor and Wadud (2004) found that the technical efficiency scores of 13 Malaysian IBS improved more compared to two Islamic banks employing DEA on 1997-2002 data.

In contrast to the general IBS favourable performance, Mokhtar, et al. (2006) who employ SFA using both cost and profit functions over 1997-2003 found that the IBS is less efficient than the fully-fledged Islamic bank and the IBS of foreign-owned bank is more efficient than the IBS of domestic counterpart.

In order to avoid model misspecification in terms of IBS sharing non-financial resources with its parent's bank, the performance evaluation of conventional banks with IBS relative to full-fledged Islamic banks will include a dummy variable assigned for the former. The investigation of the relative efficiency of Islamic to conventional banks will therefore take into account the operation of conventional banks with IBS window, fully-fledged Islamic banks and conventional banks without IBS window.

3.2.4 The Cross-country Studies of Islamic Banks Performance: DEA and SFA Approaches

Using DEA and by geographic location, the Iranian bank on average is consistently found to be among the most cost efficient relative to other banks in most countries which operate Islamic banking when both, country differences are controlled for (Brown and Skully 2003) and country differences are not controlled for (Brown 2003; Brown and Skully 2003). In the latter model, Brown (2003) estimated efficiency of Islamic banks from 14 countries over 1998-2000 and discovered that Iran, Yemen and Brunei to be consistently the most efficient markets whilst Indonesia and Sudan are the least cost efficient market. On the other hand, controlling for country differences, Brown and Skully (2003) estimated the efficiency of 33 Islamic banks from 19 countries in 2000 using two models in which each model has different input and output specifications and a different dataset. In the model where labour and capital are treated as the inputs, the authors found that Brunei, Iranian, Malaysian, Yemeni, Tunisian and UAE banks are fully efficient and in another model where labour, capital and equity are the inputs, they found

Egyptian, Gambian, Iranian, Brunei and Kuwaiti banks are fully efficient. Please refer to Appendix II for a summary on selected cross-country studies of Islamic bank efficiency and productivity.

Yudistira (2004) estimated a common frontier of 18 Islamic banks from 12 countries using DEA over 1997-2000 and found average inefficiency estimate of 10 percent and diseconomies of scale in small-sized and medium-sized banks. In addition, the Middle Eastern countries are found to be the least efficient market compared to other regions (Yudistira 2004; Hassan 2005).

Hassan (2003) who measured efficiency and decomposed productivity change of Pakistani, Sudanese and Iranian (Islamic) banks over 1994-2001 concluded that banks in these countries could improve their efficiency by better use of technology. By employing SFA in a common frontier, banks are found to have higher cost efficiency (52 percent) rather profit efficiency (34 percents) and banks with larger size and high profitability are generally found to be more efficient. In addition, the productivity change of Islamic banks in these countries is driven by technical change through penetration into various markets, introducing new market and capturing market shares despite productivity loss. However, this study does not control for country-specific factors.

In another study, Hassan (2005) measures productivity and efficiency of Islamic banks from 22 countries using both DEA and SFA, and the latter through costs and profit functions. The author found that Islamic banks are less efficient in containing costs (74 percent) compared to generating profit (84 percent). Furthermore, the DEA result suggests that banks could have improved their efficiency by managing their inputs rather than using technology. The second stage of regression in which DEA efficiency score, being the dependent variable, suggests that the higher the efficiency, the larger the bank size and the higher the profitability. In addition, moderate productivity growth which has been found in Islamic banks is mainly driven by technical change.

In conclusion, a very limited cross-country study on Islamic bank efficiency has employed SFA and none of them has controlled for country-specific factors. The cross-country research in chapter 6 will improve the methodology by employing SFA and control for country-specific factors measuring not only efficiency of Islamic banks but also comparing them with conventional banks using a common frontier. While previous

studies proved that efficiency improved with size and profitability (Hassan 2003, 2005), they have also discovered that diseconomies of scale are associated with small and medium size banks (Yudistira 2004). Chapter 6 of the thesis will investigate the economies of scale of Islamic banks in different countries and further compare them with conventional banks. The limited studies on Islamic bank productivity found that the growth has been driven by the technical change but they have employed only the non-parametric Malmquist Productivity Index. While most Islamic banks experience moderate growth (Hassan 2005), banks in Pakistan, Sudan and Iran experience productivity loss (Hassan 2003). Moreover, none of the studies has measured productivity change of Islamic to conventional banks. Chapter 4 and 5 of the thesis will therefore, employ a parametric generalised Malmquist index to measure productivity change of Islamic and conventional banks in Malaysia and investigate their determinants.

3.3 EFFICIENCY

This section will review literature related to the concept of efficiency measurement, SFA, returns to scale and environmental factors. Bank performance can be measured through efficiency and productivity (productivity will be discussed further in section 3.5). Both measurements managed to inform interested parties such as bank managers on the different aspects of bank performance as well as to inform governments for policy purposes. The increased competition in the banking industry particularly between Islamic and conventional banks, domestic and foreign banks as well as between banks and non-banks require them to be efficient. The concept of efficiency is important in the thesis because it allows the comparison of performance particularly between Islamic and conventional banks.

Efficient banks will be able to increase profitability, intermediate more funds, offer better prices and service quality as well as enhance bank soundness and safety if efficiency improves capital buffer to absorb risks (Berger, Allen N., Hunter, and Timme 1993). In efforts to improve bank efficiency, certain countries such as Malaysia have encouraged domestic banks to merge, the number of foreign-owned to increase and public-owned shares in banks to be reduced. The study of the effect from these changes on efficiency which will be analysed in the thesis managed to give some directions to both bank managers and policy makers in managing bank performance.

The concept of efficiency measurement has two components namely technical and allocative inefficiencies (Farrell 1957). A firm is technically inefficient if it utilised more of each input than should be needed in order to produce a given level of output or; if it produced less of each output than maximum possible given input, with the specified technology (Fare and Primont 1995; Kwan and Eisenbeis 1996). The optimal value for a technically efficient firm is not related to any behavioural objectives of a firm such as cost minimisation, revenue or profit maximisation. In contrast, allocative efficiency measure is the comparison of observed mix of inputs or outputs with optimal mix that would minimise costs, maximise profit or obtain any other behavioural objective (Kwan and Eisenbeis 1996).

As it is not possible to decompose individual residual into efficiency and random variation, the estimation of inefficiency by observation is unfeasible but Jondrow, Lovell, Materov, and Schmidt (1982) has suggested a technique to estimate firm inefficiency for each firm in the sample based on the mean of conditional distribution. Therefore, inefficiency estimate is relative to the best firm in the sample and any additional firm may reduce the estimate. Furthermore, inefficiency is usually assumed to be drawn from an asymmetric half-normal distribution (e.g., Maudos and de Guevara 2007) although it may also assume other shapes of distribution such as gamma and exponential distributions (Berger, Allen N. and Humphrey 1997). Half-normal inefficiency distribution assumes most firms are clustered near full efficiency. In addition, it is important to mention that in estimating efficiency, panel data has several advantages over cross-sectional data such as tracking of firm efficiencies through a series of time periods (Coelli, Rao, and Battese 1998). The present thesis assumes inefficiency is drawn from an asymmetric half-normal distribution and employs panel data.

In bank efficiency analysis, banks are assumed to have the same production technology hence differences between banks are in their managerial ability. Under parametric model, the shape of production frontier is assumed to be characterised by an explicit functional form such as cost or profit function.[3] [4] Furthermore, efficient

[3] Examples of parametric model are SFA, distribution-free approach (DFA) and thick frontier analysis (TFA).

[4] Non-parametric model which include DEA does not specify any functional form but interpolate linearly between certain data points. The best-practice bank is located on this frontier and other banks are relatively inefficient.

production frontier can be estimated from the sample data and banks with superior managerial ability known as the best-practice bank is located on this frontier. Therefore, the discrepancy between the "optimal" level of input and output of a production firm which lie on the production frontier and its observed level is the estimated efficiency.

Finally, production frontier can be generalised into deterministic or stochastic. Error term in deterministic frontier is comprised of only inefficiency and given input level, deterministic frontier assumes exact maximum possible output (e.g., English, Grosskopf, Hayes, and Yaisawarng 1993; Iqbal, Z., Ramaswamy, and Akhigbe 1999). On the other hand, error term in the stochastic frontier contains random (statistical) noise and inefficiency components, and given input level, stochastic frontier assumes random maximum output.

3.3.1 Stochastic Frontier Analysis (SFA)

The thesis employs SFA, an econometric frontier approach which was independently developed by Aigner, *et al.*, (1977) and Meeusen and Broeck (1977) followed by Battese and Corra (1977). The efficiency measures assume that the function of fully efficient firm is known. However, as the functions are practically unknown, it has to be estimated from sample data by fitting a function that minimises variations in the observations. Being a parametric stochastic approach, SFA imposes particular functional form for this best-practice frontier such as cost or profit, and allows error term with two components; the random error term and the inefficiency term. It modifies standard (such as cost and profit) function to include inefficiency in error term although it is predicted that the standard function to characterise the frontier. Therefore, SFA varies with probability of distribution assumed for inefficiencies to disentangle inefficiency from random error and functional form imposed on the frontier. The detail models which will be employed in the thesis is explained in methodology section 4.3, 5.3 and 6.3.

Error term is stochastic in nature as it captures measurement error as well as other random factors including misspecification of input variables and luck. In addition, random error is drawn from a symmetric normal distribution (Berger, Allen N. and Humphrey 1997). On the other hand, the inefficiency term is deterministic as it contains a non-negative random variable which measures managerial inefficiency.

As residuals capture random error and inefficiency which is essential in efficiency measurement, the functional form for production technology needs to be carefully chosen in order to minimise specification error. One typical specification for the frontier is based upon translog function (e.g., Bonin, Hasan, and Wachtel 2005; Fries and Taci 2005; Maudos and de Guevara 2007). As in the case of cost function, translog allows for the elasticity of scale to vary with output which is suitable in representing the activity of financial institutions (Forestieri 1993). However, as noted by some studies (Berger, Allen N., et al. 1993; Freixas and Rochet 1997) translog function is not free from weaknesses such as needs a large sample due to the large number of parameters involved, and not being flexible enough for firms with increasing returns to scale up to a certain level and constant returns thereafter (Berger, Allen N., et al. 1993).

A frontier specification which has been employed to solve problems arising from the standard translog function is Fourier flexible function (Spong, Sullivan, and DeYoung 1995) which has been employed by several studies (e.g., Berger, Allen N. and Mester 2003; Williams, Jonathan and Nguyen 2005). Nevertheless, this function has limitations such as facing problems for heterogeneous data sets and requires a larger sample due to higher number of parameters to be estimated (Altunbas, Y. and Chakravarty 2001). Bos and Kool (2006) noted that despite Fourier flexible function is more flexible than standard translog function, the difference in results between the two functions is negligible. Furthermore, Berger, Allen N. and Mester (1997) observed that the average inefficiency estimates using standard translog and Fourier-flexible functional forms are almost similar. The thesis will therefore, employ translog function.

The efficiency measurement can be input-oriented or output-oriented. The former compares the observed inputs level with the minimum input that could produce the observed output level and producers are assumed fully capable of allocating resources when improving efficiency, while outputs are assumed exogenous. Examples of functional form for input-oriented measure are input-oriented parametric distance function and cost function. Cost function is defined as a function that depicts the minimum cost to generate certain output given input prices and technology (Lovell and Schmidt 1988) and it has frequently been employed in bank efficiency studies (e.g., Berger, Allen N., et al. 1993; Berger, Allen N. and Mester 1997; Altunbas, Yener, Carbo, Gardener, and Molyneux 2007).

On the other hand, an output-oriented efficiency measure compares the observed output level with the maximum output that could be produced for given input level and assumes that producers are fully capable of adjusting production mix when improving efficiency whereas inputs are assumed exogenous. The examples of functional form which can be employed in output-oriented efficiency measure are the output-oriented parametric distance function (e.g., Coelli and Perelman 1999; 2000; Orea 2002; Li, Hu, and Chiu. 2004) and profit function.

Distance function can be estimated without price information and without having to assume any behavioural objectives of the firm. A growing number of banking studies has employed distance function in estimating bank efficiency (e.g., Cuesta and Orea 2002; Li, et al. 2004; Rezitis 2007), but none of them has been applied to Islamic banking. This thesis will employ both translog cost and translog output distance functions. This is consistent with the suggestion proposed by Bauer, Berger, Ferrier, and Humprey (1998) of not to have a single best argued frontier because different approaches with consistent results are useful for regulatory purposes. Details on the cost and output distance functions including the production technology will be explained in the methodological section 4.3 and 5.3 respectively.

3.3.2 Returns to Scale

One of the features for production technology is returns to scale. Returns to scale refer to the rate at which output change as the quantity of all factors varies by the same or different proportion (Molyneux, Altunbas, and Gardener 1996). Thus, production technology can be defined as constant returns to scale (CRS), increasing returns to scale (IRS) or decreasing returns to scale (DRS). IRS or economies of scale occur when rises in the costs of the total input, result in greater than proportional increase in output (Hunter and Timme 1986). This concept is also based on the average cost curve in which some of the factors of production are fixed in the short run and all factors of production vary in the long run (Koutsoyiannis 1979). The average costs of producing a product in the long run, holding all other factors constant, decline as banks get bigger in size or more output is being produced (Molyneux, et al. 1996).

The interest in returns to scale enables banks to identify potential savings that they have if they change the operation scale. Bank costs decline when outputs are increased up

to the optimal scale (Kasman 2005) however, the economies of scale do not continue indefinitely as the increase in size above the optimal scale of operation increase the costs and reduce the revenue. Therefore, banks have to produce at the optimal scale or constant returns to scale in order to have the lowest achievable average costs in which any changes in output will change the costs proportionately. The thesis will examine the economies of scale or returns to scale of the banks in the sample.

3.3.3 Environmental Factors in the Parametric Bank Efficiency Model

In measuring the efficiency of a firm, whether environmental factors such as mergers, Islamic banks, foreign banks, economic conditions and country-specific factors influence the operating environment of firms or directly influence efficiency, is an issue (Coelli, Perelman, and Romano 1999). While some studies assume environmental factors to affect the firm directly (e.g., Kasman 2005), others believe that they directly influence inefficiency through the inefficiency effects model (e.g., Al-Jarrah and Molyneux 2005). In addition, certain studies presume that environmental factors influence both location of the frontier and directly influence inefficiency (e.g., Rezitis 2007). The review of literature below will particularly focus on this issue.

This section will thus, focus on the environmental factors in reviewing both single- and cross-country studies. As the thesis will employ both costs and output distance functions, the review on single-country studies will focus on both functions. On the other hand, the review for cross-country studies will not be limited to the above two functions due to the limited number of studies. Furthermore, it is important to mention that these studies vary based on procedures adopted to estimate inefficiency; whether "two-steps" or "one-step". In both procedures, the studies assume certain environmental factors to influence frontier estimation and/ or directly influence inefficiency.

As inefficiency differs among firms and over time, it is in the interest of the researchers to study the determinants of its variation which generally follow either of these two procedures. In the first, the "two-steps" procedure estimates firm-level inefficiencies in the first stage through frontier estimation [5] and further regresses the estimated inefficiencies against explanatory variables as an independent step in a second stage, in an

[5] In this first stage of estimating frontier, technical efficiency is assumed to be independently and identically distributed.

attempt to identify some of the reasons in estimated efficiencies difference between firms[6] (Kumbhakar and Lovell 2000). Nevertheless, this "two-steps" approach has been recognised to have several anomalies such as possible correlated structures of the random errors in the frontier with the inefficiency effects model (Coelli, et al. 1998). The "one-step" procedure can therefore solve the problem by estimating the frontier and directly incorporating the explanatory variables into the inefficiency component in which the mean of inefficiency distribution is assumed to be a function of explanatory variables (Battese, G.E. and Coelli 1995; Williams, J. and Gardener 2000).

3.3.3.1 Cost and Output Distance Functions in Single Country Studies

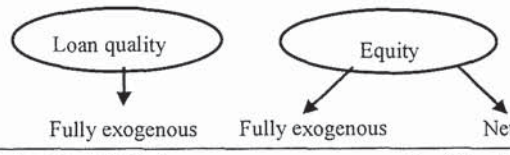
Based on the treatment of environmental variables, the studies can typically be divided into four groups for the cost function and three groups for the output distance function as summarised in Table 3.1. This section will first discuss the cost function followed by the output distance function.

3.3.3.1.1 Cost Function in Single Country Studies

In single country studies that employ cost function, certain studies have controlled for either, both bank loan quality and equity capital (Mester 1996; Girardone, Molyneux, and Gardener 2004) or only the latter (Berger, Allen N. and Mester 1997). While certain studies (Mester 1996; Girardone, et al. 2004) have controlled for these factors as fully exogenous, others (e.g., Hasan and Marton 2003; Bonaccorsi di Patti and Hardy 2005; Kraft, Hofler, and Payne 2006) have made these variables fully interactive with inputs and outputs in the function which is known as netput.

In estimating the cost function, besides previously mentioned output quality and equity variables, certain studies do control for other factors such as merger and ownership while other studies confine estimating cost function to only input and output variables. The former can be generalised into four categories. The first category assumes environmental factors such as merger and number of branches (Lozano-Vivas 1998) to influence frontier estimation.

[6] This second stage assumes causal relationship between the efficiency estimate and the explanatory variables hence, contradicts to the first stage assumption of independently and identically distributed efficiency.

Cost function[a]					Output distance function[e]			
					X			
Category of studies[b]	1[c]	2[d]	3	4	1	2	3	**Category of studies**
Factors in frontier ➢ Merger ➢ Foreign ownership ➢ Bank size ➢ Branch ➢ Holding company ➢ Regulation ➢ Solvency	/	X	/	X	X	/	X	**Factors in frontier** ➢ Merger
Inefficiency effects model (one-step) ➢ NPL to loan ➢ Private-ownership ➢ Foreign ownership	X	/	X	X	/	/	X	**Inefficiency effects model (one-step)** ➢ Merger ➢ Branch ➢ Market share ➢ Bank services ➢ Market concentration ➢ Government share
OLS regression (two-steps) ➢ NPL ➢ Age operation ➢ Other bank-specific factors ➢ Market specification factors ➢ Loan loss provision ➢ Equity ➢ Public ownership ➢ Foreign ownership ➢ Islamic Bank	X	X	/	/				
					X	/	X	**Inefficient scores by;** ➢ Organizational structure ➢ Economic condition

Notes:
[a] Certain studies do not control for equity or quality or both, but certain studies treated quality as fully exogenous and others have controlled for equity as fully exogenous, or interactive with input and output variables.
[b] While / indicates factors have been controlled for, X for factors which have not been controlled for.
[c] Studies in Category 1 only include environmental factors in frontier estimation.
[d] Studies in Category 2 do not assume any factors to influence frontier estimation but assumes certain factors to influence inefficiency using "one-step" procedure.
[e] Studies using output distance function do not control for neither quality nor equity.

Table 3.1: Single country studies employing cost and output distance functions

The second category does not assume any factors to influence frontier estimation but simultaneously assumes certain factors to directly influence inefficiency by specifically employing Battese and Coelli (1995)'s model. In addition, NPL-to-loans (Bouchaddakh and Salah 2005), private-ownership, new bank and foreign-ownership (Kraft, et al. 2006) have been assumed to directly influence efficiency using "one-step" procedure.

The third category assumes environmental factors such as foreign ownership, bank size (Rao 2005), number of branches, holding company dummy (Mahajan, Rangan, and Zardkoohi 1996), bank regulation (Berger, Allen N. and DeYoung 1997) and solvency (Bos and Kool 2006) to influence frontier estimation and further correlates the inefficiency estimates with factors such as non-performing loans (NPLs) (Girardone, et al. 2004; Rao 2005), age of operation, organisational structure (Mester 1996), bank-specific and market-specific factors (Bos and Kool 2006) using the "two-steps" procedure.

The final category of studies (e.g., Clark 1996; Chang, Hasan, and Hunter 1998; Esho 2001; Casu and Girardone 2002; Isik and Hassan 2002; Hasan and Marton 2003; Huang and Wang 2004; Abdul-Majid, et al. 2005; El-Gamal and Inanoglu 2005; Kwan 2006; Mokhtar, et al. 2006) does not assume any factors to influence frontier estimation but correlates the inefficiency estimates with other factors such as loan loss provision (Kwan 2006), equity (Hasan and Marton 2003), public ownership (Isik and Hassan 2002; Huang and Wang 2004), foreign ownership (Chang, et al. 1998; Isik and Hassan 2002; Hasan and Marton 2003) and Islamic bank dummy (Abdul-Majid, et al. 2005) based on the "two-steps" procedure using Ordinary Least Square (OLS) regression (Please refer to Appendix III for summary of selected bank efficiency studies using cost function).

3.3.3.1.2 Output distance function in single country studies

Single country bank efficiency studies which employ output distance function have neither controlled for bank output quality nor equity capital in the models. Furthermore, only a limited number of studies have employed output distance function (e.g., Cuesta and Orea 2002; Li, et al. 2004; Cuesta and Zofío 2005; Rezitis 2007) which can be grouped

into whether environmental factors are assumed to influence frontier estimation or to influence both, frontier estimation and inefficiency (see Table 3.1).

Without assuming any factor to influence the location of the frontier, Li, et al. (2004) in the first category has assumed the percentage of government shareholding in banks to directly influence efficiency using the "one-step" procedure. The authors have employed translog output-oriented function and defined Taiwanese banks outputs over 1997-1999, as loans, portfolio investments and real revenue. Furthermore, banks have been shown to have average technical inefficiency of 6 percent and that they performed worse on average after the Asian financial crisis. In addition, based on the inefficiency scores, organisational structure of mixed private and public ownership has been discovered to be the most efficient organisational form compared to public-ownership and private-ownership (Please refer to Appendix IV for summary of selected bank efficiency studies using output distance function).[7]

On the other hand, Rezitis (2007) which is in the second category has assumed merger to influence both frontier estimation and inefficiency using the "one-step" procedure. Besides merger, the author has assumed the number of bank branches, bank market share, banks services and market concentration to directly influence inefficiency.

The rest of the single country studies which employ output distance function (Cuesta and Orea 2002; Cuesta and Zofío 2005) have not assumed any environmental factors to influence the estimated function or directly influence inefficiency. Cuesta and Orea (2002) have employed loans, other earning assets and off-balance sheet items to measure Spanish bank outputs for the period of 1985-1998. Using the same database, Cuesta and Zofío (2005) which allows for the maximum equiproportionate expansion of outputs and reduction of inputs found similar output inefficiency of about 6 percent. From the efficiency scores, Cuesta and Orea (2002) observed that the inefficiency of merged banks is higher (14 percent) than the non-merged banks (9 percent) and based on their trends, the authors hypothesized that the former will be more efficient in the end.

In conclusion, based on cost and output distance functions in single country studies, there is no consistent opinion on whether environmental factors either influence

[7] Some studies (English, et al. 1993; Iqbal, Z., et al. 1999) have employed deterministic output distance functions which is very sensitive to the existence of white noise because it does not have a stochastic term to control for random disturbances, resulting in lower efficiency estimates compared to the stochastic function.

frontier estimation hence, location of the frontier, or they directly influence inefficiency. Single country studies in chapter 4 and 5 will therefore, demonstrate both concepts of efficiencies; first, when environmental factors are assumed to capture legitimate difference in the cost or output hence, actual indicator of higher (lower) efficient costs or lower (higher) efficient output that should be allowed for and second, when inefficiencies are assumed to quantify the differences in environmental factors hence, the indicators of higher (lower) costs inefficiency or lower (higher) output inefficiency. The following section will review cross-country bank efficiency literature.

3.3.3.2 Cross-country Studies of Bank Performance

Since efficiency measurement has first been introduced, most researchers have studied a single country and very few cross-country studies have been done. The latter is however, gaining importance despite difficulties in analysing them due to the different banking market in different countries. In the earlier cross-country studies, it was not unusual to estimate separate frontier for different countries, but the recent trend is to estimate a common frontier for multiple countries (e.g., Bonin, et al. 2005; Carvallo and Kasman 2005).

Most earlier cross-country studies have been done on the European countries (e.g., Altunbas, Y. and Chakravarty 1998; Cavallo and Rossi 2001; Carbo, Gardener, and Williams 2003) but have now spread to other regions such as transition countries (e.g., Bonin, et al. 2005; Kasman 2005), Latin American and the Caribbean (e.g., Carvallo and Kasman 2005), developing countries (e.g., Boubakri, Cosset, Fischer, and Guedhami 2005; Clarke, Cull, and Shirley 2005) and Asian countries (e.g., Abd Karim 2001; Williams, Jonathan and Nguyen 2005). While the joining of Central and Eastern European countries into the European Union (EU) becomes a new motivation for efficiency studies on these countries (e.g., Kasman and Yildirim 2006), the increasing number of countries operating Islamic banking has raised interest on measuring their performance (e.g., Brown 2003; Hassan 2003; Yudistira 2004) and in comparison with conventional banks in single and multiple countries (e.g., Al-Jarrah and Molyneux 2005; Alpay and Hassan 2006). Therefore, environmental factors such as country differences and banking types play some role in measuring bank efficiency and may have some effects on the estimated efficiency.

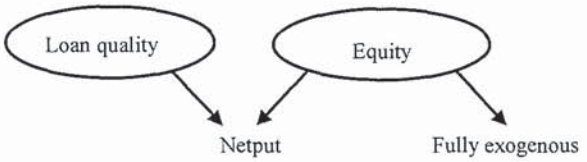
As shown in Table 3.2, cross-country bank efficiency studies can be generalised into those who do control for country-specific factors in frontier estimation (e.g., Dietsch and Lozano-Vivas 2000; Bonin, et al. 2005; Carvallo and Kasman 2005; Fries and Taci 2005; Kasman 2005; Williams, Jonathan and Nguyen 2005; Kasman and Yildirim 2006; Maudos and de Guevara 2007) and those who do not (Abd Karim 2001; Maudos, Pastor, Pérez, and Quesada 2002; Alshammari 2003; Al-Jarrah and Molyneux 2005).

3.3.3.2.1 Controlling for Country-specific Factors in Cross-country Studies

Chaffai, Dietsch, and Lozano-Vivas (2001) argued that ignoring country-specific factors in a common frontier is a misspecification because a frontier assumes the same technology for all banks but each country may have different banking technology, as well as different environmental and regulatory conditions (Dietsch and Lozano-Vivas 2000). The investigation on how the environment determines bank efficiency has been done by Dietsch and Lozano-Vivas (2000) on the French and Spanish banking industries. With country-specific environmental factors in a common frontier, the average efficiency estimates in each country improved markedly and differences in cost efficiency scores between countries reduced substantially. Furthermore, the less favourable the country-specific conditions, the greater improvement in average efficiency scores when country-specific environmental factors are considered in a common frontier (Dietsch and Lozano-Vivas 2000). Similarly, Kasman (2005) who compared cost efficiency of Polish and Czech banks over 1995-2000 observed that differences in inefficiency scores between banks in the two countries decreased dramatically after considering country-specific factors in a common frontier. In addition, Bonin, et al.(2005) who measured bank efficiency of 11 transition countries over 1996-2000 discovered that the average cost and profit efficiencies improved when year and country effects were included in a common frontier. Based on the previous studies, country-specific factors can be broadly generalised into macroeconomic conditions, bank structure and accessibility of banking services and they will be discussed in detail in section 6.4 (Please refer to Appendix V for summary of selected cross-country studies that control for country-specific factors).

The studies that have controlled for the country-specific factors can be divided into three categories (see Table 3.2). In the first category of studies, having controlled for country-specific factors using the "one-step" procedure; they simultaneously assume

inefficiency distributions to be directly influenced by bank-specific factors such as size and governance related factors (e.g., Williams, Jonathan and Nguyen 2005).

With country–specific factors [a]				Without country–specific factors[e]		
• Macroeconomic condition • Bank structure • Accessibility of bank services				X		
				X		
Category of studies [b]	1[c]	2[d]	3[d]	1	2	**Category of studies**
Inefficiency effects model (one-step) ➢ Size ➢ Governance related factors ➢ Country dummy	/	/	X	/	X	**Inefficiency effects model (one-step)** ➢ Country- specific factors ➢ Bank types ➢ Ownership ➢ Size ➢ Liquidity ➢ Islamic Bank
OLS regression (two-steps) ➢ Country- specific factors ➢ Loan quality ➢ Profitability ➢ Equity ➢ Non-interest income	X	X	/	X	/	**OLS regression (two-steps)** ➢ Country- specific factors ➢ Profitability ➢ Ownership ➢ Risk ➢ Organizational structure ➢ Size ➢ Specialisation
Inefficiency scores by: ➢ Public-ownership ➢ Market concentration ➢ Equity ➢ Foreign- ownership	X	/	X			

Notes:
[a] Certain studies do not control for equity or quality or both, but certain studies treated quality as interactive with input and output variables and others have controlled for equity as fully exogenous, or interactive with input and output variables.
[b] While / indicates factors have been controlled for, X for factors which have not been controlled for.
[c] Studies in Category 1 only assumes certain factors to influence inefficiency using "one-step" procedure.
[d] Studies in Category 2 assumes certain factors to influence inefficiency using "one-step" procedure and also regress the inefficiency scores over certain factors.
[e] Studies which do not control for country-specific factors do not control for neither quality nor equity.

Table 3.2: Cross-country bank efficiency studies employing SFA

In the second category, after controlling for country-specific factors and assuming certain factors to directly influenced inefficiency in the "one-step" procedure, they further correlate the inefficiency scores using OLS regression with factors such as public ownership, market concentration (deposits), equity capital (Fries and Taci 2005) and foreign ownership (Bonin, et al. 2005). In addition, Bonin, et al.(2005) found that country effects continue to play a significant part in explaining differences in efficiency measures even after they have been controlled in the frontier estimation.

The final category of studies control for country-specific factors and the resulting inefficiency scores are then employed in the "two-steps" procedure using OLS regression in order to find correlations with bank-specific factors such as loan quality, profitability, equity capital, non interest income (Carvallo and Kasman 2005) and country-specific factors such as concentration ratio (Dietsch and Lozano-Vivas 2000). Carvallo and Kasman (2005) who employ stochastic translog cost function to measure efficiency of Latin American and Caribbean banks found that the efficiency level increased remarkably in most countries when country-specific environmental variables were controlled in the common frontier. However, a wide range of average inefficiency estimates still exists across countries even after having controlled for these country-specific factors in the common frontier. Furthermore, the authors discovered the most efficient banks are located in countries with high demand density, low market power and high economic growth. Although country-specific factors have been shown in the previous discussion to be important, certain cross-country bank efficiency studies do not control for these factors which will be discussed in the following section.

3.3.3.2.2 Without Controlling for Country-specific Factors in Cross-country Studies

Cross-country bank efficiency studies that do not control for country-specific factors can be grouped into two, based on the procedures to determine factors influencing inefficiency (see Table 3.2). The first category employs Battese and Coelli's (1995) model using the "one-step" procedure and assumes country-specific factors (Alshammari 2003; Al-Jarrah and Molyneux 2005; Kasman and Yildirim 2006), bank types dummy variables (Abd Karim 2001; Alshammari 2003; Al-Jarrah and Molyneux 2005), ownership, size (Abd Karim 2001), assets, liquidity and concentration ratio (Al-Jarrah and

Molyneux 2005) to directly influence inefficiency. Efficiency scores from this procedure indicate that Islamic banks are more cost and profit efficient compared to conventional commercial and investment banks involving GCC countries namely Bahrain, Saudi Arabian (Alshammari 2003; Al-Jarrah and Molyneux 2005), Kuwaiti, Oman, Qatar and U.A.E banks (Alshammari 2003), and involving Egyptian and Jordanian banks. (Al-Jarrah and Molyneux 2005). Assuming bank size and ownership to directly influence inefficiency, Abd Karim (2001) who studied the efficiency of commercial banks in Indonesia, Malaysia, the Philippines, and Thailand over the 1989-1996 period found that cost efficiencies improved with size and private ownership. Furthermore, the average cost efficiency tends deteriorated before the 1997 Asian financial crisis and a significant difference in average bank cost efficiency has existed between countries.

In the other category, without controlling for any country-specific factors in a common frontier, these studies (e.g., Allen and Rai 1996; Altunbas, Y., Gardener, Molyneux, and Moore 2001; Maudos, et al. 2002) have employed the resulted efficiency scores and correlate them with bank-specific factors such as ownership (Weill 2002), organisational structure (Boubakri, et al. 2005), bank size, specialisation, profitability, risk and country-specific factors (Maudos, et al. 2002) using the OLS regression "two-steps" procedure. The efficiency of banks has been proved to improve with loan-to-asset ratio, concentration ratio, risk, and GDP growth rate but deteriorate with network density (Maudos, et al. 2002). Furthermore, the efficiency of Islamic banks in most countries improves with size and profitability (Hassan 2003, 2005).

Based on the importance of country-specific factors in the previous discussion, cross-country research in chapter 6 of this thesis will control for these factors in a common frontier. In order to avoid problems associated with the "two-steps" procedure, Battese and Coelli's (1995) model of "one-step" procedure will be employed to investigate the explanation for differences in inefficiency of banks under study by including country dummy variables and further tests for statistically significant differences in the parameters that define each country's efficiency distributions.

3.3.3.2.3 Equity and Bank Output Quality in Cross-country Studies

Besides country-specific factors, equity and bank output quality have frequently been controlled in frontier estimation of cross-country studies. Equity has either been

controlled in frontier estimation as fully exogenous (Carvallo and Kasman 2005; Bos and Schmiedel 2007), netput (fully interactive with input and output variables) (Maudos, et al. 2002; Williams, Jonathan and Nguyen 2005; Kasman and Yildirim 2006) or to proxy bank regulations in the form of equity-to-assets ratio (Dietsch and Lozano-Vivas 2000; Kasman 2005). On the other hand, bank output quality has either been controlled as fully exogenous (Fries and Taci 2005) or as netput (Alshammari 2003). Equity is an alternative to deposits in financing bank operations and the equity participation principle is widely employed by Islamic banks. As the number of Islamic banks in the sample of chapter 6 cross-country study is larger as compared to single-country studies in chapter 4 and 5, equity will be considered to be one of the banks' inputs. However, bank output quality will not be controlled in cross-country study in chapter 6 due to incomplete information. Having discussed the environmental factors in previous cross-country studies, the following section will briefly identify the functions employed in these studies.

3.3.3.2.4 Costs, Profit and Output Distance Functions in Cross-country Studies

In cross-country bank efficiency studies, while cost function has frequently been employed (Dietsch and Lozano-Vivas 2000; Abd Karim 2001; Carvallo and Kasman 2005; Fries and Taci 2005; Kasman 2005; Carbo Valverde, Humphrey, and Lopez del Paso 2007; Maudos and de Guevara 2007), increasing studies have employed both cost and profit functions (Alshammari 2003; Hassan 2003; Al-Jarrah and Molyneux 2005; Hassan 2005; Bos and Schmiedel 2007). However, a very limited study has used output distance function (Chaffai, et al. 2001; Olgu 2006; Rezitis 2007) and its employment is mainly to analyse bank productivity despite its advantages of not requiring input price information subsequently avoiding distorted and inaccurate estimates. Furthermore, it does not require any behavioural assumption which is appropriate for Islamic banks that have dual objectives of profit or revenue maximisation, and social obligations. While chapter 4 will employ a cost function, chapter 5 and 6 will employ output distance function.

3.3.3.3 Returns to Scale in Cross-country Studies

Focussing on returns to scale, the majority of banks in Latin America and Caribbean countries have experienced economies of scale (Cavallo and Rossi 2001).

Slight economies of scale are found in every production scale but are more pronounced in small banks of the European countries (Altunbas, Y., et al. 2001; Cavallo and Rossi 2001) and ASEAN countries (Abd Karim 2001). There is also evidence that small banks have experienced economies of scale (Kasman 2005). In contrast to the significant diseconomies of scale experienced by large banks found in certain studies (Allen and Rai 1996; Abd Karim 2001; Carvallo and Kasman 2005; Kasman 2005), Yudistira (2004) discovered diseconomies of scale in small- and medium-sized Islamic banks. Although diseconomies increase with size in GCC banks (Alshammari 2003), Carvallo and Kasman (2005) found no clear relationship between size and scale economies in Latin American and Caribbean banks. In addition, bank types of Islamic, conventional commercial or conventional merchant banks are found to have no effect on the returns to scale (Alshammari 2003). Irrespective of differences in the results, the estimated scales are almost one, suggesting that banks operate at almost constant returns to scale (e.g., Clark 1996; Cuesta and Orea 2002; Orea 2002; Carvallo and Kasman 2005). As very limited studies have been done on returns to scale particularly in the context of Islamic and conventional banks comparison, the present research will investigate this issue further in single-country research involving Malaysian banks in chapter 4 and 5 as well as cross-country research involving 10 countries which have Islamic banking in operation in chapter 6.

In conclusion, previous cross-country literature has demonstrated the mix of opinions on the employment of country-specific factors in frontier estimation, inconsistent evidence to whether environmental factors influence frontier estimation or directly influence inefficiency, and the mix procedures in estimating efficient frontier and factors influencing inefficiency. In addition, country effects have been found to influence inefficiency distributions even after having controlled for country-specific factors in frontier estimation. Furthermore, previous studies have demonstrated the importance of equity and bank output quality in frontier estimation and have shown the lack of output distance function employment in cross-country studies. Finally, mixed results have been found on returns to scale in banking. As environmental factors have been shown to have some roles in estimating bank efficiency, the following section will highlight the potential

factors to be employed in the current research based on partly previous studies and data availability.

3.3.4 Selected environmental factors in single and cross-country studies

Environmental factors for which data is available and relevant to the current research are bank output quality, equity, merger, foreign ownership, private ownership, Islamic banking and country-specific factors. This section summarises the role played by these environmental factors in estimating bank efficiency and discusses their relationships with efficiency except for country-specific factors which will be discussed in section 6.4.

Bank output or loan quality has either been controlled as fully exogenous (Fries and Taci 2005) or as netput (Alshammari 2003). Bank output quality which is frequently proxied by NPL-to-loan ratio (e.g., Mester 1996; Girardone, et al. 2004) has been controlled in the frontier because unmeasured differences in loan quality that are not captured by banking data may be mistakenly measured as inefficiency (Berger, Allen N. and Mester 1997). Banks with low NPLs or high loan quality incur extra expenses for using more labour and physical capital in monitoring their loans, hence may appear inefficient (Mester 1996; Berger, Allen N. and Mester 1997). However, Berger, Allen N. and Mester (1997) noted that NPLs should only be controlled for if it is exogenous to bank management.

Besides bank output quality, equity capital has frequently been controlled for in frontier estimation (e.g., Clark 1996; e.g., Mester 1996; Berger, Allen N. and Mester 1997; Girardone, et al. 2004) as fully exogenous (Bos and Schmiedel 2007), netput (fully interactive with input and output variables) (Kasman and Yildirim 2006) or to proxy bank regulations (Carvallo and Kasman 2005). Other than deposits and inter-bank borrowings, banks employ equity capital to finance their operation (Bonaccorsi di Patti and Hardy 2005). Furthermore, Islamic banks that apply the equity participation principle depend more on their equities to finance loans as compared to conventional banks (Metwally 1997). In view of the importance of equity, this thesis will therefore, control for equity in frontier estimation as fully exogenous in single-country research of chapter 4 and 5 but will treat equity as one of the inputs in cross-country research of chapter 6 which involves a larger sample of Islamic banks.

Merger has also been assumed to influence frontier estimation (Lozano-Vivas 1998). Merged banks may appear inefficient for the extra cost incurred when they merged (Peristani 1997; Sherman and Rupert 2006). Furthermore, a pre- and post-merger comparison of merging banks and a corresponding control of non-merging banks[8] reveals that banks participated in a merger realised a significant decline in efficiency two to four years after the merger (Peristani 1997) as they need some time for system integration and personnel integration (Rhoades 1998; Sherman and Rupert 2006).

The fourth environmental factor is foreign-ownership which is assumed by Rao (2005) to influence the location of the frontier. Foreign-owned banks are found to be more efficient than domestic-owned banks in most studies (e.g., Bhattacharyya, Lovell, and Sahay 1997; Matthews and Ismail 2006; Mokhtar, et al. 2006) despite strict regulations and requirements imposed on foreign banks. By allowing them to extend their services from small branch networks into metropolitan areas in India, their efficiency has increased (Bhattacharyya, et al. 1997). In addition, most foreign banks in Turkey still perform better than domestic banks although they have high price of physical capital due to high rent of office spaces in expensive buildings or areas, which is suitable with their target customers (Isik and Hassan 2002). Some of the reasons for them being more efficient in financial intermediation are they managed to borrow with lower interest rates from abroad and are very efficient in labour hiring practice (El-Gamal and Inanoglu 2005).

Concentrating on bank ownership, private-owned banks have generally been shown to be superior to state-owned banks in developing countries (e.g., Isik and Hassan 2003a; Berger, Allen N., Clarke, Cull, Klapper, and Udell 2005; Bonaccorsi di Patti and Hardy 2005), possibly because the latter is usually associated with directed lending or with specific objectives (Berger, Allen N., et al. 2005). Nevertheless, certain countries are in exception such as India, in which the government-owned banks are more efficient than both private-owned and foreign-owned banks (Bhattacharyya, et al. 1997). Similarly, the state-owned bank in Turkey is efficient in generating loans especially in specific sectors that suffer from financial disintermediation although inefficient in labour hiring (El-Gamal

[8] Peristani (1997) used the Distribution Free Approach (DFA) which is defined as an average deviation of each bank from the best average-practice frontier rather efficiency at any point in time. Under DFA, the efficiency of each bank is stable overtime and random errors tend to average out over time.

and Inanoglu 2005). Certain bank privatisations are followed by improvement in performance (e.g., Beck, Cull, and Jerome 2005; Nakane and Weintraub 2005) however, profit efficiency of Pakistani privatised banks generally improved only immediately after being privatized but not in the subsequent years despite the fact that they were efficient banks before the merger (Bonaccorsi di Patti and Hardy 2005). In previous studies, private-ownership however, has not been assumed to influence frontier estimation but to correlate with inefficiency (Isik and Hassan 2002; Huang and Wang 2004).

Focussing on Islamic banking, this *shariah* compliant banking has been assumed to directly influence inefficiency (Alshammari 2003; Al-Jarrah and Molyneux 2005) and tested for correlation with inefficiency (Abdul-Majid, et al. 2005) but, has not been assumed to influence location of the frontier. Furthermore, Islamic banks are found to be equally efficient if not superior to conventional banks in Turkey using a cost function despite limited investment avenues for Islamic banks due to the interest-bearing nature of the investment even in government securities (El-Gamal and Inanoglu 2005). The authors also noted that Islamic banks do not have a negative effect on the Turkish financial system and have helped the economy to mobilise funds otherwise hoarded outside formal financial sector in this large Muslim population country. On the other hand, Malaysian Islamic banks have been demonstrated to be equally cost efficient to conventional commercial banks over 1993-2000 (Abdul-Majid, et al. 2005) and 1997-2003 (Mokhtar, et al. 2006). Mokhtar, et al (2006) who have taken IBS into account, observed that domestic parent banks[9] are more efficient than their IBS divisions but vice versa for foreign banks. Furthermore, the authors discovered that IBS divisions are less efficient than full-fledged Islamic banks. These studies however, do not assume any environmental factors to influence either the estimated cost function or the inefficiency.

Finally, country dummy variables have been assumed to influence frontier estimation (e.g., Abd Karim 2001) or directly influence inefficiency (e.g., Maudos and de Guevara 2007) as well as simultaneously influence frontier estimation and inefficiency (e.g., Bonin, et al. 2005). In addition, differences in inefficiencies among countries have been found to be still significant even after having controlled for country dummy in frontier estimation (Bonin, et al. 2005).

[9] Domestic parent banks refer to conventional banking operation of domestic conventional banks that have IBS in operation.

Based on the literature reviewed, samples and data availability, single country studies in chapter 4 and chapter 5 will assume loan quality, equity, Islamic bank, IBS, merger, economic condition, foreign-ownership and private-ownership to influence frontier estimation. On the other hand, cross-country study in chapter 6 which will define equity as one of the bank inputs, assumes that country-specific factors of loan quality, merger and Islamic banking influence frontier estimation, and country dummy variables directly influence inefficiency. While output quality and private-ownership will be further discussed in section 4.4.2, environmental factors of equity capital, merger, foreign-ownership, and Islamic banking will be discussed in both section 4.4.2 and 5.3.3.

Efficiency as previously reviewed, measures the performance of banks in producing output from input as compared to the optimum level. Besides efficiency, bank performance can be measured based on how much output is being produced from input which is known as productivity and will be discussed in the following section.

3.4 PRODUCTIVITY

Generally, productivity is a measure of the relationship between how much output has been produced and the input used by a firm (Coelli, Estache, Perelman, and Trujillo 2003). Change in productivity is the net change in output resulting from the efficiency change, technical change and scale change effects (Orea 2002). Hence, efficiency is part of the productivity elements.

While TFP involves all factors of production which is a comprehensive measure of productivity, partial factor productivity analyses only certain aspect of productivity such as labour or capital (Coelli, et al. 1998). TFP had been traditionally calculated by taking the ratio of a weighted output index to a weighted input index known as index number approach[10] (Coelli, et al. 2003). However, productivity change cannot be decomposed using index number approach (Grifell-Tatje and Lovell 1996).

In the previous studies, productivity change has been decomposed using both non-parametric (Berg, Førsund, and Jansen 1992; Pastor, Pérez, and Quesada 1997) and parametric techniques (Orea 2002; Olgu 2006). Malmquist productivity indices which could be calculated either through non-parametric or parametric approach provide sources

[10] Index number techniques such as Torqvist and Fisher Ideal require information on price, quantity and the assumption on technology (Grifell-Tatje and Lovell 1996).

for productivity change by isolating efficiency change from technical change[11] (Färe, Grosskopf, Norris, and Zhang 1994; Grifell-Tatje and Lovell 1995; Isik and Hassan 2003b) as well as scale change effects (Orea 2002). The non-parametric Malmquist Productivity Index which is based totally on output and input quantities and ignores changes in the market prices (Berger, Allen N. and Mester 2003) has been employed to decompose productivity change in most studies (e.g. Grifell-Tatje and Lovell 1996, 1997; Wheelock and Wilson 1999; Alam 2001).

In the parametric model, besides the parametric Malmquist Productivity Index (Orea 2002; Olgu 2006), econometric estimation has frequently been employed in banking studies to decompose productivity change (Berger, Allen. N. and Mester 1999; Stiroh 2000; Berger, Allen N. and Mester 2003). However, parametric Malmquist Productivity Indices have the advantages of needing neither price information nor restrictive behavioural assumptions such as cost minimization or profit maximization.

3.4.1 Parametric Malmquist Productivity Index

Past studies employing the parametric Malmquist index have excluded the impact of scale changes and this gives a biased estimate of TFP change, unless firms operate with constant returns to scale (CRS) (Caves, Christensen, and Diewert 1982).[12] Orea's (2002) generalised Malmquist Productivity Index offers a solution to this problem by including a scale term (which, vanishes under CRS) to the Malmquist Productivity Index, hence offering a theoretically unbiased measure of TFP change (parametric Malmquist Productivity Index is explained in detail in the methodological sections 4.3 and 5.3.2.). Therefore, Orea's (2002) approach extends the standard Malmquist Productivity Index which confines only the impact of technical efficiency change (TEC) and technical change (TC), by further allowing for the impact of scale change effects (SCE) on productivity change. The decomposition is important to give indications to banks of how they have improved their productivity either through TEC, TC or SCE hence, improved their productivity further.

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[11] It can decompose productivity change into technical efficiency change, which suggest convergence towards or divergence from best practice and technical change, which indicate improvement or deterioration in the performance of best practice banks (Grifell-Tatje and Lovell 1996).

[12] CRS firms do not gain or lose if they employ extra unit of input or produce extra unit of output hence do not affect the productivity (Coelli, et al. 1998).

Concentrating only on Spanish banks, Orea (2002) decomposed productivity change into efficiency change, technical change and scale change effect using a parametric generalised Malmquist Productivity Index, and discovered that the growth rate was mainly attributed to technical change and modest scale effects. Moreover, the author found slower growth for merged banks relative to their unmerged counterparts. Employing both Orea's (2002) parametric Generalised Malmquist Productivity Index and generalised non-parametric Malmquist Productivity Index, Olgu (2006) decomposed productivity growth of banks in developed and accession countries of the Euro zone. The author observed that the latter banks are on average performing better. Employing Orea (2002) also, Rezitis (2007) found that merged banks in Greece have lower productivity change as compared to unmerged counterparts due to deteriorated technical efficiency and disappearance of economies of scale in Greece.

On the other hand, in a cross-country study, Chaffai, Dietsch, and Lozano-Vivas (2001) who employ the Malmquist type index to decompose French, German, Italian and Spanish bank productivity observed that the existence of productivity differences among banking industries in different countries are primarily due to environmental conditions rather banking technologies (Please refer to Appendix VI for summary of bank productivity studies which employ the parametric Malmquist Productivity Index).

Although the parametric Generalised Malmquist Productivity Index has the advantages of not requiring for any behavioural assumptions and price information, there are very limited studies applying this index (e.g., Orea 2002; Olgu 2006) and lack of application on Islamic banking. Chapter 4 and 5 will therefore employ Orea (2002)'s parametric Generalised Malmquist Productivity Index which will decompose productivity change into TEC, TC and SCE in comparing Islamic to conventional banks. It is expected that in these chapters, merged banks will have a slower productivity growth attributed to deteriorating TEC and SCE, and environmental factors play a significant role in cross-country differences of productivity change.

3.4.2 Non-parametric Malmquist Productivity Index and Econometric Estimation

This section will review literature employing the non-parametric Malmquist Productivity Index and econometric estimation in decomposing productivity change. Previous studies employing the non-parametric Malmquist Productivity Index have

decomposed productivity change into several different components. Casu, Girardone, and Molyneux (2004) have decomposed productivity change into TEC, TC and SCE, and further decomposed TEC into pure efficiency change and scale. On the other hand, Isik and Hassan (2003b), Krishnasamy, Ridzwa, and Perumal (2004) and Pastor, J., Pérez, and Quesada (1997) have decomposed productivity change into TC and TEC. Having decomposed productivity change into TC and TEC, Hassan (2003) further decomposed TEC into changes in pure technical and scale efficiency.

Technical change has been the main determinant of productivity change in most studies employing the non-parametric Malmquist Productivity Index (e.g., Hassan 2003; Isik and Hassan 2003b; Casu, et al. 2004; Krishnasamy, et al. 2004). Furthermore, Islamic banks in Pakistan, Iran and Sudan have been found to make technological progress by penetrating into various markets as well as capturing market shares although they experienced productivity loss over 1994-2001 period (Hassan 2003). Similarly, productivity growth of Malaysian commercial banks over 2000-2001 was attributed to technical change rather technical efficiency change (Krishnasamy, et al. 2004). In addition, the substantial productivity loss experienced by Turkish banks over 1992-1996 was largely attributable to technical regress rather than efficiency decrease (Isik and Hassan 2003b).

In contrast to the above finding, decreasing efficiency has been the main determinant of the decline in productivity growth of USA banks over the period 1984-1993 as most small banks unable to adapt to the technological development and moved farther away from the efficient frontier (Wheelock and Wilson 1999). In cross country study of European and USA banks for 1992 in which bank technology of a country was set as the benchmark, their productivity change was due only to technology differences (Pastor, et al. 1997). In view of the findings in most previously reviewed studies particularly on Islamic and Malaysian banks, chapter 4 and 5 are therefore, expected to find technical change as the main determinants of productivity change for both Islamic and conventional banks.

A number of parametric studies have employed econometric estimation to estimate productivity change (e.g., Berger, Allen. N. and Mester 1999; Stiroh 2000; Kumbhakar, Lozano-Vivas, Lovell, and Hasan 2001; Berger, Allen N. and Mester 2003). Kumbhakar, et al.(2001) have decomposed the rate of productivity change into technical

change and technical efficiency change. On the other hand, certain studies (e.g., Berger, Allen. N. and Mester 1999; Berger, Allen N. and Mester 2003; Casu, et al. 2004) have decomposed TFP change over time into changes due to business conditions as well as bank productivity, and bank productivity has been further decomposed into technical change and inefficiency change.

Parametric models usually include a time trend to estimate technical change (Casu, et al. 2004). However, Kumbhakar and Lozano-Vivas (2002) noted that both technological and deregulatory changes affect technology in the same way by shifting the frontier and thus cannot be distinguished. Frontier may also shift from one period to another due to other factors such as financial shock, increased competition in the market, innovation, substantial bank entries and exits overtime[13] (Isik and Hassan 2003b; Casu, et al. 2004). The related models in the thesis will therefore, include time trend and its interaction with input and output variables as well as dummy variables for bank mergers and financial crisis.

Certain studies have employed more than a single method to decompose productivity change in order to check for consistency of results (e.g., Stiroh 2000; Casu, et al. 2004). For example, technical change has been found to be the main determinant for productivity change in large banks of the five largest European banking markets during the 1990s using both the non-parametric Malmquist Productivity Index and econometric estimation (Casu, et al. 2004). Stiroh (2000) who employs Berger and Mester's (2003) econometric technique and other econometric methodologies in decomposing productivity over the 1991-1997 period discovered that USA bank holding companies recorded productivity growth. In contrast, Berger, Allen N. and Mester (2003) found that the USA banks particularly those involved in mergers over 1984-1997 have deteriorated costs productivity (costs of producing a given level of output increased) but improved profit productivity substantially. The authors further argued that providing additional services or higher service quality may have raised bank costs but also raised revenues by more than the costs increases.

[13] As a result, different samples of banks and thus different frontiers across periods.

Based on the reviewed literature on productivity change, it can be summarised that the Malmquist Productivity Index has the advantage of not having to assume any behavioural objectives of firms as well as requires no price information, and a generalised Malmquist Productivity Index can be decomposed into TEC, TC and SCE. In addition, technical change has been found to be the main contributor to productivity change in Islamic and most conventional banks. However, frontiers may shift not only due to technical change but also other factors such as merger and economic shock. Furthermore, merged banks have slower productivity growth relative to unmerged banks due to declining technical efficiency change and disappearing scale effects. Finally, the relatively large productivity difference between countries is due to differences in environmental conditions rather than technology. Models in the thesis will carefully consider dummy variables for mergers and economic shock, and employ a generalised Malmquist Productivity Index to decompose productivity change. It is expected that technical change is the main determinant of the productivity change and merged banks have lower productivity change relative to unmerged banks. In measuring bank efficiency and productivity, different approaches to define bank outputs have been employed in previous literature which will be discussed in the following section.

3.5 THE MICROECONOMICS OF BANKING

A bank is a financial intermediation institution and it operates by accepting deposits from and gives out loans to the public. By providing liquidity and payment services, transforming assets,[14] monitoring and processing information, and managing risk, financial intermediation improves resource allocation in the economy. However, the definition of banking inputs and output is unclear because banking firms produce multiple products. Two major approaches to measure the flow of services offered by financial institutions are the *production* approach and the *intermediation* approach. Both approaches relate to the microeconomic theory of firms to the banking sector (Freixas and Rochet 1997).

Under the *production* approach, financial intermediaries are perceived as producers; producing services (e.g. transferring money and processing loan applications) from physical inputs (e.g. physical capital and labour) for depositors and borrowers

[14] Asset can be transformed in terms of convenience of denomination and quality transformation.

(Ferrier, Grosskopf, Hayes, and Yaisawarng 1993). Berger and Humphrey (1997) noted that if a bank is seen as primarily producing services for account holders, output is best measured by the number and type of documents or transactions processed, over a given period of time. Nevertheless, the number of accounts is often used as proxy because of difficulty in obtaining data on the number of transactions (e.g., Ferrier, et al. 1993). Under this approach, inputs are defined as physical inputs, such as labour and capital. Furthermore, this approach is appropriate if the study is made with bank branch level data because a branch principally produces documents and transactions such as loans as a whole for its customers and the manager does not have much authority on bank funding and investment decisions (Berger, Allen N. and Humphrey 1997).

The other main approach is the *intermediation* approach which assumes that the existence of the financial institution is to intermediate funds between savers and investors (Berger, Allen N. and Humphrey 1997). It diverges from the *production* approach in terms of its definition of banking activities in which the financial institution transforms the money borrowed from the depositors to the money lent to the borrowers (Freixas and Rochet 1997). Hence, in the production process, loans and other assets are considered as output while deposits and other liabilities are considered as inputs. This approach can be traced back to Sealey and Lindley (1977) who recognised that the decision making practice of individual financial firms focuses on the production of earning assets. Besides labour and capital, money borrowed from depositors and serviced by the firm are regarded as inputs. This approach is more relevant if the study is made at bank level rather than branch level because the manager does have influence on bank funding and investment decisions (Berger, Allen N. and Humphrey 1997) and does not deal directly with customers (Freixas and Rochet 1997).

Neither the *production* nor *intermediation* approach cover the dual function of the bank; as a producer of bank transactions or loan documents and as an intermediary between savers and investors and the approach adopted to measure output affects the inferences regarding efficiency (Berger, Allen N. and Humphrey 1997). Applying both approaches on the same dataset, Wheelock and Wilson (1995) found that scale, technical and overall efficiencies differ between the *intermediation* approach and *production* approach although some similarities exist in the mean of the allocative efficiency and the ranking of bank efficiency scores. Therefore, measured efficiency relies on the

researcher's perception of what banks do. Furthermore, if the model fails to take into account the main features of bank production, the efficiency estimate will be inaccurate (Wheelock and Wilson 1995).

Besides the above two main approaches, there are other methods to assign financial goods to input and output categories; the *asset* approach, *user cost* approach and *value-added* approach. Under *asset* approach, output is defined by assets and mainly by loans (Favero and Papi 1995). Specifically, this approach assumes banks produce various loans and investments from deposits, other funding sources, labour, capital and other materials and some of those who employ the *intermediation* approach maintain this notion (Wheelock and Wilson 1995). The *user-cost* and the *value-added* approaches are not related to the macroeconomic function of banks but they are empirical criteria employed by researchers to decide what services are considered as inputs and outputs. In the *user-cost* approach, the classification of bank inputs and outputs depends on the net contribution to the bank revenue (Favero and Papi 1995). A bank asset is categorized as an output if the financial returns of the asset exceed the opportunity cost of the investment. A liability is regarded as an output if the financial cost of the liability is less than the opportunity cost of the funds. Finally, according to the *value-added* approach, the definition of inputs and outputs is based on the share of value-added. Items on the balance sheet or activities which have high value-added may be considered as important outputs (Wheelock and Wilson 1995).

There is also controversy on assigning deposits as outputs or inputs. Deposits have the characteristic of being inputs as the funds raised provide raw material for the bank to invest. On the other hand, the output attribute of a deposit is that it provides banks with liquidity and safekeeping. A bank can utilise the deposits money for short advance notice of withdrawal by customers, or as a cautious reserve and safeguard for the customers' money. When Favero and Papi (1995) first treated deposits as output and then treated deposits as input, the efficiency estimate was somewhat higher with the former approach. Therefore, the treatment of deposits as output or input in the efficiency model can affect the efficiency estimate (Berger, Allen N. and Humphrey 1997).

In summary, while based on the *user-cost* approach, bank output is defined as items that contribute most to bank revenue, according to *value-added* approach it is one that has most value-added to banks. If a bank is assumed to produce services from

physical inputs, the *production* approach is the most suitable in defining bank output, but if banks are perceived as intermediating savers and investors, the *intermediation* approach is the most appropriate in defining bank output. The latter approach concurs with the *assets* approach in which banks produce assets such as loans and investment from deposits, other funding sources, labour, capital and other materials. As part of the present research sample is the Islamic bank, which applies the equity participation principle that basically intermediates between savers and investors, the *intermediation* approach will be consistently employed throughout the research. Details of the inputs and outputs employed in the thesis will be defined in sections 4.4.2, 5.3.3 and 6.4.

3.6 CONCLUSIONS

This chapter has brought together the flows of literature on conventional and Islamic bank efficiency as well as productivity in single and cross-country studies. Having integrated and evaluated these research areas, it can be concluded that bank output quality and equity have generally been assumed to influence frontier estimation, and other environmental conditions to either influence frontier or directly influence inefficiency.

Despite mixed results found in the relative efficiency between Islamic and conventional banks, there has been a great lack of research that has specifically investigated this issue in terms of controlling for differences in environmental conditions. Within the limited existing studies on Islamic and conventional bank efficiency comparison, differences in operating environments particularly *shariah* compliant banking have not been assumed to influence frontier estimation but to directly influence inefficiency hence, efficiency estimates incorporate bank characteristics. This research will therefore explore differences in efficiency for both Islamic and conventional banks, taking into account differences in operating environments such as *shariah* compliant banking, mergers, foreign-ownership, private-ownership and country-specific factors.

The literature review previously presented, has also helped to structure the research problem, identify the relevant concepts, and define the variables of interest in the study. The main conclusions and gaps drawn from this exercise are listed below. Firstly, although equity capital is important in bank production, it has been controlled either as fully exogenous or fully interactive with input and output of banks in SFA studies and none of the studies has directly controlled equity as bank input or output.

Secondly, past empirical studies on the relative performance of Islamic and conventional banks have employed financial ratio analysis and made relatively little use of more sophisticated techniques such as SFA particularly the output distance function. This is despite the fact that output distance function neither requires price information nor specifies a behavioural objective which is suitable with dual objectives of Islamic banks. Thirdly, regardless of the recent surge of interest in conventional banks offering Islamic banking products, limited research interest has been shown to study the effect of the full-fledged Islamic bank, conventional bank with Islamic window (IBS) and conventional banks on bank efficiency.

Fourthly, Islamic banks do not operate in a similar environment with other banks and conflicting views in inefficiency measurement literature exist; first, environmental factors influence the shape of technology, hence efficiency measure indicates how banks would be ranked if they operate in a similar environment or managerial efficiency. The other view is that the environmental factors directly influence the inefficiency terms, hence efficiency measures incorporate environmental effects which determine not only the managerial efficiency but also efficiency for being an Islamic bank. Despite raising interest in this issue, limited studies on bank efficiencies have considered environmental factors in the function, and there is a lack of studies that have applied both efficiency measures. Fifthly, despite importance of returns to scale especially to expanding and relatively new Islamic banks, there has been very limited research on this and its comparison with conventional banks.

Finally, in comparing productivity change of Islamic and conventional banks, to date, there is no research applying parametric technique and a very limited research using non-parametric technique. Furthermore, there is a limited amount of research applying non-parametric technique to measure productivity change of Islamic banks. These gaps were perceived to require further research. This thesis will explore these issues and consistent with the research objectives, as stated in chapter 1, the aim of the research is to compare the efficiency of Islamic banking relative to conventional banks, highlighting the impact of operational characteristics on efficiency, and to determine the factors influencing their productivity change.

In the literature, it is obvious that when estimating efficient cost or output, differences in operating characteristics should be allowed for, but it is unclear whether

such factors are indicators of higher (lower) efficient costs or lower (higher) efficient outputs that should be allowed for, or instead indicators of inefficiency. Chapter 4 and 5 will demonstrate both, if the control for such factors captures the legitimate difference in cost or output (net efficiency estimates), and if operating characteristics are more towards being an indicator of higher or lower inefficiency (gross efficiency estimates) which quantify the impact of differences in operating characteristics on actual cost or actual output, respectively. As cost function employed in chapter 4 involves input price estimates that might be distorted and inaccurate, chapter 5 will check the consistency of results by using output distance function that needs no price information. Moreover, by not having behavioural assumptions, output distance function is more aligned to dual objectives of social obligations and profit/ revenue maximising in Islamic banking. Chapter 4 and 5 will also investigate economies of scale (returns to scale), productivity change and its determinants for both Islamic and conventional banking using the parametric Generalised Malmquist Productivity Index.

The investigation of relative efficiency of Islamic to conventional banks and their returns to scale will then be extended to the wider population in chapter 6 by including sample banks in countries that operate Islamic banking. It will follow the recent major approach of estimating a common frontier for cross-country bank efficiency by controlling for country-specific factors; population density, per capita income, demand density, GDP growth rate, concentration ratio as well as accessibility of banking services through road paved and telephone lines per 100 inhabitants in the frontier estimation.

Only bank-specific characteristics, Islamic banking and merger will be tested to influence frontier estimation in cross-country-study of chapter 6 due to data unavailability. Although previous SFA literature has controlled equity as either fully exogenous or netput, this thesis will include it as one of the inputs due to its importance. Chapter 6 will further test for statistically significant differences in the parameters that define each country's efficiency distribution. Country dummy variables will be included in the inefficiency effects model to investigate the explanation for the differences in efficiency estimates across banks under study (e.g., Abd Karim 2001; Bonin, et al. 2005; Rezitis 2007). Finally, in evaluating the returns to scale for Islamic relative to conventional banks, chapter 6 will also make cross-country analysis on this measure. Based on previous literature, chapter 6 is expected to have lower output efficiency for Islamic banks

compared to conventional banks, and show significant difference in efficiency distributions between countries even after controlling for country-specific factors, and slight returns to scale for Islamic banks.

CHAPTER 4
THE IMPACT OF ISLAMIC BANKING ON THE COST EFFICIENCY AND PRODUCTIVITY CHANGE OF MALAYSIAN COMMERCIAL BANKS: 1996-2002

4.1 INTRODUCTION

Malaysian financial institutions can generally be divided into banks and non-bank financial intermediaries. The banks can be further divided into monetary and non-monetary institutions. Monetary institutions refer to institutions whose principal liabilities are accepted as money, namely the Central Bank of Malaysia (BNM), the commercial banks, and the Islamic banks. The non-monetary institutions are the finance companies, merchant banks, and discount houses whose liabilities are normally accepted as near money. The banking system also covers the representative offices of foreign banks and offshore banks in the International Offshore Financial Centre in Labuan. BNM is responsible for the regulation and supervision of the banking system except for the offshore banks operating in Labuan, which are regulated by the Labuan Offshore Financial Services Authority (Central Bank of Malaysia 1999b).

Commercial banks are the largest component of the Malaysian banking system. They have increased their share of total banking assets from 56.6 to 69.2 percent between 1992 and 2005 (Central Bank of Malaysia 1999b, 2005). Commercial banks provide banking services such as accepting deposits, granting loans, and providing trade-financing facilities. Historically, foreign banks played a more important role in the Malaysian banking system because domestic banks were not well developed, and in 1957, domestic banks accounted for less than 10 percent of all commercial bank deposits and loans. However, in 1966, foreign banks were restricted from opening

new branches in Malaysia[1], and by 1974, the number of domestic banks exceeded the number of foreign banks. By September 1988 the share of domestic commercial bank deposits and loans had respectively increased to 75 and 72 percent (Central Bank of Malaysia 1989), and by 1997, these shares further increased to over 80 percent (Detragiache and Gupta 2004). However, starting from January 2006, foreign banks were once again allowed to open additional branches (Central Bank of Malaysia 2005). [2] This is consistent with the commitment to achieve a higher level of liberalisation under the General Agreement on Trade in Services (GATs) (World Trade Organization 2008).

Malaysian commercial banks have also consolidated in recent years with their number reducing slightly from 38 in 1994 to 36 in 1997, as the result of mergers. The 1997-98 East Asian financial crisis further pushed the industry to consolidate, and the number of commercial banks subsequently shrunk from 36 in 1998 to 25 in 2003. Starting from 2004, some commercial banks merged with finance companies in an effort to increase the capacity and capability of domestic financial institutions (Central Bank of Malaysia 2004). However, despite substantial declines in the number of domestic banks since 1996, the number of foreign banks has remained almost the same.

A further important development in Malaysian banking has been the increasing prevalence of Islamic banking. The history of Islamic banking in Malaysia began in 1963 with the establishment of *Tabung Haji* by the government in order to both mobilise funds for Muslims going on pilgrimage to Mecca, and to encourage them to participate in economic activities. Building on this experience, Malaysia has implemented a systematic Islamic financial system and has emerged as the first country to have a dual system where the Islamic banking system operates side by side but separately from the conventional banking system. Islamic banking has not only allowed the banking industry to tap the previously unexploited business potential of providing banking services to the Muslim community, it has also allowed the mobilization of funds for productive purposes, that would have otherwise not been available. Moreover, the development of Islamic banking in Malaysia has not been in isolation as some form of Islamic financial services is now available in at least 70 countries (Husain 2005). However, while Sudan and Iran have entirely converted to

[1] The share of domestic banks in the market can be increased by limiting the activities of foreign banks.
[2] Foreign banks also have minority shares in some local banking institutions (Detragiache and Gupta 2004).

Islamic financial systems (Sundararajan and Errico 2002), it is more common for countries with large Muslim populations to operate Islamic banking systems alongside conventional banking systems, as is now the case in Malaysia, Bahrain, Pakistan, Saudi Arabia, and Egypt (Hassan 2003).

Islamic banking differs from conventional banking because it strives to be compliant with the basic precepts of *shariah*, which is based on the principles of justice, fair dealings and harmony through equitable distribution of wealth. The salient features of Islamic banking are therefore the prohibition of interest payment in transactions, and the prohibition of undertaking or financing anti-social and unethical behaviour such as gambling[3], prostitution, alcoholism, and narcotics. The 1983 Islamic Banking Act (IBA) governs Islamic banking, and the first full-fledged Islamic bank was established in 1983.[4] However, sixteen years would elapse before the second full-fledged Islamic bank was opened by separating existing IBS assets from a conventional bank's assets in October 1999.

More significant growth in Islamic banking was triggered in 1993, when BNM initiated a pilot project that allowed three conventional banks to offer Islamic banking products through the IBS. This scheme proved quite successful and by 2004, 90 percent of domestic commercial banks provided Islamic banking products through IBS windows, and Islamic banking assets were RM94.6 billion or 8 percent of the total Malaysian banking system assets (Central Bank of Malaysia 2004). In order to operate an IBS Islamic window, commercial banks must have a separate Islamic Banking Division (IBD) and a dedicated Islamic Banking Fund (IBF), which is the only allowed source of funding for the IBD, although physical capital and personnel may be shared with conventional banking (Rosly and Bakar 2003). Moreover, a committee comprised of experts in *shariah* must be formed at bank level to determine the validity of new products and the compatibility of daily operations with *shariah*. Any new IBS product must also be approved by the *shariah* Advisory Council established by BNM. Banks operating IBS must also submit separate Islamic and conventional statistical reports[5] on a monthly basis to BNM, and provide an additional disclosure of their Islamic banking portfolio in their financial statements. In order to

[3] Any gambling or games of chance which have something valuable (money and/or material goods) at stake. However, games in which nothing is really at risk for any participants are permissible.
[4] Under this act, an Islamic bank is allowed to operate based on equity participation such as *musharaka* (partnership), which is similar to the activity of merchant banks and debt-like financing such as *murabaha* (sale at cost plus margin of profit) and *ijarah* (leasing), which are similar to the activities of commercial banks.
[5] Islamic banking is financially separated from conventional banking operation.

facilitate the parallel operating of the Islamic and conventional banking systems, BNM has also established an Islamic cheque clearing and settlement system, as well as an Islamic inter-bank money market system, which operates alongside but separately from conventional banking systems.

Malaysian Islamic banking entered a more mature stage in its development in 2005, when a further ten full-fledged Islamic banks were established or given regulatory approval by BNM. Of these, seven were established by separating existing IBS assets from conventional assets, thereby further demonstrating the important role that the IBS has played in promoting Islamic banking. The establishment of these full-fledged Islamic bank subsidiaries is meant to encourage more flexible operations, which will allow the new Islamic banks to engage in a range of activities similar to those of commercial, investment, and merchant banks. The further three new Islamic banks resulted from the entry of foreign full-fledged Islamic banks. Attracting full-fledged foreign Islamic banks is aimed at enhancing the competitiveness of the domestic Islamic banking industry and to further develop global linkages (Central Bank of Malaysia 2005). To further facilitate Malaysia becoming a premier international Islamic financial centre, BNM has also established an Islamic finance education centre for the local and international banking industry in response to the scarce provision of expertise.

This rapid expansion of full-fledged Islamic banks caused the share of IBS in total Islamic banking assets to drop significantly to 53 percent in 2005, and this share will decline further in the future, as full-fledged Islamic banking becomes increasingly prevalent. Thus, while full-fledged Islamic banking has grown from 0.7 to 12 percent of all banking assets between 1988 and 2007 (Bank Islam Malaysia Berhad 1989; Central Bank of Malaysia 1999b; Aziz 2007), this share is expected to increase to 20 percent by 2010 (Central Bank of Malaysia 2002a). Nevertheless, within the Malaysian context, it is extremely important to note that IBS banking can be seen as the critical catalyst that led to this dramatic growth in Islamic banking, as highlighted by the fact that at least eight of the 12 full-fledged Islamic banks currently operating were founded as IBS banks. Moreover, within the available sample period of 1996 to 2002 for this study, IBS banking was the predominant form of Islamic banking in Malaysia.

Given these developments within the Malaysian banking sector, this chapter aims to measure the relative efficiency of Malaysian banks as well as the determinants

of their productivity performance, and will particularly focus on the relative performance of Islamic banks. More specifically, by deriving estimates of net and gross efficiency for Malaysian commercial banks after estimating a cost function with stochastic frontier techniques, current analysis highlights the impact of operating characteristics, including Islamic banking, foreign ownership, loan quality, equity to asset ratios, and the East Asian financial crisis on the relative costs of Malaysian banks. In particular, the gross efficiency estimates highlight that during the chosen sample period Islamic banking activities appear to be associated with higher input usage. However, the estimates of productivity change, which is decomposed into efficiency change, technical change and scale change effect using the generalised parametric Malmquist Productivity Index, also suggest that full-fledged Islamic banks in particular have been able to overcome some of these cost disadvantages due to rapid technical change.

The rest of the chapter is organised as follows. Section 4.2 provides a brief literature review focused on Islamic banking, and is followed by a description of the methodology in section 4.3. Data and the empirical specification are discussed in section 4.4. Section 4.5 reports on results which are comprised of the cost function estimates, net and gross efficiency estimates, economies of scale, average productivity change and its decomposition, and firm specific productivity change and its decomposition. Finally, section 4.6 offers some conclusions and policy implications.

4.2 PREVIOUS FINDINGS ON THE RELATIVE PERFORMANCE OF ISLAMIC BANKS

While some of the previous literature on Islamic banking performance has employed relatively unsophisticated techniques such as financial ratios, some studies have also employed more advanced techniques such as DEA and SFA. This literature will be reviewed and the focus is on its findings with regard to: the relative performance of full-fledged Islamic banks relative to conventional banks, the relative performance of Islamic banking windows operated by conventional banks relative to conventional banking operations and full-fledged Islamic banks.

For studies using financial ratios, the performance of Islamic banks relative to conventional banks varies according to the financial indicators employed and across the studies. Islamic banks are found to outperform conventional banks in term of overall productivity as measured by an income-to-expenditure ratio (Hamid, M. A.

1999) and profitability, as measured by return-on-equity (ROE) (Hamid, M. A. 1999; Iqbal 2001; Hassoune 2002). Islamic banks have higher growth in equity, deposits, investment and total assets (Iqbal 2001), better asset quality and capital adequacy (Hassan and Bashir 2003), better credit performance (Samad 2004), less risk due to excess liquidity (Metwally 1997; Hamid, M. A. 1999; Samad and Hassan 1999; Samad 2004) and greater investment in government securities (Samad and Hassan 1999). Excess liquidity and high investment in government securities are due to relatively limited investment opportunities, because of the restrictions imposed by *shariah* (Metwally 1997; Hamid, M. A. 1999; Samad and Hassan 1999; Samad 2004). However, not all Islamic banks suffer from excess liquidity (Iqbal 2001; Hassan and Bashir 2003) and some Islamic banks are relatively less cost effective as measured by a cost-to-income ratio (Iqbal 2001) and have higher labour costs (Hamid, M. A. 1999). Nevertheless, some Islamic banks perform as well as conventional banks in terms of profitability (Nienhaus 1988; Metwally 1997; Samad 2004), liquidity (Samad 2004), total asset (Nienhaus 1988), credit risk, and efficiency as measured by an operating expenditure-to-assets ratio (Metwally 1997).

Using the linear regression technique, Hassoune (2002) found that the ROE of Islamic banks is less volatile compared to conventional banks, because the latter is more heavily influence by interest rate fluctuations. The next focus is on studies employing SFA and DEA. Islamic banks are found to have superior cost efficiency relative to conventional commercial and investment banks, in (Alshammari 2003) studies of banks located in Bahrain, Saudi Arabian, Kuwaiti, Oman, Qatar and the UAE. This study also finds that no significant difference in economies of scale exists between Islamic and conventional banks. Similar efficiency results are found in a study of banks in Bahrain, Egypt, Jordan, and Saudi Arabia (Al-Jarrah and Molyneux 2005), and it was also found that Bahraini banks are the most cost efficient. Al-Jarrah and Molyneux (2005) include controls for bank types, country dummies, assets, liquidity, a concentration ratio, market shares, but allow these factors to directly influence cost inefficiency, rather than modelling these factors as environmental variables directly influencing the cost function. In contrast, when loan quality and capital are directly controlled for in the cost function, and bank type controls and country dummies are allowed to directly influence inefficiency, Alshammari (2003) found Bahraini banks to be least cost efficient. These differing results suggest that

careful consideration of the impact of control variables on measured efficiency is necessary when judging the relative efficiency of banks.

Islamic banks are found to be equally if not more efficient when compared to conventional banks in Turkey, using a cost function estimated with SFA (El-Gamal and Inanoglu 2005) and DEA (Alpay and Hassan 2006), despite limited investment avenues for Islamic banks. Turkish Islamic banks cannot even invest in government securities because they are interest bearing in Turkey. On the other hand, Islamic banks in Malaysia are found to be equally cost efficient with conventional commercial banks by (Mokhtar, Abdullah, and Al-Habshi 2006) and (Abdul-Majid, Mohammed Nor, and Said 2005). However, these Malaysian bank studies do not control for any environmental factors either directly in the estimated costs function, or as directly influencing inefficiency. The model below will therefore improve on this earlier work by both controlling for such environmental factors, but also considering their impact on estimated efficiency.

Finally, it is noted while Hassan (2003) and Hassan (2005) have estimated the productivity change of full-fledged Islamic banks, (Alpay and Hassan 2006)'s study of Turkish banks, which employs a non-parametric Malmquist Productivity Index, is the only study that has considered differences in productivity change between Islamic and conventional banks.[6] Interestingly, this study finds that the productivity change and technical change of Islamic banks have declined relative to that of conventional banks between 1990 and 2000. Given these limited previous findings, the model below will employ Orea's (2002) generalised Malmquist total factor productivity index so that the determinants of productivity change in Malaysian banking and the relative productivity performance of Islamic banks can be better analyzed. (Please refer to Appendix I for a summary of selected Islamic and conventional bank comparative efficiency studies.)

As discussed above, the growth of Islamic banking in Malaysia was greatly stimulated by the IBS, which allowed conventional banks to operate an Islamic banking windows if certain rules were adhered to. Therefore, the impact of IBS banking on performance is obviously of interest. Compared to Malaysian conventional banks, Rosly and Bakar (2003) observed that during 1996-99, IBS banking operations have higher profitability as measured by ROA but lower asset utilization and

[6]Hassan (2003; 2005) employs non-parametric Malmquist Productivity Index to analyze the productivity growth of full-fledged Islamic banks. Islamic banks are found to experience moderate productivity growth in most countries operating Islamic banking (Hassan 2005), but experience productivity loss in Pakistan, Sudan and Iran over 1994-2001 (Hassan 2003). Despite these differences, technical change is the dominant determinant of productivity growth in both studies

investment margin ratios. Performance comparisons between IBS banking operations and the Malaysian full-fledged Islamic bank over 1996-1999 using financial ratios, found that the former is more efficient in terms of capital structure, assets, deposit structure and profitability (Hamid, S. A. and Ahmad 2002). In contrast, after estimating a cost function with SFA for the period 1997-2003, Mokhtar, et al (2006) argued that domestic Malaysian parent banks are more efficient than their IBS divisions, while this result is reversed for foreign banks. Moreover, this study found that IBS banking operations are less efficient than full-fledged Islamic banks. However, as the conventional and Islamic operations of IBS banks share their non-financial resources, it is difficult to see how these studies could have meaningfully separated non-financial costs for IBS operations, as would be required to properly specify these models. The model below will therefore simply consider the overall performance of banks, which operate IBS windows relative to other types of banks, so that the author can provide what is argued as less biased estimates of the impact of IBS Islamic banking on bank efficiency and productivity growth.

From the literature review, it can be concluded that past empirical studies on the relative performance of Islamic and conventional banks have used financial ratio analysis, DEA, SFA, and linear regression techniques. However, on balance, there has been relatively little use of more sophisticated techniques such as SFA and DEA, and limited studies (Alpay and Hassan 2006) have provided estimates of differences in productivity change between Islamic and conventional banks. Moreover, despite the recent surge of interest in conventional banks offering Islamic banking products, no study has compared the efficiency of conventional banks operating IBS, full-fledged Islamic bank, and conventional banks without IBS. Furthermore, those studies that have compared the relative performance of IBS banking operations are potentially biased because they must assume an artificial separation between Islamic and conventional operations, which is not consistent with the nature of IBS banking operations.

Finally, most previous studies have not controlled for environmental factors when estimating efficiency. Moreover, consideration of those that do (Alshammari 2003; Al-Jarrah and Molyneux 2005) suggests that the method employed to allow for environmental factors will have a significant impact on relative efficiency estimates. While it is clear that legitimate differences in operating characteristics that influence operating costs should be allowed for when estimating efficient costs, it is not always

clear whether such factors are actually indicators of higher efficient costs that should be allowed for, or are instead indicators of higher inefficiency. Thus, for example, a control for whether a bank engages in Islamic banking, could be interpreted as capturing legitimate difference in costs associated with compliance with *shariah*, or could alternatively be interpreted as a control for systematic inefficiency that may be associated with Islamic banking. If the former dominates, netting out the impact of operating characteristics is appropriate and the resulting net efficiency measure, as defined by Coelli, Perelman, and Romano (1999), is an appropriate measure of managerial efficiency. In contrast, if operating characteristics are predominantly indicators of higher inefficiency, then a gross efficiency measure, as defined by Coelli, et al. (1999), is a more appropriate managerial efficiency measure as it will quantify not only the impact of net inefficiency but also the impact of differences in operating characteristics on actual costs. Regardless of whether operating characteristics are indicators of higher efficient costs or higher inefficiency, gross efficiency estimates allow not only the impact of net inefficiency, but also the impact of operating characteristics on observed costs to be quantified, and are therefore useful if the study of how differences in operating characteristics influence observed differences in the costs of firms is of interest. Therefore, by providing both net efficiency estimates and gross efficiency estimates as proposed by Coelli, et al. (1999), this study would be able to analyse the relative impact of these operating characteristics on the costs of Malaysian commercial banks, and therefore expand upon the existing literature that has analyzed the relative efficiency of Islamic banks.

4.3 METHODOLOGY

The measured efficiency of a firm is calculated as the difference between its observed input and output levels and the corresponding optimal values. An output-oriented measure of efficiency compares observed output with the maximum output possible for given input levels. Alternatively, an input-oriented efficiency measure compares the observed level of inputs with the minimum input that could produce the observed level of output. However, these are measures of technical efficiency, and as such ignore the behavioural goals of a firm. Comparison of the observed mix of inputs or outputs with the optimal mix that would minimise cost, maximise profit or obtain any other behavioural goal is a measure of allocative efficiency. In a cost minimisation context, allocative efficiency occurs when a firm uses the optimal mix of

inputs to minimize costs given input prices. In this context, the author follows previous bank efficiency studies (e.g., Ferrier and Lovell 1990; Mester 1993; Kwan and Eisenbeis 1996; Dietsch and Lozano-Vivas 2000; Isik and Hassan 2002; Abdul-Majid, et al. 2005; Carvallo and Kasman 2005; Mokhtar, et al. 2006) and adopts a cost function approach for Malaysia in this chapter.

However before proceeding, recall that Islamic banking differs from conventional banking in at least two significant ways. Firstly, Islamic banks are prohibited from paying or receiving interest. Therefore, they cannot issue or hold interest-bearing loans or securities but use alternative contract arrangements (Karim 2001).[7] However, as the available investment avenues using contracts are very limited, and most of them concentrate on short term investments, they may yield lower returns. Secondly, by *shariah*, while Islamic banks operate as businesses, they must also act to improve socio-economic development. As business firms, they seek to maximize profit in order to give a good return to shareholders and depositors[8]. However, when meeting their duties to promote economic development, they must also satisfy objectives such as promoting justice and the equitable distribution of income and wealth, maintaining sectoral balance in the economy, and developing human resources through training and retraining (Hamid, M. A. 1999; Choudhury and Hussain 2005).

Given, that the Islamic banks cannot charge or pay interest and are therefore likely to face higher capital costs[9] and satisfy objectives other than profit maximization, it would be inappropriate to judge the relative performance of Islamic banks with a profit or revenue function. In contrast, using a cost function allows the potential higher costs of capital faced by Islamic banks to be controlled for. Moreover, if the non-profit oriented activities of the Islamic bank are carefully controlled for, it is reasonable to assume that Islamic banks will attempt to minimize their costs of operation. It is therefore argued that a cost efficiency study is appropriate for countries such as Malaysia where Islamic and conventional banks operate side-by-side.[10] Moreover, several studies have adopted a cost function approach to consider the

[7] Examples of contracts are *musharaka*, *murabaha* and *ijarah*.
[8] Islamic bank managers attract depositors by offering high returns, which rely on the profits earned from the investment of deposit funds. In Islamic banking, the profit rate is pre-determined (e.g. 80:20 where 80 percent of the profit from the investment of the deposit funds goes to the depositor and the other 20 percent goes to the bank), unlike interest rates that fluctuate in conventional banks.
[9] Islamic banks use alternative contract agreements which focussed on short and medium-term hence, yield lower returns. In contrast, interest-based banks have wide choice of both short- and long-term investments thus potentially yield higher returns.
[10] El-Gamal and Inanoglu (2005) noted that it is appropriate to jointly assess the efficiency of Islamic and conventional banks.

relative efficiency of Islamic banking. These include El-Gamal and Inanoglu (2005) which uses Turkish data and finds that Islamic banks are equally if not more efficient than conventional banks. For Malaysia, Abdul-Majid, et al. (2005) finds no evidence of efficiency differences between Islamic, and conventional banks for the period 1993-2000. Similarly, Mokhtar et al. (2006) also found that the efficiency of full-fledged Islamic banks in Malaysia does not differ from conventional banks.

In specifying the cost function model, the intermediation approach, which has been widely employed in conventional bank studies (e.g., Cebenoyan, Cooperman, and Register 1993; Mester 1993; Kwan and Eisenbeis 1996; Mester 1996; Berger and Mester 1997; Altunbas, Evans, and Molyneux 2001; Isik and Hassan 2002; Rao 2005) as well as in Islamic bank studies (e.g., Brown and Skully 2003; Hassan 2003; Saaid, Rosly, Ibrahim, and Abdullah 2003; Yudistira 2004), and Islamic and conventional bank studies (e.g., Alshammari 2003; El-Gamal and Inanoglu 2005) is employed. The intermediation approach is the most suitable with the concept of Islamic banking in intermediating savers and investors of funds. This is because the nature of Islamic banking that relies on profit-sharing contract, which involves equity participation principle[11] with depositors[12] and banks, can therefore be seen as intermediating savers and investors by transforming deposits into earning assets, rather than as producers of services and loans.[13]

Given this discussion, SFA will be employed in order to estimate a total cost function for Malaysian commercial banks. A single-equation stochastic cost function model can be described as:

$$\ln C_{n,t} = f(Y_{n,t}, W_{n,t}, Z_{n,t}) + \varepsilon_{n,t} \qquad 4.1$$

where $C_{n,t}$ is the observed total cost of production for the n-th firm at time t, $Y_{n,t}$ is a vector of outputs, $W_{n,t}$ is an input price vector and $Z_{n,t}$ is an exogenous factor vector. Following Aigner, et al. (1977), the assumption of the composed error term is as below;

[11] Some current Islamic banks also practice debt-like financing such as *murabaha*.
[12] Similar to conventional banks, some Islamic banks, including 2 Islamic banks in Malaysia put equity contributed by depositors, under deposits from customers, but for some Islamic banks, the equity is categorised under shareholders' funds (Karim 2001).
[13] Islamic banks can be seen as being relatively more focussed on intermediating betwee depositors and borrowers rather than as producer of loans and services.

$$\varepsilon_{n,t} = v_{n,t} + u_{n,t} \qquad 4.2$$

where $v_{n,t}$ and $u_{n,t}$ are independently distributed; $v_{n,t}$ represents random uncontrollable error and is assumed to be normally distributed with zero mean and variance, σ_v^2. $u_{n,t} \geq 0$ is drawn from a one-sided distribution that is assumed to capture inefficiency. Similar to many previous studies, $u_{n,t}$ is assumed to be drawn from a half-normal distribution with mean zero and variance σ_u^2 (e.g., Kaparakis, Miller, and Noulas 1994; Mester 1996; Berger and Mester 1997). Given this assumption, the approach of Jondrow, Lovell, Materov, and Schmidt (1982) is followed to derive the log likelihood for inefficiency which is expressed in terms of the two variance parameters, $\sigma^2 = \sigma_v^2 + \sigma_u^2$ which captures the variance of composed error and $\lambda = \sigma_u / \sigma_v$, which is a measure of the amount of variation originating from inefficiency relative to statistical noise.

Maximum-likelihood estimates are obtained by estimating a multiproduct translog cost function. The specified cost function, after including environmental variables, imposing the standard assumption of homogeneity in input prices, and allowing for the composed error terms, is:

$$\begin{aligned}
\ln \tilde{C}_{n,t} = {} & \varphi + \sum_{k=1}^{K-1} \alpha_k \ln P_{k,n,t} + 0.5 \sum_{k=1}^{K-1} \sum_{s=1}^{K-1} \alpha_{ks} \ln P_{k,n,t} \ln P_{s,n,t} \\
& + \sum_{m=1}^{M} \beta_m \ln Y_{m,n,t} + 0.5 \sum_{m=1}^{M} \sum_{j=1}^{M} \beta_{mj} \ln Y_{m,n,t} \ln Y_{j,n,t} \\
& + \sum_{k=1}^{K-1} \sum_{m=1}^{M} \theta_{k,m} \ln P_{k,n,t} \ln Y_{m,n,t} + \sum_{k=1}^{K-1} \delta_k \ln P_{k,n,t}\, t \\
& + \sum_{m=1}^{M} \psi_m \ln Y_{m,n,t}\, t + \lambda_1 t + 0.5 \lambda_{11} t^2 \\
& + \sum_{h=1}^{H} \xi_h Z_{h,n,t} + v_{n,t} + u_{n,t}
\end{aligned} \qquad 4.3$$

where, $P_{k,n,t} = W_{k,n,t} / W_{K,n,t}$ and $\tilde{C}_{n,t} = C_{n,t} / W_{K,n,t}$

k=1,…,K, and s=1,…,K are indices for input prices; m=1,…M and j=1,…,M are indices for output prices; h=1,…,H is an index for environmental variables; while the

Greek letters (except v and u) represent unknown parameters to be estimated (variables will be defined in section 4.4.2). Standard symmetry is imposed to the second order parameters: $\alpha_{ks} = \alpha_{sk}$ and $\beta_{mj} = \beta_{jm}$. In addition, all input prices and output variables in this approximation are normalized around their means. The parameters defined in Equation 4.3 as well as the σ^2 and λ parameters discussed above are estimated using Maximum-Likelihood Estimation (MLE).[14]

Given the above model specification and assumptions, it can be readily demonstrated that a measure of cost efficiency can be derived as the ratio of observed costs to predicted efficient costs, which is theoretically equivalent to:

$$CE_{n,t} = \exp(u_{n,t}) \tag{4.4}$$

These relative efficiency measures range from one to infinity with a score of one indicating full efficiency. However, $CE_{n,t}$ relies on the unobservable inefficiency, $u_{n,t}$. The author therefore follows the now standard approach of Jondrow, et al. (1982) and employs the conditional expectation of $u_{n,t}$ given the observed value of the overall composed error term, $\varepsilon_{n,t}$, which can be expressed as:

$$E(u_{n,t}|\varepsilon_{n,t}) = \frac{\sigma\lambda}{1+\lambda^2}\left[\frac{\phi(\varepsilon_{n,t}\lambda/\sigma)}{1-\Phi(\varepsilon_{n,t}\lambda/\sigma)} + \left(\frac{\varepsilon_{n,t}\lambda}{\sigma}\right)\right] \tag{4.5}$$

where, ϕ is the standard normal density function and Φ is the standard normal cumulative distribution function.

In the current model, the author has also followed the standard practice of controlling for differences in operating characteristics that may influence the efficient level of costs, by including Z factors directly in the cost function. Moreover, Bos and Kool (2006) and Bos, Koetter, Kolari, and Kool (2008) argue that failure to account for differences between bank groups may yield inappropriate conclusions about bank performance. However, this also implies that the resulting efficiency scores are net of

[14] The author has attempted to use more robust panel data approaches allowing for time varying inefficiency, but such models did not converge. Therefore, each observation is treated as a different firm to avoid the assumption of the same efficiency scores for firms in each year.

the impact of environmental influences on efficient input requirements. As a result, these net efficiency measures enable one to predict how firms are ranked under the assumption that firms operate in an equivalent environment. Moreover, given the assumption that all major environmental influences have been accounted for and are truly exogenous, the net efficiency measure can theoretically be interpreted as a measure of managerial performance (Coelli, et al. 1999).

However, in practice, this assumption is less than tenable, as it is common to employ exogenous factors such as foreign ownership, and bank type dummies, which are potentially indicative of differences in efficiency rather than differences in efficient costs. Thus previous studies, have included exogenous variables such as bank location and branch banking limitation indicators (Berger and DeYoung 1997), the number of branches and mergers (Lozano-Vivas 1998) and dummy variables for foreign ownership (Rao 2005).[15] Therefore, in order to better judge the impact of such factors on estimated efficiency, the author follows the approach of Coelli, et al. (1999) to provide alternative gross efficiency $\left(GE_{n,t}\right)$.

This is done by first, identifying the most favorable operating characteristics by identifying the observation with the minimum value of $\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$, which hereafter is referred to as $Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$ where ξ is the estimated parameter for the Z environmental variable. By assuming that other firms face this most favoured operating environment, rather than their own; a predicted efficient cost for firms relative to the most favoured operating environment can be estimated. This yields a revised estimate of the deviation of a firm's actual costs from frontier costs, which can be expressed as:

$$\varepsilon_{n,t}^{Gross} = \varepsilon_{n,t+}\sum_{h=1}^{H}\xi_h Z_{h,n,t} - Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right] \qquad 4.6$$

[15] Another potential method is to model exogenous factors such as size, organizational type (Al-Jarrah and Molyneux 2005), private-owned, new bank (Kraft, Hofler, and Payne 2006) as directly influencing inefficiency effects.

For given residuals (level of efficiency), output level and input prices, bank with $Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$ has the lowest costs, and hence the lowest negative impact in costs due to operating conditions. Thus, such a bank can be assumed to have the most favourable operating environment. Therefore, it can in practice serve as a virtual benchmark benefiting from the most favoured environmental conditions.

Measures of the firm's gross inefficiency $\mu_{n,t}^{Gross}$ can then be obtained by substituting $\varepsilon_{n,t}^{Gross}$ for $\varepsilon_{n,t}$ in Equation 4.5, and then calculating gross efficiency as:

$$GE_{n,t} = \exp(u_{n,t}^{Gross}) \qquad 4.7$$

Because $(GE_{n,t})$ is calculated under the assumption that a firm faces the most favourable observed operating environment, differences that can be attributed to differences in Z-factors will be reflected as differences in gross efficiency. As discussed above, this is not the case with $CE_{n,t}$, which by definition nets out the impact of differences in operating environment (Coelli, et al. 1999).

As one of the features for production technology, the estimated economies of scale enable banks to identify potential costs savings if they change the operation scale. It can be obtained by first calculating the M output elasticities:

$$\varsigma_{m,n,t} = \frac{\partial \ln \tilde{C}_{n,t}}{\partial \ln Y_{m,n,t}} = \beta_m + \sum_{j=1}^{M}\beta_{m,j}\ln Y_{j,n,t} + \sum_{k=1}^{K-1}\theta_{k,m}\ln P_{k,n,t} + \psi_m t \qquad 4.8$$

From which a scale elasticity can be calculated as:

$$\varsigma_{Scale,n,t} = \left(\sum_{i=1}^{M}\varsigma_{m,n,t}\right)^{-1}. \qquad 4.9$$

If $\varsigma_{Scale,n,t} > 1$, there is economies of scale, if $\varsigma_{Scale,n,t} = 1$, there is constant returns to scale, and if $\varsigma_{Scale,n,t} < 1$, there is diseconomies of scale. Producing at constant returns to scale,

banks realise the lowest average costs in which any increase (decrease) in output will increase (decrease) costs proportionately.

Besides efficiency, bank performance can be gauged by calculating the productivity change. In order to measure productivity change, the author follows the generalised Malmquist approach that has recently been proposed in the literature (Orea 2002; Coelli, Estache, Perelman, and Trujillo 2003). This approach extends the standard Malmquist Productivity Index, which captures only the impact of technical change (TC) and cost efficiency change (CEC), by further allowing for the impact of scale change effect (SCE) on productivity change. Therefore, previously estimated cost function and inefficiency estimates can be employed to calculate the Total Factor Productivity Change (TFPC) and decompose it such that $TFPC = CEC + TC + SCE$. Thus, TFPC can be expressed in log differences as:

$$\begin{aligned} TFPC &= \ln(TFP_{n,t+1} / TFP_{n,t}) \\ &= \ln(CE_{n,t} / CE_{n,t+1}) - 0.5\left[\partial \ln \tilde{C}_{n,t+1} / \partial t + \partial \ln \tilde{C}_{n,t} / \partial t\right] \\ &+ 0.5 \sum_{m=1}^{M} \left[\left(\left(\varsigma_{Scale,n,t+1} - 1\right)\varsigma_{m,n,t+1} + \left(\varsigma_{Scale,n,t} - 1\right)\varsigma_{m,n,t}\right)\ln\left(Y_{m,n,t+1} / Y_{m,n,t}\right)\right] \end{aligned} \quad 4.10$$

CEC measures the change in productivity attributable to improved efficiency and is captured by the first term on the right hand side Equation 4.10 as:

$$CEC = \ln(CE_{n,t} / CE_{n,t+1}). \quad 4.11$$

The second term in Equation 4.10 estimates TC as the mean of the estimated trend change rate of estimated efficient costs:

$$TC = -0.5\left[\partial \ln \tilde{C}_{n,t+1} / \partial t + \partial \ln \tilde{C}_{n,t} / \partial t\right] \quad 4.12$$

The contribution of scale change effect to productivity change is captured in Equation 4.10 by the term:

$$SCE = 0.5 \sum_{m=1}^{M} \left[\left(\left(\varsigma_{Scale,n,t+1} - 1 \right) \varsigma_{m,n,t+1} + \left(\varsigma_{Scale,n,t} - 1 \right) \varsigma_{m,n,t} \right) \ln \left(Y_{m,n,t+1} / Y_{m,n,t} \right) \right] \quad 4.13$$

Consideration of Equation 4.13 reveals that for firms characterized by economies (diseconomies) of scale, output growth results in increased (decreased) rates of productivity change. In contrast, under constant returns to scale, SCE=0, and TFPC will be equivalent to the standard Malmquist productivity change rate. Thus, the further ς_{Scale} deviates from one, the greater the estimated impact of scale change on TFPC will be. Thus, Equation 4.13 reveals an important link between estimated economies of scale and the potential TFPC that can be generated through bank growth.

4.4 DATA AND EMPIRICAL SPECIFICATION

4.4.1 Data

Data on 33 banks was drawn from Bureau van Dijk's (BvD's) BankScope database for the period 1996-2002 and were verified against the banks' annual reports. The data is expressed in Malaysian Ringgit (MYR) and are adjusted for inflation using the Malaysion GDP Deflator, which was extracted from IMF (2004). The number of full-time workers and ownership information is taken from the Central Bank of Malaysia (2002b) and Association of Banks in Malaysia (Various Years). As some banks have incomplete information, this has resulted in an unbalanced panel of 168 observations. Mergers during the sample period have caused a marked reduction in the number of Malaysian commercial banks. Over this period, ten mergers and acquisitions took place: two in 1999, one in 2000, six in 2001 (involving 14 banks) and one in 2002. Given these trends, each pre-merger commercial bank is included as a separate bank and these banks are assumed to have merged into one of the pre-merger banks.

Table 4.1 describes the sample of Malaysian banking institutions by type of bank for each of the years under study. The sample is representative and covers 70 percent of all Malaysian banks. By illustrating trends in the number of banks in several alternative categories, the table reveals the increasing preponderance of merged

banks over time, a significantly greater preponderance of conventional banks operating IBS windows rather than full-fledged Islamic banks, and, particularly at the end of the sample period, a significantly greater preponderance of conventional banks operating IBS windows among domestic banks relative to foreign banks.

Table 4.2 demonstrates the size distribution of sample banks in each year, with size measured in total assets in 2000 MYR. Given mergers, the distribution of banks has shifted towards larger banks over time. In the smallest asset range, there was a relatively balanced mixture of domestic and foreign banks over the period 1996-1998. Subsequently, domestic banks have merged with other banks leaving only foreign banks in this category after 2000. Generally, the number of foreign banks in the very small-sized category is increasing over time and decreasing in the small-asset category. Although most banks in the largest-sized category are domestic banks, the number of foreign banks increased over time, and particularly after 2000.

Table 4.1
Sample of Malaysian banking institutions by category: 1996-2002

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*All Years*
All banks	*16*	*24*	*28*	*28*	*24*	*24*	*24*	*168*[d]
Without IBS	6	6	7	7	9	8	8	51
With IBS	9	17	20	20	13	14	14	107
Islamic	1	1	1	1	2	2	2	10
Foreign banks	*5*	*7*	*8*	*9*	*11*	*11*	*11*	*62*
Without IBS	4	5	6	6	8	7	7	43
With IBS	1	2	2	3	3	4	4	19
Domestic banks	*11*	*17*	*20*	*19*	*13*	*13*	*13*	*106*
Without IBS	2	1	1	1	1[c]	1	1	8
With IBS	8	15	18	17	10	10	10	88
Islamic	1	1	1	1	2	2	2	10
Merged banks[a,b]	-	*1*	*1*	*3*	*4*	*10*	*10*	*29*
Without IBS	-	1	1	1	2	2	2	9
With IBS	-	-	-	2	2	8	8	20
Unmerged banks	*16*	*23*	*27*	*25*	*20*	*14*	*14*	*139*
Without IBS	7	6	7	7	9	8	8	52
With IBS	9	17	20	18	11	6	6	87

Notes;
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.
[c] In 1999 (reflected in 2000 account) 2 banks that operate IBS merged and their IBS assets were transferred to form a new Islamic bank.
[d] Resulted in 168 number of observations due to incomplete information of 33 sample banks from 1996-2002.

Table 4.2
Frequency distribution of banks by year, size, foreign-domestic ownership in the sample

Year	Assets range (MYR, millions)											
	531-5,137			5,138-10,638			10,639-20,207			20,208-114,756		
	Dom	*For*	*All*	*Dom*	*For*	*All*	*Dom*	*For*	*All*	*Dom*	*For*	*All*
1996	3	2	5	3	2	5	3	1	4	2	0	2
1997	2	3	5	8	1	9	3	2	5	4	1	5
1998	3	4	7	7	2	9	5	2	7	5	0	5
1999	2	4	6	8	2	10	5	2	7	5	0	5
2000	1	6	7	3	1	4	5	3	8	4	1	5
2001	0	6	6	2	0	2	5	0	5	7	4	11
2002	0	6	6	3	0	3	4	2	6	6	3	9

Notes:
Dom and For respectively refer to domestic and foreign banks.
Assets measured in 2000 Malaysian Ringgit (MYR)
Source:
Central Bank of Malaysia Annual Reports, various issues, author's calculations, and Bank Scope 2002.

4.4.2 Empirical Specification

The selection of output and input variables follows the existing literature (e.g., Allen and Rai 1996; Mester 1996; Casu and Girardone 2002). Total costs (C) are defined as operating and financial costs and are calculated as the sum of labour expenses, physical capital expenses, and either income paid to depositors for Islamic banks or interest expense for conventional banks. Input prices are the price of labour (W_1), the price of financial capital (W_2), and the price of physical capital (W_3). W_1 is labour expenses divided by the number of full time workers, and labour expenses include wages, salaries, bonuses, costs of defined contribution plans, termination benefits and other personnel costs. W_2 is the amount of income paid to depositors divided by total deposits, and total deposits include customer funding and short term funding. W_3 is the physical capital expenses divided by the fixed assets, and physical capital expenses is total expenses on fixed assets allocated for all furniture, equipment, and bank premises, including depreciation, and administration and general expenses. Bank outputs, are defined as the sum of total loans (Y_1), and total other earning assets (Y_2). The latter are comprised of deposits with other banks, securities and equity investments.

The first operating environment variable is an indicator of loan quality (Z_1), and is proxied by the ratio of the non-performing loans (NPL)-to-total loans (e.g., Clark 1996; Mester 1996; Berger and Mester 1997; Girardone, Molyneux, and Gardener 2004; Williams and Nguyen 2005)). When comparing efficiency, banks must have homogeneous output quality, otherwise unmeasured differences in loan quality may be mistakenly measured as inefficiency (Berger and Mester 1997). This is

because, banks with superior loan quality may appear inefficient because they use more labour and physical capital to monitor loans (Mester 1996; Berger and Mester 1997). Similarly, according to the 'bad management hypothesis', a bank may incur extra expenses in administering bad loans if it has bad management, while the 'bad luck hypothesis' argues that a negative economic shock will cause some banks extra expenses to recover default loans and related administration costs. Finally, according to the 'skimping hypothesis', banks may save costs now by not investing in loan monitoring expenses and face high default loans later (Berger and DeYoung 1997; Berger and Mester 1997). It is expected that the 'bad luck hypothesis' will prevail in this study because the financial crisis caused banks' NPL to rise significantly in 1998 and remain high for the rest of the sample period. Moreover, since the increase in the NPL is due to an external shock, it should be controlled for in the function (Berger and Mester 1997). It is therefore expected a positive coefficient for this variable, thereby indicating that banks with high NPL-to-loans (lower loan quality) incur higher costs.

The second operating environment variable is measured by the equity-to-total assets ratio (Z_2) (e.g., Clark 1996; Mester 1996; Berger and Mester 1997; Girardone, et al. 2004; Williams and Nguyen 2005). Two contrasting theoretical arguments on the relationship between equity financing and inefficiency exist. In the first, raising equity involves higher costs relative to raising deposits, hence, risk adverse banks that prefer equity financing would appear inefficient, in the absence of this control variable. In contrast, unlike income paid to depositors, in the standard specification of the intermediation model, dividends paid on equity is not considered as a cost, hence if the equity-to-total-asset ratio is not controlled for, banks with more equity financing will appear more efficient (Berger and Mester 1997).[16] Therefore, no *a priori* assumption is made on the sign of Z_2.

The remaining environmental variables are dummy variables that are designed to capture potential differences in bank characteristics, and operating environment that may influence costs. The dummy variable indicating full-fledged Islamic banks (Z_3), is to control for the potential impact of full-fledged Islamic banking on bank costs. No *a priori* assumption is made due to mixed results in literature on the direction of the influences (e.g., Al-Jarrah and Molyneux 2005; El-Gamal and Inanoglu 2005; Mokhtar, et al. 2006). Given that some banks have gone through mergers, one can control for this effect by using a merger dummy variable (Z_4). This dummy is

[16] Mester (1996) noted that in the cost function, level of financial capital rather than its price should be controlled for.

expected to have a positive impact on costs because merged banks need some time for system integration and personnel integration (Peristani 1997; Rhoades 1998; Sherman and Rupert 2006). As changes in bank scale should be captured through the impact of output growth on estimated costs, the impact of mergers identified through Z_4 will be net of the impact of changes in bank scale attributable to the merger.

A dummy for observations in 1998 is included to control for the East Asian financial crisis (Z_5). The financial crisis, which started in the third quarter of 1997 hit the stock market and banking sector badly. In response, banks eliminated a large number of employees and cut other expenses drastically during and after the crisis (Central Bank of Malaysia 1997, 1998, 1999a). However, the government also took several immediate measures, such as reducing interest rates, to both counter the banking crisis and stimulate the economy (see Lindgren, Balino, Enoch, Gulde, Quintyn, and Teo 1999 for actions taken). As a result of these immediate measures, much of the impact of the financial crisis was concentrated in 1998 as demonstrated by Malaysian GDP growth, which was respectively 7.3, -7.4, and 6.1 percent in 1997, 1998, and 1999 (Ministry of Finance Malaysia Various Years). As the decline in interest rates coupled with cost cutting on operating expenses resulted in declines in total costs for banks, it is expected that the coefficient of the 1998 financial crisis dummy to be negative.[17]

The author considered including a foreign-owned dummy, for banks with more than 50 percent foreign ownership. However, while almost all domestic banks operate an IBS window relatively few foreign banks do (see Table 4.1). The author therefore, chose to interact a foreign dummy variable with a dummy variable for conventional banks that operate IBS windows and include the resulting set of dummy variables. Therefore, the model includes dummy variables for foreign banks without IBS (Z_6), foreign banks with IBS (Z_7), domestic banks with IBS (Z_8), and leaves domestic banks without IBS as the base case measured in the constant.[18]

When predicting the expected impact of these dummy variables on efficient costs, it is noted that foreign banks are expected to have lower cost relative to domestic

[17]A dummy variable for 1996, 1997, all post-crisis years as well as individual dummy variables for each of the years after 1998 were tested but were found to be statistically insignificant. Other potential environmental variables such as asset size and potential relevant ratios are also not significant in this model. It is also noted that the increase in bad loans that was associated with the crisis are controlled for with the Z_1 variable.

[18] As all Islamic banks in the sample are domestically owned, and by definition are not conventional banks, the impact of Islamic banking on costs measured by Z_3 is also relative to the base case of a domestic bank that does not operate IBS.

banks because they have priority access to technology from their parent banks and better access to multinational clients (Berger, Clarke, Cull, Klapper, and Udell 2005). Moreover, in the literature foreign banks are found to be more efficient than domestic banks in Malaysia (Matthews and Ismail 2006; Mokhtar, et al. 2006), transition countries (Hasan and Marton 2003; Kasman and Yildirim 2006), India (Bhattacharyya, Lovell, and Sahay 1997), Australia (Sturm and Williams 2004) but not the USA (Mahajan, Rangan, and Zardkoohi 1996; Chang, Hasan, and Hunter 1998).

With regard to banks operating IBS windows, there is a less clear-cut expected relationship. Thus, the provision of IBS banking services may reduce efficient costs by allowing a bank to service additional market segments with its existing staff and facilities. However, higher costs may be associated with Islamic financing and/ or the need to maintain strict financial separation between Islamic and non-Islamic operations.

Therefore, while the previous literature suggests that the coefficient on (Z_6) will be negative to reflect that foreign banks without IBS will incur less cost then domestic banks without IBS services, the ambiguity with regard to the likely impact of IBS banking services on efficient costs, implies that the sign of the coefficient for the Z_7 and Z_8 variables cannot be *a priori predicted.*

Finally, Z_9 provides a dummy variable indicating public ownership, and is expected to have a positive sign indicating higher costs.[19] Generally, state-owned banks perform poorly relative to private-owned banks in developing nations (e.g., Isik and Hassan 2003a; Berger, et al. 2005; Bonaccorsi di Patti and Hardy 2005). This may be because state-owned banks are usually associated with directed lending or with specific objectives such as developing certain industries or regions (Berger, et al. 2005).

Descriptive statistics are presented in Table 4.3 and the values are in real 2000 MYR. The difference in bank size is relatively high. The biggest bank has approximately 200 times the assets of the smallest bank. Most banks with a high price of physical capital are foreign banks.[20] Foreign banks usually rent office spaces in expensive buildings or areas suitable with their target customers and they only have a few branches, thereby making their costs for physical capital very high. There is a

[19] Publicly-owned banks are defined as banks with more than 50 percent government ownership through its agencies such as the *Employees Provident Fund* (EPF) and *Permodalan Nasional Berhad* (PNB). By definition, no foreign banks are included in the publicly owned category.
[20] Similar to Isik and Hassan (2002).

bank with a loan quality (NPL-to-loans) ratio of 0.77 in 1999, reflecting an extremely high level of NPLs relative to the sample average of 0.13. Another bank has an equity-to-asset ratio of -0.05 in 2000 that is due to negative equity. High-accumulated losses in this bank have led to high negative reserves and thus negative equity.

Table 4.3:
Descriptive statistics for sample banks, 1996-2002

Symbol	*Variables*	*Mean*	*St. Dev*	*Min*	*Max*
C	Total Costs (MYR, million)	8.44	10.19	0.22	70.81
	Outputs				
Y_1	Loans (MYR, million)	103.85	130.21	1.46	767.70
Y_2	Other earning assets (MYR, million)	56.76	71.04	1.52	357.56
	Input Prices				
W_1	Price of labour (MYR, thousand)	0.59	0.34	0.18	2.30
W_2	Price of financial capital (MYR, thousand)	47.53	23.04	13.29	155.45
W_3	Price of physical capital (MYR, thousand)	1,158.77	1,522.02	179.78	9,975.00
	Control Variables				
Z_1	Loan quality	0.13	0.12	0.01	0.77
Z_2	Equity/Asset Ratio	0.10	0.05	-0.05	0.33
Z_3	Islamic bank Dummy	0.06	0.24	0	1
Z_4	Merged bank Dummy	0.17	0.38	0	1
Z_5	Financial crisis Dummy	0.17	0.37	0	1
Z_6	Dummy- Equals 1 for 1998. Foreign without IBS Dummy	0.26	0.44	0	1
Z_7	Foreign with IBS Dummy	0.11	0.32	0	1
Z_8	Domestic with IBS Dummy	0.52	0.50	0	1
Z_9	Publicly owned bank Dummy	0.16	0.37	0	1

4.5 RESULTS

4.5.1 The Cost Function Estimates

The estimated cost function parameters are reported in Table 4.4. Model A includes the nine environmental variables (Z_1-Z_9) described above, while Model B

excludes the foreign with IBS (Z_7), domestic bank with IBS (Z_8), and public (Z_9) dummy variables, which are individually insignificant in Model A. Moreover, as a log likelihood ratio test of the joint significance of these three parameters is 4.81, the null hypothesis that these parameters are jointly insignificant cannot be rejected and as it is the preferred model, the following discussion will be limited to Model B. However, as domestic banks without IBS windows are the base case in Model A, this result suggests that *ceteris paribus* no statistically significant difference in efficient costs can be identified for the group made up of all conventional domestic banks, foreign banks with IBS windows, and publicly owned banks.

Recalling that $\lambda=\sigma_u/\sigma_v$ the highly significant estimate of 1.501 implies that estimated deviation from the frontier is due mainly to inefficiency rather than statistical noise. Loan quality (Z_1) is positive as predicted and indicates that the lower output quality (higher the NPL-to-loan ratio), the higher the cost incurred by banks, which may reflect higher monitoring costs. Moreover, as the NPL-to-loan ratio increased significantly from 6 to 17 percent for the average bank between 1997-1999, this implies that estimated efficient costs for an average bank increased by 3.5 percent, because of the increase in NPLs associated with the financial crisis. Moreover, as the average NPL-to-loan ratio remains stable at approximately 16 percent after 1999, the financial crisis appears to have a long-term upward effect on costs by causing a sustained reduction in loan quality. The equity-to-asset ratio (Z_2) has a negative relationship with costs, indicating that as the equity-to-asset ratio increases, costs are lower relative to those banks that depend more on deposits. However, while the average equity-to-asset ratio increased slightly between 1996 and 2002, this change is not substantial and there is no significant impact attributed to financial crisis.

The positive coefficient for the Islamic bank dummy (Z_3) indicates that full-fledged Islamic banks are found to have costs that *ceteris paribus* are 15.0 percent higher than for other banks. This may result from constrained opportunities in terms of investments and limited expertise in Islamic banking. Merged banks (Z_4) are found to have costs that are 10.8 percent higher, after controlling for other variables.[21] The dummy variable for the financial crisis (Z_5) is positive, indicating that costs fell by 4.8 percent in 1998 after controlling for other variables. Finally, foreign banks without IBS windows (Z_6) are found to have costs that are 21.8 percent lower than the

[21] Berger and Humphrey (1997) noted that some mergers improve cost efficiency whereas others worsen their performance. Orea (2002) found that merged banks have negative efficiency change in contrast to the unmerged banks in the initial period of merger activities.

combined group of all domestic banks, publicly owned banks, and foreign owned banks with IBS windows.

Table 4.4
Maximum likelihood estimates for parameters of the costs function for Malaysian banks: 1996-2002

Coefficient	*Parameters*	*Model A*		*Model B*	
		Estimated value	Std Error	Estimated value	Std Error
φ_0	Constant	0.134**	0.058	0.088**	0.043
α_1	ln P_1	0.205***	0.039	0.183***	0.030
α_2	ln P_2	0.779***	0.028	0.796***	0.026
$\alpha_{1,1}$	$(\ln P_1)^2$	-0.004	0.077	-0.024	0.070
$\alpha_{2,2}$	$(\ln P_2)^2$	0.048	0.059	0.030	0.057
$\alpha_{1,2}$	ln P_1 ln P_2	-0.011	0.054	0.001	0.051
β_1	ln Y_1	0.550***	0.030	0.533***	0.029
β_2	ln Y_2	0.425***	0.024	0.435***	0.024
$\beta_{1,1}$	$(\ln Y_1)^2$	0.144***	0.025	0.138***	0.026
$\beta_{2,2}$	$(\ln Y_2)^2$	0.251***	0.038	0.258***	0.035
$\beta_{1,2}$	ln Y_1 ln Y_2	-0.192***	0.028	-0.191***	0.027
$\theta_{1,1}$	ln P_1 ln Y_1	-0.040	0.026	-0.050**	0.023
$\theta_{1,2}$	ln P_1 ln Y_2	0.033	0.032	0.038	0.032
$\theta_{2,1}$	ln P_2 ln Y_1	0.050	0.030	0.060**	0.029
$\theta_{2,2}$	ln P_2 ln Y_2	-0.051	0.034	-0.055	0.034
λ_1	t	-0.029***	0.007	-0.026***	0.008
λ_{11}	t^2	-0.001	0.006	0.0001	0.006
δ_1	ln P_1 t	0.025	0.016	0.028*	0.016
δ_2	ln P_2 t	-0.023	0.016	-0.025	0.016
ψ_1	ln Y_1 t	0.016*	0.008	0.015*	0.009
ψ_2	ln Y_2 t	-0.015	0.009	-0.013	0.009
ζ_1	Loan quality	0.327***	0.098	0.309***	0.103
ζ_2	Equity/Asset Ratio	-0.743***	0.231	-0.736***	0.229
ζ_3	Islamic bank	0.142**	0.072	0.150***	0.041
ζ_4	Merged bank	0.089***	0.028	0.108***	0.026
ζ_5	Financial crisis	-0.044*	0.025	-0.048**	0.023
ζ_6	Foreign without IBS	-0.268***	0.053	-0.218***	0.028
ζ_7	Foreign with IBS	-0.084	0.063		
ζ_8	Domestic with IBS	-0.045	0.049		
ζ_9	Publicly owned bank	-0.030	0.033		
λ	Lambda	2.123***	0.647	1.501***	0.439
σ	Sigma	0.103***	0.013	0.096***	0.014
Log likelihood			208.158		205.751
Economies of scale for the sample average bank [a]				1.033**	0.015

Notes;
*, **, *** Significant at 90, 95 and 99 percent confidence level.
[a] Significantly different from 1, hence indicating presence of economies of scale.

4.5.2 Net and Gross Efficiency Estimates

Table 4.5 and 4.6 respectively report estimated net and gross efficiency for Model B. As expected, given the theoretical discussion above, average net efficiency is higher than estimated average gross efficiency. The net efficiency of Malaysian commercial banks is on average 1.066, and ranges from 1.019 to 1.217. In contrast, the average gross efficiency measure is 1.340, thereby indicating that the costs of the average bank are 34 percent higher than if it faced the most favourable operating environment. Moreover, the gross efficiency estimates range from 1.032 to 1.688. Thus, while the net efficiency scores demonstrate that there is relatively little variation in the estimated efficiency once differences in the Z variables are controlled for, the gross efficiency scores suggest that substantial difference in costs can in fact be attributed to differences in operating environment.

Table 4.5
Average net efficiency for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive statistics: All banks								
Average	1.064	1.057	1.064	1.071	1.075	1.056	1.075	1.066
Standard Deviation	0.029	0.026	0.033	0.039	0.048	0.036	0.041	0.037
Minimum	1.033	1.022	1.025	1.026	1.02	1.019	1.024	1.019
Maximum	1.142	1.124	1.155	1.181	1.217	1.157	1.206	1.217
Average efficiency by category								
All banks	*1.064*	*1.057*	*1.064*	*1.071*	*1.075*	*1.056*	*1.075*	*1.066*
Without IBS	1.071	1.057	1.066	1.082	1.078	1.057	1.083	1.071
With IBS	1.061	1.057	1.062	1.068	1.076	1.057	1.072	1.065
Islamic	1.058	1.056	1.072	1.061	1.062	1.042	1.059	1.057
Foreign banks	*1.089*	*1.059*	*1.061*	*1.060*	*1.072*	*1.059*	*1.089*	*1.070*
Without IBS	1.075	1.057	1.069	1.066	1.081	1.056	1.086	1.071
With IBS	1.142	1.064	1.038	1.048	1.05	1.065	1.094	1.067
Domestic banks	*1.053*	*1.056*	*1.065*	*1.077*	*1.078*	*1.053*	*1.062*	*1.064*
Without IBS	1.062	1.055	1.05	1.181	1.053	1.066	1.06	1.074
With IBS	1.051	1.056	1.065	1.071	1.083	1.054	1.063	1.064
Islamic	1.058	1.056	1.072	1.061	1.062	1.042	1.059	1.057
Merged banks[a,b]	-	*1.093*	*1.082*	*1.052*	*1.059*	*1.058*	*1.067*	*1.063*
Without IBS	-	1.093	1.082	1.097	1.071	1.069	1.061	1.075
With IBS	-	-	-	1.030	1.046	1.055	1.069	1.057
Unmerged banks	*1.064*	*1.055*	*1.063*	*1.073*	*1.079*	*1.054*	*1.080*	*1.067*
Without IBS	1.069	1.051	1.065	1.077	1.076	1.050	1.083	1.068
With IBS	1.061	1.057	1.062	1.072	1.081	1.060	1.076	1.066

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.

Tables 4.5 and 4.6 also indicate that the yearly average as well as the range of the efficiency scores, has increased for both net and gross efficiency. The trend in net efficiency suggests a decline in average efficiency over the sample period, but also the presence of a group of firms that were steadily slipping further away from the cost frontier. Thus, average net efficiency deteriorated from 1.064 in 1996 to 1.075 in 2002 and the maximum net efficiency score increased from 1.142 in 1996 to 1.206 in 2002. This may indicate that there are high gains achieved by best-practice banks (technical change) but declines in efficiency as other banks struggle to keep up with best practice (Wheelock and Wilson 1999).

Focusing on Table 4.5, after netting out the impact of environmental factors, the efficiency estimates of different bank categories consistently cluster around the overall mean, with a minimum group average of 1.057 for full-fledged Islamic banks and a maximum group average of 1.075 for merged banks without IBS windows. Thus, once the impact of operating characteristics on estimated costs is netted out, there is little further difference in estimated efficiency across the identified categories. Stated more pointedly, if efficiency is judged against an efficient frontier, which for example allows full-fledged Islamic banks to have 15 percent higher costs and requires foreign banks without IBS windows to have 21.8 percent lower costs, it is not surprising that the resulting net efficiency scores demonstrate little difference across these groups. It is also noted that this criticism is relevant for studies such as (Berger and DeYoung 1997; Lozano-Vivas 1998) which have reported net efficiency scores by including exogenous variables directly into the cost function.

In contrast, because the gross efficiency estimates reported in Table 4.6 include the impact of net efficiency as well that of unfavourable operating characteristics, they yield considerable information with regard to the underlying differences in the costs of banks across the various identified categories. Moreover, these differences are broadly consistent with the above interpretation of the cost implications for the relevant dummy variables in Table 4.4. Thus, for example, while the average gross efficiency score is 1.34 for all banks, foreign banks without IBS have average gross efficiency of 1.173, demonstrating relatively low costs for these banks. Similarly, the poorer average gross efficiency estimates for merged banks (1.432) versus unmerged banks (1.321) suggest that the process of consolidation in Malaysian banking may have contributed to increased banking costs. Moreover, it is also noted that this result cannot be attributed to a misspecification that attributes the effects of economies of

scale to the merger dummy, because such effects will be directly controlled for with the output variables. Thus, rather than contributing to improved efficiency, the spate of mergers in Malaysian banking may have actually resulted in transitional problems and managerial inefficiency that reduced the cost effectiveness of the merged banks.

Table 4.6
Average gross efficiency for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive statistics: All banks								
Average	1.309	1.308	1.293	1.366	1.361	1.351	1.385	1.340
Standard Deviation	0.109	0.109	0.099	0.112	0.155	0.173	0.164	0.136
Minimum	1.113	1.032	1.037	1.108	1.043	1.066	1.052	1.032
Maximum	1.508	1.509	1.555	1.564	1.615	1.688	1.651	1.688
Average efficiency by category								
All banks	*1.309*	*1.308*	*1.293*	*1.366*	*1.361*	*1.351*	*1.385*	*1.340*
Without IBS	1.226	1.184	1.169	1.261	1.236	1.184	1.220	1.212
With IBS	1.342	1.340	1.330	1.397	1.422	1.428	1.457	1.386
Islamic	1.508	1.509	1.422	1.480	1.527	1.480	1.544	1.502
Foreign banks	*1.222*	*1.212*	*1.179*	*1.262*	*1.250*	*1.221*	*1.266*	*1.234*
Without IBS	1.160	1.151	1.149	1.212	1.207	1.138	1.181	1.173
With IBS	1.471	1.365	1.272	1.364	1.364	1.365	1.416	1.371
Domestic banks	*1.348*	*1.347*	*1.339*	*1.415*	*1.455*	*1.461*	*1.486*	*1.402*
Without IBS	1.359	1.350	1.291	1.556	1.469	1.506	1.492	1.423
With IBS	1.325	1.336	1.337	1.403	1.439	1.453	1.473	1.389
Islamic	1.508	1.509	1.422	1.480	1.527	1.480	1.544	1.502
Merged banks [a,b]	-	*1.305*	*1.251*	*1.360*	*1.405*	*1.451*	*1.475*	*1.432*
Without IBS	-	1.305	1.251	1.304	1.387	1.388	1.387	1.354
With IBS	-	-	-	1.388	1.423	1.467	1.497	1.467
Unmerged banks	*1.309*	*1.308*	*1.295*	*1.367*	*1.352*	*1.280*	*1.321*	*1.321*
Without IBS	1.267	1.218	1.193	1.286	1.267	1.207	1.259	1.243
With IBS	1.342	1.340	1.330	1.398	1.421	1.377	1.403	1.367

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.

Focusing more specifically on Islamic banking, the pure Islamic banks have average gross efficiency equal to 1.502, thereby strongly suggesting that full-fledged Islamic banking has been associated with higher input requirements. Moreover, while the group of all conventional banks without IBS have average gross efficiency of (1.212), those with Islamic banking windows have higher input requirement as

demonstrated by deteriorating gross efficiency (1.386).[22] Thus, after the impact of operating characteristics on input requirements is allowed for, these results suggest a clear hierarchy with pure conventional banks exhibiting the best cost performance, followed by conventional banks that operate IBS windows, and finally pure Islamic banks with the worst cost performance. These results can be compared to the previous literature: Islamic banks are found to have no difference with conventional banks in Malaysia (Abdul-Majid, et al. 2005; Mokhtar, et al. 2006), but be equally if not more efficient in Turkey (El-Gamal and Inanoglu 2005), more efficient in Arabian countries (Al-Jarrah and Molyneux 2005) and in GCC countries (Alshammari 2003) when compared to conventional banks. These differences may potentially be due to the absence of environmental variables particularly the control for loan quality (Z_1) and equity-to-assets ratio (Z_2) in some previous studies employing the intermediation approach, different input and output specifications, and cross-country differences in Islamic banking that may influence relative cost efficiency.[23]

Finally, focussing on the overall trend in gross efficiency, the average gross efficiency estimates show that average gross efficiency improves moderately from 1.308 in 1997 to 1.293 in 1998, and this improvement in average estimated gross efficiency is observed in all bank categories. However, average gross efficiency deteriorates to 1.366 in 1999 and remains near this level until 2002. Thus, the results suggest a temporary improvement in overall cost performance in 1998 followed by a sustained reduction in cost performance. These results are interpreted as reflecting the dual impact of the financial crisis on cost efficiency. Thus, the sustained deterioration in gross efficiency after 1998 reflects the sustained increase in non-performing loans and the resulting increase in input requirements discussed above. In contrast, the temporary improvement in gross efficiency in 1998 reflects an immediate but temporary response to the financial crisis, which can be attributed to a decline in total costs as a result of elimination a large number of workers, cuts in other operating expenses, and declines in the interest rate. However, in the long run, it is clear that reduced loan quality had a significant positive impact on costs in the Malaysian banking sector.

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[22] It is noted that higher input requirements as reflected by higher average gross efficiency estimates for IBS banks are also observed within the foreign banks, merged banks, and unmerged banks categories, thereby supporting this conclusion. While this conclusion is not suggested by the domestic banks category, only 8 out of 96 conventional domestic bank observations do not have IBS banking, and this result is therefore dependent on a single non IBS bank in the domestic group in each year after 1996.

[23] For example, Islamic banks in other countries may employ more equity-based financing rather than debt-like financing which is more common in Malaysia.

4.5.3 Economies of Scale

Table 4.4 reports that the estimated scale economies for the sample average bank are 1.033 and significantly different from one, thereby indicating the presence of moderate scale economies. Table 4.7 provides firm specific scale economy estimates for all banks and by bank category. The range of the estimated scale economies is between 0.911 and 1.218 and is consistent with the previous literature (e.g., Clark 1996; Orea 2002; Carvallo and Kasman 2005).

Table 4.7
Economies of scale for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive statistics: All banks								
Average	1.066	1.061	1.059	1.042	1.026	1.026	1.025	1.043
Standard Deviation	0.036	0.042	0.041	0.040	0.053	0.039	0.049	0.048
Minimum	0.990	0.973	0.965	0.944	0.925	0.936	0.911	0.911
Maximum	1.115	1.140	1.150	1.166	1.218	1.084	1.104	1.218
Average economies of scale by category								
All banks	*1.066*	*1.061*	*1.059*	*1.042*	*1.026*	*1.026*	*1.025*	*1.043*
Without IBS	1.070	1.080	1.073	1.054	1.032	1.013	1.015	1.045
With IBS	1.064	1.056	1.054	1.038	1.027	1.038	1.038	1.045
Islamic	1.051	1.045	1.056	1.023	0.992	0.992	0.980	1.010
Foreign banks	*1.060*	*1.065*	*1.062*	*1.045*	*1.033*	*1.021*	*1.028*	*1.041*
Without IBS	1.052	1.068	1.065	1.049	1.035	1.010	1.016	1.039
With IBS	1.091	1.058	1.053	1.037	1.026	1.039	1.049	1.045
Domestic banks	*1.068*	*1.060*	*1.058*	*1.040*	*1.021*	*1.030*	*1.023*	*1.044*
Without IBS	1.105	1.140	1.121	1.079	1.008	1.032	1.012	1.075
With IBS	1.061	1.055	1.054	1.038	1.028	1.038	1.033	1.045
Islamic	1.051	1.045	1.056	1.023	0.992	0.992	0.980	1.010
Merged banks[a,b]	-	*1.063*	*1.053*	*1.026*	*1.032*	*1.036*	*1.027*	*1.033*
Without IBS	-	1.063	1.053	1.064	1.023	1.032	1.033	1.040
With IBS	-	-	-	1.007	1.041	1.037	1.025	1.030
Unmerged banks	*1.066*	*1.061*	*1.059*	*1.043*	*1.025*	*1.018*	*1.024*	*1.045*
Without IBS	1.067	1.077	1.074	1.048	1.025	1.003	1.002	1.039
With IBS	1.064	1.056	1.054	1.042	1.025	1.040	1.054	1.048

Notes:
[a] No mergers between Islamic banks have occurred during the sample period
[b] Includes 2 foreign mergers.

On average, these estimated scale economies have declined from 1.066 in 1996 to 1.025 in 2002, and this result is consistent with the general increase in the scale of banks through mergers discussed above. Similarly, within almost all of the bank categories summarized in Table 4.7, very moderate economies of scale and a slight downward trend in estimated scale economies is evident. Thus, there is little evidence for a difference in scale economies across the groups identified in Table 4.7. Moreover, even though full-fledged Islamic banks are the only category with average economies of scale less than one in any year, this result is also consistent with the broader finding that most banks in the sample appear to operate at or near CRS.[24] In sum, the presence of moderate economies of scale in 1996, the subsequent decline in these estimates and the consolidation of banks, suggests that if TFPC in Malaysian banking was affected by scale change during 1996-2002, these improvements would not only have been small, but would have also been largely dissipated by the end of the sample period. Moreover, this conclusion is appropriate for most of the bank categories summarized in Table 4.7.

4.5.4 Average productivity change and its decomposition

Table 4.8 reports average estimated productivity change across all banks and its decomposition into technical efficiency change, technical change and scale change effect. Over the sample period, average productivity change was 2.68 percent per year.[25] Thus, productivity change has been largely driven by technical change.[26] However, as estimated average technical change declined from 3.41 percent in 1997 to 1.65 percent in 2002, the trend decline in overall productivity change can also be attributed to declining rates of technical change.

The positive average scale change effect of 0.32 is consistent with the finding that banks are characterised by moderate economies of scale, but also further reinforces the finding that mergers have not contributed substantially to productivity gains. However, between 1996 and 1997 scale change contributed a 1.35 percent

[24] Yudistira (2004) found that small and medium-sized Islamic banks in most countries have diseconomies of scale but Alshammari (2003) found that bank type has no effect of economies of scale in GCC countries.

[25] Sufian and Ibrahim (2005) reported average total productivity growth for post-merger Malaysian banks of -1.3 percent for the period 2001-2003.

[26] This result is similar to findings by Orea (2002) on Spanish banks, Isik and Hassan (2003b) for Turkish banks and Casu, Girardone, and Molyneux (2004) on Spanish and Italian banks where technical change is the main determinant of productivity change. Krishnasamy, et al. (2004) found productivity improvement in 10 Malaysian commercial banks was also primarily determined by technical change during the 2000-2001 period.

increase in productivity change, and it may be significant that this occurred before the financial crisis and cannot be attributed to mergers, which are concentrated later in the sample. The following year saw a negative scale change effect of 0.43 percent, which may reflect declines in output due to the financial crisis and reduced economic growth in Malaysia in 1998. Subsequent to this, the average scale effect declined from 0.48 percent in 1999 to 0.07 percent in 2002, and this result is highly consistent with the decline in estimated economies of scale documented above. Moreover, as the average returns to scale in Malaysian banking was only 1.025 in 2002, there is little reason to believe that scale change will contribute significantly to productivity change in the future.

Table 4.8
Productivity change in Malaysian banking, annual percentage rate of change

Period	*Mean Cost Efficiency Change*	*Mean Technical Change*	*Mean Scale Change Effect*	*Mean Productivity Change*
1996/97	0.75	3.41	1.35	5.51
1997/98	-0.86	3.72	-0.43	2.43
1998/99	-1.04	3.71	0.48	3.15
1999/2000	-1.18	2.72	0.49	2.03
2000/01	1.58	2.09	0.26	3.93
2001/02	-1.74	1.65	0.07	-0.02
1996/2002	-0.52	2.88	0.32	2 .68

While on average technical change and scale change have contributed positively to productivity change, cost efficiency change is on average responsible for a 0.52 percent reduction in productivity change over the sample period. However, the pattern of annual efficiency change is quite erratic with large positive contributions to productivity change in 1997 and 2001 but substantial negative effects in other years. Thus, while technical change has determined the long-term downward trend in average productivity change, efficiency change has been responsible for dramatic deviations around this trend. Moreover, while efficiency change reduced average productivity change by 0.86 percent in 1998 during the financial crisis, the magnitude of this effect is actually less than in other years when efficiency change was negative. Thus, the results suggest that no systematic decline in productivity caused by declines in net efficiency can be attributed to the financial crisis in 1998. In contrast, as the gross efficiency estimates suggest, the financial crisis has had the impact of driving up efficient costs by triggering a sustained increase in non-performing loans.

4.5.5 Firm specific productivity change and its decomposition

Table 4.9 provides average productivity change estimates over the entire sample period for all banks and by bank category. It also decomposes these rates into efficiency change, technical change, and a scale change effect. It is clear that substantial differences exist between average productivity changes for the various bank categories. Thus, the small group of full-fledged Islamic banks have the highest average productivity change at 4.23 percent,[27] while the minimum group average of 0.75 is for foreign banks with IBS windows. Merged banks also have lower average productivity change (1.48 percent) relative to unmerged banks (2.88 percent). However, this result appears to be largely attributable to the low average productivity change of merged banks with IBS windows (0.86 percent). Compared to foreign banks (2.12 percent), domestic banks have higher average productivity change (3.01 percent). Nevertheless, this result is largely attributable to the above-mentioned high productivity change of full-fledged Islamic banks, and the relatively low average productivity change of foreign banks with IBS (0.75 percent).

Focusing on the decomposition of productivity change reveals some important insights into these substantial differences in productivity change across bank categories. The high estimated productivity change for full-fledged Islamic banks can be primarily explained by particularly rapid technical change (3.70 percent), and moderate gains in efficiency (0.27 percent), thereby suggesting that Islamic banks have not only been adept at developing new cost reducing products and processes, but have also managed to eliminate inefficiencies in their operations.[28] Thus, despite the relatively higher costs of Islamic banking detailed in the above discussion of the gross efficiency estimates, full-fledged Islamic banks appear to be making rapid strides in improving their productivity and may be able to eliminate a substantial proportion of their cost disadvantage over time.

In contrast, the relatively low average productivity change rates of foreign banks that operate IBS windows is attributable to very low average technical change (1.13 percent), as well as substantial deterioration in efficiency (-0.61 percent). As foreign banks without IBS windows have relatively superior technical change (2.63 percent) and efficiency change (-0.17), these results suggest that, in particular, foreign

[27] Moderate productivity growth is found in Islamic banks for most countries (Hassan 2005) but productivity loss is found for Islamic banks in Sudan, Iran and Pakistan (Hassan 2003).
[28] This is consistent with Hassan (2003; 2005) who also found that the productivity change of Islamic banks is driven by technical change.

banks that have adopted IBS have not only failed to develop new cost saving technologies, but have also become less efficient over time. This may suggest that despite the fact that these banks moved into the developing market for Islamic banking services, they were laggards in developing cost efficient products and processes for this market. In contrast, foreign banks that have remained focused on conventional banking services have been able to sustain technical change and have been more able to maintain efficiency levels. Thus, the results may suggest that, for foreign conventional banks, entering the Islamic banking market has been a distraction from their core competencies.

Table 4.9
Productivity change for all banks and by category 1996-2002,
annual percentage rate of change

	Mean Efficiency Change	*Mean Technical Change*	*Mean Scale change effect*	*Mean Productivity Change*
Descriptive statistics: All banks				
Average	-0.52	2.88	0.32	2.68
Standard Deviation	3.41	1.41	1.07	3.66
Minimum	-11.69	-0.76	-2.64	-7.93
Maximum	9.38	6	5.58	12.67
Average productivity change by category				
All banks	*-0.52*	*2.88*	*0.32*	*2.68*
Without IBS	-0.41	2.72	0.33	2.64
With IBS	-0.64	2.88	0.32	2.56
Islamic	0.27	3.7	0.26	4.23
Foreign banks	*-0.3*	*2.18*	*0.24*	*2.12*
Without IBS	-0.17	2.63	0.24	2.71
With IBS	-0.61	1.13	0.24	0.75
Domestic banks	*-0.64*	*3.3*	*0.36*	*3.01*
Without IBS	-1.83	3.21	0.85	2.23
With IBS	-0.65	3.26	0.33	2.94
Islamic	0.27	3.7	0.26	4.23
Merged banks [a,b]	*-0.53*	*1.89*	*0.12*	*1.48*
Without IBS	0.31	2.01	0.22	2.54
With IBS	-1.01	1.82	0.06	0.86
Unmerged banks	*-0.52*	*3.05*	*0.35*	*2.88*
Without IBS	-0.4	3.02	0.34	2.96
With IBS	-0.58	3.06	0.36	2.84

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.

When compared to unmerged banks, which have average productivity change of 2.88 percent, merged banks achieved a much lower average productivity change of 1.48 percent. This can be largely attributed to much higher rates of technical change for the unmerged banks (3.05 percent) relative to the merged banks (1.89 percent), and may be a symptom of the need to focus managerial effort on integrating personnel and synchronising the systems (Rhoades 1998; Sherman and Rupert 2006). [29] However, it is also evident that the scale change effect for the merged banks (0.12) is lower than for the unmerged banks (0.35 percent), once again suggesting that mergers have not contributed to productivity change through scale effects.

However, as mentioned above, much of the difference in productivity change between merged and unmerged banks can be attributed to the 0.86 average productivity change for merged banks with IBS windows, which is largely attributable to average efficiency change of -1.01 per annum and a very low scale change effect (0.06 percent). When coupled with the broad similarity in estimated productivity change, technical change, efficiency change, and scale change effect for unmerged banks with or without IBS windows, this suggests a further disruptive impact of Malaysian banking mergers during the sample period. Put simply, merged banks with IBS banking windows may have been unable to devote sufficient managerial effort to developing their IBS operations, because their managers were distracted by these mergers.

Finally, it is noted that no substantial difference in average productivity, technical change and efficiency change is evident between the group of all conventional banks with or without IBS windows, although the detrimental impact of efficiency change for the latter group (-0.41) is moderately lower than for the former group (-0.64). This suggests that there is little difference in productivity change that can be generally attributed to the provision of IBS Islamic banking services by conventional banks. However, it is noted that the above discussion suggests that both foreign banks and merged banks that offered IBS banking services have experienced lower average rates of productivity change, and that the potential explanations for this have been offered above. In contrast, if the group of unmerged banks that operate IBS windows is focussed on, it can be seen that their average productivity change (2.84

[29] The result is consistent with Orea (2002) on revenue efficiency that average rate of productivity change of merging banks is lower than non-merging banks, and Berger and Mester (2003) that productivity deterioration is more for merging banks than non-merging banks.

percent) and the contribution of technical change (3.06 percent) are moderately higher than the overall sample average, while their efficiency and scale change effect are quite similar to the sample average. This therefore suggests that those banks that have been able to sufficiently focus on the development of IBS banking products have been able to achieve productivity change rates that are at least comparable to banks that only provide conventional banking services.

4.6 CONCLUSIONS AND POLICY IMPLICATIONS

The aim of this study is to examine the efficiency, economies of scale and productivity of Islamic banks relative to conventional banks using SFA and a generalised parametric Malmquist Productivity Index. In achieving this objective, the study found some important results with regard to the Malaysian banking industry. The average Malaysian bank faced 6.6 percent higher costs than a bank on the most efficient frontier, but 34.0 percent higher costs than the efficient costs defined by the bank with the most favourable operating environment, thereby suggesting that differences in bank characteristics play a significant role in determining bank costs. On average, banks became more inefficient between 1996 and 2002, causing an average 0.52 percent decline in productivity change. In contrast, most banks exhibited moderate scale economies, and as a result, scale change effect contributed a 0.32 percent increase in average productivity change. However, as it contributed 2.88 percent to average productivity change, technical change was the primary determinant of productivity change, which averaged 2.68 percent per year between 1996 and 2002.

Focusing more specifically on the efficiency estimates, consideration of gross efficiency in addition to net efficiency enables better understanding of differences in observed costs across bank categories. This is because, by definition, net efficiency estimates net out the impact of operating characteristics on bank costs by first allowing for increases or decreases in predicted efficient cost attributable to the operating environment. In contrast, gross efficiency estimates are measured relative to an efficient frontier with most favourable operating environment, hence gross efficiency implicitly includes not only the impact of net inefficiency but also the impact of increased operating costs associated with an unfavourable operating environment. Thus, regardless of whether one argues that cost differences attributable to differences in operating characteristics, provide evidence of differences in efficiency (thereby supporting the use of gross efficiency estimates) or that they provide evidence of

differences in efficient frontier costs (thereby supporting the use of net efficiency estimates), gross efficiency estimates have increased the researcher's understanding of the impact of differences in operating characteristics on observed differences in costs. Moreover, as in current application, it is unclear whether characteristics such as foreign ownership or IBS banking capture legitimate differences in costs or differences in efficiency, and the results suggest little difference in net efficiency, the gross efficiency estimates suggest that it is differences in operating characteristics, which explain much of the observed cost differences between Malaysian banks.

Thus, for example, the high gross efficiency estimates for both full-fledged Islamic banks and conventional banks with IBS windows suggest that Islamic banking requires substantially higher costs, a finding that is not reflected in the net efficiency estimates. Similarly, while the net efficiency estimates suggest little impact from the East Asian financial crisis, the gross efficiency estimates suggest that the crisis had a temporary cost reducing effect in 1998. More significantly, the gross efficiency estimates also demonstrate that the crisis triggered a sustained negative impact on the cost performance of Malaysian banks, which can be attributed to an increase in non-performing loans.

The pattern and determinants of overall productivity change also reveals some significant findings. Most interestingly, despite their relatively poor gross efficiency, full-fledged Islamic banks also exhibited very high productivity change, which is explained by high rates of technical change. This suggests that while full-fledged Islamic banks were initially costly to operate, they have been able to eliminate a significant proportion of this cost disadvantage during the sample period, and may be able to continue this in the long term. In contrast, given the inferior gross efficiency of conventional banks with IBS windows, and the finding that their productivity, efficiency, scale, and technical change are broadly similar to that of an average bank, there would appear to be less prospect for these banks to overcome the cost disadvantages associated with Islamic banking.

Given the substantial number of bank mergers in Malaysia during the sample period, it is also striking that merged banks have experienced substantially lower productivity change relative to unmerged banks. However, this difference can be largely attributed to the lower efficiency change of merged banks that operate IBS services. This suggests that the need for managers to simultaneously develop new Islamic banking products and consolidate operations after mergers, may have

contributed to this poor performance. Looking forward, this result has two possible implications for the full-fledged Islamic banks that were created from the Islamic operations of IBS banks in 2005: On the positive side, the separation of Islamic from conventional banking services may allow managers to better focus on improving the cost efficiency of Islamic banking. However, on the negative side, there is also the potential that at least in the short run, the new Islamic banks will suffer similar transitional problems. Nevertheless, once the new full-fledged Islamic banks overcome any transitional problems, the experience of existing Islamic banks suggests that there is the potential for these banks to significantly, reduce the cost disadvantage that is currently associated with Islamic banking. However, it is far from certain that this experience will be replicated as the full-fledged Islamic banking sector rapidly expands.

In sum, the results suggest that given the rapid growth of Islamic banking as well as its existing cost disadvantages, policy makers must continue to work to both make the banking environment more conducive for Islamic banking and to encourage managers to reduce these cost disadvantages. If these goals can be achieved, this majority Muslim country will not only be able to satisfy its demand for Islamic banking services: It will also be able to minimize the increase in costs associated with a move to a dual-banking system. If these goals are not achieved, Malaysia will certainly benefit from a banking system that is compliant with its majority religious faith and the resulting mobilization of untapped financial resources that this will allow: However, it will also suffer from a substantial increase in the average cost of banking services. Nevertheless, provided that Malaysia continues its policy of a dual banking system, competition between both Islamic and non-Islamic banks, and between the10 full-fledged Islamic banks that have existed since 2006, may in principle act to drive the Islamic banking cost premium down to the minimum level required for compliance with *shariah*.

CHAPTER 5
THE EFFICIENCY AND PRODUCTIVITY OF MALAYSIAN BANKS 1996-2002: AN OUTPUT DISTANCE FUNCTION APPROACH

5.1 INTRODUCTION

The consistency condition is very useful in getting exact information for decision makers because they have to be well-informed on the likely effects of the operation of institutions that they supervise (Bauer, Berger, Ferrier, and Humprey 1998). In other words, efficiency measures derived from different approaches may produce consistent estimates of efficiency and efficiency rankings, as well as consistent results over time. Cost efficiency, which has been employed in chapter 4 can be seen as being dual to an input-oriented distance function approach, which measures how efficient banks minimise inputs, given outputs (Fare and Primont 1995). An alternative approach is an output-oriented distance function, which measures how efficient banks transform inputs into outputs, given fixed inputs. As the latter approach is also a frontier approach and the research is still using the same time setting as in the former, this approach will allow a check of whether consistent results are produced, particularly with regard to average efficiency estimates for the industry as a whole and in each bank category as well as the identification of best and worst performing banks.

By employing an output-oriented distance function, this chapter also has the benefit of employing a quantity measure to identify bank inputs such as labour, deposits and capital as well as bank outputs. It therefore allows the researcher to avoid potential problems associated with price endogeneity (Orea 2002). Given differences in asset

classification among Islamic and conventional banks, relying on accounting information to define output and input prices may potentially lead to distorted and inaccurate price estimates, and, hence, unreliable estimates of cost or profit efficiency. An output distance function also does not require the strong behavioural assumptions of a profit maximisation or cost minimisation approach. This is appropriate for Islamic banks as they have dual objectives of fulfilling non-profit obligations for the society and profit or revenue maximisation for the depositors and shareholders. Moreover, if behavioural objectives between Islamic and conventional banks differ, the weaker behavioural assumptions of the output distance function approach may allow more consistent estimates of relative efficiency. The author, therefore adopts an output distance function approach as its characteristics, it is believed, will better measure the efficiency of Islamic banks relative to conventional banks.

This chapter seeks to determine the relative efficiency of Malaysian banks as well as the determinants of their productivity performance, and will specifically concentrate on the relative performance of Islamic banks using an output-oriented distance function. More specifically, by obtaining estimates of net and gross efficiency for Malaysian commercial banks the study draws attention to the impact of operating characteristics, including loan quality, Islamic banking, foreign ownership, and the East Asian financial crisis on the relative outputs of Malaysian banks. The gross efficiency estimates clearly highlight that during the chosen sample period of 1996-2002, Islamic banking performance appears to be associated with higher input usage. Moreover, the estimates of productivity change, which are decomposed into efficiency change, technical change and scale change effects using a generalised parametric Malmquist Productivity Index also imply that full-fledged Islamic banks, in particular, have been unable to overcome these disadvantages.

The remainder of this chapter is organised as follows. Section 5.2 provides a brief literature review focussing on the application of output-oriented distance functions in banking, and is followed by a description of the methodology in section 5.3 which includes data and the empirical specifications. Section 5.4 reports on the results which are comprised of the output distance function estimates, net and gross efficiency estimates, returns to scale, average productivity change and its decomposition, and firm specific

productivity change and its decomposition. Section 5.5 ends the chapter with some conclusions.

5.2. LITERATURE REVIEW: OUTPUT-ORIENTED DISTANCE FUNCTION IN BANKING

Distance functions are increasingly employed as an alternative specification of production technologies, with increasing numbers of empirical applications being made in the efficiency and productivity literature. Several techniques such as non-parametric DEA and parametric SFA have been applied to estimate distance functions (Cuesta and Zofío 2005). However, none of these distance function studies (e.g., Li, Hu, and Chiu. 2004; Cuesta and Zofío 2005) have analysed the relative efficiency of Islamic and conventional banks.

In defining bank output variables, the intermediation approach which has frequently been applied in previous efficiency studies involving Islamic and conventional banks (e.g., Al-Jarrah and Molyneux 2005; El-Gamal and Inanoglu 2005) is followed. As mentioned in the previous chapters, this approach focuses on the role of a bank as an intermediary between savers (depositors) and investors of funds (borrowers) which is more consistent with the role of Islamic banks than considering them to be producers of loans and services. This chapter will therefore measure the efficiency of conventional and Islamic banks using an output distance function and define bank outputs using the intermediation approach.

The average efficiency scores obtained in previous bank efficiency studies that have employed an output-oriented distance function (e.g. English, Grosskopf, Hayes, and Yaisawarng 1993; Adams, Berger, and Sickles 1999; Iqbal, Ramaswamy, and Akhigbe 1999; Cuesta and Orea 2002; Li, et al. 2004; Cuesta and Zofío 2005) are in the range of 54 to 95 percent. With regard to returns to scale, on average, banks are found to have experienced moderate increasing returns to scale (Li, et al. 2004; Cuesta and Zofío 2005). Furthermore, the efficiency of merged banks has been found to be lower than that of unmerged banks (Cuesta and Orea 2002), and mixed private and public ownership is the most efficient organisational structure compared to publicly-owned or privately-owned banks (Li, et al. 2004). Larger banks are also found to be more efficient relative to smaller banks (English, et al. 1993). With regard to the East Asian financial crisis, banks

in Taiwan are found to perform worse in the post-crisis period (Li, et al. 2004). However, it is important to note that these studies do not control for differences in operating environment in the frontier estimation. They instead, made comparisons between the efficiency estimates of banks with different operating characteristics, only after estimating efficiency with a common frontier. In contrast, Rezitis (2007) has controlled for differences in operating characteristics such as mergers and bank effects in the frontier estimation, and simultaneously assumed that these factors as well as branches, market share, market concentration and year dummy variables directly influence inefficiency. The current model will therefore, control for differences in operating characteristics in frontier estimation and will also quantify the impact of these differences on the efficient frontier.

While some studies (English, et al. 1993; Iqbal, et al. 1999) employ a deterministic output distance function which does not have a stochastic term to control for random disturbances, it is believed that this approach is very sensitive to measurement error (Resti 1997) which can be better accounted for with a stochastic frontier approach. The model in this chapter will therefore employ a stochastic output distance function which will separate inefficiency from random error. Assuming different bank types have different technology, Iqbal et al (1999) estimated separate frontiers for two different types of banks and compared their efficiency scores. This technique however, is subject to criticism because comparison of efficiency could only be made if all the banks have access to the same frontier (Mester 1996), and this approach assumes two separate frontiers. The current model will therefore estimate a common frontier for all banks, but will control for different types of banks in the frontier estimation using a dummy variable (See Appendix IV for a further review of studies measuring bank efficiency employing output distance function).

The previous literature has also applied Malmquist index to decompose bank productivity using a parametric output distance function. Using this approach, Chaffai, Dietsch, and Lozano-Vivas (2001) concluded that the existence of productivity gaps between banking industries in different countries are mainly due to environmental conditions rather than banking technologies. Focussing only on Spanish banks, Orea (2002) decomposed productivity growth into efficiency change, technical change and scale change using a generalised parametric Malmquist Productivity Index, and found that

production growth is mainly determined by technical change and modest scale effects. The author also found slower growth for merged banks relative to their unmerged counterparts. Olgu (2006) employed both Orea (2002)'s generalised parametric Malmquist Productivity Index and a generalised non-parametric Malmquist index, to decompose productivity growth of banks in developed and accession countries within the Euro zone. The author concludes that the latter banks are on average performing better. Rezitis (2007) also employs Orea's approach, and found that merged banks have lower productivity change as compared to unmerged counterparts due to increased technical inefficiency and the disappearance of economies of scale in Greece. Given these precedents, the below model will also employ Orea's (2002) generalised parametric Malmquist Total Factor Productivity (TFP) Index to analyse the determinants of productivity change in Malaysian banking with particular focus on the relative performance of Islamic banks compared to conventional banks (See Appendix VI for a review of previous bank productivity growth studies using a parametric Malmquist Productivity Index approach).

Based on the literature review, it can be concluded that a limited number of previous bank efficiency studies have employed parametric output distance functions and a parametric generalised Malmquist Productivity Index and none of them have considered the efficiency and productivity of Islamic banks. Moreover, only one study (Rezitis 2007), has controlled for different operating characteristics in the frontier estimation. Therefore, in most of the studies (e.g., Cuesta and Orea 2002; Li, et al. 2004; Cuesta and Zofío 2005) factors such as organisational structure, mergers and economic conditions are assumed to not affect potential efficient output. However, in practice, it is often unclear whether differences in operating characteristics influence the frontier or directly influence inefficiency. If the former effect dominates, netting out the impact of environmental factors is more appropriate and would be necessary to determine a bank's managerial efficiency. In contrast, if the latter effect dominates one should quantify the impact of differences in operating characteristics on bank efficiency and therefore employ a gross efficiency measure. By employing a method proposed by Coelli, et al. (1999), this chapter provides estimates of both gross and net efficiency so that the author can better analyse the relative impact of these operating characteristics on the output of Malaysian banks.

5.3 METHODOLOGY

5.3.1 Output-oriented Distance Functions

Distance functions can be applied to describe multi-input, multi-output production processes without having to specify strong behavioural objectives such as profit maximization or cost minimisation. An output-oriented efficiency measure compares the observed level of output with the maximum output that could be produced with given inputs. A production technology that transforms inputs into outputs can be represented by the technology set, which is the technically feasible combination of inputs and outputs (Fare and Primont 1995; Coelli, Rao, and Battese 1998; Cuesta and Orea 2002). If the vector of K inputs, indexed by k is denoted by $X=(X_1,X_2,\ldots,X_K)$ and the vector of M outputs, indexed by m, is denoted by $Y=(Y_1,Y_2,\ldots,Y_M)$, the technology set can be defined as:

$$T=\{X,Y): X\in R_+^K, Y\in R_+^M, X \textit{ can produce } Y\} \tag{5.1}$$

Where R_+^K and R_+^M are the sets of non-negative, real K and M-tuples respectively. For each input vector, X, let P(X) be the set of producible output vectors, Y, that are obtainable from the input vector X:

$$P(X)=\{Y:(X,Y)\in T)\}. \tag{5.2}$$

The output distance function can then be defined in terms of the output set, P(X) as:

$$D_o(X,Y)=\min\left\{\varpi>0:\left(\frac{Y}{\varpi}\right)\in P(X)\right\}. \tag{5.3}$$

The output distance function is non-decreasing, positively linearly homogeneous and increasing in Y, and decreasing in X, and defined as the maximum feasible expansion of the output vector given the input vector (Cuesta and Orea 2002). Figure 5.1 illustrates the concept of an output distance function with two outputs and a given input vector, X. The

production possibility set is the area bounded by the production possibility frontier (PPF), which indicates the maximum feasible output given X, and the Y_1 and Y_2 axes. If the output vector, Y, is an element of the feasible production set, P(X), $D_o(X,Y) \leq 1$. For firms such as B and C in Figure 5.1 which produce on the PPF, $D_0(X,Y) = \varpi = 1$, thereby indicating technical efficiency. In contrast, for a firm operating at A, $D_0(X,Y) = \varpi = \frac{OA}{OB} < 1$, thereby indicating the proportion by which output is below potential output.

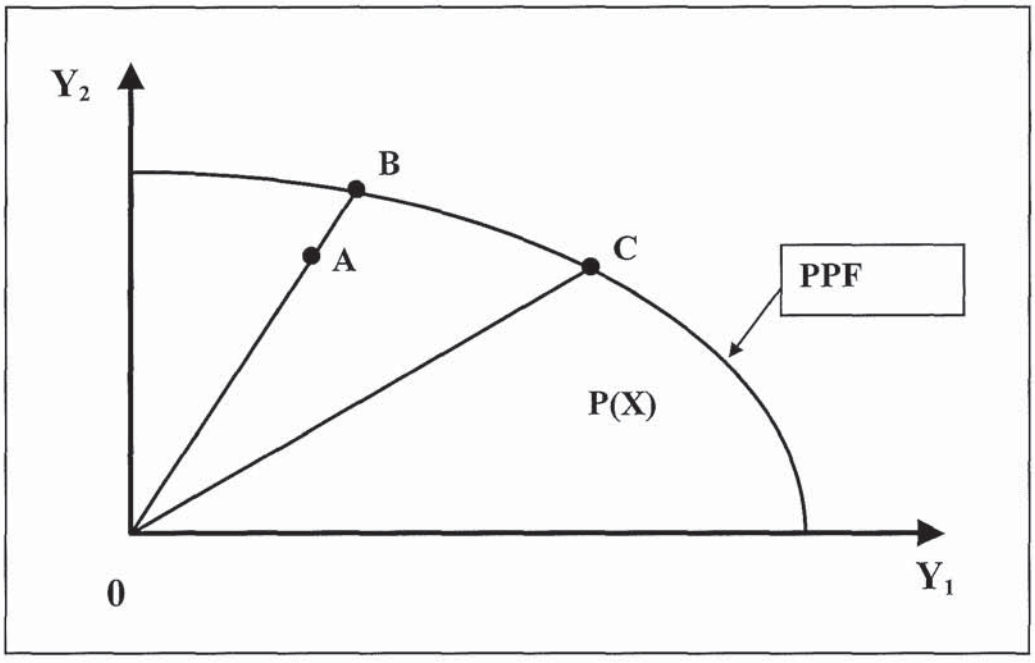

Figure 5.1: Output-oriented distance function with 2 outputs, Y_1, Y_2 given input vector, X.

This also illustrates that Farrell (1957)'s output-oriented measure of technical efficiency, defined as the maximum producible radial expansion of the output vector, can be represented as:

$$OE_0 = 1/D_0(X,Y) \qquad 5.4$$

OE_0 lies between one and infinity and increases with inefficiency. If Y is located on the outer boundary of the production possibility set, $OE_0 = 1$, indicating efficiency. In

contrast, if Y is in the interior of the production possibility set, $OE_0 > 1$ indicating inefficiency.

5.3.2 The econometric specification

Following Fare and Primont (1995) and Cuesta and Orea (2002), but also allowing for exogenous factors, the general form of a stochastic output distance function can be shown as follows:

$$1 = D_o\left(Y_{n,t}, X_{n,t}, Z_{n,t}, \beta\right)\ h\left(\varepsilon_{n,t}\right) \qquad 5.5$$

where $h\left(\varepsilon_{n,t}\right) = \exp\ \left(u_{n,t} + v_{n,t}\right)$, $Y_{n,t}$ is a vector of outputs, $X_{n,t}$ is an input vector, $Z_{n,t}$ is an exogenous factor vector and β is a vector of parameters. Inefficiency is accommodated in the specification of $h(.)$ as $\varepsilon_{n,t}$ is a composed error term comprised of $v_{n,t}$ which represents random uncontrollable error that affects the n-th firm at time t, and $u_{n,t}$, which is assumed to be attributable to technical inefficiency.

In order to facilitate estimation, the author follows the standard practice of imposing homogeneity of degree one in outputs on the distance function, which implies that $D_o\left(Z, X, \pi Y\right) = \pi D_o\left(Z, X, Y\right), \pi > 0$. By arbitrarily choosing the M-th output, the author can then defines $\pi = \frac{1}{Y_M}$ and write:

$$D_o\left(Z, X, \frac{Y}{Y_M}\right) = \frac{D_o\left(Z, X, Y\right)}{Y_M} \qquad 5.6$$

From 5.5 and after assuming $Y^*_{n,t} = \left(Y_{1,n,t}/Y_{M,n,t}, Y_{2,n,t}/Y_{M,n,t}, \ldots\ldots, Y_{M-1,n,t}/Y_{M,n,t}\right)$ and rearranging terms yields the general form:

$$\frac{1}{y_{M,n,t}} = D_o\left(Y^*_{n,t}, X_{n,t}, Z_{n,t}, \beta\right).\ h\left(\varepsilon_{n,t}\right) \qquad 5.7$$

Finally after assuming the standard translog functional form[1] to represent the technology, the output distance can be represented as:

$$-\ln Y_{M,n,t} = \varphi_o + \sum_{k=1}^{K} \alpha_k \ln X_{k,n,t} + \sum_{m=1}^{M-1} \beta_m \ln Y^*_{m,n,t} + 0.5 \sum_{k=1}^{K} \sum_{s=1}^{K} \alpha_{k,s} \ln X_{k,n,t} \ln X_{s,n,t}$$

$$+ 0.5 \sum_{m=1}^{M-1} \sum_{j=1}^{M-1} \beta_{m,j} \ln Y^*_{m,n,t} \ln Y^*_{j,n,t} + \sum_{k=1}^{K} \sum_{m=1}^{M-1} \theta_{k,m} \ln X_{k,n,t} \ln Y^*_{m,n,t}$$

$$+ \sum_{k=1}^{K} \delta_{k,t} \ln X_{k,n,t} t + \sum_{m=1}^{M-1} \psi_{m,t} \ln Y^*_{m,n,t} t + \lambda_1 t + 0.5 \lambda_2 t^2 + \sum_{h=1}^{H} \xi_h Z_{h,n,t} + v_{n,t} + u_{n,t} \qquad 5.8$$

where, $Y^*_{m,n,t} = Y_{m,n,t} / Y_{M,n,t}$, k=1,2,..K and s=1,2,..K are indices for inputs; m=1,2,...M and j=1,2,..M are indices for output; h=1,2,...H is an index for environmental variables, and the Greek letters (except v and u) represent unknown parameters to be estimated. Standard symmetry is imposed to the second order parameters: $\alpha_{k,s} = \alpha_{s,k}$ and $\beta_{m,j} = \beta_{j,m}$ in Equation 5.8. $v_{n,t}$ is assumed to be normally distributed with zero mean and variance, σ_v^2. $u_{n,t} \geq 0$ is drawn from a one-sided distribution and can be assumed to be drawn from one of four possible distributions, which are the exponential, half-normal, truncated-normal or the gamma distribution. Similar to some studies, $u_{n,t}$ is assumed to follow a normal distribution with zero mean and variance, σ_u^2 (e.g. Berger and Mester 1997; Mertens and Urga 2001; Kasman 2005). Given this assumption, the approach of Jondrow, Lovell, Materov, and Schmidt (1982) is followed to derive the log likelihood which is expressed in terms of the two variance parameters, $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$. The parameters in the translog function as defined in Equation 5.8 as well as σ^2 and γ are estimated using maximum likelihood estimation (MLE) techniques.

[1] In the literature, the translog function is preferred in estimating a parametric distance function because it is flexible, easy to calculate and permits the imposition of homogeneity (Fuentes, Grifell-Tatjé, and Perelman 2001).

Following from Equation 5.5, and given current model assumptions, an estimate of output distance can be derived as $D_o(Y_{n,t}, X_{n,t}, Z_{n,t}, \beta) = \exp(-\mu)$. Equivalently an estimate of Farrell output oriented efficiency is obtainable as:

$$OE_{n,t} = \frac{1}{D_0(Y_{n,t}, X_{n,t}, Z_{n,t}, \beta)} = \exp(\mu) \qquad 5.9$$

However, as $OE_{n,t}$ relies on the unobservable inefficiency, $u_{n,t,}$ the author follows the approach of Jondrow, et al. (1982) and employ the conditional expectation of $u_{n,t}$ given the observed value of overall composed error term, $\varepsilon_{n,t}$ which can be expressed as:

$$E(u_{n,t}|\varepsilon_{n,t}) = \sigma_A \left[\frac{\phi(\gamma\varepsilon_{n,t}/\sigma_A)}{1-\Phi(-\gamma\varepsilon_{n,t}/\sigma_A)} + \left(\frac{\gamma\varepsilon_{n,t}}{\sigma_A} \right) \right] \qquad 5.10$$

where, $\sigma_A = \sqrt{\gamma(1-\gamma)\sigma^2}$, $\phi(.)$ is the standard normal density function and $\Phi(.)$ is the standard normal cumulative distribution function.

With SFA, it is effectively assumed that firms operate with the same production technology. It is therefore necessary to control for differences in characteristics and the operating environment that may influence the efficient level of output. Failure to account for differences between bank groups may yield inappropriate conclusions about a bank's performance (Bos and Kool 2006; Bos, Koetter, Kolari, and Kool 2008). Environmental variables are therefore often included directly in the estimated distance function to control for these differences. However, the resulting efficiency scores must be carefully interpreted as estimates of net efficiency after accounting for the impact of environmental influences on potential output. Therefore, $OE_{n,t}$ provides estimates of efficiency net of the impact of the environmental Z factors on efficient output. Stated differently, $OE_{n,t}$ estimates efficiency after allowing for differences in potential output that can be attributed to differences in the included environmental variables, and should therefore be interpreted as a net efficiency estimate (Coelli, et al. 1999).

As far as the author is aware of, no previous output distance function studies in the banking literature have included environmental variables, but a number of cost function studies have included regressors such as bank location and branch banking limitations (Berger and DeYoung 1997), the number of branches, and merger controls (Lozano-Vivas 1998). Although this approach is quite common in the literature, the author would argue that its suitability is dependent on the assumption that the included environmental variables are factors which only directly influence the production technology, and hence potential output. On the other hand, if some or all of the included environmental factors have a more direct influence on firm efficiency, net efficiency ($OE_{n,t}$) will give a biased measure of managerial efficiency, because it nets out the impact of such characteristics. This therefore implies that the common exercise of reporting efficiency scores after including factors such private or foreign ownership directly in the function is likely to result in biased measures of efficiency if these factors are associated more with differences in efficiency rather than differences in production technology.

As the current study includes several Z factors, such as foreign ownership and a dummy for Islamic banks, which could be argued to have a greater direct influence on inefficiency rather than the location of the efficient frontier, the author will investigate the potential implications of this on the efficiency scores. The approach of Coelli, et al (1999) is therefore employed to generate alternative gross efficiency $\left(GE_{n,t}\right)$ estimates. In order to do this, the author first identifies the observation with the most favorable operating characteristics given the estimated parameters. This observation will have the minimum value of $\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$, which will be referred to as $Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$. If it is assumed that other firms face this most favoured operating environment, rather than their own, the author can estimate a predicted efficient output for firms under the assumption that all firms face this most favoured operating environment. As noted earlier, for given residuals (level of efficiency), the bank with $Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$ has the most favorable impact due to operating conditions and it functions as a benchmark.

$Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right]$ is used to generate an adjusted estimate of the deviation of a firm's actual output from frontier output, which can be expressed as:

$$\varepsilon_{n,t}^{Gross} = \varepsilon_{n,t} + \sum_{h=1}^{H}\xi_h Z_{h,n,t} - Min\left[\sum_{h=1}^{H}\xi_h Z_{h,n,t}\right] \qquad 5.11$$

Measures of the firm's gross inefficiency $\mu_{n,t}^{Gross}$ can then be derived by substituting $\varepsilon_{n,t}^{Gross}$ for $\varepsilon_{n,t}$ in Equation 5.10, yielding:

$$GE_{n,t} = \exp(\mu_{n,t}^{Gross}) \qquad 5.12$$

Because $(GE_{n,t})$ is computed under the assumption that a firm faces the most favourable operating environment, differences in operating environment as well as differences in net efficiency will be reflected as differences in $GE_{n,t}$. This is not the case with $OE_{n,t}$, which by definition nets out the impact of differences in operating environment (Coelli, et al. 1999). It would be inappropriate to assess relative managerial performance with $GE_{n,t}$ if all the exogenous factors only influenced the production technology. Nevertheless, if it can be argued that some or all of these factors have an influence on expected managerial efficiency, $GE_{n,t}$ will better attribute differences in measured efficiency to differences in these factors.

Given the estimated model, estimated scale elasticity can be calculated as the negative of the sum of the input elasticities (Cuesta and Orea 2002):

$$SCALE_{n,t} = -\sum_{k=1}^{K}\frac{\partial \ln D_o\left(Y_{m,n,t}, X_{k,n,t}\right)}{\partial \ln X_{k,n,t}} \qquad 5.13$$

If $SCALE_{n,t} > 1$, a bank is operating with increasing returns to scale (IRS). If $SCALE_{n,t} < 1$, there is decreasing returns to scale (DRS) and constant returns to scale (CRS) are present if $SCALE_{n,t} = 1$.

Malmquist productivity indices are commonly used in the literature because they require neither price information nor restrictive behavioural assumptions such as cost minimization or profit maximization. Moreover, they can be readily employed to isolate efficiency change from technical change (Färe, Grosskopf, Norris, and Zhang 1994; Grifell-Tatje and Lovell 1995; Isik and Hassan 2003). However, as Caves, Christensen, and Diewert (1982) prove, the parametric Mamquist index will give a biased estimate of TFPC, that excludes the impact of scale changes, unless firms operate with CRS. Orea's (2002) generalised Malmquist Productivity Index provides a solution to this issue by adding a scale term (which, vanishes under CRS) to the Malmquist Productivity Index, thus providing a theoretically unbiased measure of TFPC. Therefore, Orea (2002)'s approach extends the standard Malmquist Productivity Index which captures only the impact of technical efficiency change (TEC) and technical change (TC), by further allowing for the impact of scale change effects (SCE) on productivity change. The author therefore employs previously estimated output distance function and inefficiency estimates to calculate TFPC and decompose it such that, $TFPC = TEC + TC + SCE$. Thus, for any given periods t and t+1, a generalised output-oriented Malmquist Productivity Index can be expressed as:

$$
\begin{aligned}
TFPC &= \ln\left(TFP_{n,t+1} / TFP_{n,t}\right) \\
&= \ln\left(D_{0,n,t+1} / D_{0,n,t}\right) - 0.5\left[\left(\partial \ln D_{0,n,t+1} / \partial t\right) + \left(\partial \ln D_{0,n,t} / \partial t\right)\right] \\
&\quad + 0.5 \sum_{k=1}^{K}\left[\left(SCALE_{OM,n,t+1} - 1\right)\Omega_{n,t+1} + \left(SCALE_{OM,n,t} - 1\right)\Omega_{n,t}\right] \ln\left(\frac{X_{k,n,t+1}}{X_{k,n,t}}\right)
\end{aligned}
\qquad 5.14
$$

where; $\Omega_{n,t} = \dfrac{-\partial \ln D_{0.n,t} / \partial X_k}{SCALE_{OM,n,t}}$

The first term on the right hand side of Equation 5.14 is TEC, which measures the contribution of efficiency change to productivity. The second term is TC, which measure the contribution of technical change. The final term is SCE, which measures the contribution of changes in scale to productivity change. With IRS (DRS), increases in scale result in increased (decreased) productivity, while under CRS, this final term, SCE vanishes and TFPC is equivalent to a standard Malmquist Productivity Index.

5.3.3 The data and empirical specifications

Similar to Cuesta and Orea (2002) and the previous chapter, the intermediation approach is employed to define bank output, as it is the most suitable with the concept of Islamic banking. The selection of the input and output variables follows the existing literature (e.g., Iqbal, et al. 1999; Cuesta and Orea 2002; Cuesta and Zofío 2005). The outputs are loans (Y_1) and total other earning assets (Y_2), and the inputs are labour (X_1), deposits (X_2), and capital (fixed assets) (X_3). X_1 is the number of full time workers, X_2 is total deposits including customer funding and short term funding, and X_3 is the total expenses on fixed assets allocated for all furniture, equipment, and bank premises, including depreciation, and administration and general expenses. It is noted that linear homogeneity in outputs is imposed using Y_2 as a numeraire and these variables have been mean-corrected prior to estimation. Table 5.1 provides a summary of descriptive statistics of these variables and the explanatory variables for all banks in the sample. All monetary variables are expressed in MYR and in real 2000 terms by deflating with the Malaysian GDP deflator index.

The first operating environment variable is loan quality (Z_1), as proxied by the ratio of the NPLs-to-total loans (e.g., Clark 1996; Mester 1996; Berger and Mester 1997; Girardone, Molyneux, and Gardener 2004; Williams and Nguyen 2005). If output quality is not controlled for, unmeasured differences in loan quality that are not captured by banking data may be mistakenly measured as inefficiency (Berger and Mester 1997). This is because banks with better loan quality may appear inefficient as they use more labour and capital to monitor loans (Mester 1996). Moreover, as the East Asian financial crisis caused banks' NPL to rise during the sample period, this negative economic shock would have caused some banks extra expenses to recover defaulted loans and related administration costs (Berger and DeYoung 1997). Therefore, a positive coefficient is

expected for this quality variable, indicating that banks with higher NPL-to-loans (lower loan quality) produce lower output.

The rest of the environmental variables are dummy variables that are designed to capture potential differences in bank characteristics and operating environment that may influence bank output. These environmental variables may capture either legitimate output changes or inefficiency, depending on the assumption with regard to whether these variables directly influence the production technology or more directly influence firm efficiency. Thus, the dummy variable indicating full-fledged Islamic banks (Z_2) is to control for the potential impact of full-fledged Islamic banking on bank output. No *a priori* assumption is made due to mixed results in the literature on the direction of these effects (e.g., Al-Jarrah and Molyneux 2005; El-Gamal and Inanoglu 2005; Mokhtar, Abdullah, and Al-Habshi 2006).

The model also includes a dummy variable for foreign banks (Z_3), foreign banks with IBS (Z_4) and all banks with IBS (Z_9), leaving conventional domestic banks without IBS as the base case measured in the constant, where banks with IBS are conventional banks offering Islamic banking products through a separate Islamic banking window. When predicting the expected impact of these dummy variables on efficient output, it is noted that relative to domestic banks, foreign banks have better access to multinational clients and priority access to technology from their parent banks (Berger, Clarke, Cull, Klapper, and Udell 2005). Moreover, in the literature, foreign owned banks are found to be more efficient relative to domestic banks in Malaysia (Matthews and Ismail 2006; Mokhtar, et al. 2006) and other countries (Bhattacharyya, Lovell, and Sahay 1997; Sturm and Williams 2004; Bonin, Hasan, and Wachtel 2005; Berger, Hasan, and Zhou 2008) but not in the USA (Mahajan, Rangan, and Zardkoohi 1996; Chang, Hasan, and Hunter 1998). Hence, the foreign-owned dummy (Z_3) is expected to have a negative coefficient indicating higher potential output.

Considering banks operating IBS windows, there is a less straight forward expected relationship. The provision of IBS windows may increase efficient output by allowing a bank to tap additional market segments with its existing workers and facilities. However, higher input requirements may be associated with Islamic financing and/ or the need to maintain strict financial separation between Islamic and non-Islamic operations. Therefore, the uncertainty with regard to the likely impact of IBS banking services on

efficient output implies that the author cannot *a priori* predict the sign of the coefficients for the Z_4 and Z_9 variables.

Table 5.1
Descriptive statistics for sample banks, 1996-2002[a]

Symbol	Variables	Mean	Std. Dev	Minimum	Maximum
	Outputs				
Y_1	Loans (MYR, million)	103.85	130.21	1.46	767.7
Y_2	Other Earning Assets (MYR, million)	56.76	71.04	1.52	357.56
	Inputs				
X_1	Labour	2,514.27	3,041.24	69.00	20,312.00
X_2	Deposits (MYR, million)	143.82	176.27	4.79	977.07
X_3	Capital (MYR, million)	1.04	1.20	0.02	6.49
	Control Variables				
Z_1	Loan Quality	0.13	0.12	0.01	0.77
Z_2	Islamic bank dummy	0.06	0.24	0	1
Z_3	Foreign owned Bank dummy	0.37	0.48	0	1
Z_4	Foreign with IBS dummy	0.11	0.32	0	1
Z_5	Financial Crisis Dummy	0.17	0.37	0	1
Z_6	Merged Bank 1 Dummy	0.01	0.11	0	1
Z_7	Merged Bank 2 Dummy	0.04	0.19	0	1
Z_8	Merged Bank 3 Dummy	0.01	0.11	0	1
Z_9	Banks with IBS Dummy	0.64	0.48	0	1
Z_{10}	Merged Banks Dummy	0.17	0.38	0	1

A dummy variable for observations in 1998 is included to control for the East Asian financial crisis (Z_5). The financial crisis started to affect the Malaysian banking sector in the third quarter of 1997 when a small decline in credit expansion occurred. However, previous good macroeconomic performance and the persistence pace of credit expansion before the crisis contributed to overall bank loan growth that remained strong in 1998. In reaction to the financial crisis, banks reduced a large number of employees and reduced other expenses drastically at the end of 1997 and throughout 1998 (Central Bank

of Malaysia 1997, 1998, 1999). Interest rates, which were initially increased at the end of 1997 and in the first half of 1998 to support MYR exchange rates in order to discourage capital outflows, were subsequently reduced in the third quarter of 1998 to support the economic recovery plan. Other government actions to support consistent bank loan growth included a government general guarantee of deposits, a reduction of reserve requirements, several prudential measures such as accelerating non-performing, doubtful and bad loans classifications, frequent and detailed reports on NPLs, and intensified central bank monitoring of banks. Furthermore, the government established a public company (*Danaharta*) for purchasing NPLs from banking institutions to ensure that the NPLs of the banking system were under control and to reduce the burden of the banking institutions in managing the NPLs, and established a central bank owned company (*Danamodal*) to inject new capital in undercapitalized banks. Selected NPLs were restructured by the Corporate Debt Restructuring Committee (CDRC), which then exempted them from NPL classification. The CDRC was a facilitator in bringing creditors and debtors to the negotiating table and in sorting out an agreeable and workable loan restructuring exercise as an alternative option to companies filing for bankruptcy. Some cases had been transferred to *Danaharta* (Lindgren, Balino, Enoch, Gulde, Quintyn, and Teo 1999; Ariff, Setapa, and Lin 2001). As a result of these actions, much of the effect of the financial crisis was concentrated in 1998 as demonstrated by Malaysian GDP growth, which was respectively 7.3, -7.4, and 6.1 percent in 1997, 1998 and 1999 (Ministry of Finance Malaysia 1999). Given that overall bank loan growth remained strong in 1998, it is expected that the relationship of raised output and the financial crisis (Z_5) to occur in 1998 when banks duality reduction in the operating inputs and deposits take place.[2] The reduction in the operating inputs is a result of the elimination of a large number of workers as well as cutting other expenses, and the drop in the deposits is due to a decline in interest rates.

Finally, given that some banks have gone through mergers, one can control for this effect by using a merger dummy variable (Z_{10}). However, as it is found that this dummy for all merged banks is not statistically significant, the author also tests for the potential effects of individual mergers, finding that the dummy is significant for 3 individual

[2] Dummy variables for 1996, 1997, all post-crisis years, as well as individual dummy variables for each of the years after 1998 were tested but were found to be statistically insignificant. It is noted that the increase in bad loans that was associated with the crisis are controlled for with the Z_1 variable.

mergers, merger 1 (Z_6), merger 2 (Z_7) and merger 3 (Z_8).[3] These dummy variables are expected to have a positive coefficient indicating lower output because merged banks need some time for system integration and personnel integration (Peristani 1997; Rhoades 1998; Sherman and Rupert 2006).

5.4 RESULTS

5.4.1 The output distance function estimates

The estimated output distance function parameters are reported in Table 5.2. All models have the same inputs and outputs but different environmental variables. Model A includes the first nine environmental variables (Z_1-Z_9), described earlier, while Model B excludes the banks with IBS (Z_9) dummy variable, which is insignificant in Model A. As the log likelihood ratio test for the inclusion of (Z_9) is 0.02, the null hypothesis that this parameter is insignificant cannot be rejected, and as it is preferred, the following discussion will be limited to Model B. However, it is noted that as conventional domestic banks without IBS windows are the base case in Model A, this result suggest that, *ceteris paribus*, no statistically significant difference in efficient output can be identified for the group made up of conventional domestic banks with IBS and domestic banks without IBS.

Finally, Model C is included solely to illustrate the statistical insignificance of the aggregate merger dummy (Z_{10}). This finding is consistent with Berger and Humphrey (1997), which noted that some mergers improve cost efficiency whereas others worsen it. Recalling that $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$, the highly significant estimate of 0.826 for this parameter suggests that the portion of technical inefficiency in total variance is high. Thus, the estimated deviation from the frontier is mainly due to inefficiency rather than statistical noise. The estimated coefficients of all variables have the expected signs. Loan quality (ζ_1) is positive as predicted, and indicates that lower output quality (higher NPL-to-loan ratio) reduces output, thereby reflecting the higher input requirement needed to monitor default loans.

Moreover, as the NPL-to-loan ratio increases significantly from 6 to 17 percent for the average bank between 1997-1999, the results suggest that outputs decrease by 4.3 percent on the efficient frontier for the hypothetical average bank because of the effects of

[3] Merger 1, 2, 3 refer to mergers between Oriental Bank and EON Bank, between Chung Khiaw Bank and UOB Bank, and between International Bank Malaysia, Sabah Bank and Multi-Purpose Bank respectively.

the East Asian financial crisis on bad loans. Furthermore, as the NPL-to-loan ratio remained stable at approximately 16 percent after 1999, this decline in output that could be due to the impact of financial crisis on non-performing loans is still relevant until the end of the sample period.

The positive estimate for ζ_2 implies that full-fledged Islamic banks are found to have outputs that *ceteris paribus* are 6.6 percent lower than other banks and this may be due to constrained opportunities in terms of investments and limited expertise in Islamic banking. The coefficient for foreign-owned banks is negative, indicating that output increases by 14.0 percent relative to domestic banks. However, foreign-owned banks with IBS (Z_4) are found to have potential output that is 11.8 percent lower than foreign banks without IBS. The coefficient for the financial crisis dummy variable (Z_5) is negative, indicating that output increased by 2.7 percent in 1998 after controlling for other variables. This finding is consistent with the reactions of banks towards the financial crisis, which was to lay off substantial number of workers and to cut other operating expenses. The individual mergers (Z_6, Z_7, Z_8) are found to be associated with output that is 8.3 percent, 9.7 percent and 6.3 percent lower respectively, after controlling for other variables.

Table 5.2
Maximum likelihood estimates for parameters of the output distance function for Malaysian banks: 1996-2002

Parameters	Coefficient	Model A		Model B		Model C	
		Estimated Value	*Std Error*	*Estimated Value*	*Std Error*	*Estimated Value*	*Std Error*
φ_0	Constant	-0.099***	0.032	-0.104***	0.014	-0.102***	0.018
α_1	$\ln X_1$	-0.039	0.024	-0.039*	0.024	-0.038	0.025
α_2	$\ln X_2$	-0.914***	0.022	-0.913***	0.022	-0.905***	0.023
α_3	ln X3	-0.034**	0.016	-0.034**	0.017	-0.043**	0.017
$\alpha_{1,1}$	$(\ln X_1)^2$	0.110*	0.060	0.111*	0.060	0.122**	0.059
$\alpha_{2,2}$	$(\ln X_2)^2$	0.038	0.056	0.041	0.053	0.070	0.054
$\alpha_{3,3}$	$(\ln X_3)^2$	0.090**	0.037	0.090**	0.037	0.087**	0.040
$\alpha_{1,2}$	$\ln X_1 \ln X_2$	-0.069	0.046	-0.072*	0.043	-0.101**	0.041
$\alpha_{1,3}$	$\ln X_1 \ln X_3$	-0.057*	0.032	-0.056*	0.032	-0.057*	0.034
$\alpha_{2,3}$	$\ln X_2 \ln X_3$	0.012	0.042	0.013	0.043	0.018	0.044
β_1	$\ln Y_1$	0.596***	0.012	0.596***	0.012	0.593***	0.012
$\beta_{1,1}$	$(\ln Y_1)^2$	0.223***	0.017	0.223***	0.018	0.211***	0.018
$\theta_{1,1}$	$\ln X_1 \ln Y_1$	0.003	0.027	0.003	0.027	0.004	0.027
$\theta_{2,1}$	$\ln X_2 \ln Y_1$	-0.008	0.037	-0.008	0.036	-0.001	0.037
$\theta_{3,1}$	$\ln X_3 \ln Y_1$	-0.035*	0.021	-0.036*	0.022	-0.035	0.023
λ_1	t	-0.026***	0.003	-0.026***	0.003	-0.026***	0.004
λ_{11}	t^2	0.004	0.003	0.004	0.003	0.004	0.003
δ_1	$\ln X_1$ t	-0.001	0.008	-0.001	0.008	-0.004	0.008
δ_2	$\ln X_2$ t	0.001	0.010	0.001	0.010	0.002	0.010
δ_3	$\ln X_3$ t	0.004	0.007	0.004	0.007	0.005	0.007
ψ_1	$\ln Y_1$ t	-0.004	0.005	-0.004	0.005	-0.002	0.005
ζ_1	Loan Quality	0.380***	0.048	0.380***	0.048	0.391***	0.048
ζ_2	Islamic Bank	0.061*	0.033	0.066***	0.021	0.058***	0.022
ζ_3	Foreign Owned Bank	-0.146***	0.040	-0.140***	0.027	-0.095***	0.020
ζ_4	Foreign with IBS	0.124***	0.045	0.118***	0.031	0.070***	0.026
ζ_5	Financial Crisis	-0.027**	0.012	-0.027***	0.012	-0.024***	0.012
ζ_6	Merged Bank 1	0.083***	0.035	0.083***	0.035		
ζ_7	Merged Bank 2	0.098***	0.034	0.097***	0.034		
ζ_8	Merged Bank 3	0.063*	0.038	0.063*	0.038		
ζ_9	Banks with IBS	-0.005	0.029				
ζ_{10}	Merged Banks					0.017	0.018
σ_2	Sigma-squared	0.005	0.001	0.005	0.001	0.005	0.002
Γ	Gamma	0.828***	0.150	0.826***	0.143	0.783	0.193
Log Likelihood			268.16		268.14		261.80

Notes:
*,**,*** Significant at 90, 95 and 99 percent confidence level.

5.4.2 Net and Gross Efficiency Estimates

Table 5.3 and 5.4 respectively provide estimated net and gross efficiency for Model B. As expected, given earlier theoretical discussion, average net efficiency is higher than average gross efficiency. Thus, net efficiency of Malaysian commercial banks is on average 1.055, and ranges from 1.011 to 1.220, hence on average, banks only produce 94.8 percent[4] of the output they could produce if they operated on the efficient frontier. In contrast, average gross efficiency is 1.215, thus signifying that the outputs of the average bank are only 82.3 percent[5] of what they could be if they operated on the frontier defined by the most favourable operating environment. In addition, the gross efficiency estimates range from 1.014 to 1.445. Hence, while the net efficiency scores demonstrate that while there is comparatively little variation in estimated efficiency once differences in the environmental variables are controlled for, the gross efficiency scores suggest that substantial differences in outputs can in fact be attributed to differences in operating environment.

Table 5.3 and 5.4 also demonstrate that the yearly average and the range of the efficiency scores, has risen for both net and gross efficiency. The trends in net efficiency imply a deteriorating in average efficiency over the sample period, but also the existence of a group of banks that were steadily deviating from the output frontier. Hence, average net efficiency worsened from 1.042 in 1996 to 1.060 in 2002 and the maximum net efficiency score deteriorated from 1.104 in 1996 to 1.211 in 2002.

Table 5.3 also shows that after netting out the impact of environmental factors, the efficiency estimates of different bank categories unfailingly cluster around the overall mean, with a minimum group average of 1.04 for merged banks with IBS and a maximum group average of 1.062 for foreign banks without IBS. Hence, once the impact of operating characteristics on estimated outputs is netted out, there is little further difference in estimated efficiency across the identified categories. In other words, if efficiency is judged against an efficient frontier, which for example, allows full-fledged Islamic banks to have 6.6 percent lower output and requires foreign banks without IBS to have 14 percent higher outputs, it should be expected that the resulting net efficiency scores exhibit small difference across these groups.

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[4] OE=(1/ 1.055)100
[5] GE=(1/ 1.215)100

Table 5.3
Net efficiency for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive Statistics: All Banks								
Average	1.042	1.061	1.054	1.052	1.060	1.050	1.060	1.055
Standard Deviation	0.023	0.027	0.034	0.026	0.052	0.037	0.044	0.036
Minimum	1.016	1.015	1.014	1.015	1.011	1.015	1.015	1.011
Maximum	1.104	1.109	1.161	1.123	1.220	1.144	1.211	1.220
Average Efficiency by Category								
All Banks	*1.042*	*1.061*	*1.054*	*1.052*	*1.060*	*1.050*	*1.060*	*1.055*
Without IBS	1.043	1.062	1.056	1.055	1.069	1.063	1.069	1.060
With IBS	1.041	1.060	1.055	1.052	1.054	1.041	1.052	1.052
Islamic	1.037	1.066	1.017	1.028	1.061	1.062	1.086	1.057
Foreign	*1.057*	*1.068*	*1.053*	*1.049*	*1.061*	*1.052*	*1.071*	*1.059*
Without IBS	1.052	1.065	1.060	1.053	1.067	1.057	1.074	1.062
With IBS	1.078	1.077	1.031	1.040	1.043	1.043	1.066	1.052
Domestic	*1.035*	*1.058*	*1.054*	*1.053*	*1.060*	*1.049*	*1.051*	*1.052*
Without IBS	1.027	1.046	1.028	1.064	1.080	1.105	1.036	1.052
With IBS	1.037	1.058	1.057	1.054	1.058	1.040	1.046	1.052
Islamic	1.037	1.066	1.017	1.028	1.061	1.062	1.086	1.057
Merged Banks[ab]	-	*1.077*	*1.037*	*1.043*	*1.044*	*1.039*	*1.046*	*1.044*
Without IBS	-	1.077	1.037	1.034	1.060	1.068	1.037	1.053
With IBS	-	-	-	1.048	1.028	1.032	1.048	1.040
Unmerged Banks	*1.042*	*1.060*	*1.054*	*1.053*	*1.063*	*1.058*	*1.071*	*1.057*
Without IBS	1.043	1.060	1.053	1.054	1.069	1.061	1.081	1.061
With IBS	1.041	1.060	1.055	1.052	1.059	1.053	1.057	1.055

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.

Table 5.4
Gross efficiency for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive Statistics: All Banks								
Average	1.163	1.207	1.200	1.235	1.225	1.222	1.237	1.215
Standard Deviation	0.064	0.071	0.074	0.074	0.111	0.093	0.089	0.085
Minimum	1.033	1.021	1.014	1.057	1.028	1.051	1.057	1.014
Maximum	1.264	1.314	1.418	1.378	1.445	1.389	1.406	1.445
Average Efficiency by Category								
All Banks	*1.163*	*1.207*	*1.200*	*1.235*	*1.225*	*1.222*	*1.237*	*1.215*
Without IBS	1.108	1.135	1.130	1.193	1.173	1.154	1.159	1.152
With IBS	1.188	1.226	1.224	1.248	1.246	1.246	1.263	1.236
Islamic	1.264	1.306	1.206	1.267	1.326	1.333	1.373	1.311
Foreign	*1.104*	*1.148*	*1.132*	*1.194*	*1.177*	*1.156*	*1.179*	*1.161*
Without IBS	1.075	1.118	1.124	1.181	1.162	1.132	1.151	1.139
With IBS	1.221	1.224	1.156	1.220	1.216	1.200	1.228	1.210
Domestic	*1.189*	*1.231*	*1.227*	*1.254*	*1.266*	*1.278*	*1.287*	*1.247*
Without IBS	1.174	1.220	1.162	1.262	1.264	1.307	1.217	1.222
With IBS	1.183	1.226	1.232	1.253	1.255	1.264	1.277	1.242
Islamic	1.264	1.306	1.206	1.267	1.326	1.333	1.373	1.311
Merged Banks[a,b]	-	*1.213*	*1.162*	*1.212*	*1.209*	*1.246*	*1.261*	*1.238*
Without IBS	-	1.213	1.162	1.188	1.223	1.231	1.200	1.208
With IBS	-	-	-	1.224	1.195	1.250	1.276	1.252
Unmerged Banks	*1.163*	*1.206*	*1.201*	*1.238*	*1.228*	*1.206*	*1.221*	*1.210*
Without IBS	1.130	1.150	1.136	1.204	1.196	1.179	1.202	1.173
With IBS	1.188	1.226	1.224	1.251	1.255	1.241	1.245	1.233

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Includes 2 foreign mergers.

On the contrary, because the gross efficiency estimates reported in Table 5.4 incorporate the impact of net efficiency as well that of unfavourable operating characteristics, they produce substantial information related to the main determinant of

variation in the input requirements of banks across the various identified categories. Furthermore, these differences are largely consistent with the preceding explanation of the output impacts for the related dummy variables in Table 5.2. Hence, while the average gross efficiency score is 1.215 for all banks, foreign banks have average gross efficiency of 1.161, indicating relatively higher outputs for these banks. Likewise, the poorer average gross efficiency estimates for merged banks (1.238) versus unmerged banks (1.210) imply that the merger activities in Malaysian banking may have played a part in reducing bank outputs.

Concentrating on Islamic banking, full-fledged Islamic banks have average gross efficiency equal to 1.311, hence clearly suggesting that full-fledged Islamic banking can be linked with higher input requirements. Furthermore, the group of all conventional banks without IBS have average gross efficiency of 1.152, while those with Islamic banking windows have higher input requirements as demonstrated by deteriorating gross efficiency (1.236).[6] Thus, after the influence of operating characteristics on input requirements is allowed for, these findings suggest an obvious order with pure conventional banks showing the best output performance, followed by conventional banks that operate IBS windows, and finally full-fledged Islamic banks with the worst output performance.

Focussing on the impact of the East Asian financial crisis, there is a similarity in the net and gross efficiency estimates as they respectively deteriorated from 1.042 and 1.163 in 1996 to 1.061 and 1.207 in 1997. Moreover, this deterioration in average estimated efficiency is observed across categories. Nonetheless, efficiencies improved in 1998. This demonstrates that despite current findings that there was not a statistically significant impact of the financial crisis in 1997 as identified by a dummy variable for that year, the net and gross efficiency estimates suggest there may still been a detrimental impact in 1997.[7]

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[6] It s noted that higher input requirements as reflected by higher average gross efficiency estimates for IBS banks are also observed within the domestic banks, foreign banks, merged banks and unmerged banks categories, thereby supporting this conclusion. However, the difference is marginal within the domestic bank category, consistent with the finding regarding the statistical insignificance of the Z_9 variable.

[7] High interest rates at the end of 1997 as the Malaysian government tried to reduce capital outflows, contributed to a decline in credit growth from an annual average of 30 percent to 26.5 percent at the end of 1997 (Lindgren, et al. 1999). Given the relative small size of this effect, this may explain for insignificant year 1997 dummy when tested in the model.

Lastly, focussing on the general trend in gross efficiency, the average estimates demonstrate that average gross efficiency improved marginally from 1.207 in 1997 to 1.200 in 1998, and this improvement in average estimated gross efficiency is noted across all categories. Nevertheless, average gross efficiency rose to 1.235 in 1999 and remained close to this level until 2002. Hence, the findings suggest a transitory improvement in general output performance in 1998 followed by a sustained decline in output performance. These results can be interpreted as manifesting the double impact of the financial crisis on output efficiency. Thus, the prolonged deterioration in gross efficiency after 1998 reflects the sustained increase in NPLs and the resulting increase in input requirements discussed earlier. On the contrary, the interim improvement in gross efficiency in 1998 reflects an immediate but temporary reaction to the financial crisis which can be attributed to a decrease in input usage as a result of the elimination of a large number of workers, cuts in other operating expenses, and declines in interest rates.[8] On the other hand, in the long run, it is obvious that deterioration in loan quality, which can be attributed to the financial crisis, has had a considerable negative impact on potential output in the Malaysian banking sector.

5.4.3 Returns to Scale

Table 5.5 shows firm specific return to scale estimates for all banks and by bank category. The average estimated return to scale is 0.990, thereby indicating the presence of mild decreasing return to scale. The range of estimated returns to scale is between 0.856 and 1.092, and is consistent with the previous output-oriented literature (e.g., Cuesta and Orea 2002).

On average, this estimated scale elasticity has decreased from 1.018 in 1996 to 0.967 in 2002, and this finding is consistent with the overall increase in the scale of banks through mergers discussed above. Likewise, within almost all bank categories summarised in Table 5.5, very mild decreasing returns to scale and a slight downward trend in estimates is observed. Thus, there is little evidence for a difference in returns to scale across the groups identified in Table 5.5.[9] The existence of mild increasing return to

[8] Interest rates, which were very high to refrain capital outflow, were reduced in the third quarter of 1998 to support the economic recovery plan.

[9] Yudistira (2004) found that small and medium-sized Islamic banks in most countries have diseconomies of scale but Alshammari (2003) found that bank type has no effect of economies of scale in GCC countries.

scale in 1996, the slight decreasing return to scale towards the end of the sample period and the consolidation of banks, suggests that if total factor productivity change in Malaysian banking was affected by scale change effects during 1996-2002, this effect is likely to be only a slight decrease on average.

Table 5.5
Return to scale for all banks and by category

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive Statistics: All Banks								
Average	1.018	1.017	1.004	0.989	0.974	0.969	0.967	0.990
Standard Deviation	0.035	0.032	0.038	0.035	0.047	0.040	0.046	0.044
Minimum	0.943	0.945	0.912	0.894	0.869	0.880	0.856	0.856
Maximum	1.062	1.061	1.081	1.067	1.092	1.034	1.051	1.092
Average Return To Scale by Category								
All Banks	*1.018*	*1.017*	*1.004*	*0.989*	*0.974*	*0.969*	*0.967*	*0.990*
Without IBS	1.015	1.030	1.006	0.988	0.968	0.957	0.957	0.985
With IBS	1.020	1.012	1.003	0.990	0.978	0.977	0.975	0.993
Islamic	1.016	1.013	1.004	0.989	0.972	0.963	0.945	0.978
Foreign	*1.004*	*1.023*	*0.996*	*0.978*	*0.968*	*0.957*	*0.959*	*0.979*
Without IBS	1.000	1.024	0.998	0.981	0.969	0.955	0.959	0.980
With IBS	1.021	1.021	0.990	0.972	0.965	0.959	0.959	0.975
Domestic	*1.024*	*1.014*	*1.007*	*0.995*	*0.978*	*0.980*	*0.973*	*0.997*
Without IBS	1.046	1.061	1.052	1.025	0.962	0.969	0.943	1.013
With IBS	1.020	1.011	1.004	0.993	0.981	0.984	0.981	0.997
Islamic	1.016	1.013	1.004	0.989	0.972	0.963	0.945	0.978
Merged Banks[ab]	-	*1.027*	*1.007*	*1.003*	*0.983*	*0.978*	*0.970*	*0.981*
Without IBS	-	1.027	1.007	1.009	0.981	0.976	0.967	0.988
With IBS	-	-	-	1.000	0.985	0.978	0.971	0.978
Unmerged Banks	*1.018*	*1.016*	*1.004*	*0.988*	*0.972*	*0.963*	*0.964*	*0.992*
Without IBS	1.015	1.028	1.006	0.985	0.966	0.954	0.952	0.984
With IBS	1.020	1.012	1.003	0.989	0.976	0.975	0.980	0.997

Notes:
[a] No mergers between Islamic banks have occurred during the sample period.
[b] Include 2 foreign mergers.
If return to scale >,< or =1, there are increasing return to scale; decreasing return to scale or constant returns to scale respectively.

5.4.4 Productivity Change and its Decomposition

Table 5.6 gives average estimated productivity change across all banks and its decomposition into efficiency change, technical change and scale change. Over the sample period, average productivity change was 2.37 percent per year. As technical change increased 2.79 percent, productivity change is largely driven by technical change.[10] However, as estimated average technical change declined from 3.95 percent in 1997 to 1.72 percent in 2002, the trend decrease in overall productivity change can also be attributed to decreasing rates of technical change.

The negative average scale change effect of 0.03 is consistent with the result of average mild decreasing returns to scale, but also strengthens the finding that mergers have not contributed to productivity increases. Between 1996 and 1997, scale change contributed a 0.28 percent increase in productivity change, but this cannot be attributed to mergers, which only occurred later in the sample period. The succeeding year saw a negative scale change effect of 0.18 percent, which possibly signals deterioration in output due to the financial crisis and reduced economic growth in 1998.

Table 5.6
Mean Productivity change in Malaysian banking, annual percentage rate of change

Period	Mean Changes in Efficiency	Mean Technical Change	Mean Scale Effect	Mean Productivity Growth
1996/97	-2.24	3.95	0.28	1.99
1997/98	0.60	3.58	-0.18	4.00
1998/99	-0.24	3.13	-0.09	2.80
1999/2000	-0.70	2.52	0.09	1.90
2000/01	0.62	2.08	-0.31	2.39
2001/02	-0.94	1.72	0.14	0.92
1996/2002	-0.39	2.79	-0.03	2.37

[10] This result is similar to findings by Orea (2002) on Spanish banks, Isik and Hassan (2003) for Turkish banks and Casu, Girardone, and Molyneux (2004) on Spanish and Italian banks where technological progress is the main determinant of productivity change. Krishnasamy, et al. (2004) found productivity improvement in 10 Malaysian commercial banks was also primarily determined by technical change during the 2000-2001 period.

While technical change has influenced the long term descending trend in average productivity change, efficiency change has been accountable for dramatic variations around this trend. The pattern of annual efficiency is quite unpredictable, with big positive contributions to productivity change in 1998 and 2001, but large negative effects in other years. While, efficiency change reduced average productivity change by 2.24 percent in 1997, efficiency change contributed 0.6 percent to productivity change in 1998 before dropping again in the subsequent years.[11] Overall, the results suggest that the financial crisis adversely affected productivity. This decline in productivity was caused by a decline in net and gross efficiency in 1997 which can be attributed to the financial crisis. Moreover, the gross efficiency estimates indicate that the financial crisis has had a continued output reducing impact by triggering a sustained increase in NPLs.

5.4.5 Firm specific productivity change and its decomposition

Table 5.7 shows productivity change estimates over the sample period for all banks and by bank category. It also decomposes these rates into efficiency change, technical change, and the scale change effect. It is clear that considerable differences exist between average productivity change for various bank categories. Thus, the small group of merged banks without IBS have the highest average productivity change at 3.33 percent, while the minimum group average of 0.54 is for merged banks with IBS. The latter group contributes to the lower average productivity change in merged banks (1.57 percent), relative to unmerged banks (2.50 percent).[12] Compared to all domestic banks (2.19 percent), foreign banks have higher average productivity change (2.68 percent), but this can be primarily attributed to the foreign banks without IBS group (3.10 percent).

The decomposition of productivity change gives some important insights into these considerable differences in productivity change across bank categories. The much lower average productivity change of 1.57 percent for unmerged banks relative to merged banks can be mainly attributed to higher rates of technical change for the unmerged banks (2.93 percent) compared to the merged banks (1.88 percent), perhaps because merged banks

[11] Contrary to the cost efficiency estimates reported in chapter 4, with the output distance function approach, the impact of East Asian financial crisis which started in the third quarter of 1997 can be seen on Malaysian bank output efficiency as early as 1997 through negative efficiency change of 2.24 percent.

[12] Sufian and Ibrahim (2005) reported average total productivity growth for post-merger Malaysian banks of -1.3 percent for the period 2001-2003.

need to concentrate more on integrating staff and coordinating their systems (Rhoades 1998; Sherman and Rupert 2006).[13]

Table 5.7
Summary of firm specific productivity growth for all banks and by category, annual percentage rate of change

	Mean Efficiency Change	*Mean Technical Change*	*Mean Scale Change Effect*	*Mean productivity change*
Descriptive Statistics: All Banks				
Average	-0.39	2.79	-0.03	2.37
Standard Deviation	3.09	0.94	0.86	3.21
Minimum	-8.07	0.93	-4.14	-5.59
Maximum	9.81	5.06	4.65	13.01
Average Productivity Change by Category				
All Banks	*-0.39*	*2.79*	*-0.03*	*2.37*
Without IBS	-0.13	3.11	0.07	3.06
With IBS	-0.51	2.64	-0.05	2.08
Islamic	-0.44	2.66	-0.29	1.93
Foreign Banks	*-0.10*	*2.80*	*-0.02*	*2.68*
Without IBS	0.04	3.05	0.02	3.10
With IBS	-0.44	2.22	-0.09	1.68
Domestic Banks	*-0.56*	*2.78*	*-0.03*	*2.19*
Without IBS	-1.10	3.52	0.39	2.80
With IBS	-0.52	2.73	-0.04	2.17
Islamic	-0.44	2.66	-0.29	1.93
Merged Banks[a,b]	*-0.28*	*1.88*	*-0.03*	*1.57*
Without IBS	1.12	2.30	-0.10	3.33
With IBS	*-1.10*	1.64	0.01	0.54
Unmerged Banks	*-0.41*	*2.93*	*-0.03*	*2.50*
Without IBS	*-0.39*	3.16	0.03	2.80
With IBS	*-0.41*	2.81	-0.06	2.33

Notes:
[a] No mergers between Islamic banks have occurred during the sample period
[b] Includes 2 foreign mergers.

[13] The result is consistent with Orea (2002)'s research who finds that the average rate of productivity change of merging banks is lower than non-merging banks, and Berger and Mester (2003) who found that productivity deterioration is greater for merging banks than non-merging banks.

However, the identical 0.03 percent deterioration in average productivity change attributed to scale change effects for both merged and unmerged banks suggests that mergers have not contributed to productivity change through scale effects.

Much of the difference in productivity change between merged and unmerged banks can be attributed to the 0.54 average productivity change for merged banks with IBS windows, which can mainly be attributed to very low technical change (1.64 percent) and a considerable decline in efficiency (-1.10 percent). When coupled with the relatively small difference in estimated productivity change, technical change, efficiency change, and scale change effects for unmerged banks with or without IBS windows, this demonstrates a further disturbing impact of Malaysian banking mergers during the chosen sample period. This is because it suggests that merged banks with IBS banking windows may have been unable to allocate adequate managerial effect to developing their IBS operations, because their managers were distracted by these mergers.

The comparatively low average productivity change of foreign banks that have IBS windows in operation is attributable to relatively low average technical change (2.22 percent) as well as deterioration in efficiency (-0.44) and a negative scale change effect (-0.09). As foreign banks without IBS have comparatively fast technical change (3.05 percent) and positive efficiency change and scale change effects, these results imply that foreign banks that operate IBS have not only failed to develop new technologies, but have also become less efficient over time. This may suggest that although these banks moved into the developing market of Islamic banking services, they were very slow in developing new products and technologies for this market. On the contrary, foreign banks that have continued concentrating on conventional banking services managed to maintain technical change and have been more able to sustain efficiency levels. Therefore, the findings may suggest that, for foreign banks, venturing into the Islamic banking market has been a disruption from their principal proficiency.

The author finally focuses on Islamic banking. Large differences in average productivity, technical change and efficiency change between the group of all conventional banks with or without IBS windows, implies that there is a sizeable difference in productivity change that can be generally attributed to the provision of Islamic banking services by conventional banks. The foregoing discussion proposes that both foreign banks and merged banks that offered IBS banking services have faced lower

average rates of productivity change. Similarly, the lower than average productivity change for full-fledged Islamic banks (1.93)[14] can be mainly explained by relatively low technical change (2.66 percent), as well as deterioration in efficiency change (-0.44 percent) and a negative scale change effect (-0.29 percent). This suggests that while Islamic banks have been moderately successful in developing new output enhancing products and technologies,[15] they have been unable to remove inefficiencies in their operation.

5.5 CONCLUSIONS AND POLICY IMPLICATIONS

The objective of this chapter was to investigate the efficiency, economies of scale and productivity of Islamic banks relative to conventional banks using an output distance function and a generalised parametric Malmquist Productivity Index. In achieving this goal, some significant results with regard to the Malaysian banking sector are found. The average Malaysian bank is estimated to produce only 94.8 percent of the output that could be produced if it operated on the frontier defined by actual operating characteristics, but only produces 82.3 percent of the potential output that could be produced if it instead faced the most favourable operating environment. This suggests that differences in bank characteristics play an important role in determining bank outputs. Moreover, on average, banks became more inefficient between 1996 and 2002, causing an average 0.39 percent decline in productivity change. The finding that banks operate at or near to constant returns to scale is also consistent with the finding that scale change contributed only a 0.03 percent decrease in average productivity change. As technical change contributed 2.79 percent to average productivity change, it was the main determinant of productivity change which averaged 2.37 percent per year between 1996 and 2002.

The estimates of gross efficiency allow better understanding of the determinants of variation in outputs across bank categories, because, by definition, net efficiency estimates net out the influence of operating characteristics on bank output by first allowing for increases or decreases in predicted efficient output attributable to the operating

[14] Moderate productivity growth is found in Islamic banks for most countries (Hassan 2005) but productivity loss is found for Islamic banks in Sudan, Iran and Pakistan (Hassan 2003).
[15] This is consistent with Hassan (2003; 2005) who also found that the productivity change of Islamic banks is driven by technical change.

environment. In contrast, the gross efficiency estimates are measured relative to an efficient frontier with the most favourable observed operating environment as gross efficiency implicitly includes not only the impact of net inefficiency but also the impact of decreased outputs associated with an unfavourable operating environment. Hence, gross efficiency highlights the impact of all operating characteristics on bank outputs. Therefore, regardless of whether one believes that operating characteristics should directly influence inefficiency (gross efficiency) or one believes that they influence the efficient output frontier (net efficiency), the gross efficiency estimates provided in this chapter has increased the author's understanding of the effect of differences in operating characteristics on observed differences in bank outputs. As a result, the finding of slight differences in net efficiency, imply that it is the differences in operating characteristics which explain a large amount of the output differences between Malaysian banks. Thus, for example, the high gross efficiency estimates for both full-fledged Islamic banks and conventional banks with IBS windows imply that Islamic banking requires considerably higher inputs, a finding that is not revealed in the net efficiency estimates. Likewise, while net efficiency demonstrates little effect from the East Asian financial crisis, the gross efficiency estimates clearly demonstrate that the crisis had an interim output increasing effect in 1998. Moreover, the gross efficiency estimates subsequently demonstrated that the crisis prompted a continuing negative impact on the output performance of Malaysian banks, which can be attributed to an increase in non-performing loans.

Given the extensive bank mergers in Malaysia during the chosen sample period, it is also remarkable that merged banks have experienced substantially lower productivity change relative to unmerged banks. However, this difference can be mainly attributed to the lower efficiency change of merged banks that operate IBS windows. This implies that the call for managers to simultaneously develop new Islamic banking products and consolidate operations after mergers, may have contributed to this bad performance. However, it also suggests that, in general, mergers do not positively influence the performance of Malaysian banks.

The author finally compares the results from this chapter with the results in chapter 4 that employs a cost function in order to check the consistency of results. With the cost function approach, slightly higher average net inefficiency estimates of 1.066 percent are

found as compared to 1.055 when using an output distance function. Using both methods however, banks experience almost constant returns to scale. The slightly higher average productivity change of 2.68 using a cost function, results from 0.52 percent deterioration in efficiency, 2.88 percent increase in technical change and the 0.32 percent contribution of scale change. In contrast, the productivity change of 2.37 percent using output distance function is attributed to a smaller deterioration in efficiency of 0.39 percent, a smaller increase in technical change of 2.79 percent, and a decrease in scale change effect of 0.03 percent. The lower technical change and absence of scale have mainly contributed to the lower productivity in the output distance function estimates compared to the cost function estimates. Both methods produce almost similar trends in productivity change and its components except in 1996-1997. During this period, cost efficiency change, and hence productivity change is higher as compared to the following period, but the output distance based efficiency change, and hence productivity change is lower in 1996-1997 compared to the following period.

While similar results of poor gross efficiency for full-fledged Islamic banks relative to average banks are found using both methodologies, estimated average productivity change reveals slightly different results. In the cost function, full-fledged Islamic banks experience high productivity change of 4.23 percent and also managed to eliminate a significant proportion of their cost disadvantages, as efficiency change averaged 0.27 percent. Furthermore, they have a 0.26 percent positive scale change effect and estimated average technical change of 3.70 percent. On the other hand, with the output distance function estimates, Islamic banks are found to experience a much lower productivity change of 1.93 percent. In addition, Islamic banks fail to eliminate their inefficiencies (-0.44 percent) and experience average negative scale change of 0.29 percent. However, while they still appear to improve their productivity through technical change of 2.66 percent per year, this rate is significantly lower than that found with the cost function approach.

For both cost and output distance functions, conventional banks, which have Islamic windows, have superior net efficiency relative to those without IBS, in each category of foreign, merged and unmerged banks. On the other hand, domestic banks with IBS are slightly more efficient than those without IBS, when evaluated with a cost function but are found equally efficient using the output distance function approach.

Similarly, for both cost and output distance functions, except for the domestic category in the cost function, banks with IBS have lower efficiency change relative to those without IBS. In terms of technical change, except for domestic and unmerged banks, banks with IBS have lower estimated technical change than those without IBS when using the cost function approach. In contrast, banks with IBS in each category have higher technical change when evaluated with the output distance function approach.

Based on this comparison, both the cost and output distance functions have produced generally similar conclusions on the relatively poor performance of banks with IBS relative to those without IBS in each category except for the domestic category. Given conventional banks with IBS windows' inferior gross efficiency, current findings therefore suggest that the productivity, efficiency, scale change, and technical change of IBS banks are inferior to other banks. On balance however, the author believes that an output distance function approach is a better method because the behavioural assumptions being made with the output distance function are less likely to create biases when jointly evaluating Islamic and conventional banks, and this approach also allows the author to avoid the further potential pitfall associated with price endogeneity.

In sum, current output distance function results suggest that the potential for Islamic banks to overcome the output disadvantages associated with Islamic banking are relatively limited. Given the moderate growth of Islamic banking, the existing output disadvantages highlighted by the gross efficiency estimates, and the relatively small output productivity change of Islamic banks when compared to other banks, policy makers in Malaysia face an interesting conundrum. Thus, if they wish to further develop Islamic banking, current results suggest that they will need to better motivate Islamic bank managers to reduce these output disadvantages, and more significantly, they will need to actively work to create a more encouraging banking environment for Islamic banking.

CHAPTER 6
EFFICIENCY IN ISLAMIC AND CONVENTIONAL BANKING: AN INTERNATIONAL COMPARISON

6.1 INTRODUCTION

The establishment of the Nasser Social Bank in Egypt in 1971 (Iqbal and Molyneux 2005), the Dubai Islamic Bank in the United Arab Emirates and the Islamic Development Bank (IDB) in 1975 paved the way for the creation of other Islamic financial institutions all over the world (Central Bank of Malaysia 1999). Some form of Islamic financial service is now available in at least 70 countries Husain (2005).

An Islamic bank is governed by *shariah*, as well as the regulations set in place by the host country. While some Islamic banks were purposely established to operate within *shariah*, some Islamic banks were converted from conventional banks. Thus, in Iran and Sudan, all conventional banks were converted to Islamic banks in order to conform with government legislation (Sundararajan and Errico 2002). However, it is more common for countries with large Muslim populations to operate Islamic banking systems alongside conventional banking systems, as is now the case in Malaysia, Bahrain, Pakistan, Saudi Arabia, and Egypt (Hassan 2003).

Previous studies using cost and/or profit functions to compare the efficiency of Islamic and conventional banks, have found Islamic banks to be similar (Abdul-Majid, Mohammed Nor, and Said 2005; Mokhtar, Abdullah, and Al-Habshi 2006) if not better (Alshammari 2003; Al-Jarrah and Molyneux 2005) than conventional banks. However, the previous analysis in chapters 4 and 5 demonstrated that after properly taking into account environmental variables in either a cost or output distance function, Malaysian Islamic banks are found to have higher input requirements. This finding of

higher input requirements for Islamic banks in Malaysia is the main motivation for this chapter, as the author wishes to further investigate how Islamic banks perform relative to conventional banks internationally. Moreover, an international study will allow analysis of how, respectively, Islamic and conventional banks from various countries perform relative to other countries, and whether significant differences across countries exist. This would potentially provide relevant findings for policy makers in the sample countries who wish to judge the relative performance of their banking sector.

The author also notes that the design of this chapter results from careful consideration of how to effectively compare the efficiency of conventional and Islamic banks, while properly allowing for relative differences between these types of banks. Thus, following several previous studies that include both conventional and Islamic banks and previous chapters, the author adopts an intermediation approach. This approach is most suitable for comparably defining the relationship between bank outputs and inputs because Islamic banks adopt an equity participation principle that effectively intermediates between savers (depositors) and investors (e.g., Al-Jarrah and Molyneux 2005; El-Gamal and Inanoglu 2005). However, the author also extends this approach by including equity as an input, because of both its role in Islamic banking and because the author believes this better reflects the fact that banks can and do raise funds through equity financing.

Similar to chapter 5, this chapter innovates by adopting an output distance function approach to compare Islamic and conventional banks. This implies the assumption of an output oriented approach, and therefore measures efficiency by comparing actual output relative to potential output, given fixed inputs. This approach has the advantage of allowing the use of identifiable output and input quantities such as deposits, total operating expenses and equity, and therefore allows us to avoid the possible problem of input price endogeneity (Orea 2002). Given differences in accounting standards across countries, as well as differences in conventional and Islamic banking assets, the author also believes that for this international study, the standard approach of employing accounting information to define output and/ or input prices, is particularly likely to result in distorted and inaccurate price estimates, and hence distorted cost or profit efficiency estimates. Finally, but most significantly, the author has also adopted the output distance function approach in this chapter because it does not require strong behavioural assumptions such as those required with a cost minimization or profit maximization approach. This is because the dual objective of

Islamic banks, which are both maximizing profit for shareholders as well as fulfilling potentially non-profit maximizing obligations, may result in managerial objectives that differ substantially from those of conventional banks. Therefore, given fewer behavioral assumptions, the output distance function approach should allow a more accurate comparison of the productive efficiency of Islamic and conventional banks, even if their managers have considerably different objectives.

In sum, this chapter aims to measure the efficiency of banks in countries that have Islamic banking in operation as well as the relative efficiency between countries, and will particularly focus on the relative performance of Islamic banks as compared to conventional banks. More specifically, by deriving estimates of efficiency for banks in different countries after estimating an output distance function with stochastic frontier techniques, the analysis highlights the impact of operating characteristics, including Islamic banking and country-specific conditions on the relative outputs of banks. In particular, the efficiency estimates highlight that during the sample period, Islamic banking appears to be associated with higher input usage. Moreover, by allowing for international differences in the underlying inefficiency distributions, the author is able to demonstrate statistically significant differences in efficiency across countries even after controlling for specific environmental characteristics and Islamic banking.

The rest of the chapter is organised as follows. Section 6.2 provides a brief literature review focused on the relative performance of banks across countries, and is followed by a description of the methodology in section 6.3. Data and the empirical specification are discussed in section 6.4. Section 6.5 reports the results which are comprised of the output distance function, efficiency, and returns to scale estimates. Finally, section 6.6 offers some conclusions.

6.2 REVIEW OF THE LITERATURE AND THE MODELLING APPROACH

This chapter contributes to both the existing literature employing a parametric approach to measure cross-country bank efficiency as well as the literature considering the comparative efficiency of Islamic and conventional banks. As an author's approach to controlling for differences in operating environment will have a significant impact on estimated efficiency, it is necessary to carefully consider the impact of the chosen operating environment variables on measured efficiency. Moreover, as the choice of appropriate inputs and outputs will significantly influence estimated efficiency, the author also considers previous definitions of the input output set in

order to better model an appropriate common frontier for Islamic and conventional banks in a cross-country analysis. It is also necessary to carefully consider the influence of functional form on the measured efficiency of both conventional and Islamic banks in an international setting. Finally, the author briefly takes into account the findings of previous studies with regard to returns to scale in banking.

In estimating cross-country bank efficiency, while some studies (Allen and Rai 1996; Altunbas, Gardener, Molyneux, and Moore 2001; Maudos, Pastor, Pérez, and Quesada 2002) do not assume that any environmental conditions influence frontier estimation, and hence location of the frontier; other studies (Dietsch and Lozano-Vivas 2000; Bonin, Hasan, and Wachtel 2005; Carvallo and Kasman 2005) do control for these factors. The environmental conditions can be categorised into country-specific factors (Fries and Taci 2005; Williams and Nguyen 2005) or country dummy variables (Bonin, et al. 2005) and bank-specific factors such as quality and equity (Alshammari 2003; Al-Jarrah and Molyneux 2005). A common frontier without controls for country-specific factors is likely to be misspecified because each country may have a different banking technology as well as different environmental and regulatory conditions (Dietsch and Lozano-Vivas 2000), but the frontier assumes the same technology for all banks (Chaffai, Dietsch, and Lozano-Vivas 2001). Therefore, by controlling for these factors in a common frontier, efficiency rankings are more persistent (Fries and Taci 2005), efficiency estimates are improved (Dietsch and Lozano-Vivas 2000; Bonin, et al. 2005; Carvallo and Kasman 2005; Kasman 2005), and the estimates of efficiency more appropriately reflect the impact of less (or more) favourable country-specific conditions on estimated relative efficiency (Dietsch and Lozano-Vivas 2000). These country-specific factors can be broadly generalised into macroeconomic factors such as per capita income, density of demand, population density, banking concentration (Dietsch and Lozano-Vivas 2000; Carvallo and Kasman 2005; Williams and Nguyen 2005), bank structure and regulation such as bank branches per capita (Maudos and de Guevara 2007), intermediation ratio (Dietsch and Lozano-Vivas 2000), as well as accessibility of banking services, as measured with GDP growth (Kasman and Yildirim 2006) and density of bank branches (Dietsch and Lozano-Vivas 2000).

In this chapter, countries involved in the sample range from low to high income economies and significant differences exist in many characteristics including those related to politics, economics, social structure, and geography. Thus, for example

Sudan is characterized by a culture of holding cash in hand, and is plagued by the effects of civil war, economic sanctions and drought, and these jointly influence the poorly developed Sudanese banking sector (Bashir 1999; Hussein 2004). In contrast, due to its high level of economic development and its comprehensive regulatory framework, Bahrain has attracted confidence among investors (Iqbal and Molyneux 2005). These country specific differences in the background operating environment as well as significant differences in bank regulatory frameworks and financial reporting formats (Karim 2001) strongly suggest that controlling for country-specific effects appropriately will have an important impact on estimated efficiency in an international sample (See section 2.7 for discussion on the socio-economic background for each country). Irrespective of controlling for country-specific factors in frontier estimation however, wide range of average inefficiency estimates exists across countries (Abd Karim 2001; Carvallo and Kasman 2005). Furthermore, Bonin, et al. (2005) found that country effects continue to play a significant part in explaining differences in efficiency measures even after they have been controlled in the frontier estimation.

As *shariah* compliant banking has different objectives and modus operandi from conventional banking, it may also have different operational characteristics from conventional banking and potentially influence the operating output. Therefore, it is appropriate to control for this bank-specific factor in the frontier estimation. Some previous SFA cross-country studies (e.g., Maudos, et al. 2002; e.g., Fries and Taci 2005; Williams and Nguyen 2005; Kasman and Yildirim 2006) have either controlled for bank output quality and/ or equity in the frontier estimation. Bank output quality[1] (Fries and Taci 2005) or equity capital (Carvallo and Kasman 2005; Bos and Schmiedel 2007; Fitzpatrick and McQuinn 2007) has always before been treated as fully exogenous in the frontier estimation, although some studies have treated equity (Maudos, et al. 2002; Williams and Nguyen 2005; Kasman and Yildirim 2006) and even both loan quality and equity (Alshammari 2003) as "netputs"[2]. However, the author would argue that even conventional banks employ equity capital as an input in addition to funds from deposits and inter-bank borrowings to finance loans (Bonaccorsi di Patti and Hardy 2005). Moreover, Islamic banks that apply the equity participation principle also depend significantly on equity as a source of funds

[1] If output quality is not controlled for, unmeasured differences in loan quality that are not captured by banking data may be mistakenly measured as inefficiency (Berger and Mester 1997).
[2] "Netputs" are operating characteristic variables that have been made fully interactive with inputs and outputs in the function.

(Metwally 1997). Therefore, while in the previous literature, equity has generally been employed only as an environmental factor in frontier estimation, the author strongly believes that a more appropriate modelling approach, which not only better specifies the input relationship for all banks but also allows a flexible specification that is more appropriate for comparing conventional and Islamic banks, is to directly include equity as an input.

Efficiency scores estimated using SFA have been correlated with environmental factors under investigation using two different methodologies. The first, which is a "one-step" methodology simultaneously estimates the frontier and the impact of environmental factors on efficiency by using an inefficiency effects model, such as that proposed by Battese and Coelli (1995). These include both studies that assume no direct impact of environmental factors on the estimated frontier, and hence assume that they only influence efficiency (Abd Karim 2001; Alshammari 2003; Al-Jarrah and Molyneux 2005) and studies that control for these factors in estimating the frontier (Bonin, et al. 2005; Williams and Nguyen 2005; Fitzpatrick and McQuinn 2007). Within the former strand of literature, bank types dummy variables (Abd Karim 2001; Alshammari 2003; Al-Jarrah and Molyneux 2005), ownership, size (Abd Karim 2001), assets, liquidity and bank concentration ratios (Al-Jarrah and Molyneux 2005) have been assumed to directly influence inefficiency. In the later studies that assume environmental conditions to influence frontier estimation, country-specific factors such as size and governance-related factors (Williams and Nguyen 2005) and country dummy variables (Bonin, et al. 2005; Fitzpatrick and McQuinn 2007) have been controlled for.

Another significant methodology that has been employed in the literature employs a "two-step" approach. Such studies have first estimated the frontier, followed by an OLS regression to find correlations between inefficiency scores and bank-specific factors (Allen and Rai 1996; Altunbas, et al. 2001; Maudos, et al. 2002). This category includes both studies that do not assume environmental conditions to influence frontier estimation and studies that control for these factors in estimating the frontier. Without controlling for any environmental conditions, the former (Allen and Rai 1996; Altunbas, et al. 2001; Maudos, et al. 2002) have subsequently correlated inefficiency with bank-specific factors such as ownership (Weill 2002), organisational structure (Boubakri, Cosset, Fischer, and Guedhami 2005), bank size, specialisation, profitability, risk and country-specific factors (Maudos, et al. 2002). On the other

hand, studies that control for these factors in estimating the frontier (e.g., Dietsch and Lozano-Vivas 2000; Carvallo and Kasman 2005) have subsequently correlated inefficiency with bank-specific factors such as loan quality, profitability, equity capital, non-interest income (Carvallo and Kasman 2005) and country-specific factors such as concentration ratio (Dietsch and Lozano-Vivas 2000). However, this "two-steps" procedure is associated with several anomalies and has been previously criticised (Coelli, Rao, and Battese 1998). The author therefore, employs a "one-step" procedure similar to Fries and Taci (2005) and Williams and Nguyen (2005). The present chapter will control for country-specific factors, and *shariah* compliant banking in the frontier estimation. It will also test for the significance of country dummy variables in the inefficiency effects model using Battese and Coelli's (1995) model of "one-step" procedure.

With regard to the chosen functional form, most cross-country studies of banking efficiency have employed a cost function approach (Dietsch and Lozano-Vivas 2000; Abd Karim 2001; Carvallo and Kasman 2005; Fries and Taci 2005; Kasman 2005; Carbo Valverde, Humphrey, and Lopez del Paso 2007; Maudos and de Guevara 2007), or a profit function approach (Kasman and Yildirim 2006; Fitzpatrick and McQuinn 2007). Moreover, studies have increasingly simultaneously employed both cost and profit functions (Alshammari 2003; Hassan 2003; Al-Jarrah and Molyneux 2005; Bonin, et al. 2005; Hassan 2005; Kasman and Yildirim 2006; Bos and Schmiedel 2007). Nevertheless, with international comparisons of efficiency, one must note that international differences in accounting information might lead to distorted price estimates, thereby undermining the common use of both cost and profit functions for measuring bank efficiency. Moreover, as the moral underpinnings of Islamic banking may cause Islamic bank managers to pursue objectives that are less consistent with an assumption of cost or profit optimisation than those of conventional bank managers, the implicit behavioural assumptions of a cost/ profit function approach may result in biased downward estimates of Islamic bank managerial efficiency. This chapter will therefore extend the approach of Cuesta and Orea (2002) and will measure the efficiency of banks internationally using an output distance function, which not only does not require price information, but also does not require any behavioural assumption such as cost minimisation or profit maximisation. This study will therefore join the limited number of studies using an output distance function approach to judge cross-country banking efficiency (Chaffai, et al. 2001; Olgu

2006), and, to the author's knowledge, is the first cross-country study of Islamic and conventional bank efficiency that has employed an output distance function approach (Please refer to Appendix V for summary of selected cross-country studies using SFA that control for country-specific factors).

Focussing briefly on returns to scale estimates in the previous literature, slight economies of scale are found in every production scale but are more pronounced in small banks in some studies (Abd Karim 2001; Altunbas, et al. 2001; Cavallo and Rossi 2001). However, other studies also find evidence of diseconomies of scale in large banks (Allen and Rai 1996; Carvallo and Kasman 2005), small and medium-sized Islamic banks (Yudistira 2004) and small banks (Kasman 2005). Irrespective of differences in the findings however, on average, returns to scale estimates are normally near one which indicates that on average, banks operate at almost constant returns to scale (e.g., Clark 1996; Cuesta and Orea 2002; Orea 2002; Carvallo and Kasman 2005). In addition, bank type (e.g. Islamic, conventional commercial or conventional merchant) is found to have little or no significant impact on estimated scale economies in GCC banks (Alshammari 2003). Given these limited previous findings, the model below will also investigate returns to scale of both Islamic and conventional banks internationally.

In sum, the discussion of the previous literature has demonstrated the importance of controlling for operating characteristics, and particularly country-specific environmental conditions, when estimating bank efficiency. In particular, it highlights that country effects play a significant part in explaining estimated efficiency differences across countries, and must therefore be carefully modelled. Moreover, in contrast to the previous literature, it has also been argued that equity should be modelled as an input because it is an important potential source of financing for conventional and particularly Islamic banks. In addition, this section has illustrated the advantage of employing an output distance function in an international study in which behavioural objectives may differ significantly between banks. The model below will therefore employ an output distance function and control for country-specific factors and *shariah* compliant banking directly in the estimated frontier as well as allowing for international differences in the underlying inefficiency distribution using Battese and Coelli's (1995) model. Moreover, given the specification below it will be possible to test for statistically significant differences in the parameters that define each country's efficiency distribution. This chapter will therefore provide a useful methodology and

therefore expand upon the existing literature that has analysed cross-country bank efficiency, in addition to providing a comparison between Islamic and conventional banks. Given this discussion, the following section further details the methodological approach employed.

6.3 METHODOLOGY

6.3.1 Output distance function

Please refer to 5.3.1. specifically for Equation 5.1-5.4 and related discussions.

6.3.2 The econometric specification

Although this chapter employs output distance function approach similar to chapter 5 (Please see 5.3.2 for the econometric specification, specifically Equations 5.5-5.8 and related discussions), the author specifies Battese and Coelli (1995)'s truncated normal SFA model with the mean of the truncated normal distribution made an explicit function of country dummy variables. This is illustrated in Equation 6.9, which follows the formulation of the model detailed in (Coelli 1996). Thus, $v_{n.t}$ is assumed to be normally distributed with zero mean and variance σ_v^2 and independently distributed of the $u_{n.t.}$ $u_{n.t} \geq 0$ is assumed to be drawn from a truncation (at zero) of the normal distribution with mean, $EM_{n,t}$ and variance σ_u^2 where δ_f is a parameter to be estimated, f=1,2..,F is an index for countries, and C is a country dummy. Therefore, given the absence of a constant in Equation 6.9, each country f is estimated to have inefficiency drawn from a distribution with mean δ_f , that is truncated at zero. The parameters in the translog function as defined in Equation 5.8, the composed error parameters $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$, and the estimated means of the country specific inefficiency distributions (δ_f) specified in Equation 6.9 are estimated simultaneously using maximum likelihood estimation (MLE) techniques.

$$EM_{n,t} = \sum_{f=1}^{F} \delta_f C_{f,n,t} \qquad 6.9$$

Figure 6.1 illustrates the implication of the specification by demonstrating that because $\delta_B < \delta_A$ expected inefficiency for Country B is smaller than for Country A.

Differences in δ_f, will therefore relate to differences in estimated average inefficiency across countries.

Following from Equation 6.5, and given the model assumptions, an estimate of output distance can be derived as $D_o(Y_{n,t}, X_{n,t}, Z_{n,t}, \beta) = \exp(-\mu)$. Equivalently, an estimate of Farrell (1957)'s output oriented efficiency is obtainable as:

$$OE_{n,t} = \frac{1}{D_o(Y_{n,t}, X_{n,t}, Z_{n,t}, \beta)} = \exp(\mu_{n,t}) \qquad 6.10$$

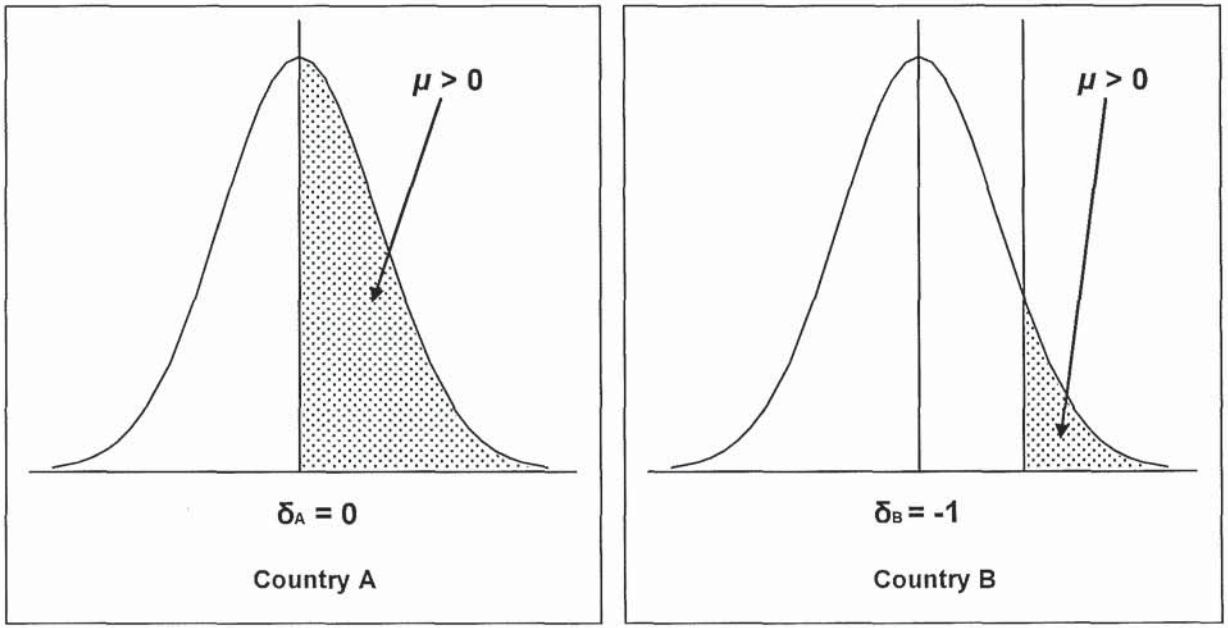
However, as $OE_{n,t}$ relies on the unobservable inefficiency, $u_{n,t,}$, the author follows the approach of Battese and Coelli (1995) and Frame and Coelli (2001) to estimate the unobservable inefficiency, $u_{n,t,}$. The author therefore employs the conditional expectation of $u_{n,t}$ given the observed value of the overall composed error term, $\varepsilon_{n,t}$, which can be expressed as:

$$E[\exp(u_{n,t})|\varepsilon_{n,t}] = \frac{\{\exp[(1-\gamma)m_{n,t} + \gamma\varepsilon_{n,t} + 0.5(\sigma_*^2)]\}\{\Phi[((1-\gamma)m_{n,t} + \gamma\varepsilon_{n,t}/\sigma_*) + \sigma_*]\}}{\Phi((1-\gamma)m_{n,t} + \gamma\varepsilon_{n,t}/\sigma_*)} \qquad 6.11$$

In the cross-country bank efficiency literature, the importance of specifying environmental variables so as to minimize bias in the efficiency model has been recognized. Dietsch and Lozano-Vivas (2000) argue that neglecting country-specific variables leads to misspecification of the common frontier and overestimates inefficiency. Thus, most previous studies have controlled for country-specific variables (e.g., Maudos and de Guevara 2007) or country dummy variables (e.g., Bonin, et al. 2005).

Furthermore, certain studies have allowed exogenous factors to directly influence inefficiency effects by including country dummies, bank organisational structure controls such as an Islamic bank dummy (Alshammari 2003; Al-Jarrah and Molyneux 2005), assets, liquidity and concentration ratios (Al-Jarrah and Molyneux 2005). In a similar approach to the current chapter, besides including country-specific variables in the estimated function, Williams and Nguyen (2005) also use the Battese and Coelli (1995)'s inefficiency effects model, to determine the effect of governance.

Figure 6.1
Truncated normal inefficiency distributions for different countries



In the model, the author has followed the recent practice of controlling for differences in economic and regulatory environments between countries that may explain differences in efficient output, by including country-specific variables directly in the distance function, and also allowing country dummies to directly influence output inefficiency. These country dummy variables simultaneously capture other country-specific environmental conditions and determine relative efficiency between countries. This implies that the resulting efficiency scores are net of the impact of controlled for environmental influences on efficient input requirement, and the differences in these scores are directly influenced by country-specific inefficiency distributions. As a result, these efficiency measures enable one to estimate how firms are ranked under the assumption that firms operate in an equivalent environment, while at the same time estimating how bank efficiency in one country differs from another. Moreover, by employing the parameter covariance matrix, the author can also directly test whether the δ_f parameters and hence estimated inefficiency is significantly different across countries.

Given the estimated model, returns of scale for the banks in the sample can also be estimated, using the estimated scale elasticity. As in Cuesta and Orea (2002), scale elasticity can be calculated as the negative of the sum of the input elasticities:

$$SCALE_{n,t} = -\sum_{k=1}^{K} \frac{\partial \ln D_o\left(Y_{m,n,t}, X_{k,n,t}\right)}{\partial \ln X_{k,n,t}} \qquad 6.12$$

If $SCALE_{n,t} > 1$ a bank is operating at increasing returns to scale (IRS). If $SCALE_{n,t} < 1$, there is decreasing returns to scale (DRS) and constant returns to scale (CRS) are present if $SCALE_{n,t} = 1$.

6.4 THE DATA AND THE EMPIRICAL SPECIFICATIONS

Data on 23 Islamic and 88 conventional banks from 10 countries that operate Islamic banking were drawn from the BankScope database for the period 1996-2002 resulting in an unbalanced panel of 558 observations. Table 6.1 describes the sample of banks by type of bank for each country under study.

Table 6.1
Sample of banks, 1996-2002

Country	Islamic		Conventional		Total	
	Number	Observations	Number	Observations	Number	Observations
Malaysia	2	10	34	188	36[a]	198
Sudan	3	16	0	0	3	16
Bangladesh	3	10	13	84	16	94
Tunisia	1	4	8	29	9	33
Jordan	1	5	4	26	5	31
Lebanon	1	3	12	64	13	67
Yemen[d]	2	8	0	0	2	8
Indonesia	1	7	11	41	12[b]	48
Bahrain	6	23	6	31	12[c]	54
Iran	3	9	0	0	3	9
Total	*23*	*95*	*88*	*463*	*111*	*558*

Notes:
[a]11 mergers occurred during the sample period.
[b]1 merger occurred during the sample period.
[c]2 mergers occurred during the sample period.
[d]Bank scope data on conventional banks are incomplete although Yemen has both types of banks.

The selection of output and input variables follows the intermediation approach which has been widely employed in conventional bank studies (e.g., Maudos, et al. 2002; Carbo, Gardener, and Williams 2003), Islamic bank studies (e.g., Brown and Skully 2003; Hassan 2003; Yudistira 2004) and Islamic and conventional bank studies (e.g., Alshammari 2003; Al-Jarrah and Molyneux 2005). As mentioned in the previous chapters, the intermediation approach focuses on a bank's role in intermediating savers and investors of funds, and is the most consistent with the concept of Islamic banking. This is because Islamic banking relies on profit-sharing contracts, which involve an equity participation principle[3] with depositors[4], and banks can therefore be seen as intermediating savers and investors by transforming deposits into earning assets, rather than as producers of services and loans.

Previous studies that employ the intermediation approach found that equity is significant in defining bank output but many (e.g., Girardone, Molyneux, and Gardener 2004; Kasman and Yildirim 2006) include it either as an environmental variable or a netput. Thus, it has not been employed as an input in single-country studies[5] (e.g., Mester 1996; e.g., Girardone, et al. 2004), and cross-country studies, nor in those using a profit function (Alshammari 2003; Al-Jarrah and Molyneux 2005; Kasman and

[3] Some current Islamic banks also practice debt-like financing such as murabaha.
[4] In some Islamic banks, deposits or equity contributed by depositors are categorised under shareholders' funds, but some Islamic banks group them as deposits from customers, similar to conventional banks (Karim 2001).
[5] Some studies have treated equity capital as netput in the translog function (Berger and Mester 1997; Hasan and Marton 2003; Bonaccorsi di Patti and Hardy 2005; Kraft, Hofler, and Payne 2006).

Yildirim 2006) or a cost function (Carbo, et al. 2003; Al-Jarrah and Molyneux 2005; Kasman and Yildirim 2006).[6] Nevertheless, in financing the operation of banks, equity capital is an alternative to deposits and inter-bank borrowings (Bonaccorsi di Patti and Hardy 2005). Furthermore, Islamic banks that apply an equity participation principle rely heavily on their equity to finance loans (Metwally 1997). Therefore, it is appropriate that equity is considered as part of bank inputs for studies employing the intermediation approach.

The author therefore includes equity as an input, because of both its role in Islamic banking and because all banks can potentially raise funds to finance their loans through equity, rather than deposits. The specification therefore extends the standard intermediation model by including two outputs, (Y_1) loans and (Y_2) total other earning assets, and three inputs, (X_1) total operating expense, (X_2) deposits, measured by total deposits including customer funding and short term funding, and (X_3) equity, measured by total equity.

Table 6.2 presents the average values of bank outputs and inputs, expressed in constant 2000 US dollars for each country over the 1996-2002 period.[7, 8] While deposits on average represent 79-92 percent of banking inputs, equity on average represents 4-19 percent of all banking inputs for each country. Non-financial inputs are on average less than 10 percent of banking inputs. Differences in average input and output between countries are high, with Sudan and Iran, respectively having the smallest and largest average volume of bank loans. However, banks in Bangladesh and Jordan have similar average volumes of loans, other earning assets, operating expenses, and deposits and equity, when they are respectively compared to Yemen and Malaysia.

[6] Dietsch and Lozano-Vivas (2000) and Kasman (2005) treat equity-to-assets ratio as a country-specific variable to proxy bank regulation.

[7] In the estimation, all input and output variables are normalized around their means and the linear homogeneity in outputs is imposed using the output Y_2 as a numeraire.

[8] All data employed in this analysis is converted into constant international dollars according to the purchasing power parity hypothesis (Lozano-Vivas, Pastor, and Pastor 2002).

Table 6.2
Average values of outputs and inputs by country, 1996-2002 (Int'l $ mil)[a]

Countries	Output		Input		
	Loans	Other earning assets	Operating expense	Deposits	Equity
Malaysia	5,480.7	3,148.0	134.6	7,113.8	740.4
Sudan	61.2	91.9	17.7	175.5	27.0
Bangladesh	176.7	13.1	4.5	218.5	13.8
Tunisia	1,871.3	498.0	44.8	1,967.5	262.0
Jordan	4,478.4	5,912.8	173.4	8,094.2	762.8
Lebanon	171.5	281.1	12.2	486.9	30.1
Yemen	115.4	51.8	3.6	173.9	21.7
Indonesia	397.2	250.2	15.9	459.4	108.6
Bahrain	993.9	941.0	28.6	1,559.8	223.8
Iran	15,391.5	10,311.9	753.6	20,960.2	812.1
Average bank	*2,736.6*	*1,793.2*	*79.1*	*3,721.6*	*371.7*

[a] Constant 2000 USD

In order to identify a common frontier, variables describing distinctive features of the economy, the banking industry as well as the geography of each country are identified. These variables are grouped into three categories. The first category includes macroeconomic conditions, and consists of a measure of population density, per capita income, density of demand (deposits per kilometer squared) and real GDP growth. These indicators explain the macro conditions under which banks operate. Population density is measured by the ratio of inhabitants per square kilometre, and it is expected that with high population density, the retail distribution of banking services becomes less costly. High per capita income, measured by Gross National Income (GNI) per inhabitant, is usually associated with countries having a mature banking environment, and thus, competitive interest rates and profit margins which lower banking costs and increase bank outputs. Density of demand is measured as total deposits per square kilometre. A less concentrated demand for banking services is costly because demand is more dispersed. As a result, bank customers are less informed and banks tend to achieve lower output.[9] Finally, real GDP growth is expected to increase bank outputs due to increasing economic activities.

[9] Countries with population concentrated in small habitable area(s) warrant careful judgement with regard to these results.

Table 6.3
Environmental characteristics by country (1996-2002) [a]

Countries	Macroeconomic conditions				Bank structures		Accessibility of banking services	
	Density of population :inhabitant/ km^2	Per capita income: GNI per inhabitant (int $)[a]	Density of demand: deposits per km^2 (Int $) [a]	Real GDP growth (%)	Concentration ratio (%)	Intermediation ratio: loan/ deposits	Road paved (% of total roads)	Telephone lines per 100 inhabitants
Malaysia	68	8,032	680,322.3	4.7	0.46	1.36	76	19.6
Sudan	13	1,413	1.4	5.1	0.70	0.45	36	0.9
Bangladesh	879	1,727	388,542.8	5.0	0.59	1.15	9	0.4
Tunisia	57	5,607	142,283.6	5.2	0.51	1.36	70	8.6
Jordan	54	3,848	174,378.9	2.6	0.90	1.03	100	11.0
Lebanon	335	5,816	2,883.7	2.4	0.34	0.92	90	16.9
Yemen	33	726	3,681.6	4.7	0.77	0.50	10	1.9
Indonesia	109	2,696	158.7	1.6	0.55	1.03	46	3.1
Bahrain	984	15,057	10,691,990.7	5.2	0.90	0.83	77	24.9
Iran	40	5,807	87.9	2.2	0.92	0.81	56	11.6
Average	257.2	5,072.9	1208433.2	3.9	0.66	0.94	57	9.9

Notes:
[a] in constant 2000 USD
Sources: BankScope, International Financial Statistic, Euromonitor, World Bank, own calculations.

The second group of environmental variables identifies differences in banking structure and therefore provides measures of both banking concentration and the intermediation ratio. The concentration ratio is defined as the ratio of the total assets of the first three largest banks in a country to total banking assets. Higher concentration may be associated with higher or lower output. If higher concentration of banks is a result of market power, then the banks may become inefficient in producing outputs (Leibenstein 1966). On the other hand, if higher concentration is a result of efficiency, then bank costs are reduced and bank outputs increase (Demsetz 1973). In order to control for differences in regulation or allow factors that may affect the ability to convert deposits to loans among banking industries, the intermediation ratio, as measured by the loan-to-deposits ratio is employed. It is expected that the higher the intermediation ratio, the higher bank outputs will be. Thus, the first two groups of variables follow closely those of Dietsch and Lozano-Vivas (2000) and Carvallo and Kasman (2005).

The final group of environmental variables includes proxies for accessibility of banking services. The proxy variables are roads paved and telephone lines per 100 inhabitants. Roads paved is the percentage of road being paved in total roads, and is expected to positively impact bank outputs. Finally, the author expects that easier access to telephone lines will also increase potential bank outputs.

One final control variable is a dummy variable indicating whether a bank is an Islamic bank, and it is illustrated in Table 6.1. Inclusion of this variable allows the author to test whether full-fledged Islamic banks have a different operating environment from conventional banks. Therefore, a dummy variable is included in the model to capture for this difference, but no *a priori* assumption is made due to mixed results in the literature on the direction of the influences of Islamic banking on inefficiency (e.g., Al-Jarrah and Molyneux 2005; El-Gamal and Inanoglu 2005; Mokhtar, et al. 2006) and none has assumed Islamic banking to influence potential bank output. The author also notes that while this modelling assumption maintains the assumption that adherence to *shariah* causes a shift in potential output obtainable from given inputs, it could also be argued that any difference in output between conventional and Islamic banks is evidence of differences in efficiency. However, the author adopts this approach because it is believed that the restrictions imposed by *shariah* require Islamic banks to operate a modified banking technology that is not equivalent to that of conventional banks.

Table 6.3 reports the average values of these environmental variables for each country over the 1996-2002 periods. The mean values exhibit significant variations in the macroeconomic conditions of banking activities across countries. In particular, Bahrain and Bangladesh have very high population density relative to other countries. Bahrain also has extremely high per capita income and deposits per kilometre squared. In contrast, Sudan has very low population density and very marginal deposits per kilometre squared. Furthermore, Bahrain, Iran and Jordan have relatively high concentration ratios. The banks in Sudan and Yemen stand out as they convert only 50 percent of their deposits into loans compared to 94 percent for the average country. This is possibly because banks in these countries face difficulties to make investments due to poor socio-economic conditions (Breitschopf 1999; Hussein 2004). The high cost of borrowing in Sudan and the Sudanese culture of holding cash (Hussein 2004) as well as Yemeni culture of relying on micro-enterprise (Breitschopf 1999) may have contributed to the low loan-to-deposits ratio in banking. In contrast to Jordan which has all roads paved, Bangladesh and Yemen have about 10 percent of roads paved. Finally, as 24.7 telephone lines per 100 inhabitants is the maximum amount, this reflects the low development of electronic communications in most countries included in the sample. In sum, the descriptive statistics suggest that while Sudan and Yemen have the worst potential operating environments, Bahrain has the most favourable operating environment (see also section 2.7 for further country differences and specificities).

6.5 RESULTS

6.5.1 The output distance function estimates

The estimated output distance function parameters are reported in Table 6.4.[10] Recalling that, $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$, the highly significant estimate of 0.491 for this parameter, suggests that the estimated deviation from the frontier is equally due to both inefficiency and statistical noise. Besides the statistically significant Islamic bank dummy variable, the only significant country-specific environmental variables are density of population, density of demand, and telephone lines per 100 inhabitants. Many country-specific variables become insignificant when country dummy variables are included in the model, thereby suggesting that these factors serve as proxies for

[10] The author notes that a log likelihood ratio test for the joint significance of the 6 parameters related to equity is 17.98, thus the author can reject the null hypothesis that these parameters are jointly insignificant at the 99 percent confidence level.

Table 6.4
Maximum likelihood estimates for parameters of the output distance function: 1996-2002

Parameters	Coefficient[a]	Estimated value[b]	Standard error
φ_0	Constant	-0.268***	0.058
α_1	$\ln X_1$	-0.069***	0.019
α_2	$\ln X_2$	-0.760***	0.021
α_3	$\ln X_3$	-0.206***	0.014
$\alpha_{1,1}$	$(\ln X_1)^2$	-0.046	0.031
$\alpha_{2,2}$	$(\ln X_2)^2$	-0.066***	0.022
$\alpha_{3,3}$	$(\ln X_3)^2$	-0.127***	0.014
$\alpha_{1,2}$	$\ln X_1 \ln X_2$	0.003	0.021
$\alpha_{1,3}$	$\ln X_1 \ln X_3$	0.020	0.019
$\alpha_{2,3}$	$\ln X_2 \ln X_3$	0.095***	0.015
β_1	$\ln Y_1$	0.590***	0.011
$\beta_{1,1}$	$(\ln Y_1)^2$	0.187***	0.008
$\theta_{1,1}$	$\ln X_1 \ln Y_1$	0.025**	0.011
$\theta_{2,1}$	$\ln X_2 \ln Y_1$	-0.011	0.010
$\theta_{3,1}$	$\ln X_3 \ln Y_1$	-0.021*	0.011
λ_1	t	0.007	0.004
λ_{11}	t^2	-0.002	0.004
τ_1	$\ln X_1$ t	-0.011	0.007
τ_2	$\ln X_2$ t	0.002	0.006
τ_3	$\ln X_3$ t	0.014***	0.005
Ω_1	$\ln Y_1$ t	0.001	0.004
ζ_1	Islamic Bank	0.141***	0.022
ζ_2	Density of Population	$2.82\text{x}10^{-4}$***	$7.83\text{x}10^{-5}$
ζ_3	Density of Demand	-0.035***	0.008
ζ_4	Telephone lines	0.015***	0.003
δ_1	Malaysia	-0.541***	0.096
δ_2	Sudan	0.537***	0.082
δ_3	Bangladesh	-0.366***	0.097
δ_4	Tunisia	0.210***	0.047
δ_5	Jordan	-0.047	0.095
δ_6	Lebanon	0.112***	0.041
δ_7	Yemen	0.412***	0.083
δ_8	Indonesia	0.212***	0.053
δ_9	Bahrain	-0.353***	0.121
δ_{10}	Iran	-0.987*	0.555
σ^2	Sigma-squared	0.029***	0.002
γ	Gamma	0.491***	0.076
Log Likelihood			288.120

Notes:
[a] X_1, X_2, X_3, Y_1, Y_2, t refer to total operating expense, deposits, equity, loans, other earning assets and year.
[b] *,**,*** Significant at 90, 95 and 99 percent confidence level.

cross country differences in bank efficiency, rather than legitimate determinants of potential output.[11]

The Islamic bank dummy (Z_1) has a positive coefficient, indicating that full-fledged Islamic banks are found to have potential efficient outputs that *ceteris paribus* are 14.1 percent lower than other banks. Therefore the results suggest a systematic reduction in potential output that can be attributed to Islamic banking, which may result from constrained opportunities in terms of investments and limited expertise in Islamic banking. However, because the estimated model effectively assumes that the reduced outputs associated with Islamic banking result from legitimate differences in operating environment that reduce potential output, the efficiency scores reported below for Islamic banks must be carefully interpreted as they net out this impact.

In contrast to expectations, the sign of the coefficient of the population density variable (Z_2) is positive indicating that, *ceteris paribus* countries with high population density have lower bank output.[12] A possible explanation for this finding is that in non-price bank competition, banks may open branches in large cities, in which real estate and labour costs are high, for strategic reasons, and thereby reduce their potential outputs (Dietsch and Lozano-Vivas 2000). As expected, lower density of demand (Z_3), tends to increase expenses thereby, limiting potential output. The finding of reducing potential output is consistent with (Dietsch and Lozano-Vivas 2000) and (Carvallo and Kasman 2005), which found that lower density of demand raises bank costs, and hence reduces efficiency. Finally, in contrast to the *a priori* assumption, the positive sign of telephone lines per 100 inhabitants' variable (Z_4) indicates that greater availability of telephone lines decreases bank outputs. This is possibly because most countries in the sample are developing economies [13] in which electronic communications including phone- and internet-banking are not fully developed. Hence, telephone usage may raise relative bank costs within the sample of countries.

Table 6.4 demonstrates that the country dummy variables illustrate systematic and significantly differences in the relative inefficiency of banks across countries. Thus, for example, δ_{Jordan} is found to be insignificantly different from zero, thereby

[11] Bank specific loan quality and merger dummy variables were also found to be statistically insignificant when they were included in the distance function.

[12] The finding is consistent with cost function studies in which higher population density contributes to an increase in banking costs in France and Spain (Dietsch and Lozano-Vivas 2000), and Latin American and Caribbean countries (Carvallo and Kasman 2005).

[13] All countries in the sample are developing economies except for Bahrain (World Bank 2007).

suggesting that inefficiency for Jordanian banks is drawn from a standard half-normal distribution. However, banks in Malaysia, Bangladesh, Bahrain[14] and Iran are found to have δ_f<0 and hence, inefficiency in these countries is estimated as being drawn from truncated normal distributions with lower expected inefficiency than in a half normal distribution. In contrast, Sudan, Tunisia, Lebanon, Yemen, and Indonesia all have δ_f>0, and hence are estimated to have higher expected inefficiency than that drawn from a half-normal distribution, with given variance σ_u^2. Furthermore, Table 6.4 suggests that while Iranian banks have on average the best output performance, Sudanese banks experience the worst output performance. This is consistent with two previous DEA studies, which find that Iranian banks are among the most efficient banks (Brown 2003; Brown and Skully 2003) and Sudanese banks are among the least efficient banks (Brown 2003).[15] The δ_f parameters suggest a clear hierarchy of estimated efficiency across countries, with higher δ_f indicating greater inefficiency.

As the δ_f parameters are inversely related to expected inefficiency in each country, they can be directly employed to test for statistically significant differences in estimated inefficiency between any two countries in the sample. This is demonstrated in Table 6.5. Statistics above the diagonal report the difference in the estimated δ_f parameters for each country relative to the country on the first column, in the same row. Below the diagonal is the corresponding *t*-ratio for a test of the significance of the difference in the estimated δ_f parameters of each country relative to the country identified on the first row in the same column. For example, the first row demonstrates the estimated δ_f for Malaysian banks is 0.446 greater than that for Iranian banks, thereby suggesting that Iranian banks are on average more efficient. Nevertheless, the related t-statistic in the first column (0.754) demonstrates that this estimated difference is not statistically significant. Similarly, while Bahrain's δ_f parameter is 0.188 greater than Malaysia's, thereby suggesting greater average inefficiency in Bahrain, this difference is not statistically significantly different from zero based on a t-statistic of 1.481. However, all other countries have higher estimated

[14] Al-Jarrah and Molyneux (2005) also found that Bahrain is relatively efficient when compared to Jordanian banks.
[15] Even within Sudanese banks, wide inefficiency difference exists (Hussein 2004).

Table 6.5

Relative difference in country's estimated mean of inefficiency distribution and *t*-ratio test

	Malaysia	Sudan	Bangladesh	Tunisia	Jordan	Lebanon	Yemen	Indonesia	Bahrain	Iran
Malaysia		*-1.078*	*-0.175*	*-0.752*	*-0.494*	*-0.653*	*-0.954*	*-0.753*	-0.188	0.446
Sudan	*7.167*		*0.903*	*0.326*	*0.584*	*0.425*	0.124	*0.325*	*0.890*	*1.524*
Bangladesh	*1.799*	*5.985*		*-0.577*	*-0.319*	*-0.478*	*-0.779*	*-0.578*	-0.013	0.621
Tunisia	*6.273*	*4.241*	*4.734*		*0.258*	0.099	*-0.202*	-0.002	*0.564*	*1.198*
Jordan	*3.120*	*5.684*	*2.047*	*2.746*		-0.159	*-0.459*	*-0.259*	*0.306*	*0.940*
Lebanon	*6.792*	*4.527*	*5.077*	1.365	1.506		*-0.301*	-0.101	*0.465*	*1.099*
Yemen	*6.538*	1.437	*5.305*	*2.626*	*4.222*	*3.039*		*0.200*	*0.765*	*1.400*
Indonesia	*5.872*	*4.875*	*4.456*	0.033	*2.820*	1.337	*2.800*		*0.565*	*1.199*
Bahrain	1.481	*5.414*	0.101	*3.882*	*1.833*	*3.912*	*4.641*	*3.722*		0.634
Iran	0.754	*2.707*	1.093	*2.144*	*1.653*	*1.997*	*2.481*	*2.124*	1.129	

Notes:

Above the diagonal reports the difference in the estimated inefficiency distributions of each country relative to country identified on the first column, in the same row.

Below the diagonal shows *t*-ratio for the test of significance on the difference in the estimated inefficiency distributions of each country relative to country identified on the first row in the same column.

inefficiency distributions compared to Malaysia and these differences are statistically significant. These results therefore suggest that Malaysian banks are significantly more efficient when compared to banks in other countries except for Iran and Bahrain.

Choosing Jordan as another example, the fifth row demonstrates that Yemeni and Indonesian banks' estimated inefficiency distributions are 0.459, and 0.259 higher than Jordanian banks, respectively. In contrast, Bahraini and Iranian banks' estimated inefficiency distributions are 0.306 and 0.940 lower than Jordanian banks, respectively. As the respective t-tests for these four statistics (4.222, 2.820, 1.833 and 1.653) are statistically significantly different from zero, this suggests that Yemeni and Indonesian banks are statistically less efficient, and Bahraini and Iranian banks are statistically more efficient than Jordanian banks. In contrast, the t-ratio of 1.506 as in the fifth column demonstrates that the estimated difference in the estimated inefficiency distributions for Lebanon is not statistically significant from zero implying that Lebanese banks are not significantly less efficient relative to Jordanian banks. In sum, analysis of various statistics reported in Table 6.5 suggest that Yemeni, Indonesian, Sudanese and Tunisian banks are significantly less efficient, while Bahraini, Iranian, Malaysian and Bangladeshi banks are significantly more efficient than Jordanian banks.

6.5.2 Efficiency estimates

Table 6.6 and Table 6.7 report the estimated efficiency of all, conventional and Islamic banks on average, and by country, respectively. The efficiency of all banks is on average 1.105, and ranges from 1.010 to 2.352. Moreover, as should be expected, the observed average efficiency hierarchy by country demonstrated in Table 6.7 is consistent with the estimated inefficiency distributions as previously detailed in Table 6.4 and 6.5. The yearly average as well as the range of the average efficiency scores, has only slightly increased over time. Thus, average efficiency deteriorated from 1.087 in 1996 to 1.112 in 2002. However, this efficiency deterioration applies only in certain countries and especially in Sudan. The trend in both conventional and Islamic banks suggests only a slight decline in average efficiency over the sample period. Hence, the conventional bank average efficiency score increased from 1.076 in 1996 to 1.094 in 2002 and the Islamic bank average efficiency score increased from 1.187 in 1996 to 1.200 in 2002. These deteriorations however, do not apply to all countries.

Table 6.6
Average efficiency estimates for all banks, by bank types

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive statistics: all banks								
Average	1.087	1.106	1.102	1.106	1.102	1.120	1.112	1.105
Standard Deviation	0.121	0.158	0.173	0.159	0.151	0.173	0.167	0.158
Minimum	1.014	1.012	1.011	1.010	1.014	1.014	1.019	1.010
Maximum	1.756	1.949	2.352	1.918	1.743	1.882	2.114	2.352
Average efficiency by bank types								
Conventional banks	1.076	1.076	1.081	1.081	1.076	1.096	1.094	1.082
Islamic banks	1.187	1.289	1.195	1.204	1.214	1.215	1.200	1.215

Across all countries, the average conventional and Islamic bank efficiency measures are 1.082 and 1.215, respectively. This suggests that on average, even after having netting out the 14.1 percent lower output associated with Islamic banking, potential output of conventional banks is only 8.2 percent higher than actual output, while for Islamic banks this difference is 21.5 percent. In contrast to this aggregate result, Table 6.7 shows little variation in estimated efficiency between Islamic and conventional banks within most countries. It is therefore clear that the substantially lower cross-country average estimated efficiency for Islamic banks relative to conventional banks reported in Table 6.6 can only be attributed to country effects. Thus, Sudan and Yemen, which have only Islamic banks in the sample, have extremely low average estimated efficiency, even after netting out the impact of the statistically significant environmental characteristics and Islamic banking. Put differently, while the results do clearly demonstrate a significant 14.1 percent decrease in potential output attributable to Islamic banking, the further particularly poor performance of Islamic banks in Sudan and Yemen must be attributed to country specific banking inefficiency.

The author finally emphasizes that because the methodology assumes that differences in operating environment influence potential output rather than efficiency, the resulting efficiency estimates should in principle be interpreted as allowing for legitimate difference in potential output associated with compliance with *shariah*. Therefore, as argued by (Coelli, Perelman, and Romano 1999), as this approach nets out the impact of operating environments, it provides a measure of managerial efficiency. Thus, based on this argument, Islamic banks are substantially more efficient in Tunisia and marginally more efficient in Malaysia, but less efficient in all

other countries where both Islamic and conventional banks operate. However, this interpretation is dependent on the assumption that all of the reduced output of Islamic banks is attributable to differences in technology rather than systematically greater inefficiency amongst Islamic banks.

Table 6.7
Average efficiency estimates for banks, by country, by bank types

	1996	1997	1998	1999	2000	2001	2002	All Years
Malaysia								
All Banks	1.025	1.025	1.024	1.026	1.024	1.025	1.025	1.025
Conventional banks	1.025	1.025	1.024	1.026	1.024	1.025	1.025	1.025
Islamic banks	1.024	1.022	1.025	1.024	1.022	1.022	1.022	1.023
Sudan								
Islamic banks	1.543	1.728	1.966	1.745	1.710	1.691	1.703	1.724
Bangladesh								
All Banks	1.035	1.035	1.036	1.030	1.033	1.036	1.036	1.034
Conventional banks	1.035	1.035	1.034	1.030	1.033	1.035	1.036	1.034
Islamic banks	1.029	1.039	1.056	1.030	1.034	1.039	1.037	1.038
Tunisia								
All Banks	1.258	1.251	1.274	1.250	1.215	1.218	1.219	1.246
Conventional banks	1.258	1.251	1.290	1.267	1.228	1.244	1.219	1.255
Islamic banks	n.a.	n.a.	1.196	1.183	1.177	1.166	n.a.	1.181
Jordan								
All Banks	1.085	1.087	1.086	1.079	1.073	1.067	1.072	1.079
Conventional banks	1.085	1.085	1.084	1.075	1.072	1.066	1.072	1.078
Islamic banks	n.a.	1.096	1.094	1.094	1.080	1.072	n.a.	1.087
Lebanon								
All Banks	1.125	1.163	1.143	1.151	1.153	1.188	1.152	1.152
Conventional banks	1.125	1.150	1.146	1.156	1.153	1.188	1.152	1.151
Islamic banks	n.a.	1.293	1.111	1.106	n.a.	n.a.	n.a.	1.170
Yemen								
Islamic banks	n.a.	1.379	1.366	1.552	1.569	1.445	1.365	1.475
Indonesia								
All Banks	1.261	1.232	1.229	1.269	1.211	1.278	1.274	1.255
Conventional banks	1.252	1.202	1.247	1.241	1.216	1.286	1.282	1.255
Islamic banks	1.290	1.352	1.141	1.434	1.184	1.211	1.203	1.260
Bahrain								
All Banks	1.030	1.031	1.034	1.036	1.035	1.038	1.036	1.034
Conventional banks	1.032	1.031	1.034	1.038	1.034	1.037	1.037	1.034
Islamic banks	1.025	1.031	1.034	1.034	1.035	1.040	1.035	1.034
Iran								
Islamic banks	1.018	n.a.	1.012	1.013	1.014	1.014	n.a.	1.014

Notes:
n.a. data not available

These results can be compared to the previous literature that does not allow for exogenous variables in either the frontier or as an influence on inefficiency: Islamic banks are found to be no different with conventional banks in Malaysia (Abdul-Majid, et al. 2005; Mokhtar, et al. 2006), and equally if not more cost efficient in Turkey (El-Gamal and Inanoglu 2005). Modelling for bank types of the Islamic bank, commercial, investment banks, country dummy, assets, liquidity, concentration ratio, and market share to directly influence inefficiency effects in Arabian countries, Islamic banks are found to be more cost efficient (Al-Jarrah and Molyneux 2005). Controlling for loan quality and capital in the function and modelling for bank type, country dummy, assets, liquidity, concentration ratio, and market share to directly influence inefficiency effects in Arabian countries using profit function, Islamic banks are also more efficient (Al-Jarrah and Molyneux 2005). Alshammari (2003) also found relatively efficient Islamic banks in GCC countries when loan quality and capital are included in the function, and bank type and country dummies are assumed to directly influence inefficiency. The differences in results may potentially be due to different environmental variables in the function, different input and output specifications, and cross-country differences in Islamic banking operation that may influence relative efficiency.[16]

6.5.3 Returns to scale

Table 6.8 and 6.9 provide firm specific returns to scale estimates for all, conventional and Islamic banks on average, and by country. Estimated returns to scale averages 1.034 for all banks, ranges between 0.945 and 1.128, and is consistent with the previous literature (e.g., Abd Karim 2001; Cavallo and Rossi 2001; Carvallo and Kasman 2005). On average, these estimated returns to scale have declined from 1.045 in 1996 to 1.022 in 2002. The average estimated returns to scale for conventional banks is lower (1.030) than for Islamic banks (1.052) and this applies to all countries except for Malaysia and Jordan. This suggests that generally a larger scale of operation will be useful if Islamic banks wish to eliminate disadvantages attributable to their relatively small size. However, there is little evidence of substantial returns to scale to be gained, nor is there substantial difference in potential returns to scale

[16] For example, Islamic banks in countries other than Malaysia may have a higher percentage of equity-based financing which has been controlled for in this study.

between conventional and Islamic banks.[17] The trend for both conventional and Islamic banks also suggests a decline in average returns to scale over the sample period. Hence, conventional bank average returns to scale declined from 1.044 in 1996 to 1.019 in 2002 and Islamic bank average returns to scale declined from 1.061 in 1996 to 1.036 in 2002. Compared to other countries, Sudanese banks exhibit relatively strong returns to scale, which is consistent with the very small bank size in this country as demonstrated in Table 6.2. This is consistent with Kasman (2005) who found economies of scale in small-sized banks in Poland and the Czech Republic.

Table 6.8
Average return to scale for all banks, by bank types

	1996	1997	1998	1999	2000	2001	2002	All Years
Descriptive statistics: all banks								
Average	1.045	1.044	1.040	1.032	1.025	1.023	1.022	1.034
Standard Deviation	0.021	0.022	0.023	0.025	0.020	0.023	0.023	0.024
Minimum	0.989	0.995	0.996	0.945	0.983	0.984	0.981	0.945
Maximum	1.093	1.117	1.128	1.106	1.097	1.103	1.096	1.128
Average return to scale by bank types								
Conventional banks	1.044	1.040	1.035	1.027	1.021	1.018	1.019	1.030
Islamic banks	1.061	1.066	1.065	1.054	1.040	1.040	1.036	1.052

While there is evidence for some variations in returns to scale across countries and across bank types, as summarized in Table 6.9, the country specific results are still consistent with the overall finding of very moderate returns to scale and a slight downward trend in estimated returns to scale. Thus, most banks in the sample appear to operate at or near constant returns to scale, and the results provide little evidence for strong returns to scale in banking.

[17] Alshammari (2003) found almost constant returns to scale in banks (including Islamic banks) in GCC countries and no difference across bank types. However, Yudistira (2004) found that small and medium-sized Islamic banks in most countries have diseconomies of scale.

Table 6.9
Average return to scale for all banks, by country, and by bank types

	1996	1997	1998	1999	2000	2001	2002	All Years
Malaysia								
All Banks	1.048	1.041	1.041	1.029	1.026	1.026	1.024	1.035
Conventional banks	1.049	1.042	1.041	1.029	1.028	1.027	1.026	1.035
Islamic banks	1.042	1.035	1.058	1.035	1.012	1.013	1.007	1.023
Sudan								
Islamic banks	1.062	1.073	1.064	1.058	1.061	1.086	1.070	1.069
Bangladesh								
All Banks	1.016	1.017	1.013	1.005	1.004	1.000	0.999	1.007
Conventional banks	1.012	1.012	1.010	1.001	1.001	0.996	0.994	1.004
Islamic banks	1.062	1.047	1.053	1.049	1.047	1.023	1.023	1.040
Tunisia								
All Banks	1.064	1.058	1.045	1.039	1.034	1.029	1.022	1.045
Conventional banks	1.064	1.058	1.043	1.036	1.032	1.027	1.022	1.045
Islamic banks	n.a.	n.a.	1.059	1.052	1.039	1.035	n.a.	1.046
Jordan								
All Banks	1.052	1.044	1.041	1.036	1.029	1.027	1.025	1.037
Conventional banks	1.052	1.044	1.041	1.038	1.031	1.032	1.025	1.038
Islamic banks	n.a.	1.044	1.039	1.029	1.018	1.011	n.a.	1.028
Lebanon								
All Banks	1.044	1.050	1.038	1.035	1.019	1.006	1.003	1.031
Conventional banks	1.044	1.048	1.033	1.031	1.019	1.006	1.003	1.029
Islamic banks	n.a.	1.072	1.090	1.081	n.a.	n.a.	n.a.	1.081
Yemen								
Islamic banks	n.a.	1.059	1.049	1.043	1.037	1.008	0.995	1.034
Indonesia								
All Banks	1.064	1.068	1.054	1.048	1.035	1.033	1.037	1.045
Conventional banks	1.058	1.063	1.045	1.042	1.030	1.031	1.036	1.041
Islamic banks	1.080	1.088	1.098	1.086	1.060	1.053	1.045	1.073
Bahrain								
All Banks	1.049	1.054	1.054	1.049	1.041	1.035	1.035	1.047
Conventional banks	1.043	1.041	1.036	1.035	1.030	1.024	1.018	1.034
Islamic banks	1.064	1.094	1.076	1.061	1.056	1.046	1.052	1.064
Iran								
Islamic banks	1.052	n.a.	1.044	1.041	1.027	1.032	n.a.	1.039

Notes:
If return to scale >,< or =1, there are increasing returns to scale; decreasing returns to scale or constant returns to scale respectively.
n.a. data not available

6.6 CONCLUSION AND POLICY IMPLICATIONS

This chapter employs an output distance function to examine the efficiency and returns to scale of Islamic banks relative to conventional banks in countries that have Islamic banks, namely Malaysia, Sudan, Bangladesh, Tunisia, Jordan, Lebanon, Yemen, Indonesia, Bahrain and Iran for the period 1996-2002. A common frontier with country-specific environmental variables has been estimated for a panel of 111 banks after allowing for country specific differences in estimated inefficiency. The

resulting model enables better understanding of difference between Islamic and conventional banks and across different countries.

As the author has modelled bank compliance with *shariah* under the assumption that this is a true exogenous factor that influences potential output, the results suggest that *ceteris paribus*, Islamic banks have 14.1 percent lower outputs. Nevertheless, it is equally plausible that the reduced potential output of Islamic banks is evidence of systematic inefficiency. Moreover, the author would argue that ultimately one's interpretation of the reduced potential output associated with Islamic banking will be influenced by one's beliefs. If one believes that the tenets of *shariah* are legitimate, then this result can be properly interpreted as the result of legitimate differences in the nature of the banking product that reduces potential output. In contrast, if one does not accept the legitimacy of *shariah*, the reduced output for compliance with *shariah* is more likely to be interpreted as inefficiency. Thus, while the results provide evidence to answer the positive query of whether Islamic banking is associated with reduced potential outputs, ultimately the interpretation of these results is a normative matter influenced by the values of the interpreter.

Turning to the actual efficiency estimates, the results suggest that for all banks, average potential output exceeds actual output by 10.5 percent, while the corresponding averages for all conventional and Islamic banks are respectively 8.2 percent and 21.5 percent. However, as these efficiency scores are net of the measured impact of Islamic banking, the lower average performance of Islamic banks must be attributed to the low country-specific efficiency scores for Sudanese and Yemeni banks. Thus, the model clearly demonstrates that even after controlling for differences in operating environment, large systematic differences in efficiency across countries exist. Moreover, the results indicate a wide range of output efficiencies across countries, ranging from 1.014 for Iran to 1.724 for Sudan, which are notably the only two countries in the sample that legally mandate Islamic banking.

Therefore, similar to Bonin et al (2005), this study shows that country effects play a significant part in explaining efficiency distributions between countries, even after controlling for country-specific environment conditions, including Islamic banking. However, this study goes further, as the author has tested for statistically significant differences in the parameters that define each country's efficiency distribution. The results therefore provide statistically validated evidence that suggests that banks in Iran, Malaysia, Bahrain and Bangladesh have achieved relatively high

levels of efficiency compared to other countries in the sample. In contrast, while the efficiency of banks in Jordan, Lebanon, Tunisia, and Indonesia falls into a middle category, banks in Yemen and Sudan can be classified as highly inefficient.

The author finally notes that on average, the banks in each of the 10 sample countries exhibit moderate returns to scale. However, the average estimated returns to scale for conventional banks are lower than those for Islamic banks, with the exception of Malaysia and Jordan. However, while this result suggests that Islamic banks will benefit more from increased scale than conventional banks, the average scale economy estimate of 1.052 for all Islamic banks indicates that only moderate gains will be achieved even if Islamic banks strive to increase their scale size. This therefore suggests that while growth may allow Islamic banks to improve their scale efficiency, identifying and overcoming the factors that cause Islamic banks to have relatively high input requirements will be the key challenge for Islamic banking in the coming decades.

CHAPTER 7
CONCLUSIONS, CONTRIBUTIONS AND IMPLICATIONS OF THE STUDY

7.1 INTRODUCTION

This chapter in turn considers firstly the conclusions, contributions and implications of the thesis findings, as well as limitations and suggestions for future research. The conclusions are reached after taking into account the results, as well as discussion of the findings and conclusions in previous chapters.

The development of modern Islamic banking arose from Muslims' rejection of the interest element in conventional banking. Islamic banks which started to operate in the early 1970s were initially concentrated in the Middle East before spreading to other regions such as Asia and Europe, due to demand from the Muslim communities as well as to provide banking choices to bank customers. Islamic banking services have now been offered by both full-fledged Islamic banks, as well as conventional banks that choose to operate Islamic banking windows, and they can either be foreign- or domestic-owned.

As Islamic banking has been in operation for over 30 years and is viewed as an alternative to interest-based banking, the performance of Islamic banking needs to be assessed. Moreover, as Islamic banking is part of a country's banking system, the performance of Islamic banks may affect the soundness and stability of the banking system. Furthermore, Islamic banking influences the performance of conventional banks, if they choose to operate Islamic banking windows in addition to conventional windows. Hence, determination of the relative performance of Islamic to conventional banks will help policy makers to devise policies in order to improve the performance of a country's

banking system as well as to provide some guidelines for managers of conventional banks with Islamic banking windows to improve bank performance. In addition, the rising number of Islamic banks has increased the competition between full-fledged Islamic banks and conventional banks. Therefore, the determination of their relative performances will encourage both full-fledged Islamic and conventional bank managers to improve their performance in order to compete with each other.

Given the above issues, the aim of the thesis has been to measure the efficiency of Islamic banking as compared to conventional banks, concentrating on the impact of operational characteristics on efficiency, and to find out factors that influence their productivity. Specifically, the first objective has been to compare the efficiency of Islamic banking relative to conventional banks in Malaysia, focussing on the impact of operating characteristics as well as to determine the productivity performance of Islamic banking relative to conventional banks. The second objective of the thesis has been to compare the efficiency of Islamic banks relative to conventional banks in countries operating Islamic banking.

In achieving the first objective, a translog cost function has been applied on the Malaysian commercial banks in chapter 4. Given that Islamic banks cannot charge or pay interest and are hence, likely to face higher capital costs and meet objectives other than profit maximization, a cost function has been employed which allows the potential higher costs of capital faced by Islamic banks to be controlled for. Furthermore, if the non-profit oriented activities of Islamic banks are carefully controlled for, it is reasonable to assume that Islamic banks will try to minimize their costs of operation. Differences in operating characteristics that may affect the efficient level of costs have been controlled for, by including environmental factors directly in the cost function, therefore the resulting efficiency scores are net of the impact of environmental influences on efficient input requirements. Consequently, these net efficiency measures permit one to predict the ranking of firms under the assumption that firms operate in an equivalent environment. Nevertheless, these exogenous factors are possibly an indicator of differences in efficiency rather than differences in efficient costs. Hence, alternative gross efficiency estimates have also been offered to better measure the effect of such factors on estimated efficiency. Besides efficiency, bank performance has been measured through productivity change. Therefore, a generalised Malmquist Productivity Index has been employed to capture the

impacts of technical change, cost efficiency change and scale change effects on bank productivity change.

Cost efficiency, as mentioned above, measures how efficient banks minimise inputs, given outputs. As efficiency estimates obtained from different approaches should generate consistent estimates of efficiency and efficiency rankings, as well as give consistent results over time, an alternative method employing an output-oriented distance function, which estimates how efficient banks transform inputs into outputs, has been applied in chapter 5. By using this function, chapter 5 has the benefit of employing a quantity measure to identify bank inputs and outputs, thus avoiding possible problems leading to distorted and inaccurate price estimates that might occur given divergences in asset classification among Islamic and conventional banks, hence, potentially resulting in unreliable estimates of cost efficiency. Moreover, this function does not call for the strong behavioural assumptions of a profit maximisation or cost minimisation approach and is therefore appropriate for Islamic banks as they have dual objectives of fulfilling non-profit obligations for the society and profit or revenue maximisation for the depositors and shareholders. Moreover, if behavioural objectives between Islamic and conventional banks differ, the weaker behavioural assumptions of the output distance function approach may allow more consistent estimates of relative efficiency. By providing estimates of net and gross efficiency for Malaysian commercial banks, this chapter brings focus to the influence of operating characteristics on the relative outputs of Malaysian banks. Likewise, a generalised Malmquist Productivity Index has been employed to estimate the productivity change which can be decomposed into efficiency change, technical change and scale change effects.

The second objective of how Islamic banks perform relative to conventional banks internationally has been examined in chapter 6 which also employs a translog output distance function. The relative efficiency and returns to scale of Islamic and conventional banks have been investigated in countries that operate Islamic banking namely Malaysia, Sudan, Bangladesh, Tunisia, Jordan, Lebanon, Yemen, Indonesia, Bahrain and Iran. Except for Sudan and Iran which only operate Islamic banking, banks from other countries operate both Islamic and conventional banking. A common frontier with country-specific environmental variables has been estimated after allowing for country specific differences in estimated inefficiency and the analysis has put emphasis on the impact of operating

characteristics, including Islamic banking and country-specific conditions on the relative outputs of banks.

The frontier in chapter 6 has controlled for variations in economic and regulatory environments between countries that may justify differences in efficiency, by including country-specific variables directly in the distance function, and also allowed country dummies to directly influence output inefficiency. These country dummy variables simultaneously capture other country-specific environmental conditions and determine relative efficiency between countries. This implies that the resulting efficiency scores are net of the impact of controlled for environmental influences on efficient input requirement, and the differences in these scores are directly influenced by country-specific inefficiency distributions. As a result, these efficiency measures enable one to determine how firms are ranked under the assumption that firms operate in an equivalent environment, while at the same time measuring how bank efficiency in one country differs from another. Furthermore, by employing the parameter covariance matrix, the author has directly tested whether the estimated inefficiency is significantly different across countries.

7.2 CONCLUSIONS, CONTRIBUTIONS, IMPLICATIONS

Chapter 4 has demonstrated that the average Malaysian banks faced 6.6 percent higher costs than a bank on the most efficient frontier, but 34.0 percent higher costs than the efficient costs defined by the bank with the most favourable operating environment, thus implying that differences in bank operating characteristics explain much of the differences in bank costs. Nevertheless, operating characteristics such as *shariah* compliant banking could capture validated differences in costs or systematic differences in efficiency. In addition, it has been found that on average, banks become more inefficient between 1996 and 2002, causing an average 0.52 percent drop in productivity change. However, productivity change is on average 2.68 percent per year contributed mainly by the technical change. Furthermore, most banks demonstrated moderate scale economies.

Despite their relatively poor gross efficiency, full-fledged Islamic banks have been demonstrated to experience very high productivity change, which is explained by high rates of technical change. This indicates that while full-fledged Islamic banks were initially costly to operate, they have been able to eliminate a significant proportion of this

cost disadvantage during the sample period, and possibly able to continue with this in the long term. Given the poorer gross efficiency of conventional banks with Islamic banking windows, and the result that their productivity, efficiency, scale, and technical change are by and large similar to that of an average bank, there would appear to be less potential for these banks to overcome the cost disadvantages associated with Islamic banking.

Chapter 4 has also shown that the merged banks have experienced significantly lower productivity change relative to unmerged banks mainly due to the lower efficiency change of merged banks that have Islamic banking windows. This indicates that the call for managers to simultaneously develop new Islamic banking products and consolidate operations after mergers may have played a part in this poor performance. The separation of Islamic banking windows from conventional banking services into Islamic bank subsidiaries as practiced in Malaysia since 2005 may allow managers to better focus on improving the cost efficiency of Islamic banking. In addition, there is the possibility that at least in the short run, the new Islamic banks will go through similar transitional problems. Nevertheless, once the new full-fledged Islamic banks overcome any transitional problems, the experience of existing Islamic banks denotes that there is potential for these banks to significantly, reduce the cost disadvantage that is currently associated with Islamic banking. Finally, the results in chapter 4 suggest that given the brisk growth of Islamic banking as well as its existing cost disadvantages, policy makers must keep on working preparing for a more conducive banking environment for Islamic banking and to encourage managers to reduce these cost disadvantages.

In using the output distance function to check consistency of the results, chapter 5 has found that the Malaysian banks on average have been estimated to produce 94.8 percent of the output they could produce if they operated on the efficient frontier, but could only produce 82.3 percent of what they could have produced if they operated on the frontier identified by the most favourable operating environment. This indicates that differences in bank characteristics play a significant role in determining bank outputs. In addition, the result has shown that banks operate at or near to constant returns to scale. Furthermore, on average, banks became more inefficient between 1996 and 2002, causing an average 0.39 percent decline in productivity change. However, the productivity change is on average 2.37 percent per year which was driven by the technical change. The high gross efficiency estimates for both full-fledged Islamic banks and conventional banks with

Islamic banking windows employing output distance function has suggested that Islamic banking requires significantly higher inputs.

In comparison with chapter 4 which employ the cost function, similar results of higher input requirements for full-fledged Islamic banks relative to average banks have been found. Both techniques have also produced generally similar conclusions on the relatively poor performance of banks with Islamic banking windows compared with those without Islamic banking windows in each category except for the domestic category. Domestic banks with Islamic banking windows are slightly more efficient than those without Islamic banking windows, when estimated with a cost function but are found equally efficient using the output distance function technique.

With the output distance function, Islamic banks have been shown to experience a much lower productivity change and Islamic banks fail to reduce their inefficiencies. Moreover, the productivity, efficiency, scale change, and technical change of Islamic banking windows banks have been found to be inferior to other banks. These results are in contrast to those using the cost function in which full-fledged Islamic banks have been shown to experience high productivity change and also be able to reduce a large proportion of their cost disadvantages. Using output distance function, merged banks have been demonstrated to suffer from considerably lower productivity change relative to unmerged banks and this difference could be attributed to the lower efficiency change of merged banks that operate Islamic banking windows which is also similar to those found using the cost function technique.

The findings using output distance function in chapter 5 imply that the potential for Islamic banks to overcome the output disadvantages related to Islamic banking are relatively limited. Given the slow output growth of Islamic banking, the existing output disadvantages highlighted by the gross efficiency estimates, and the relatively small output productivity change of Islamic banks when compared to other banks, policy makers in Malaysia face a real challenge. The results in chapter 5 imply that they will have to better motivate Islamic bank managers to reduce these output disadvantages, and more importantly, they will need to aggressively work to create a more encouraging banking environment for Islamic banking, if they plan to further expand Islamic banking.

Similar to chapter 4 and 5, chapter 6 has concluded that bank compliance with *shariah* has higher input requirements and it is possible that the reduced potential output is

proof of systematic inefficiency. Having netted out the 14.1 percent lower output, the potential output of conventional banks is only 8.2 percent higher than actual output, while for Islamic banks this difference is 21.5 percent. However, as these efficiency estimates are net of the measured effect of Islamic banking, the inferior average performance of Islamic banks must be in part attributed to the low country-specific efficiency scores for Sudanese and Yemeni banks. In addition, the results have shown a broad range of output efficiencies across countries, ranging from 1.014 for Iran to 1.724 for Sudan, which are notably the only two countries in the sample that fully practiced Islamic banking.

Furthermore, chapter 6 has demonstrated that country effects play a significant role in explaining efficiency distributions between countries, even after controlling for country-specific environment conditions, including Islamic banking. In addition, this chapter has tested for the statistically significant differences in the parameters that define each country's efficiency distribution. The results thus, have provided statistically validated evidence that suggests banks in Iran, Malaysia, Bahrain and Bangladesh have attained relatively high levels of efficiency compared to other countries in the sample. While the efficiency of banks in Jordan, Lebanon, Tunisia, and Indonesia is in a middle category, banks in Yemen and Sudan can be categorized as highly inefficient. This chapter has also shown that the average estimated returns to scale for conventional banks are lower than those for Islamic banks, with the exception of Malaysia and Jordan. Therefore, moderate benefits will be realized even if Islamic banks attempt to increase their scale size.

Finally, based on the thesis findings, the answer to the research question of how Islamic banking performs relative to conventional banks is ultimately a value judgement. If one believes in the legitimacy of *shariah*, Islamic banking is associated with higher input requirements which can be interpreted as "true inefficiency" because it meets the requirements of *shariah* that increase potential costs or reduces potential output, but the increased cost or reduced output for compliance with *shariah* is more likely to be interpreted as inefficiency if one refuses to accept the legitimacy of *shariah.*

7.3 LIMITATIONS OF THE PRESENT STUDY AND FURTHER RESEARCH

The findings of this research are with limitations, but such shortcomings can motivate potential research. Although the chosen techniques which have been employed in the thesis are appropriate, consistent with the scope, sample and data of the studies, the thesis has only employed stochastic frontier analysis using cost function in chapter 4 and output distance function in chapter 5 and 6. Different techniques such as DEA as well as input distance function will provide stronger support to the findings while recommending some insights on the advantages and weaknesses of different techniques.

The cross-country research in chapter 6 is subject to limitations of the number of observations for each country in the sample. It also has a very small number of Islamic banks as compared to the number of conventional banks in each country although all Islamic banks with complete information from the database have been included. In this light, interpretation of the relative efficiency between countries and the efficiency of Islamic banks relative to conventional banks should be read carefully.

Besides Malaysia, conventional banks in other countries have also offered Islamic banking windows, but the researcher could not access such information. Therefore, this limitation warrants careful judgement on the results of the cross-country study in chapter 6 particularly on the relative efficiency of Islamic and conventional banks.

Within the area of cross-country study in chapter 6, due to unavailability of information on foreign and private ownerships for panel data, future research may investigate the effect of these ownership differences on conventional and Islamic bank efficiency by conducting cross-sectional research. Ideally, sample banks should also be increased in order to more representative of the population of banks in each country.

Based on the findings of the research and the limitations previously emphasized, the following subsequent directions for future research are suggested. To the best knowledge of the researcher, chapter 4 and 5 are the first studies to have measured the efficiency and productivity change of Islamic banks, conventional banks with Islamic banking windows and conventional banks without Islamic banking windows. Chapter 6 is also the first research that measured efficiency of Islamic and conventional banks across countries using an output distance function. In order to expand our knowledge and understanding concerning the investigated issues, more research especially applying

advanced techniques needs to be carried out in different time and country settings. The investigation should also extend to foreign-owned Islamic banks.

Finally, the main conclusion derived from the thesis, in which Islamic banks have relatively higher input requirements compared to conventional banks should however, motivate policy makers involved in Islamic banking and Islamic bank managers to identify and overcome factors leading to these higher input requirements. In addition, they should aggressively work to create a more encouraging banking environment for Islamic banking, if they plan to further expand Islamic banking

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Appendix I
Islamic and conventional bank efficiency studies

Author	Sample data	Input	Output	Methodology	Findings
Alshammari (2003)	Year: 1995-1999 Sample: GCC countries (Bahrain, Saudi Arabia, Oman, Qatar, UAE, Kuwait) banks. Source: BankScope	• Price of fund (interest expense and trading expense)/ customer deposits • Price of labour (personnel expense/ total assets) • Price of physical (other operating expense/ total assets)	Intermediation approach • Loans • Other earning assets	Stochastic cost function and profit function *Control variables;* Capital (equity) Asset Quality (loan loss reserves/ total loans) *Inefficiency Effects;* Dummy variable for each country and bank type. *Inefficiency correlates* -	Cost efficiency, 0.88; profit efficiency, 0.68 and both improve overtime. Islamic bank is the most efficient by type (commercial, investment, Islamic). Bank type has no effect on scale economies. Strong diseconomies of scale in Saudi, moderate diseconomies of scale in Kuwait, Qatar, Bahrain, economies of scale in UAE, Oman. Diseconomies of scale increase with size.
Abdul-Majid, Mohammed Nor, and Said (2005)	Year: 1993-2000 Sample: 34 Malaysian commercial banks (32 conventional banks, 2 Islamic banks) Source: Bank annual report, ABM Bankers Directory.	• Price of labour (personnel expenses/ no. of full time labour) • Price of physical capital (Expenses on fixed assets/ fixed assets) • Price of funds (Income paid to depositors/ total deposits)	Intermediation approach • Loans, advances, financing • Deposits, short term funds • Securities, Investment	Stochastic cost function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Bank type, ownership, bank size, time.	No evidence inefficiency is a function of Islamic-conventional bank type, foreign-local ownership and public-private ownership. Bank size has negative relationship with inefficiency.

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Appendix I
Islamic and conventional bank efficiency studies (continued)

Author	Sample data	Input	Output	Methodology	Findings
El-Gamal and Inanoglu (2005)	Year: 1990-2000 Sample: 53 Turkish banks (49 conventional banks, 4 special finance houses (Islamic banks) Source: The Banks Association of Turkey	• Price of labour (personnel expenses/ total borrowed funds) • Price of funds (interest expense/ total borrowed funds) • Price of physical capital (fixed asset expenses, depreciation/ total fixed asset)	Intermediation approach • Loans	Stochastic cost function Loans the only output because Islamic banks do not have securities. Homogeneity test on bank technology: Size, ownership (private & foreign), mode of operation. *Control variables* Loan quality, equity capital *Inefficiency Effects* - *Inefficiency correlates* -	No evidence Islamic bank uses different technology from conventional banks, and state-from private-owned. Heterogeneity only for small and large, foreign- and domestic-owned. Foreign-owned has less cost due to short term borrowing abroad and high return government bond.
Al-Jarrah and Molyneux (2005)	Year: 1992-2000 Sample: 82 banks in Jordan, Egypt, Saudi Arabia, Bahrain. Source: BankScope	• Price of funds (total interest expenses/ total demand, saving and time deposits). • Price of labour (total personnel expenses/ total assets). • Price of physical capital (Non-interest expense/ Average assets).	• Loans (short-term investment, equity and other investment, and public sector securities) • Off-balance sheet items	Stochastic cost and profit functions. <u>Cost function:</u> *Control variables* - *Inefficiency Effects* Bank types, country dummy, assets, liquidity, concentration ratio, and market share *Inefficiency correlates* - <u>Profit function:</u> *Control variables* Loan quality, capital and time. *Inefficiency Effects* Bank types, country dummy, assets, liquidity, concentration ratio, and market share *Inefficiency correlates* -	More cost efficient (0.95) rather profit efficient (standard, 0.66; alternative, 0.58) By bank type, Islamic bank most efficient using all functions. By geographic location, Bahrain bank is the most efficient in both cost and profit function.

Abdul-Majid, Mariani, Nor Ghani Mohammed Nor, and Fathin Faizah Said. 2005. "Efficiency of Islamic Banks in Malaysia," in *Islamic Finance and Economic Development*. Munawar Iqbal and Ausaf Ahmad eds. New York: Palgrave Macmillan, pp. 94-115.

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Appendix II
Islamic bank efficiency and productivity cross-country studies

Author	Sample data	Input	Output	Methodology	Findings
Brown (2003)	Year: 1998-2001 Sample: 24 Islamic banks from 14 countries Source: BankScope	• Labour (Personnel expenses) • Non-interest expenses	Intermediation approach • Deposits • Loans • Other earning assets	DEA Common frontier Without country-specific variables.	Most efficient banks are consistently found in Iran, Brunei, Yemen. Least cost efficient banks are in Indonesia and Sudan.
Yudistira (2004)	Year:1997-2000 Sample:18 Islamic banks from 12 countries Source: BankScope	• Labour (Personnel expenses) • Physical capital (fixed assets) • Funds (Total deposits)	Intermediation approach • Total loans • Other Income • Liquid assets	DEA Common frontier for banks from different countries without country-specific variables.	Average inefficiency estimate is 10 percent. Middle Eastern banks are less efficient than other regions. Small- and medium-sized banks experience diseconomies of scale.
Brown and Skully (2003)	Year: 2000 Sample: 33 Islamic banks from 19 countries. *Global Model* (22 banks from 13 countries) *Islamic model* (21 banks 13 countries) Source: BankScope, World Fact Book, International Financial Statistics (IFS), World Development Indicators (WDI), International Bank for Reconstruction & Development.	*Global model:* • Labour (Personnel expenses) • Non-interest expenses *Islamic model:* • Labour, Physical capital (General and administration costs, personnel expenses) • Fund (Equity/ Islamic funding)	Intermediation approach *Global model:* • Deposits • Loans • Other earning assets *Islamic model:* • Deposits and other earning assets (Islamic asset) • Loans (Customer, short term funding)	DEA Common frontier for banks from different countries Global model and Islamic model: 2 different input and output specifications based on different accounting reporting format and different datasets. With and without environmental factors.	Iran and Brunei are fully efficient in both models. *Global model;* Brunei, Iran, Malaysia, Yemen are fully cost efficient. Tunisia, UAE become fully efficient when environmental factors included. *Islamic model;* Egypt, Gambia, Iran are fully cost efficient. Brunei and Kuwait become fully efficient when environmental factors included. By region, Middle East is the most cost efficient followed by Asian and African banks.

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Appendix II
Islamic bank efficiency and productivity cross-country studies (continued)

Author	Sample data	Input	Output	Methodology	Findings
Hassan (2003)	Year: 1994-2001 Sample: 28 Islamic banks in Pakistan Sudan, Iran. Source: BankScope, IFS, World Development Bank, Global Development Finance (GDF).	• Price of labour (Personnel expenses/ customer and short-term funding) • Price of physical capital (total expenses on premises and fixed assets/ customer and short-term funding) • Price of funds (Total interest expenses on deposit and non-deposit funds/ customer and short-term funding) *Input;* • Customer and short-term funding • Number of labour • Fixed capital	Intermediation approach • Total loans • Other earning assets • Off-balance sheet items	Stochastic cost and profit functions, DEA, non-parametric Malmquist productivity index. Common frontier Stochastic cost and profit functions *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - DEA Efficiency scores correlate with size (total assets), market power (loans), profitability (ROA, ROE).	More cost efficient (0.52) rather profit efficient (0.34) Using DEA, banks could improve efficiency by better use of technology. Banks with larger size and high profitability are generally more efficient. Productivity change is driven by technical change. Islamic banks make technical progress by penetrating into various markets and capturing market shares despite productivity loss.
Hassan (2005)	Year: 1995-2001 Sample: 43 Islamic banks from 21 countries Source: BankScope, IFS, WDI, GDF.	• Price of labour (Personnel expenses/ total assets) • Price of physical capital (Non-interest expense/ average assets value) • Price of funds (Total non-interest expense/ deposits) *Input;* • Customer and short-term funding • Number of labour • Fixed assets	Intermediation approach •Total loans •Other earning assets • Off-balance sheet items	DEA, stochastic cost and profit functions Productivity measured by non-parametric Malmquist productivity Index. Stochastic cost and profit functions *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - DEA Efficiency scores correlate with size (total assets), market power (loans), profitability (ROA, ROE).	More profit efficient (0.84) rather cost efficient (0.74) DEA: banks could have improved efficiency by managing inputs rather than use of technology. OLS regression, DEA efficiency score being dependent variable suggests efficiency increase with size and profitability. Moderate productivity growth mainly driven by technical change.

Appendix III

Selected bank efficiency studies using cost function

Author	Sample data	Input	Output	Methodology	Findings
Clark (1996)	Year: 1988-1991 Sample: 109-111 USA commercial banks Source: Bank Compustat, CRSP.	• Price of fund • Price of labour (salaries and benefits/ number of employees) • Price of physical capital (expenses for furniture, equipment, premises/ value of furniture, equipment, premises)	Value-added approach • Commercial and industrial loans • Consumer and real estate loans • Total securities • Core deposits (demand, savings, time deposits)	Stochastic cost function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - Scale efficiency measured by degree of scale economies	Some banks concentrate more on production and cost efficiency without giving much weight on risk. Smaller, less diversified organisations remain viable. Omission of core deposits overstates efficiency estimates.
Mester (1996)	Year: 1991-1992 Sample: 214 US banks in 3rd Federal Reserve District. Source: Consolidated Reports of Condition and Income	• Price of fund (interest expense/ funds) • Price of labour (salaries and benefit expenses/ premises and fixed assets) • Price of physical capital (premise and fixed assets expenses net rental income/ premise and fixed assets)	Intermediation approach • Real estate loans • Commercial and industrial loans, lease financing, loans to foreign government, obligations of states and political subdivisions, other loans. • Loans to individual	Stochastic cost function *Control variables* Output quality (NPL), risk (equity) *Inefficiency Effects* - *Inefficiency correlates* Bank's age, organizational and regulatory structure, member of holding company, member of federal reserve system, bank offices, size, capital adequacy, ROA, reliance on non-core deposits, portfolio mix.	Inefficiency scores of 6-9 percent. Constant returns to scale. Inefficient bank characteristics are young, higher loan percentage in construction, land development and industry, low capital-to-assets ratio.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Mahajan, Rangan, and Zardkoohi (1996)	Year: 1987-1990 Sample: Domestic & multinational banks (MNBs) in the USA Source: Report of Income & Condition	• Price of fund (interest expense/ purchased funds) • Price of labour (employees' compensation/ number of employees) • Price of physical capital (net expenses on office occupancy and equipment / total office premises and equipment)	Intermediation approach • Loans • Demand deposits accounts • Government securities	Stochastic cost function. *Control variables* Number of branches Holding company dummy variable *Inefficiency Effects* - *Inefficiency correlates* - Scale economies measured by change in costs as a result of change in outputs.	Cost structure of domestic and MNBs are different. Domestic banks experience greater diseconomies with size. Average low-cost and high-cost difference in domestic is stable, but in MNCs more pronounced in smallest and largest banks.
Berger and Mester (1997)	Year: 1990-1995 Sample: 6,000 USA commercial banks. Source:	• Price of fund (interest rates on purchased funds and core deposits) • Price of labour	Intermediation/ asset approach • Loans • Gross total assets-loans-physical capital) Netput items • Off-balance sheet items • Physical capital • Financial equity capital	Stochastic cost function and profit function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Size, organisational form and corporate governance, other bank characteristics, state geographic restrictions on competition, federal regulator.	Cost efficiency 86.8%. Profit efficiency 50%. Only small difference in average, dispersion or rank in efficiencies between translog and Fourier-flexible specifications. Large banks experience constant returns to scale with slight diseconomies of scale because large banks have lower costs per dollar assets. Improvement in technology has reduced costs more for larger banks. Most variance in measured efficiencies remains unexplained.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Berger and DeYoung (1997)	Year: 1985-1994 Sample: USA commercial banks Source: Annual Reports of Condition and Income	• Price of labour • Price of physical capital	Intermediation approach • Loans • Deposits • Fee-based income	Stochastic cost function *Control variables* Restricted branch banking state dummy Banned branch banking state dummy *Inefficiency Effects* - *Inefficiency correlates* - Test relationship between inefficiency, NPL, equity capital, and with year, region.	Data support bad luck hypothesis: NPL reduced efficiency. For industry as a whole, decreased cost efficiency is largely followed by NPLs Decreased capital ratios generally precede increases in NPLs for low capital banks. Efficiency from standard translog and Fourier flexible are highly correlated.
Lozano-Vivas (1998)	Year: 1985-1991 Sample: 88 Spanish commercial banks, 55 Spanish savings banks. Source: -	• Price of fund (interest expense/ deposits) • Price of labour (labour expenses/ number of employees) • Price of physical capital (office occupancy and equipment expenses/ total office premises and equipment)	Intermediation approach • Loans • Number of deposit accounts • Value of deposit account	Stochastic cost function *Control variables* Number of branches Merger dummy Time trend dummy *Inefficiency Effects* - *Inefficiency correlates* -	Commercial and saving banks have similar inefficiency, 13.5% and 11.4%. Deregulation did not generate better performance for Spanish banking industry.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Chang, Hasan, and Hunter (1998)	Year: 1984-1989 Sample: 241-260 foreign-owned (FOMNBs) and US-owned multinational banks (USMNBs) Source: Reports of Condition and Income	• Price of funds (total interest expense/ deposits, funds, securities) • Price of labour (salary, benefit/ number of employee) • Price of physical capital (expenses on premises and fixed assets/ total assets)	Intermediation approach • Commercial and industrial loans • Other loans • Money market assets • Non-interest income net service charges and foreign exchange gain/ losses.	Stochastic cost function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* FOMNBs dummy, % foreign ownership, bank holding company (BHC), assets, sales growth, FOMNBs X asset, BHC X asset.	FOMNBs are less efficient than USMNBs. Large banks in a holding company with fewer foreign assets are potentially more efficient.
Esho (2001)	Year: 1985-1993 Sample: New South Wales credit institutions Source: State supervisory body, annual reports, 1993 survey data	• Price of borrowed funds (total interest expense/ deposits) • Price of labour (total wage expenses/ number of full time labour) • Price of physical capital (office expenses/ total assets)	Intermediation approach • Loans • Securities • Deposits	Stochastic cost function (BC 1992, DF, WITHIN) Different models based on different input output specification. *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - BC-All firms assumed to have same efficiency rate and individual firm efficiency ranking held constant overtime. DF-Inefficiency is fixed overtime, random error averages to zero. WITHIN-Allow inefficiency to vary overtime.	Efficient credit institutions are older, high capital ratio, large deposit balance, pay higher interest rates on loans and lower deposit interest rates respectively. Efficiency rankings vary overtime using WITHIN. High correlation between DF and BC; insensitive to cost function modelling. Efficiency ranking in WITHIN is the most sensitive to cost function models.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Casu and Girardone (2002)	Year: 1995 Sample: 32 banking groups, 43 bank parent companies, 35 bank subsidiaries in Italy Source: BankScope	• Price of fund (interest expenses/ customer and short term funding) • Price of labour • Price of physical capital (total capital expenses/ fixed assets)	Intermediation approach • Loans • Other earning assets	Stochastic cost function and DEA *Control variables* - *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - Scale economies as a cost elasticity; elasticity of total cost with respect to output	Bank groups are less efficient than bank parent companies and bank subsidiaries based on both SFA and DEA. Efficiency is not linked to bank size. On average very mild scale economies.
Isik and Hassan (2002)	Year: 1988 1992, 1996 Sample: 39-56 Turkish commercial banks Source: Istanbul Stock Exchange and Banks Association of Turkey.	• Price of funds (total interest expenses on deposit and non-deposit funds/ total deposits) • Price of labour (total expenditure on employees/ total number of employees) • Price of physical capital (total expenditures on premises and fixed assets/ book value of premises and fixed assets)	Intermediation approach • Short term loans • Long term loans • Other earning assets (loans to special sectors, inter-bank funds sold, investment securities) • Off-balance sheet items	DEA, Stochastic cost function and profit function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Bank size, foreign ownership, private ownership, management-team structure, holding company structure.	Cost efficiency 72%, profit efficiency 83%. Decline in efficiency overtime due to increased costs of funding and bank growth in later period. Heterogeneous bank characteristics have significant impact of efficiency. Major source of inefficiency is technical rather allocative efficiency. Mainly, banks experience diseconomies of scale.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Author	Author	Author	Author	Author
Hasan and Marton (2003)	Year: 1993-1998 Sample: Hungarian commercial banks Source: Hungarian Financial & Stock Exchange Almanac, NBH, Hungarian Ministry of Finance.	• Price of borrowed funds (total interest expense/ interest bearing borrowed funds) • Price of labour (non-interest expense/ number of full time labour)	Intermediation approach • Loans • Investments (other earning assets) • Non-interest income • Interest bearing borrowed funds Netput items • Equity capital • Loan loss provision/ total loan	Stochastic cost function and profit function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Liquid assets, short term loans, investment, retail loans, retail deposits, equity, cost (profit) inefficiency, log assets, age, hours service, share, foreign share, acquisition, year dummy.	Foreign-owned more efficient than domestic banks. Cost inefficiency, 28.76%, profit inefficiency, 34.50%. Privatisation, larger foreign shares in local banks increase efficiency. Efficiencies improve overtime.
Huang and Wang (2004)	Year: 1981-2001 Sample: 22 Taiwan domestic banks Source: -	• Price of fund (interest payments/ deposits and borrowed money) • Price of labour (employees' compensation/ full-time equivalent employee) • Price of physical capital (occupancy and fixed asset expenditures/ net premises and fixed assets)	Intermediation approach • Short-term loans • Long-term loans • Investments (government and corporate securities)	Stochastic cost (translog, fourier flexible) functions *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Assets, deregulation, public-ownership	Inefficiency 18-23% (translog), 26% (fourier flexible). Public banks are more efficient to private banks. Private banks are more effective in production technique.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Girardone, Molyneux, and Gardener (2004)	Year: 1993-1996 Sample: 424-545 Italian credit institutions. Source: Bilbank, Associazione Banch Private Italiane	• Price of fund • Price of labour • Price of physical capital	Intermediation approach • Loans • Total securities	Stochastic cost function *Control variable* Risk (equity capital) Asset Quality (NPL-to-total loans) *Environmental variables* - *Inefficiency Effects* - *Inefficiency correlates* Assets, interest margin, branches, retail, ownership, NPL, net income, capital, location, bank types. Scale economies measured by sum of individual cost elasticities.	Average inefficiency, 13-15% Big and medium sized banks are most efficient and experience economies of scale. Efficiency estimates similar for both translog and fourier-flexible cost function. Scale economy level lower when risk and quality factors included. Inefficiency inversely correlated with capital, positively correlated with NPL, greater retail banking, higher interest margin, more branches, and not related to size.
Bonaccorsi di Patti and Hardy (2005)	Year: 1981-2002 Sample: 33 licensed banks in Pakistan. Source: State Bank of Pakistan	• Price of fund (Total interest expense and fees/ total purchased funds) • Price of labour (Wage and administration expenses/ earning assets and payable liabilities)	Intermediation approach • Loans and advances • Other earning assets Netput items • Equity capital and reserves • Fixed assets	Stochastic cost function and profit function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* - Total change in these variables is decomposed into change in productivity and business conditions	Moderate increase in profit in first market reform as a result of revenue increase more than costs. State-owned banks are least efficient. Liberalisation and reform lead to higher bank performance.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Author	Author	Author	Author	Author
Bouchaddakh and Salah (2005)	Year: 1997-2003 (semi-annual) Sample: 10 Tunisian commercial banks Source:	• Price of fund (interest expense/ deposits and assets of customers) • Price of labour (expenditures on employees/ number of employees) • Price of physical (expenditures on premises and fixed assets/ value of premises and fixed assets)	Intermediation approach • Loans	Stochastic cost function *Control variables* - *Inefficiency Effects(B&C 1995)* NPLs-to-loans *Inefficiency correlates* - *Economies of scale* Change in total cost as a result of change in output.	Cost inefficiency, 16%. Efficiency improved overtime especially publicly-owned. On average, increasing economies of scale. NPLs-to-loans is not significant in detemining inefficiency.
Rao (2005)	Year: 1998-2001 Sample: 37 UAE commercial banks. Source: Published financial statements (Islamic banks (2) were excluded due to different operation)	• Price of borrowed funds • Price of labour	Intermediation approach • Net loan (loans net of loan loss provisions) • Investments (securities, equity investments, all other investments) • Off-balance sheet items	Stochastic cost function (translog, fourier flexible, fixed effects) *Control variables* large, foreign, year dummy variables. *Inefficiency Effects* - *Inefficiency correlates* Risk variables (NPL/loans, cash/total assets, equity capital/total assets), output mix variables (retail deposits to total deposits, net loans to total earning assets), large, foreign ownership, year dummy variables.	Choice between models does not significantly change efficiency estimates. Cost inefficiencies, 20.4% (translog), 25.3% (flexible fourier), 10.4% (fixed-effect). While loans and investment increase the costs, off-balance sheet activities reduce cost significantly. Cost efficiency improved with liquidity, capitalisation, domestically-owned bank.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Kraft, Hofler, and Payne (2006)	Year: 1994-2000 Sample: 26-60 Croatian banks Source: Croatian National Banks	• Price of fund (interest and fees paid on funds) • Price of labour (Employee compensation and taxes) • Price of physical capital (Costs of equipment and premises)	• Loans to enterprise • Loans to household • Deposits of enterprises • Deposits of households Netput items • Total assets • Total capital (share capital, capital reserves, retained earnings)	Stochastic cost function (fourier flexible) *Control variables* - *Inefficiency Effects(B&C 1995)* Private owned dummy New bank dummy Foreign-owned dummy *Inefficiency correlates* -	Average inefficiency 37% Foreign banks are more efficient. Efficiency benefits are not immediate to privatisation. Reputable foreign banks seem do not have strong efficiency advantages. New private bank perform for particular market niche rather universal banking.
Bos and Kool (2006)	Year: 1998-1999 Sample: 401 small cooperative Dutch (Rabo) banks Source: Rabo banks, Statistics Netherland.	• Price of fund (interest expense/ deposits) • Price of labour (total personnel costs/ total assets) • Price of physical (Administrative costs and write-offs/ total assets) • Price of public relations (public relation costs/ total assets) • Price of housing (net housing costs/ total assets)	Intermediation approach • Retail Loans • Wholesale Loans • Mortgages • All services (life insurance, brokerage, travel provisions)	Stochastic cost function and profit function *Control variable* Solvency (quasi-liquid assets/ total assets) *Inefficiency Effects* - *Inefficiency correlates* Bank-specific variables (Main office, local branch office, main office ATMs, other ATMs) Market-specific variables (wholesale market share, wholesale product purchase, wholesale membership, wholesale client base, retail market share, retail product purchase, retail membership, retail client base) Regional macro variables (market inhabitants)	A small but significant part of estimated inefficiency differentials between banks can be attributed to differences in the market and region in which these banks operate. Failing to account for these differentials may lead to inappropriate conclusions about bank performance. Local banks can influence efficiency through choice of main and branch office, spread and location of ATMs.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Kwan (2006)	Year: 1992:Q1-1994:Q4 Sample: 59 multi-branch Hong Kong banks. Source: Hong Kong Monetary Authority	• Price of fund (interest expenses/ total liabilities) • Price of labour (staff expenses/ number of employees) • Price of physical capital (rental & other expenses/ number of employees)	Intermediation approach • Loans to finance import, export, trade. • Loans for non-trade-related financing • Earning assets	Stochastic cost function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Size, deposits-to-assets, trade loans-to-assets, non-trade loans-to-assets, loan-loss-provision, off-balance sheet, loan growth.	Inefficiency, 16-30%. Inefficiency declines overtime. Large bank is less efficient to small banks. Inefficient banks associated with smaller size, lower deposits-to-assets, lower trade loans-to-assets, higher off-balance sheet activities, lower loan growth. Efficiency drops after financial crisis.
Bos et. al. (2008)	Year: 1993-2005 Sample: German cooperative and savings bank Source: Deutsche Bundesbank	• Price of fund (interest expenses/ total borrowed funds) • Price of labour (average wage rate/ number of employees) • Price of physical capital (other expenditures on fixed assets, depreciation/ fixed assets)	Intermediation approach • Inter-bank loans • Customer loans • Securities	Stochastic cost and profit function *Control variables* Equity,* *Inefficiency Effects* * *Inefficiency correlates* - *Baseline SFA specification and 4 variants (mean of truncated half-normal, exogenous factor in inefficiency term, exogenous variables in deterministic kernel, heterogeneity in both kernel and error) used to evaluate stability of efficiency estimates.	Banking type, regional location & size influence bank cost, profits, efficiency. Cost and profit efficiency level differs significantly between preferred (heterogeneity in both kernel and error) specification, and other specifications. Average profit efficiency is underestimated, average cost efficiency is under- and overestimated using non-preferred specification. How heterogeneity is considered in terms of accounting for systematic differences across banks are important in estimating cost and profit efficiency.

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Appendix III
Selected bank efficiency studies using cost function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Berger et. al (2008)	Year: 1994-2003 Sample: 38 Chinese banks Source: BankScope, Almanac of China's Finance and Banking, China Statistical Yearbook, banks annual reports.	• Price of fund (interest expenses/ total deposits) • Price of labour & physical capital (non-interest expense/ fixed assets) * Fixed input: total earning assets	• Loans. • Deposits • Liquid assets • Earning assets *output/fixed input	Stochastic cost and profit function *Control variables* Year dummies. *Inefficiency Effects* - *Inefficiency correlates* ownership	Average profit and cost efficiencies, 50% and 10% respectively (more cost efficient). Banks are more efficient when reduce state-ownership and increase role of foreign ownership. Majority foreign banks are the most profit efficient.
Fu and Heffernan (2008)	Year: 1985-2002 Sample: 187 observations Source: Almanac of China's Finance and Banking, China Statistical Yearbook.	• Price of fund • Price of labour • Price of physical capital	• Loans. • Deposits • Investment • Non-interest income	Stochastic cost function *Control variables* - *Inefficiency Effects* - *Inefficiency correlates* Concentration, market share, ownership,	Joint-stock bank more efficient than state-banks after reforms. No significant evidence that concentration reduces efficiency.

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Appendix IV
Selected bank efficiency studies using output distance function

Author	Sample data	Input	Output	Methodology	Findings
English, Grosskopf, Hayes, and Yaisawarng (1993)	Year: 1982 Sample: 442 US Banks Source: US Federal Reserve's Functional Cost Analysis Program	• Labour • Capital (Occupancy Expense) • Deposits less than USD100 000 • Borrowed funds and deposits greater than USD100,000	Intermediation Approach • Investments income (investment in US securities, federal funds sold and assets in trading account) • Real estate Loans • Commercial loans • Consumer instalment loans	Deterministic Output Distance Function Frontier was first estimated, efficient firms are omitted and frontier was re-estimated sequentially until parameters satisfy regulatory conditions such as correct curvature (including appropriate monotonicity and convexity).	Estimated average technical efficiency, 0.754 Revenue could have been improved if more real estate loans and fewer consumer loans. Larger banks are more efficient than smaller banks.
Iqbal, Ramaswamyand Akhigbe (1999)	Year: 1994 Sample: 64 US minority-owned banks (MOB) & comparable non-minority-owned bank (NMOB) Source: US Minority Bank Monitor and FDIC, Call Report	• Retail deposits (time, savings) • salaries and wages • fixed asset expenses	Intermediation Approach • Investment in securities, federal funds sold, and assets in trading accounts • Consumer instalment loans • Commercial loans	Deterministic output distance function Parameters for MOB and NMOB estimated separately due to different technology	MOBs are less efficient (0.88) than NMOB's (0.95) in maximising output. Their efficiencies could have been improved if they used more efficient technology and revenue-maximising output mix.
Adam, Berger and Sickles (1999)	Year: 1980-1989 Sample: US commercial banks Source: Call Report, FDIC.	• Purchased funds • Demand deposits • Retail time & savings deposits • Number of employees • Capital (Fixed assets)	Intermediation Approach • Commercial & industrial loans • Instalment loans • Real estate loans	Cobb-Douglas stochastic distance frontier. Samples are divided 3 regulatory environments.	Average relative technical efficiency range from 54% - 57% based on the regulatory environments.
Cuesta and Orea (2002)	Year: 1985-1998 Sample: Spanish banks Source: Confederacion Espanola de Cajas Ahorros (CECA)	• Time deposits, savings deposits • Other deposits and funds • Labour (personnel expenses) • Capital (depreciation, other non-interest expense)	Intermediation Approach • Bonds, cash, other assets not covered in followings • Loans • Non-interest income	Stochastic translog output distance function Extending (BC,1992's) temporal variation of efficiency by relaxing monotonicity of temporal variation pattern in efficiency term (firm effect to increase some years and decrease in others in order to allow flexibility in the way efficiency changes over time) and allow for different patterns of efficiency change between merged and non-merged banks.	Merged (efficiency, 0.86) and non-merged firms (efficiency, 0.91) have different patterns of efficiency change. Mergers have some impact on efficiency. Hypothesized that at the end, merged firm will be more efficient than non-merged firms.

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Appendix IV
Selected bank efficiency studies using output distance function (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Li, et al. (2000)	Year: 1997-1999 Sample: Taiwanese banks Source: Financial release, public statement, and Taiwan Economic Journal Database.	• Labour (Number of employees) • Fixed assets • Total Deposits	Intermediation approach • Loans (business, individual) • Investments (government securities and shares, public and private securities) • Other revenues	Stochastic translog output distance function Applying Battese and Coelli (1995) to estimate parameters of distance function and efficiency model simultaneously.	On average, mixed private and public ownership is the most efficient (0.96) compared to public (0.95) and private (0.93) -owned banks. Banks perform worse after 1997 Asian financial crisis. Moderate increasing returns to scale
Cuesta and Zofio (2001)	Year: 1985-1998 Sample: Spanish savings bank Source: CECA	• Deposits (time, savings) • Deposit from banks and other funding • Personnel expenses • Capital (value of fixed assets)	Intermediation approach • Loans to non-banks • Bonds, cash, other assets • Non-interest income	Hyperbolic distance function Allows for the maximum equiproportionate expansion of outputs and reduction of inputs.	Average technical efficiency higher than Cuesta and Orea (2002)'s output-oriented distance function using same database (0.95). Bank can improve performance by increasing output by 5.64%, and simultaneously reduce input by 5.34% (1-0.95). Moderate increasing returns to scale

Appendix V
Selected international bank efficiency studies that control for country-specific conditions

Author	Sample data	Input	Output	Methodology	Findings
Dietsch and Lozano-Vivas (2000)	Year: 1988-1992 Sample: 223 French, 101 Spanish commercial and savings banks. Source: Annuario de la Confederacion de Cajas de Ahorros y del Consejo Superior Bancario, Commission Bancaire.	• Price of fund (interest expense/ interest bearing liabilities) • Price of labour (wages and taxes) • Price of physical capital (capital equipment, occupancy expenses/ fixed assets)	Value-added approach • Loans • Deposits • Other productive assets (deposits with banks, investments)	Stochastic cost function *Control variables* Population density, per capita income, demand density, concentration index, capital ratio, intermediation ratio, branch density. *Inefficiency effects* - *Inefficiency correlates* -	Neglecting country-specific environmental variables leads to misspecification of common frontier and overestimates inefficiency. Average efficiency each country is lower using common frontier without considering country-specific environmental conditions compared to results obtained from national frontier. With country-specific environmental conditions, average efficiency from common frontier improved markedly in each country. French banks are more efficient than Spanish banks.
Abd Karim (2001)	Year: 1989-1996 Sample: 82 Indonesian, 31 Malaysian, 27 Filipinos and 15 Siamese commercial banks. Source: BankScope	• Price of fund (interest on deposits per deposits value) • Price of labour (wage and salary expenses per employee) • Price of physical capital (land, building and equipment expenses per asset value)	Intermediation approach • Commercial and industrial loans • Other loans • Demand deposits • Time deposits • Securities and investments	Stochastic cost function *Control variables* - *Inefficiency effects(B&C 1995);* Bank ownership (private/ state), country dummy, bank size, bank size squared, time. *Inefficiency correlates* -	Significant difference in average bank cost efficiency between countries. Inefficiencies tend to increase before 1997 financial crisis and decrease with size. Private-owned banks are more cost efficient than state-owned banks. Economies of scale up to USD3billion asset size before diseconomies of scale. Average economies of scale, 1.11.

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Appendix V
Selected international bank efficiency studies employing SFA and control for country-specific conditions (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Carvallo and Kasman (2005)	Year: 1995-1999 Sample: 16 Latin American and Caribbean banks. Source: BankScope	• Price of fund (total interest expense/ total deposits) • Price of labour (personnel expenses/ total assets) • Price of physical capital (Operating costs-personnel expenses/ fixed assets)	Value-added approach • Loans • Deposits • Other earning assets (investment securities)	Stochastic cost function *Control variables* Equity, population density, per capita income, demand density, concentration index, equity-to-assets Intermediation ratio, roads paved, GDP growth, money-to-GDP *Inefficiency effects(B&C 1995)* - *Inefficiency correlates* Net income-to-total assets, total costs-to-total assets, equity-total assets, loans-to-assets, deposits to assets, log total assets, non-interest income to total income, NPL to total loans, loan loss provision to total loans.	Wide range of inefficiencies across countries. Very small and very large banks are more inefficient than large banks. Less performed banks tend to be smaller, undercapitalised, poor profit, more depend on non-interest income, more risky, less stable deposit based and to intermediate less. Efficient banks are in countries with high density of demand and with less market power, grow faster.
Kasman (2005)	Year: 1995-2000 Sample: 35 Polish, 19 Czech banks. Source: BankScope	• Price of fund (total interest expense/ total deposits) • Price of labour (personnel expenses/ total assets) • Price of physical capital (Operating costs-personnel expenses/ fixed assets)	Intermediation approach • Loans • Other earning assets	Stochastic cost function *Control variables* Country-specific variables (Population density, per capita income, demand density, inflation, equity to total assets, loan to deposits, telephone lines, GDP growth, money per GDP) *Inefficiency effects* - *Inefficiency correlates* -	Environmental variables are important in common frontier specifications. Polish banks are more efficient than Czech banks. Foreign banks in Czech are more efficient than domestic banks Economies of scales in small and medium-sized banks Diseconomies of scale in large banks

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Appendix V
Selected international bank efficiency studies employing SFA and control for country-specific conditions (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Bonin, Hasan, and Wachtel (2005)	Year: 1996-2000 Sample: 225 banks from 11 transition countries Source: BankScope	• Price of fund (interest expense/ total deposits) • Price of physical capital (non-interest expense/ total fixed asset)	Intermediation approach • Loans • Deposits • Liquid assets • Other investments	Stochastic cost and profit functions *Control variables* Country effects, time effects. *Inefficiency effects* Country effects, time effects *Inefficiency correlates* -	Privatization is not sufficient to increase efficiency. Foreign-owned is more cost efficient than domestic private banks.
Fries and Taci (2005)	Year: 1994-2001 Sample: 289 banks from 15 transition countries. Source: BankScope, bank annual report, EBRD research, EBRD transition reports, IFS.	• Price of non-financial inputs (non-interest expenses/ total assets)	Value-added approach • Loans to customers (loans to non-bank entities, loans to other banks) • Deposits	Stochastic cost function *Control variables* Non-loan assets-to-total loans, NPL/ total loans, country-specific variables (Per capita GDP, nominal interest rate, demand density, market concentration, foreign share, intermediation ratio, equity-to-assets, banking reform) *Inefficiency effects (B&C 1995);* Ownership (private & foreign, new & foreign) market power (deposit share), international accounting standard, merger, equity-to-assets. *Inefficiency Correlates* Test with and without country-specific variables. *Annual cross-section estimation and single panel estimation have similar average efficiency by country and ownership.	Country-specific factors which improve cost efficiency are lower nominal interest rates, higher share of foreign ownership, higher intermediation ratio, higher capital ratio & lower loan loss. Transformation from socialist to market-oriented banking improves efficiency. Bank efficiency ranking is more persistent when country-specific factors are controlled for. Bank efficiency estimates are higher when country-specific factors are included. When country-specific factors are allowed to influence cost frontier (net efficiency), variations in average bank efficiency across countries diminish. Private banks with majority foreign-ownership are the most efficient banks.

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Appendix V
Selected international bank efficiency studies employing SFA and control for country-specific conditions (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Kasman and Yildirim (2006)	Year: 1995-2002 Sample: 190 commercial banks of 8 Central and Eastern European countries which joined EU May 2004 Source: BankScope	• Price of fund (Total interest expense/ total deposits and other purchased funds) • Price of labour and physical capital (Total operating costs/ total assets)	Value-added approach • Loans • Deposits • Other earning assets	Stochastic cost and alternative profit functions *Control variables;* Population density, per capita income, demand density, capital ratio, concentration ratio, intermediation ratio, inflation, money per GDP, GDP growth, banking market size, market capitalisation. *Inefficiency effects* - *Inefficiency correlates* -	Foreign banks perform better than domestic banks. No strong and consistent efficiency gains in banking cost.
Maudos and de Guevara (2007)	Year: 1993-2002 Sample: Commercial, cooperative, savings banks, other banking firms of 15 EU countries Source: BankScope	• Price of labour (personnel expenses/ total assets) • Price of physical capital (Operating costs-personnel expenses/ fixed assets)	Value-added approach • Loans (total earning assets) • Deposits (customer and short term funding)	Stochastic cost function *Control variables;* Per capita income, population density, bank branches per capita, real GDP growth, country dummy variables. *Inefficiency effects* - *Inefficiency correlates* Concentration, market power, size, specialisation.	Average cost efficiency, 86 percent. Efficiencies increase in almost half of countries over time. Positive relationship between market power & cost efficiency.

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Appendix V
Selected international bank efficiency studies employing SFA and control for country-specific conditions (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Carbo Valverde, Humphrey, and Lopez del Paso (2007)	Year: 1996-2002 Sample: 153 large banks in 10 European countries Source: BankScope, Bank annual reports	• Price of labour • Price of physical capital-depreciation	Production approach • Loans • Deposits	Stochastic cost function Parametric model of operating costs as a function of: Business environment Country average wage, population density, GDP per person, cash level, paper-based transaction, electronic-based transaction, electronic payment-to-non cash transaction, bank size, concentration ratio. Cost function Risk, bank types. Internal bank productivity Deposits per labour, labour per branch, deposits per branch.	Bank productivity internal measure raises efficiency scores in most countries. Banks are equally efficient once have accommodated to their different national environment. Sets of efficient banks can be found in every country regardless environmental differences. Cost function is dominant explanation for cost efficiency differences among banks at cross country and individual country levels.
Bos and Schmiedel (2007)	Year: 1993-2004 Sample: Commercial banks from 15 EU countries Source: BankScope	• Price of fund (non-interest operating expenses/ sum of assets) • Price of labour (total assets) • Price of physical capital (interest expense/ total assets)	Intermediation approach • Loans • Investments • Off-balance sheet items	Meta (single efficient) frontier Stochastic cost & profit frontier analysis To estimate efficiencies across countries using meta-frontier model to account for different technology in EU banking industry. Meta-efficiency scores are technical efficiencies of each bank in different countries corrected by technology gaps in a given country relative to industry as a whole. *Control variable* Equity-to-assets *Inefficiency effects* -	Average cost and profit efficiencies vary substantially across Europe. Efficient banks in home country may have difficult time to be equally efficient abroad. Local competition is an important factor for bank efficiency.

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Appendix V
Selected international bank efficiency studies employing SFA and control for country-specific conditions (Continued)

Author	Sample data	Input	Output	Methodology	Findings
Fitzpatrick ad McQuinn (2007)	Year: 1996-2002 Sample: 55 large commercial banks* in Canada (11), Ireland (5), UK (28). Source: BankScope, OECD *unmerged during sample period.	• Price of fund (total interest expenses/ total deposits) • Price of labour (total personnel expenses/ total assets) • Price of physical capital (non-interest expense- personnel expenses/ corrected fixed assets)	Intermediation approach • Loans • Other earning assets	Stochastic profit function *Control variables;* Equity capital, country dummy variable. *Inefficiency effects (B&C 1995)* Bank dummy variable, GDP growth rate, unemployment rate, country dummy variable *Inefficiency correlates* -	Significant difference in the profit level and inefficiency across country. UK banks have the highest average inefficiency scores. Average profit inefficiency of 31%.

Appendix VI
Bank productivity studies using parametric Malmquist productivity index

Author	Sample data	Input	Output	Methodology	Findings
Chaffai, Dietsch, and Lozano-Vivas (2001)	Year: 1993-1997 Sample: French, German, Italian, Spanish banks Source: BankScope	• Interest expense • Labour expenses • Fixed assets	Production approach • Loans • Other assets • Total deposits	Stochastic translog output distance function, Malmquist type index Decompose inter-country productivity difference into pure technical and environmental effects. *Environmental variables;* Population/km^2, GDP/ population, number of banks/ population, number of branches/ km^2, number of banks.	Productivity gap among banking industries in different countries can be broken down into pure technological effects and environmental effects Differences due to environmental conditions are larger than differences in banking technology.
Orea (2002)	Year: 1985-1998 Sample: Spanish banks Source: CECA	• Time, savings deposits • Other deposits and funds • Labour (personnel expenses) • Capital (depreciation, other non-interest expense)	Intermediation approach • Bonds, cash, other assets not covered in followings • Loans • Non-interest income	Stochastic translog output distance function (same dataset and output distance function methodology with Cuesta and Orea (2002)) Parametric method of decomposing generalised Malmquist productivity index into technical efficiency change, technical change and scale term.	Average productivity growth rate for non-merged banks exceeds merged-banks by small margin. Increased productivity growth for merged and non-merged banks. Return to scale has positive effect on productivity growth. Increased productivity growth largely attributed to strong technical progress and modest effect of scale.
Olgu (2006)	Year: 1997-2001 Sample: 162 commercial banks from 22 European countries Source: BankScope	• Deposits • Personnel expenses	Intermediation approach • Loans • Other earning assets	Stochastic translog output distance function Employ both Orea (2002)'s parametric Generalised Malmquist productivity index and non-parametric generalised Malmquist productivity index to decomposes productivity index into technical efficiency change, technical change and scale term.	Transition economies perform better than developed countries. Decreasing return to scale at sample mean and for small Euro zone developed and accession countries commercial banks. Euro does not have considerable effects on the productivity levels. Accession banks experienced good performance in catching up with EU-12 counterparts. Enlargement had slight negative effect on the productivity of EU-12 commercial banks.

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Appendix VI
Bank productivity studies using parametric Malmquist productivity index (Continue)

Author	Sample data	Input	Output	Methodology	Findings
Rezitis (2007)	Year: 1993-2004 Sample: 10 Greek banks Source: Bank annual reports and accounts	• Labour (number of workers) • Capital (expenses on tangible and intangible fixed assets)	Production approach • Loans, advances • Deposits	Stochastic translog output distance function, Orea (2002)'s generalised Malmquist productivity index *Control variables* Merger, bank specific dummy variables for each bank in sample *Inefficiency effects (B&C 1995)* Bank-specific dummy for each bank in sample, merger dummy, no. of branches, bank market share, service (output), concentration, year dummy.	Average efficiency, 0.80; average productivity change, 2.4%. Merged banks have lower efficiency. Productivity change of merged banks are also lower than unmerged banks attributed to increased in technical inefficiency and disappearance of economies of scale; technical change remain similar to unmerged banks.