Efficiency, Survival, and Non-Performing Loans in Islamic and Conventional Banking in the GCC

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EFFICIENCY, SURVIVAL, AND NON-PERFORMING LOANS IN ISLAMIC AND CONVENTIONAL BANKING IN THE GCC

by

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Abstract

The success of Islamic banks is determined by several factors, among which are their performance, efficiency, stability and ability to grow in conjunction with the economic and financial growth of the GCC's national economy. Due to the successes resulting from these factors, which are located within the inherent value system of Islamic finance, the GCC's Islamic banks were praised for their resilience during the recent financial crisis. This research thus aims to examine the efficiency, performance, survival-time analysis and issues related to non-performing loans (NPL) in the case of the Islamic banks within the GCC through four different yet interconnected empirical essays.

The first essay aims to examine the technical efficiency of the Saudi Arabian Islamic banks in a comparative analysis with the *Sharia*-compliant windows of Saudi Arabian conventional banks by using Data Envelopment Analysis (DEA) for the period from 2005 to 2010. In doing so, some selected variables related to the banks' characteristics also are examined through second stage regression of the DEA model. Overall, the results indicate that the performance of Islamic banks decreased sharply until it reached its lowest level in 2008. In addition, as a result of the influence of environmental variables, it has been found that the efficiency of Islamic banks was affected negatively more than traditional banks during the period in question.

The second essay aims to measure the efficiency and productivity growth of the banking sector in the GCC through DEA meta-frontier analysis for the period from 2005 to 2010. This essay offers a comparative study on two levels: between each country and between three types of bank, namely Islamic banks, conventional banks providing Islamic windows and conventional banks. The second stage of the analysis attempts to examine the influence of the banks' characteristics, financial structures and rule-of-law variables on technical efficiency (TE) scores by applying a two-stage approach via panel random effect and bootstrap models. The findings reveal that Islamic banks have underperformed in comparison with Islamic window banks during the specified period. However, the catch-up value of the total factor productivity illustrates that Islamic banks appear to be the most productive group.

The third essay aims to investigate the survival time of Islamic and conventional banks in the GCC countries, taking into account the impact of the global financial crisis by employing the discrete-time duration models for the period of 1995 to 2011. In addition, to examine the differences between banks, a range of explanatory variables from both the micro- and macro-levels are included in several models. The results from hazard and survivor functions indicate that the Islamic and conventional banks form two distinct bank types, where Islamic banks potentially have a higher incidence of failure and therefore a shorter survival time. The discrete-time duration model findings for the all-banks-pooled model confirm that the hazard rate increases with Islamic banks. Furthermore, the analysis of each bank type reveals that the effect of covariates on survival time differs between Islamic and conventional banks. For instance, increasing the net interest margin ratio causes the hazard rate in Islamic banks to rise, whereas this rate is lowered in conventional banks.

The fourth essay aims to identify the macro- and micro-level factors determining NPL in Islamic banking within the GCC via the panel data econometrics model for the period from 2005 to 2011. In addition, this paper examines the impact of the sectoral distribution of Islamic financing on the NPL in the GCC banking system as a whole by utilising dynamic panel data models. The findings indicate that the relationship between efficiency and NPL supports the "bad management" and "bad luck" hypotheses. Further, the sectoral distribution of Islamic financing extended by the GCC Islamic banks shows an adverse impact on NPL, thus demonstrating that Islamic bank financing, which is related to real estate and construction projects, increases the credit risk exposure. It is suggested that increasing financing by profit-and-loss-sharing instruments could enhance loan quality, thereby implying that the growth influence of fixed-income debt contracts could increase NPL more than profit-and-loss-sharing contracts.

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LIST OF ABBREVIATIONS

IB	Islamic Banks
IW	Islamic Window
CB	Conventional Banks
IBF	Islamic Banking and Finance
GDP	Gross Domestic Product
DEA	Data Envelopment Analysis
SFA	Stochastic Frontier Approach
MPI	Malmquist Productivity Index
GDP	Gross Domestic Product
PRS	Political Risk Service
NPL	Non-Performing Loans
EIU	Economist Intelligence Unit
CRS	Constant Return to Scale
VRS	Variable Returns to Scale
NRS	Non-increasing Returns to Scale
SE	Scale Efficiencies
TE	Technical Efficiency
TFP	Total Factor Productivity
BCPS	Banks' Claims on Private Sector
MC	Market Capitalisation
MF	Meta-Frontiers
ROAA	Return on Average Assets
ROAE	Return on Average Equity
CF	Country Frontier
GF	Group Frontier
TGR	Technology Gap Ratio
MPIG	MPI of a Group
MPIM	MPI of the Meta-frontier
NLD	Net Loans to Deposits and Short-Term Funding
Con	Concentration
FO	Foreign Ownership

Gov	Government Ownerships
RL	Rule of Law
Cloglog	Complementary Log-Log
GNIR	Growth of Net Interest Revenue
NIM	Net Interest Margin
LLR/L	Loan Loss Reserves / Loans
NL/A	Net Loans / Assets
BC	Bank Concentration
Inf.	The annual inflation rate
RQ	Regulatory Quality
GMM	Generalised Method of Moments
RWA	Risk-Weighted Assets to Assets
EFF	Efficiency Scores
MI	Manufacturing and Industry Financing
IBA	Assets of IB to Total Assets
IWA	IW Assets to Total Assets
IBIWA	IB and IW Assets to Total Assets
CBA	CB Assets to Total Assets
PLS	Profit and Loss Sharing
FID	Fixed-income creating Debt
REC	Real Estate and Construction Financing
RECIB	Real Estate and Construction Financing of IB

DECLARATION

I declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due acknowledgment has been made in the text. I confirm that no part of the material presented in this thesis has previously been submitted by me or any other person for a degree in this or any other institution.

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May God reward them all.

CHAPTER 1

INTRODUCTION AND OVERVIEW

1.1 BACKGROUND

Islamic banking and finance (IBF) is considered to be an innovative and novel method of financing that is based on Islamic principles, which have been developed over the years. During the early stages of Islamic history Muslims worked to create financial contracts with no interest for the purpose of mobilising capital to finance commercial needs. Given that the Islamic structure worked efficiently for centuries without institutionalisation, such a development within Islamic finance has only been made possible in the last quarter of the twentieth century (Iqbal and Llewellyn, 2002).

From the perspective of Islamic economists, Islamic banks (*IB*) are classified as financial institutions working via an essential principle of profit and loss sharing (PLS), which is derived from the Islamic moral economy. In other words, transactions in *IB* are different from those in conventional banks (*CB*) since they function with participating revenues acquired from the use and investment of funds, rather than by means of generating income through the use of interest rates (Ayub, 2007; Kettell, 2008).

IB offer a range of financial services and products; most of them are categorised into trade and investment, and they are based on equity participation and on profit-, loss- and risk-sharing between banks and investors. In addition, there are many types of contracts and financial instruments within the IBF universe.

IBF contracts are grouped into two categories: contracts that are based on PLS, which involve *mudarabah* and *musharakah*, and contracts that are based on cost-plus-sale, deferred sale contracts or fixed income, which create types of debt including *murabahah, salam, ijarah, istisna.* In addition, Dar (2003) categorises four kinds of financial instruments that are used as alternative options to interest: investment-based, sale-based, rent-based and service-based. Crucially, PLS instruments are preferred by

Islamic economists, yet *murabahah* or cost-plus-sale contracts are the most popular instrument as PLS instruments are more at risk than cost-plus-sale contracts. For this reason, most *IB* use *murabahah* as a substitute for credit in *CB* (Ayub, 2007).

Another important principle of IBF is that Islamic transactions must be backed by real assets (Eedle, 2009). To illustrate this notion, *CB* lend money for any financial requirements so as to be paid interest on the money lent; that money could be provided for financing the purchase of assets. However, whether or not it is provided, *CB* do not own the assets, they are only concerned with interest and the return of their principal amount of money. On the other hand, the principles of IBF institutions do not allow them to finance any requirement without the transfer of the ownership of the asset (Usmani, 2009).

Based on these fundamental principles, the IBF industry, which emerged in the 1970s as a modern institution of the religious-historical knowledge, has shown tremendous growth over the last thirty years. This growth can be attributed to a number of factors: increased Islamic awareness in the Muslim world in the sense of a search for Islamic identity, the increased wealth mainly in the GCC region due to petro-dollars, and the recognition by the global financial system of IBF. Millions of Muslims around the world need banking services for many purposes, such as financing a new business, buying a house or a car, facilitating capital investment, undertaking trading activities, and as a safe place for savings.

The period from the mid-1970s to the 1990s was vital in the history of the growth of IBF for four reasons. Several Islamic financial institutions were established in many Muslim countries around the world, and the corresponding Islamic finance products were adopted and offered by a number of multinational *CB*. Further, the development of Islamic finance witnessed the advance of financial modes, transactions and products. Importantly, in the third stage of development, the applications of such Islamic finance functions and modes were acknowledged by two international institutions: the International Monetary Fund (IMF) and the World Bank. This acknowledgement has been evident in their publications since the early 1990s. Finally, three countries in the Muslim world, namely Iran, Pakistan and Sudan, replaced interest in their banking systems with Islamic finance models (Iqbal and Molyneux, 2005). Likewise, until the present day, the number of commercial and investment *IB* around the world has increased so that they now exist in more than seventy-five countries (The Banker, 2013).

To identify the developments that have taken place in the IBF industry, the number of banks reporting *sharia*-compliant assets can be used as evidence, which has increased to 185 in 2013 (The Banker, 2013) from scratch in the last forty years. The assets base of IBF institutions has grown rapidly over the years; for instance, according to The Banker (2013), the assets of Islamic financial institutions over the world increased from USD 1166 billion in 2012 to USD 1267 billion in 2013, thus recording 8.67% annual growth. In addition, the compound annual growth rate of the IBF industry from 2007 to 2013 has also been remarkable, as it has demonstrated healthy progress at 16.02% (The Banker, 2013).

As for the tipping points, IBF practices are intensively applied in the Middle East area and within the GCC region in particular, which represents the largest number of *IB* and the largest percentage of assets. Such a growth trajectory can be attributed to the increase of oil revenues that generate a large amount of liquidity in the GCC countries, which has notably had the result of increasing the number of *IB* significantly since the 1970s. For instance, in 2013 the percentage of the global total assets of *IB* accounted for by the GCC region was 39.2%, compared to 38.6% in non-GCC Middle East countries, 19.6% in Asia, 1.7% in Australia, Europe, and America and up to 0.82% in Sub-Saharan Africa (The Banker, 2013, November). In the course of such developments, many large *IB* have been launched since the first Islamic bank (namely the Dubai Islamic Bank), including the Al-Baraka Group and the Al-Rajhi Bank. Importantly, Saudi Arabia represents one of the biggest parts of the market in Islamic finance and investment, for in 2013 it was estimated at USD 227.2 billion (The Banker, 2013).

It should be noted that IBF institutions, as part of the banking sector, have a significant impact on the economic and financial sectors in the Gulf countries. Despite having faced fierce competition from *CB* and adverse political attitudes from the establishment, *IB* have remained an important growth area.

Due to the dramatic rise in oil income throughout the 1970s and 1980s, the banking sector in the GCC countries grew considerably. Jbili *et al.* (1997) point out that until the 1990s most dealings in the GCC banking sector were generally associated with short-term lending to finance the trade and building sectors (Hussein and Omran, 2005: 2). During the 1990s, after the adverse effect of the First Gulf War, the capital and base deposits of the GCC's *IB* were increased; their productivity was also advanced by employing new technology (Hussein and Omran, 2005).

Over the last decades a number of *IB* have been established with various asset sizes. According to The Banker (2013), the Al-Rajhi Bank has the largest amount of assets within the GCC's IBF industry at USD 71 billion; it is followed by the Kuwait Finance House, which accounts for USD 52 billion. The National Commercial Bank (NCB), which as a conventional bank, provides a *sharia*-compliant window, and the Dubai Islamic Bank, have USD 27.8 billion and USD 25.9 billion respectively, and are also among the top *IB* in the world. It is important to state that IBF has also made important inroads in other parts of the world; the most remarkable development has been witnessed in Malaysia, but some of the European countries have opted to facilitate IBF in their countries in a bid to attract GCC financing.

Despite such developments, there still exist certain challenges. For instance, IBF institutions suffer from inappropriate regulatory regimes, and the shortcomings in invention and product development remain important and challenging for IBF (Hancock, 2009). In addition, Hussein and Omran (2005) state that GCC *IB* need to expand their size and evolve operations for improving performance in order to face competitors.

It should be noted that the success of *IB* depends on several factors, among which are their performance, efficiency, stability and ability to grow. These factors are coupled with the economic and financial growth of the national economy by taking into account the impact of any factor related to the financial surroundings, such as the global financial crisis. Hence, this study is extensively focused on GCC Islamic banking and aspects of its performance.

When providing the specific context of the topics in this study, an increasing amount of empirical research conducted on the dynamics of IBF and on the factors contributing to its success has been published, with particular emphasis following the middle of the last decade. Significantly, this research has been primarily concerned with the performance and efficiency of IBF institutions by using their efficiency as a measurement, whether through financial indicators or methods that are utilised to compute their efficiency scores, to evaluate both their individual and general performance in the banking industry (Mokhtar *et al.*, 2007). Equally, stability-related studies emerged in response to the global financial crisis, such as Hasan and Dridi (2010) and Parashar (2010).

In the existing body of knowledge related to efficiency analysis, two types of approaches are utilised to measure efficiency: non-parametric and parametric. For example, the non-parametric approach involves Data Envelopment Analysis (DEA) and the parametric approach includes the Stochastic Frontier Approach (SFA). Further, some studies have measured efficiency and productivity growth, to specify the differences in production technologies of groups of firms or countries in a particular industry by employing the meta-frontier approach (such as O'Donnell *et al*, 2008; Chen and Yang, 2011).

A few studies on *IB* have investigated efficiency and performance in particular through the application of the meta-frontier approach in the Gulf region, yet the limitations of the data have obstructed any inclusive analysis in the last three decades (Sufian, 2006). In addition, the collection of data from across several countries with very different economies is a challenging matter when studying efficiency and performance issues in IBF institutions (Johnes *et al*, 2009). It is important to note that most of the available studies in the subject literature have been conducted within Malaysia. Only a small number of studies have, however, been conducted to investigate performance-related issues for *IB* in the GCC region (e.g. Johnes *et al.*, 2009; Srairi, 2010; Srairi, 2011; and Ben Naceur *et al.*, 2011).

With regard to issues of survival analysis and stability, exploring the survival-time analysis and the risk of bank failure, studies are generally based on probability and likelihood forms. Such topics are investigated through duration-time methods, of which there are two main types: continuous-time models and discrete-time models. Most studies have, however, focused on applying continuous-time models to investigating the risk of bank failure (for example, Lana *et al.*, 1986; Leung *et al.*, 2003; and Evrensel, 2008). Significantly, this topic is quite recent and infrequently investigated within Islamic banking. For instance, Pappas *et al.* (2012) provided a comparative analysis between *IB* and *CB* that were at risk of failure by utilising a sort of continuous-time model, namely the Cox PH model.

In the face of global financial crisis IBF was praised for its resilience by various sources, yet the deviation from its ethical foundation is somewhat concerning in terms of *IB* developing practices similar to those seen in *CB*. It is therefore important to investigate the stability of IBF so as to identify whether there has been any deviation from its trend-based growth. It is only through stability that greater efficiency and high growth can be attained. A crucial part of these concepts of sustainable growth and efficiency (and by extension stability) is considered to be that of 'non-performing loans' (NPL). This study also then aimed to explore the NPL in the case of the GCC's *IB* with the intention of identifying the determinants which should be considered as expanding the narrative initiated within this study. Indeed, beyond political economy reasons, the macroeconomics-oriented business cycles have an impact on the creation of NPL, which should be considered alongside the financing types and trends of *IB*, to develop a comprehensive understanding of the determinants of NPL in the GCC region. Thus, the economic reasons for NPL are considered to be an important aspect of the research in this study when continuing with the efficiency narrative, as indicated at the beginning of the study.

The other aspect of sustaining the efficiency, growth and stability of *IB* is that of the NPL or the problem loans issue, which is deemed to be a key factor among the causes that lead to bank failure (for example, Demirguc-Kunt, 1989 and Whalen, 1991). Investigating such matters, several studies have taken different approaches; thus, Berger and De Young (1997) examined the link between cost efficiency and NPL via the Granger causality method to explore the intertemporal relationship directions between them. Several studies investigated the determinants of NPL in developed and developing countries by applying the dynamic panel data through generalised method of moments (GMM) methods (see, for example: Salas and Saurina, 2002; Espinoza and Prasad, 2010; and Louzis *et al.*, 2012). Nonetheless, in relation to studies of *IB*, issues of bank financing and NPL are explored infrequently.

1.2 AIMS AND OBJECTIVES

The main aim of this research is to explore and analyse efficiency, performance, survivability and NPL in the case of the GCC's Islamic banking with the objective of providing a comparative analysis between *IB* and *CB* in the region. This analysis is provided via four different topics and via empirical modelling in the form of four studies.

The following objectives are developed to fulfil the research aims for each individual essay, as is shown below:

(i) The first essay aims to investigate and analyse empirically the efficiency of *IB* and *CB* in Saudi Arabia. For this aim, the following objectives are developed:

   a) To provide a comprehensive comparative analysis of the technical efficiency level of the *IB* and traditional banks that provide Islamic windows.

   b) To examine the impact of some internal financial indicators on the Saudi banks' efficiency, which are related to the quality of loans, liquidity, and bank type.

(ii) The second essay aims to measure and investigate the efficiency of *IB* and *CB* in the GCC countries through meta-frontier analysis. In fulfilling this aim the following objectives will be developed:

   a) To measure the technical efficiency levels of the GCC's banking sector.

   b) To evaluate the gaps and achieve comparable efficiency scores through a comparative study on two levels, as all banks in these countries operate under different technologies and different bank groups; between each country in an individual frontier, then between three bank groups, namely *IB*, *IW*, and *CB*.

   c) To measure the total factor productivity growth via the MPI in order to investigate the catch-up term, which locates how a country's or group's frontiers perform in terms of production points and productivity growth towards the meta-frontier from period t to period $t+1$.

d) To examine the high potential influence of banks' characteristics, financial structures and rule-of-law variables on the efficiency scores that are obtained by the DEA meta-frontier method.

(iii) The third essay aims to investigate the survival analysis and risk of bank failure through time-duration models for *IB* and *CB* of the GCC countries. In pursuing this aim the following particular objectives will be developed:

a) To measure the survival-time of *IB* and *CB* by taking into account the impact of the global financial crisis and other circumstances by employing the discrete-time duration models.

b) A range of explanatory variables from both the micro-level and the macro-level are included in several models to explore the risk of bank failure and the hazard rate.

c) To examine whether *IB* or *CB* are more susceptible to the risk of failure.

(iv) The fourth essay aims to investigate the macro-level and micro-level factors determining NPL in the GCC banks. When completing this aim the following objectives will be developed:

a) To explore the impact of some selected sectors of Islamic financing and Islamic finance contracts on the NPL of both the Islamic banking and commercial banking systems of the GCC countries as a whole.

b) To identify the macro-level and bank-level factors that contribute to NPL in the GCC Islamic banking system through the panel data econometrics model.

c) To examine the dynamic impact of these factors that determine the NPL of the GCC banking sector by utilising dynamic panel data (GMM) models.

1.3 RESEARCH QUESTIONS

Based on the identified research aims and objectives, the following research questions are developed in each essay:

(i) For the first essay, the research question is: do *IB* perform better than *CB* in Saudi Arabia? And if so, how far can these banks influence the efficiency level of the commercial banking sector as a whole? Further, what factors determine the efficiency of Saudi banks?

(ii) For the second essay, the research questions to be explored are as follows: Among the GCC countries, which country's *IB* and *CB* are more efficient, productive and perform closest to the meta-frontier? With regard to the bank type, which bank group has an outstanding performance and has been more productive over the years? With regard to all of the utilised variables, which variable has a significant impact on a bank's efficiency? Do government and foreign ownerships play an important role in determining a bank's efficiency? Does the rule of law have an effect on a bank's efficiency?

(iii) For the third essay, the research questions are as follows: Are *IB* or *CB* more at risk of failure? Do the micro-level and macro-level variables contribute enough to compute the hazard rate of the GCC banking sector?

(iv) For the fourth essay, the research questions to be discussed are as follows: Do the Islamic sectoral financing and Islamic finance contracts contribute when determining the NPL of Islamic banking and of the whole commercial banking sector of the GCC countries? If Islamic contracts contribute when determining the NPL, which sort of contract has a potential significant impact on NPL, fixed-income contracts, or PLS contracts? Do the macro-level and bank-level variables determine the NPL? Do these variables have a significant and dynamic impact on the NPL of the GCC banking sector?

1.4 THE SCOPE OF THE RESEARCH

As identified, this research is constructed through four empirical papers. In the first paper, as mentioned, the efficiency of the Saudi Arabian *IB* and *IW* are examined. As being the largest GCC economy, Saudi Arabia houses a number of fully fledged *IB* have been operating, and most importantly all *CB* in the country offer Islamic banking services through Islamic window (*IW*). Thus, it is substantially significant to the present study to start by examining the efficiency of the Kingdom's *IB* by comparing their performance with the other traditional banks provide Islamic window, through Data Envelopment Analysis (DAE) method by taking into account the effects of some environmental variables related to bank's characteristics. Therefore, to investigate the influence of such variables on the Saudi banks' efficiency, the second stage regression of DEA method is applied. Moreover, Stochastic Frontier Analysis (SFA) is utilised to examine the robustness of the estimated model of DEA second stage regression.

In the second paper, this study utilises the meta-frontier approach to measure the technical efficiency and to obtain an accurate comparison between the GCC countries and the three bank types as this approach takes into account the technology differences across the countries and firms. In addition, the meta-frontier approach is employed with the DEA method, which helps to measure the efficiency between different countries (Ben Naceur *et al.,* 2011). Further, it utilises the Malmquist Productivity Index (MPI) to evaluate productivity change over time and to obtain the catch-up rate (Chen and Yang, 2011). Moreover, to determine the variation in efficiency scores, which are produced from the meta-frontier approach, several environmental variables related to the banks' characteristics, financial structures, and regulations are employed with different models, including bootstrap procedure, as are derived from Simar and Wilson (2007).

The third empirical essay and modelling aims to provide a survival-time analysis and risk of bank failure related issue for the GCC countries, in which the continuous-time and discrete-time models are applied to investigate whether *IB* or *CB* are more susceptible to the risk of failure. It commences with the life-table method, which is a non-parametric technique and unconditional analysis that depends on the observation of failure events (Kalbfleisch and Prentice, 2002); this is followed by the conditional analysis, which is based on the availability of data and covariates at a micro-level and macro-level (Evrensel, 2008). Furthermore and most importantly, the third study pivots on the application of 'complementary log-log' (cloglog) to estimate the banks' failure; a comparative analysis will then be conducted between *IB* and *CB*.

The last essay provided in this study is based on studies related to NPL, which examine the macro-level and micro-level factors in determining the NPL of *IB* and *IW*, in the GCC countries via means of the panel data econometrics model. In addition, it examines the factors contributing to NPL in the GCC commercial banking sector as a whole by utilising more sophisticated econometric tools to observe the time-condition impacts on the NPL through dynamic panel data (GMM) models. Crucially, among those examined factors, the present study investigates the impact of Islamic financing and Islamic finance contracts on the NPL, which enables the identification of Islamic finance in the NPL of the Islamic banking sector and in the NPL of the GCC commercial banking system as a whole.

1.5 THE SIGNIFICANCE OF THIS RESEARCH

Despite the attention shown by many researchers to the performance, growth and stability of IBF institutions, the prior literature on such issues is limited in the case of GCC member countries. It is important to state that many of the existing studies suffer from certain shortcomings, such as that suggested by Bashir (2000), who pointed out in his paper that 'several Islamic banks are not included and several interesting questions are not answered' (Bashir, 2000: 25). In relation to measuring the efficiency of the Saudi banking sector, and according to the existing studies, only one study has investigated the performance of Saudi banks, namely that by Akhtar (2010). However, his study examines efficiency and productivity without presenting a comparative analysis between *IB* and *CB*. This study therefore presents an accurate comparison between *IB* and *CB* with Islamic windows of technical and scale efficiencies by taking into account the impact of some selected variables that relate to the banks' characteristics, which are bank type, ratios of loan quality and liquidity.

It should be indicated that there are not enough empirical studies which shed light on measuring the efficiency and productivity change of the *IB* and *CB* of GCC countries via the meta-frontier approach by endogenising the impact of environmental variables, and in particular those that are related to financial structures and the rule of law on technical efficiency. Given that the meta-frontier method evaluates the gap between the meta-frontier and the group frontiers of each country or bank group, this helps the research to provide a precise comparative description between each country and between the *IB* and *IW* and the *CB* that do not offer such windows (O'Donnell *et al.,* 2008). The findings of both empirical essays that analyse the efficiency of *IB* in Saudi Arabia and then in other GCC countries are therefore expected to identify the most efficient institution, country and bank group so that they can be used as benchmarks to improve the performance of other *IB* in the region.

With regard to survival analysis conducted using the GCC's *IB* in this study, there is only one recognised study, by Pappas *et al.* (2012), that examines the failure risk of *IB* in a number of countries and which covers several regions of developing countries, thereby indicating the dissimilarities in the framework between them; this in turn could cause misleading comparative findings. In addition, their study does not present a comprehensive finding that focuses solely on the GCC's *IB*. Thus, such a gap in these studies on *IB* has inspired this study to focus on the risk of failure in the GCC region by taking into account the impact of real economy growth on these banks. The findings are expected to contribute substantially to the understanding of the mechanism of failure risk in *IB*; it will then enable appropriate suggestions to be highlighted for policy makers to enhance the stability growth of the GCC's banking sector in general and of *IB* in particular.

In relation to NPL in Islamic banking within this essay, and according to prior literature, there is no study examining the impact of Islamic financing and, most importantly, Islamic finance contracts on the NPL of Islamic banking in the whole banking sector of the GCC countries. The findings of this study may therefore lead bank managers to restructure the diversification of investment portfolios according to those contracts. Finally, these findings could pave the way for future research.

1.6 RESEARCH METHODOLOGY

The identified research aims, objectives and research questions indicate that the empirical essays in this research apply a quantitative research methodology by utilising secondary data. The secondary data source mainly consists of annual balance sheets and financial statements from the GCC's banking sector, with the exception of Oman due to the absence of Islamic bank applications in the country during this research period, which were drawn from Bank-scope. Nonetheless, each essay in this study differs in terms of utilising the theoretical frameworks, econometric methods, timelines and study samples, which are described in each chapter and are briefly explained as follows.

The first essay utilises the cross-sectional data of Saudi banks over the period from 2005 to 2010 by applying a non-parametric DEA model to compute efficiency scores and scale efficiency; following that, the second stage regression of efficiency scores, which were obtained from the DEA model, is conducted to estimate the coefficients of environmental variables from pooled data by utilising ordinary least squares (OLS), generalised difference (feasible GLS), and Maximum Likelihood (ML) estimates. Moreover, the SFA production function is utilised to examine further the validity of second stage regression. The programme employed to obtain the estimate of efficiency and coefficients is LIMDEP.

The second essay uses the panel data set of GCC banks from 2005 to 2010. Efficiency scores and the MPI of DEA meta-frontier models are estimated as the first stage of the analysis. After that, the second stage regression is employed to estimate the coefficients of bank characteristics, financial structures and the rule of law through the following models: panel data with random effect and bootstrap procedures, which were proposed by Simar and Wilson (2007). The program used to estimate the efficiency and productivity is LIMDEP, whereas the STATA programme is employed to estimate the coefficients of second stage regression.

The third essay employs unbalanced panel data from the *IB* and *CB* of the GCC countries, covering the period from 1995 to 2011. The life-table method is applied to obtain the survival-time data as unconditional results; continuous-time and discrete-time methods are then conducted to estimate the coefficients of micro-level and macro-level variables in order to evaluate the hazard rates. Here again the programme used to estimate survival analysis and those coefficients is STATA.

The last essay covers the period from 2005 to 2011, and it applies panel data random effect and fixed effect models to estimate the coefficients of bank-level and macro-level variables that determine the NPL of Islamic banking. This step will be followed by the use of dynamic panel data GMM models, including GMM-difference and GMM-system, to estimate the coefficients of the bank-level and macro-level variables, which determine the NPL of the GCC's commercial banking sector. The programme employed to estimate these coefficients is STATA.

1.7 OVERVIEW OF THE RESEARCH

The research presented in this thesis covers six chapters, including this introductory chapter that briefly presents the background, aims and objectives, questions, methodology and significance of the research.

Chapter Two presents the empirical study by analysing the efficiency of *IB* and *CB* in Saudi Arabia. The essay begins by describing the environment of the Saudi economy and banking sectors, illuminating recent developments in this area and the financial surroundings, as well as analysing the banks' performances through several financial indicators and surveying banking efficiency literature. This is followed by illustrating the applied approaches and models, which include the distance function concept, the non-parametric DEA approach with bootstrap techniques, scale efficiency and the second stage model of DEA. In ensuring the direction of these variables, the SFA model is employed with Cobb-Douglas function forms. The econometric specification and the empirical application are presented to describe the data and identify the variables included in the model. The paper in the last section collates all the findings of the selected models by displaying the efficiency scores for each Saudi bank through the DEA application model, representing the results of the environmental variables in order to evaluate the adjusted efficiency scores with the DEA application so that they can be compared with the initial scores. To conclude the essay, there will be a discussion of the models and their implications.

Chapter Three presents the second empirical paper on determining the efficiency of the Islamic and conventional commercial banking sectors of the GCC through meta-frontier analysis. This essay begins by describing the environment of the financial and banking sectors, thereby shedding light on recent developments in these sectors in each country and group. This is followed by a review of the literature on efficiency in the case of banks and financial institutions. The methodology is described in terms of output distance function, meta-frontier, technical efficiency and meta-technology ratios, DEA method, MPI with meta-frontier and the second stage regression. It will be followed by an empirical modelling and application, including statistical description and variable definition. The following sections present the findings based on the DEA meta-frontier results, MPI results of meta- and group frontiers and the second stage regression results. Finally, there will be a discussion and conclusion of the study.

Chapter Four, which presents the third empirical essay, is developed within survival analysis of the GCC's *IB* and *CB* by focusing on discrete-time duration models. The essay begins by discussing some of the relevant literature on the subject before describing the methods that are employed to investigate survival time and failure within the banking sector in the GCC. These steps are followed by a preliminary survey of both the data and the definition of the covariates. The study then proceeds to interpret the findings of the empirical application by presenting the unconditional and conditional findings.

Chapter Five is the last empirical paper, and it is based on the examination of the NPL in GCC Islamic banking; it focuses on the impact of Islamic financing types on the NPL in the GCC banking system as a whole. The essay begins by presenting an overview of NPL in banking surface studies; it then describes the determining factors of NPL, including macroeconomic, structural, organisational, bank-level and product development factors. The research methodology presentation is then conducted via panel data, dynamic panel data (GMM) models and econometric specification; this presentation is followed by the empirical findings for each of the stated methods.

Chapter Six provides the conclusion of this research by summarising its findings and presenting the implications of the research via a deliberation that contextualises the results in the case of GCC Islamic banking. Finally, it presents a discussion of the observed limitations of the study and offers a case for future research.

CHAPTER 2

EXAMINING THE EFFICIENCY OF ISLAMIC BANKS AND CONVENTIONAL BANKS IN SAUDI ARABIA: A COMPARATIVE ANALYSIS

2.1 INTRODUCTION

In response to the global developments and trends in the Islamic finance industry, the Saudi Arabian financial sector has shown positive advances and demonstrated successful expansion and development strategies. Being the largest economy within the GCC and the Arab world, the Saudi economy offers great potential for the development of the financial sector. When expanding the sector and contributing to its development, fully-fledged *IB* have been established along with a number of *IW* to offer Islamic financial services on different levels. This study thus aims to investigate the efficiency of Saudi Arabia's *IB* in comparison with the *IW* for the period from 2005 to 2010. The study will be part of a number of essays on Islamic banking within the GCC that use DEA and second stage regression, to investigate the effects of some selected environmental variables, which are related to banks' characteristics.

This chapter is organised as follows: section 2.2 describes the Saudi economy and the environment of the banking sector, as well as analysing the banks' performance through several financial indicators. Section 2.3 discusses banking efficiency literature in an attempt to shed light on the empirical evidence. Section 2.4 illustrates the research methods and modelling framework, including the distance function concept, the non-parametric DEA model with bootstrap techniques, scale efficiency, the second stage model of DEA and the SFA model employed with Cobb-Douglas (CD) function form. Section 2.5 describes the empirical process and Section 2.6 presents all of the findings for the selected models. Finally, section 2.7 contains the conclusion and discussion.

2.2 THE BANKING SECTOR ENVIRONMENT IN SAUDI ARABIA

When presenting the banking sector environment in Saudi Arabia, this section initially describes the Saudi economic conditions and the commercial banking environment in general. Further, the second section discusses the recent developments in the Saudi banking sector and its financial situation. By contextualising the study, the last section describes the performance of *IB* and *CB* with *IW* through some selected financial ratios.

2.2.1 Overview of the Saudi Economy and the Environment of the Banking Sector

The Saudi economy is controlled by oil prices and petrochemical production, which have recorded high profits over the past few years. Table 2.1 illustrates that the real gross domestic product (GDP) decreased by 4.1% in 2009 due to a decline in the growth rate of the oil sector. Consequently, this decline directly affected the government revenues.

Table 2.1- Selected Indicators of the Saudi Economy and Banking Sector (2005 to 2010)

Economic Indicators (% of GDP)	2005	2006	2007	2008	2009	2010
GDP Real Growth	5.6	3.1	2.0	4.2	0.1	3.8
GDP Growth (oil sector)	45.8	16.6	9.5	37.1	-38.8	25.0
GDP Growth (non-oil sector)	9.5	9.0	6.3	7.5	7.4	9.1
Central Government Budget Revenue	47.7	50.4	44.6	61.6	36.5	45.4
Central Government Budget Expenditure	29.3	29.4	32.3	29.1	42.7	38.4
Banking Sector Indicators (AV; %)						
Capital Ratio: Equity to Assets	15.5	15.6	13.9	13.2	13.7	14.1
Liquidity Ratio: Liquid Assets to Deposits	17.7	23.4	20.8	18.5	22.6	21.5
Net Loans to Total Assets	60.6	58.5	58.1	58.2	57.8	57.8
Operations Ratio: Return on Average Assets (ROAA)	3.5	4.9	2.9	2.03	1.4	1.63
Return on Average Equity (ROAE)	29.9	32.8	20.6	16.4	11.2	11.9

Data Sources: The Saudi Arabian Monetary Agency (SAMA) 47th Annual Report, EIU Country Report (March 2010, May 2011), and Bankscope.

Note: All numbers are reported at the nominal prices except the real GDP growth.

As can be seen in Table 2.1 and despite the global financial crisis in 2009, the real GDP growth of Saudi Arabia was affected negatively as a sustained increase in oil prices until 2008 allowed the government to make a significant reserve (The PRS

Group Saudi Arabia Country Forecast, May 2010). Although the government has made substantial efforts to support local and foreign investments, such as power and water projects, to enhance the GDP growth rate of the non-oil sector, the oil sector itself remains an essential part of the Saudi economy (EIU Country Report, May 2007). Due to such a direct link between the oil prices and the performance of the Saudi Arabian economy, any change in the price and production of oil by the Organization of Petroleum Exporting Countries (OPEC) plays an important role in the macroeconomic environment and the performance of the financial sector in Saudi Arabia.

Since the oil boom phase of 1973, which resulted in the government revenues reaching their peak, the Saudi banking sector has witnessed increases in liquidity and deposits; several Saudi banks were also established, such as the Bank Al-Jazira (1975) and the Saudi Investment Bank (1976). As a result of liquidity and deposits increasing (particularly during recent years due to the increased oil prices and revenues), Saudi banks had to enlarge their amount of investment and consumer lending. Moreover, according to a Jadwa Investment report in 2010, seven top banks in the Kingdom have managed to cover loan-loss by more than 100%; the provision of bad loans is also covered by 109% due to credit losses (taken from EIU Country Report, May 2011: 14). In 2011 the SAMA therefore stated that Saudi banks had ultimately attained a satisfactory level with provisioning, which stimulated Saudi banks to expand their lending significantly (EIU Country Report, May 2011).

2.2.2 Recent Developments in the Saudi Banking Sector and its Financial Environment

Saudi Arabia has twelve banks for commercial and trade services; five of them are entirely Saudi-owned, the rest are owned jointly by Saudi and foreign owners (Ariss *et al*., 2007: 467). It should be noted that in recent years and as a result of joining the World Trade Organisation (WTO), Saudi Arabia has had to liberate its banking sector by allowing international banks to enter the Saudi Arabian market. The SAMA, acting as a central bank, was therefore given permission by the Cabinet to licence several branches of foreign banks to operate in the Saudi financial market, including BNP Paribas (a completely European-owned bank) and the State Bank of India (EIU Country Report, February 2006).

In terms of bank types, there are four fully-fledged *IB*; the rest are *CB* that provide Islamic products through *IW*. Table 2.2 shows a detailed list of banks operating in the Saudi Arabian market that also offer *IW* with the ratio of the *sharia*-compliant assets of their *IW* to the total assets of their parent banks; in addition, it shows the bank's ranking according to the amount of *sharia*-compliant asset holdings.

Table 2.2- IB and IW Operating in the Saudi Arabian Market (2010)

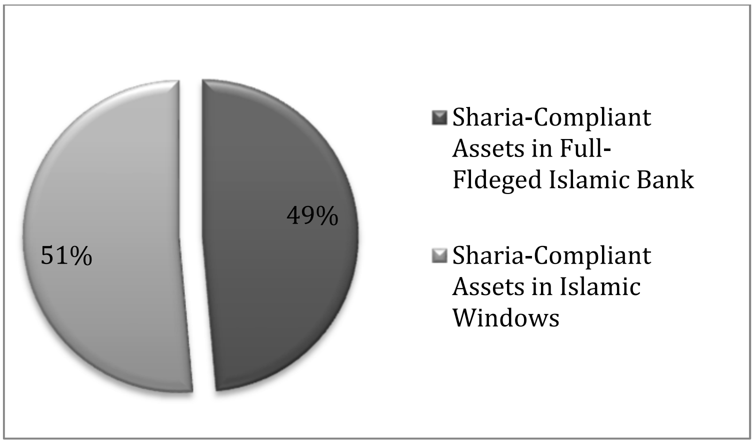
Bank Name	Bank Type	*Sharia*-Compliant Assets (mSR)	Total Assets (mSR)	% *Sharia*-Compliant / total Assets	Started Year Service
Al Rajhi Bank	*IB*	170,747.84	170,747.84	100	1987
National Commercial Bank (NCB)	*IW*	64,178.72	257,479.59	24.93	1991
Riyad Bank	*IW*	44,676.64	176,418.07	25.32	2001
Saudi British bank (SABB)	*IW*	41,995.63	120,319.56	34.90	1978
Arab National bank	*IW*	31,903.52	110,308.99	28.92	1980
Banque Saudi Fransi	*IW*	30,471.25	120,585.49	25.27	2005
Bank AlJazira	*IB*	29,979.95	29,979.95	100	1975
Alinma Bank	*IB*	24,948.96	24,948.96	100	2008
Samba Financial Group	*IW*	23,070.35	185,537.60	12.43	1980
Bank Albilad	*IB*	17,413.10	17,413.10	100	2004
Saudi Hollandi Bank	*IW*	11,447.35	59,116.06	19.36	1926
Saudi Investment Bank	*IW*	9,452.13	50,153.35	18.85	1976

Note: In the column for bank type, *IB* denotes Islamic banks and *IW* indicates Islamic windows.
Data Source: The Banker (November, 2010).

From a *sharia*-compliant perspective, the Al-Rajhi bank is considered to be the largest Saudi Islamic bank, and it is listed as the second largest banking institution in the GCC (EIU Country Report, May 2011). It is followed by the Bank Al-Jazira, the Alinma Bank and the Bank Albilad as *IB*. For *CB* with *IW*, the NCB represents the second largest bank that offers *sharia*-compliant assets. The maximum percentage of *sharia*-compliant assets to total assets is with the SABB, which is approximately 35%; in contrast, the minimum share appears to be with the Samba Financial Group at 12.40%.

Figure 2.1 illustrates that the total *sharia*-compliant assets of *CB* outweigh the total assets of *IB* by 2%, owing to the number of *CB* with *IW* being more than *IB*. In addition, the amount of total assets in some of the *IW* is larger than the holdings of *IB*, such as the NCB and the Riyad Bank. It should also be noted that although the NCB has the largest total asset holdings, a significant share of its holdings are owned by the Public Investment Fund (EIU Country Report, November 2006).

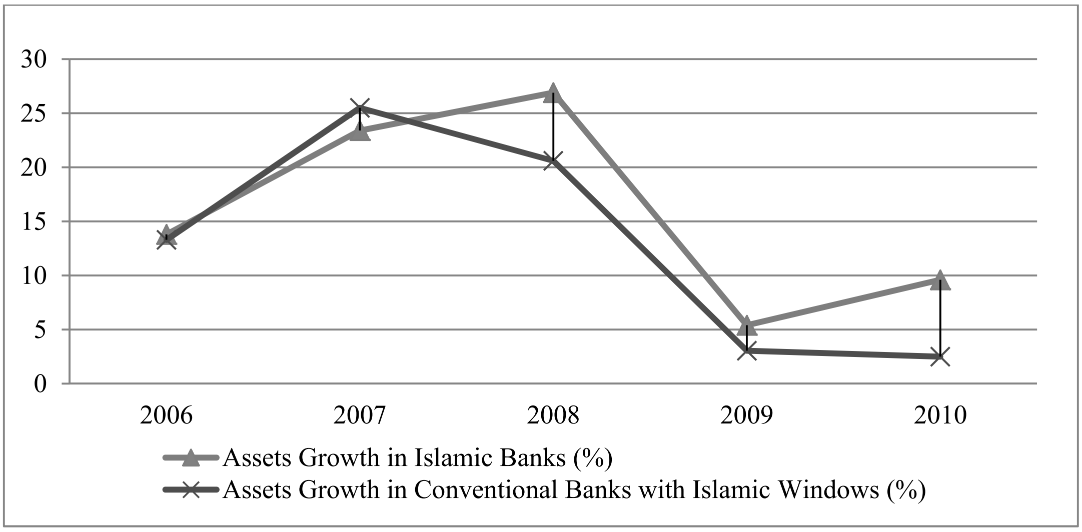
Figure 2.1- A Comparison of *Sharia*-Compliant Assets Held by *IB* and *IW*



Data Source: The Banker (November, 2010).

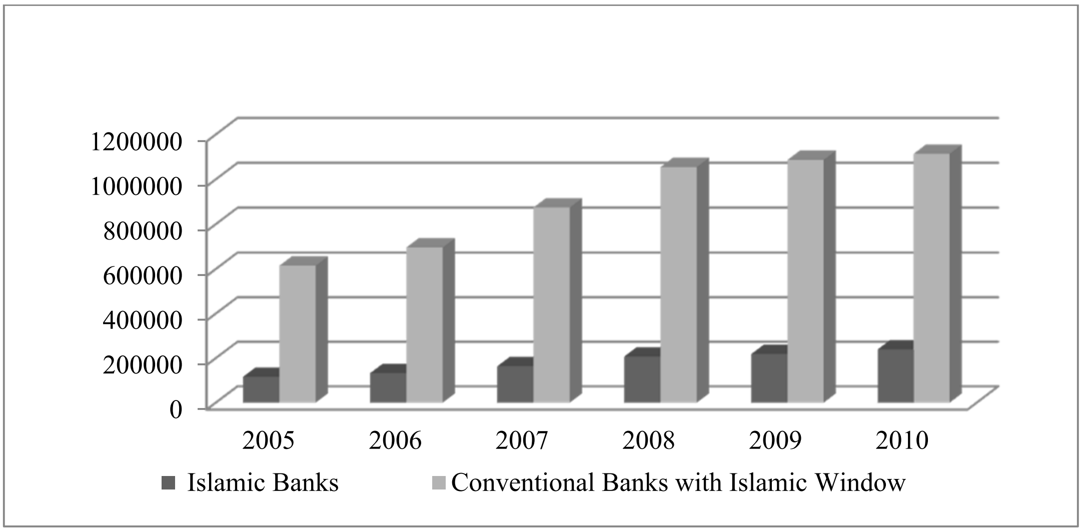
Figures 2.2 and 2.3 depict the assets growth in both types of Saudi banks. It can be noted that in 2007 the total assets rose by more than 10% when compared with 2006, a result which could be due to the liquidity boom experienced in the Saudi stock market as its index, the Tadawul All-Share Index (TASI), doubled in 2005 and reached its peak in February 2006. These changes in the Saudi financial market illustrate that the main reasons for the observed increases in assets during 2006 to 2007 were loans and investments, which represent a high level of liquidity (EIU Country Report, February 2006 and May 2007). In 2009 the growth of total assets in Saudi Arabian banks declined sharply by more than 15% when compared with 2008 as a result of the global financial crisis at the end of 2008. Despite the substantial decreases and low performance in the Saudi Arabian banking sector in 2009, *IB* managed to recover their assets growth significantly in comparison to *IW*.

Figure 2.2- Assets Growth Rate in Saudi Arabian Banks



Data Source: Bankscope.

Figure 2.3- Total Assets in Saudi Banks (M SR)



Data Source: Bankscope.

The Saudi Capital Market Company was launched in 2007 by transforming the Saudi stock exchange, Tadawul, into a shared-stock company that would be fully owned by the Public Investment Fund (EIU Country Report, May 2007). In addition, Tadawul is controlled by the Capital Market Authority (CMA) in terms of regulations. It should be noted that Tadawul had a substantial impact on the performance of the Saudi banking sector, particularly during 2005 and 2006.

As part of the financial development, since 2007 foreign investors from five other GCC countries have been allowed to invest in Saudi Arabian bank shares and several financial companies in the Saudi Arabian market. The Saudi Arabian capital market does, however, need further liberalisation in order to substantiate its position. For instance, foreign institutions from other members of the GCC cannot be listed on the Tadawul (EIU Country Report, November 2007). As part of the on-going reform, all of the Saudi banks had to set up new procedures in banking investment practices during 2007 to be consistent with CMA regulations (EIU Country Report, May 2007).

2.2.3 Comparing the Financial Indicators of *IB* with *IW*

In order to develop an understanding of the performance of Saudi Arabian *IB* and *IW*, this section reflects on their performance through some financial measures.

With regard to Return on Average Assets (ROAA) and Return on Average Equity (ROAE), and as can be seen in figures 2.4 and 2.5, the returns on average assets and equity were influenced significantly by the TASI movement in 2005 and 2006; the value of these ratios therefore reached the highest level in 2006, especially the ratios for the *IB*, when TASI recorded the maximum index number. During 2007 those ratios dropped sharply, which can be explained by the decrease in investment banking activities, such as the decrease in brokerage revenue and asset-management fees (EIU Country Report, May 2007). In 2009 Saudi Arabian bank returns declined to reach the minimum level, especially in terms of the returns for *IB*; this decline was mainly as a result of the global financial crisis in 2008, but they have recovered gradually during 2010.

As part of the performance measurement, the ratio of equity to total assets in Figure 2.6 indicates that during the period of 2005 to 2006, *IB* had a high level of equity in comparison with *CB* that offered *IW*; such a finding can be attributed to the liquidity boom and stock market activities as described in the previous section. Generally however, the average ratio of equity in all Saudi banks seems to have remained steady at around 15% during the period in question.

Figure 2.4- Percentage of ROAA for Saudi Banks

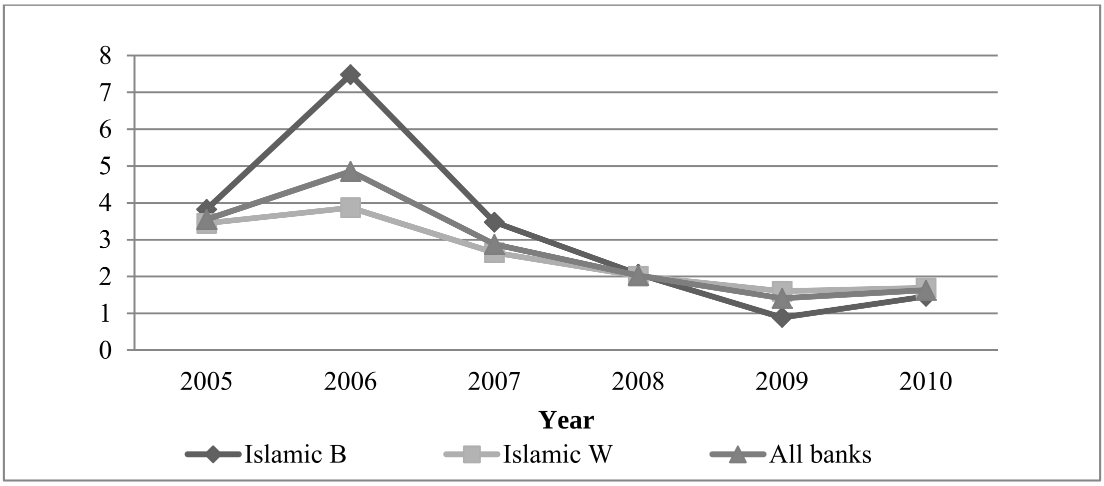


Figure 2.5- Percentage of ROAE for Saudi Banks

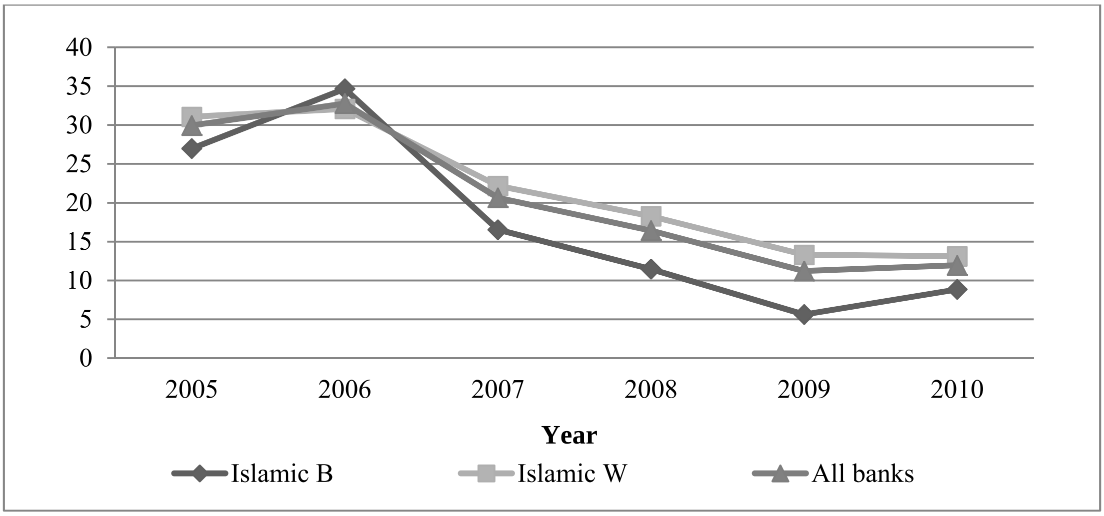


Figure 2.6- Average Ratio of Equity to Total Assets

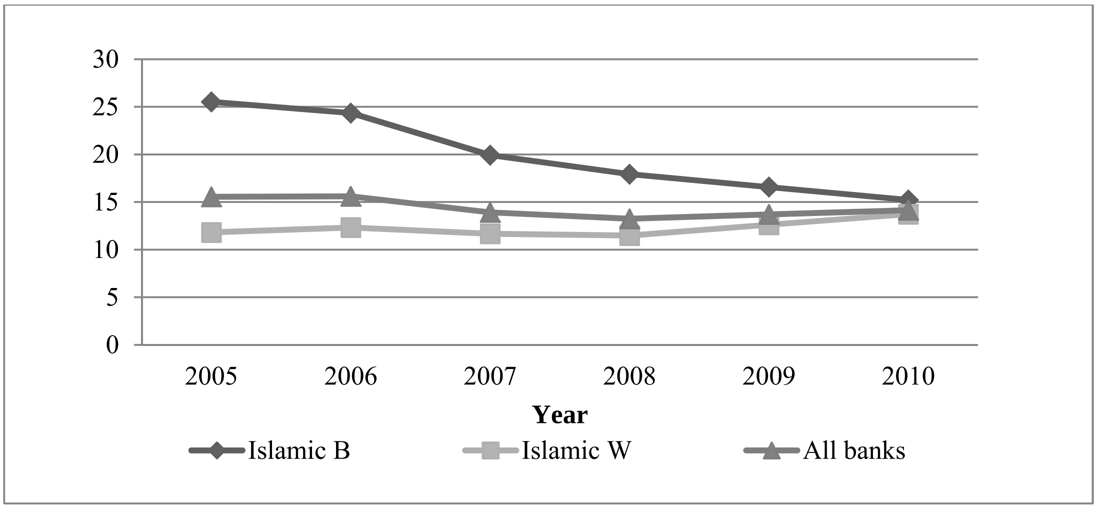
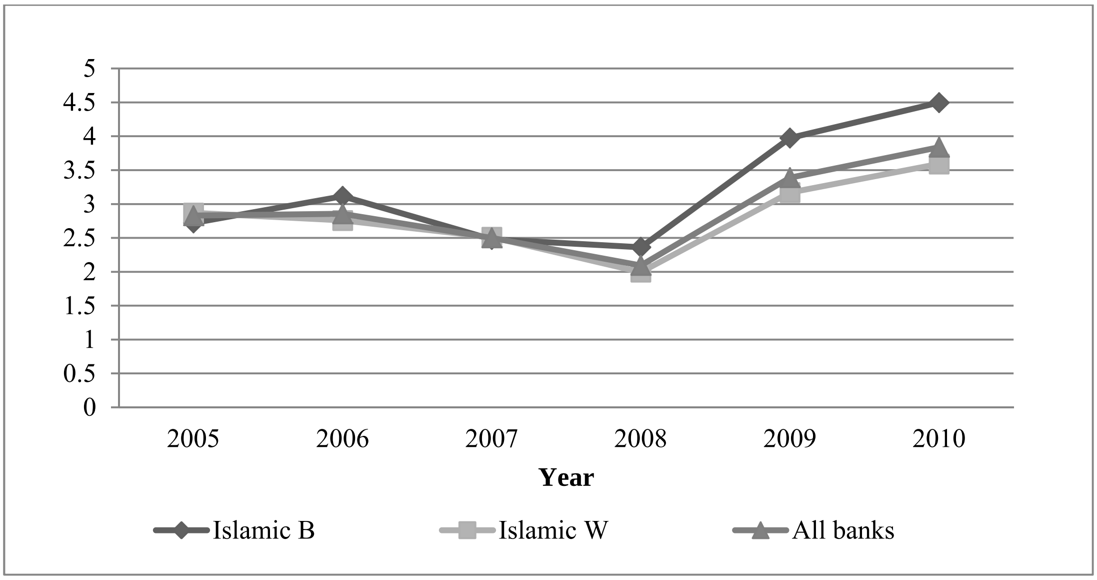


Figure 2.7- Non-Performing Loans (NPL) to Total Loans



Data Source: Bankscope.

As can be seen in Figure 2.7, the ratio for NPL in all of the banks remained fairly steady during the period from 2005 to 2007; nevertheless, it has increased gradually since 2008 by approximately 1.5%. Such an increase can be explained by the financial crisis, for as can be seen from the trend, the ratio jumped in *IB* more than *IW*. In addition, consumer lending went up rapidly in 2005; consequently, because of concerns over the risk of problem loans, SAMA took some action in authorising consumer loans by Saudi banks (EIU Country report, February 2006).

Overall, the Saudi banking sector is influenced by internal factors and most importantly by developments in the macroeconomic and financial environments. Thus the global financial crisis and the developments in the Saudi capital market have had a great impact on bank performance. As can be seen from the financial indicators, the performance of *IB* is, however, affected by such factors more than the performance for *CB*. This result can be explained by the size of the Islamic banking assets and their smaller significance in the economy.

2.3 BANK EFFICIENCY: A LITERATURE SURVEY OF DETERMINING FACTORS

Studies on banking efficiency have systematically revealed that two methods are employed to compute efficiency: the non-parametric, mathematical-based "Data

Envelopment Analysis" (DEA) and the parametric statistics-based SFA. Many studies examining efficiency in the banking sector imply that the advantages of parametric techniques outweigh the advantages of non-parametric techniques. Berger and Humphrey (1997) indicated, however, that there is no consensus as to which of the two main approaches gives the best measure of efficiency because the factual stage of efficiency is unknown. Other studies, besides examining the efficiency, therefore investigate the effect of environmental variables, either those related to internal factors (bank characteristics) or to external factors (financial structures and economic conditions). In addition, the published material on bank efficiency used a specific country or a group of countries as case studies. This section, however, reviews the available material on a single country, given that the main objective of this present study is to measure the efficiency of the Saudi banking sector.

Initially, studies on developed countries, as individual case studies, which focus on bank efficiency are reviewed. For example, Drake and Hall (2003) investigated efficiency in the Japanese banking sector by employing DEA to explore the technical and scale efficiencies through the use of a cross-section sample for 149 banks. They also categorised according to the sample by bank size and type. Another study of Japanese banking by Loukoianova (2008) also used DEA with MPI for the period from 2000 to 2006. The results for both studies indicated that large banks have a significant impact on efficiency; the latter study generally showed that the performance of Japanese banks has gradually improved since 2001.

In terms of European countries, Fiorentino *et al.* (2006) examined the cost efficiency of banking in Germany by applying SFA and DEA; they also compared the results of both methods, according to several standards, over the period from 1993 to 2004. The findings emphasise that the use of SFA to benchmark the efficiency of the banking system seems to provide clearer information on efficiency due to random error effects.

In the case of another country, Altunbas *et al.* (2008) investigated the performance of nineteen medium and large commercial Turkish banks over the period from 1992 to 2006 by using DEA and MPI. In addition, they examined the effect of some environmental variables, including the domestic economic crises of 1994, 2000 and 2001, foreign ownership and the IMF reorganising programme in 1999. The results suggested that Turkish banks have generally witnessed a growth in productivity, yet productivity was shown to have decreased over the periods 1996 to 1998, 2000 to 2001 and 2005 to 2006, which could be explained by the economic and financial conditions that the country experienced.

The performance of IBF is a very recent topical issue, and the increased attention during this decade is mainly due to the increased numbers of *IB* and *IW* as well as the importance of IBF around the world, including its important presence in Malaysia and the GCC countries, especially in Saudi Arabia. Empirical studies devoted to *IB* have therefore followed available literature in employing econometric and statistical models to measure their efficiency. The existing body of knowledge shows that some of the available studies have compared efficiency between bank types (Mokhtar *et al.*, 2007; Hussein, 2004), whereas other studies have differentiated between the bank types by employing environmental variables (Al-Jarrah, 2002; Abdul- Majid, 2008).

Given that Malaysia has become an important hub for Islamic banking, a large number of studies have emerged on Malaysian *IB*. For example, Sufian (2006) and Kamaruddin *et al.* (2008) explored the efficiency of *IB* and banks with *IW* by utilising DEA, whereas Mokhtar *et al.* (2007) evaluated the technical and cost efficiency of *IB*, *IW* and conventional Malaysian banks by employing DEA. The results in both studies show that the efficiency of the Islamic banking industry has improved over the period chosen by the study, and it was also found that *IB* were more efficient than *IW*. *IB* in general are, however, found to be less efficient than *CB*.

In another study on Malaysian Islamic banking, Hadi and Saad (2010) investigated the technical efficiency and productivity change of domestic and foreign banks by applying DEA and MPI. Their findings indicate that the performance of local *IB* is noticeably better than that of foreign banks, which could be attributed to the number of domestic *IB* outweighing their foreign counterparts. In addition, they found that large banks operate more efficiently, implying that increasing a bank's size is a significant element in determining its efficiency. Accordingly, it is suggested that *IB* need to expand their size and further advance their technology and client services to be more viable when attempting to compete with *CB*.

Another study in a single country is that by Hassan and Hussein (2003), which measured the efficiency and productivity of Sudanese banks by utilising SFA and

DEA on seventeen banks for the period from 1992 to 2000. The results revealed that the productivity had mainly decreased due to the lack of technology and the political surroundings in the Sudanese banking sector. Hassan and Hussein do, however, state that *IB* need to be more efficient in terms of their operating and management so as to advance in the international market.

In terms of case studies specifically located within GCC countries, Hussein (2004) compares the profit efficiency of the Islamic and conventional banking industries in Bahrain as an important financial centre within the GCC by applying SFA to his sample of eight *IB* and eight *CB*, regardless of whether they were commercial or investment banks, over the period from 1985 to 2001. Overall, the findings showed that although several *IB* were small and offer venture capital, they did not differ much from conventional investment banks in terms of profit efficiency. Another study on Bahrain by Hassan *et al.* (2004) aimed to investigate the cost efficiency of thirty-one banks for the years 1998 and 2000 by using DEA and MPI. In addition, they examined the effects of several selected variables on efficiency, which were related to profitability, bank size, the assets of shareholders and market power. The findings indicated that ultimately the efficiency of all the banks had notably increased. The efficient banks were Bahrain's *IB* as well as another two foreign banks, and the main cause of inefficiency scores in Bahrain's banking was found to be technical, that is pure technical inefficiency. Moreover, the determining variables showed that large banks have a substantial propensity to increase their efficiency; further, efficient banks tend to have more loans to total assets. It can, however, be noticed that the study was limited in its coverage to only two years, which is considered to be too short a time in which to obtain accurate results.

A study of the Saudi banking sector by Akhtar (2010) measured the efficiency and productivity growth of nine banks (including *IB*) over the period from 2000 to 2006 by applying DEA and MPI. The findings indicated that Saudi banks tended to catch up in some periods with the best available technology; efficiency also increased in some years. They did, however, see their efficiency level decline in other years, which could be attributed to changes in oil prices. Furthermore, for future studies, Akhtar (2010) recommended that to obtain more accurate results the banks should be grouped according to their size and type; for instance, *IB* and *CB*. In addition, Akhtar suggested that as the Saudi economy has been heavily reliant on the oil sector, the impact of oil prices on the banks' performance should also be investigated.

From the preceding survey of the empirical papers on bank efficiency, it can be observed that several of these studies have indicated the significance of environmental factors, which could have an impact on bank efficiency. Therefore, this study distinguishes itself from the existing studies on Saudi banking efficiency on two points. Initially, it utilises the DEA approach to obtain an accurate comparison between three *IB* and eight *CB* that provide *IW* in order to compute the technical and scale efficiencies. Further, it applies second stage regression to investigate the effects of some selected environmental variables related to the banks' characteristics, such as bank type, ratios of NPL, and liquidity with the objective of locating the impact of these variables on the efficiency of Saudi banks. In addition, bootstrap procedure (as derived from Simar and Wilson (2000)) is applied to determine the location of the obtained efficiency scores between the upper and lower confidence limits. Moreover, when examining the robustness of the estimated model of DEA second stage regression, the SFA model is also applied by including the selected variables directly in one model to ensure the direction of those variables on efficiency. This, in line with the surveyed empirical papers above, provides a theoretical justification for the research in general and the empirical analysis conducted in this thesis.

2.4 EMPIRICAL MODELING AND MODEL SELECTION

This section delineates the methods and models that were employed in measuring the performance within Saudi banks by comparing the efficiency levels of *IB* relative to *IW* through the application of an output distance function, or the DEA model with a constant return to scale (CRS) assumption, which helps to obtain efficiency scores with bootstrap techniques and measuring the scale efficiency through variable returns to scale (VRS) and non-increasing returns to scale (NRS).

To assess the variation in efficiency scores, some environmental variables related to banks' characteristics are investigated through the second stage model of DEA. Furthermore, to re-examine the direction of those variables, the SFA model was employed. This section is therefore divided into four parts to describe and discuss the applied function and models. Initially, the concept of output distance measure, followed by the mathematical form of the DEA model, is defined in the second part, including the calculation of scale efficacy, bootstrap technique and the second stage regression of the DEA model. SFA is then examined through the CD function forms, which is followed by the econometric specification of the empirical model tested in this study.

2.4.1 Output Distance Function

The concept of efficiency measurements relies on production, profit or cost functions, as well as distance function, which will be discussed in detail later. Koopmans (1951), who defined the basis of technical efficiency, along with Debreu (1951) and Farrell (1957), who presented a standard measure of technical efficiency. In addition, Shephard (1953 and 1970) provided the framework for distance function, whereas Coelli *et al.* (2005) specified that the mechanism for distance function permits the demonstration of a multi-input or multi-output production technology, and it does not require a precise objective, such as to minimise cost or maximise profit, in a behavioural model of a firm. An input distance function takes into account a minimum point of input with a given output in production technology. In contrast, the output distance function takes into account a maximum level of output that can be produced with a given input.

The basic framework of the output distance function is illustrated by Lovell (1993: 10). Accordingly, it can be assumed that x and y are input and output vectors of elements N and M. To describe the production technology function according to Lovell (1993), input vector x can be defined via the output set as:

$$P(x) = \{y: (x, y) is\ feasible\} \quad (2.1)$$

Thus, these input and output mixtures are comprised in the technology set to be efficient as:

$$EFP(x) = \{y: y \in P(x), y' \notin P(x), y' \geq y\} \quad (2.2)$$

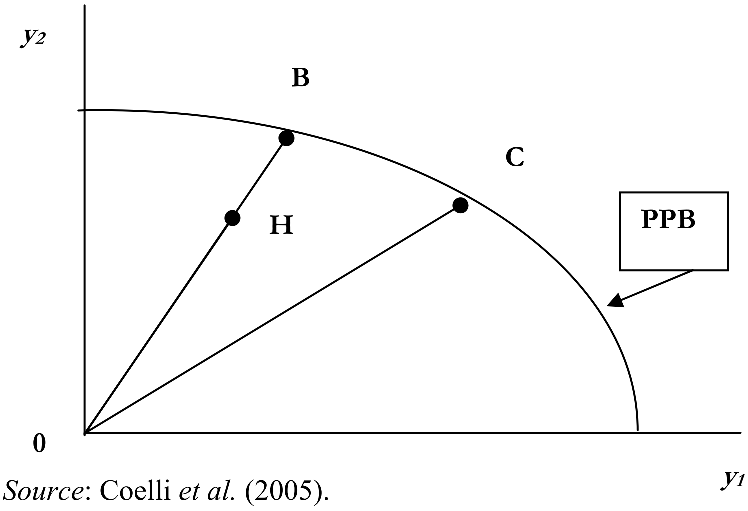
According to Shephard (1970), an output distance function model can therefore be defined on the output set $P(x)$ as:

$$D_o(x, y) = min\{\delta > 0 : (y/\delta) \in P(x)\} \quad (2.3)$$

Färe and Primont (1995) listed properties on the technology set of $D_o(x,y)$ as truisms that include: non-decreasing in y and non-increasing in x; linearly homogeneous in a positive way in y; is quasi-convex in x and convex in y, when y includes the possible production set of x ($y \in p(x)$) and $D_o(x,y) \leq 1$; when y is located on the "frontier" of the production set that means distance of y is equal to one (taken from Coelli *et al.*, 2005: 47-48).

The concept of output distance function is described by Figure 2.8 through the use of a given input vector (x) to produce two outputs, y_1 and y_2.

Figure 2.8- Output Distance Function



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

The production possibility set (x), represented by the production possibility boundary PPB- $P(x)$, with observing producing points B and C on the PPB frontier, which indicate that the values of the distance function are equal to one and that the points are technically efficient. When the firm utilises level x to produce outputs at point H, the distance function ratio appears as $D_o(x,y) = \delta = \frac{0H}{0B} < 1$, which indicates that to be technically inefficient.

As well as describing the concept of distance function, Figure 2.8 describes the output distance function technology with a given input of a firm that produces a maximum amount of output.

2.4.2 Data Envelopment Analysis (DEA)

DEA is conducted through mathematical and linear programme methods, which envelops the data set as closely as possible, but it does not make accommodation for random errors; it therefore does not envelop a data set in the manner of most econometric models (Lovell, 1993: 26). The DEA model estimates efficiency for each level of a firm (bank) and involves two different methods: input-orientated, where outputs are held constant to reach the maximum reduction proportional in input levels through the technology set, and output-orientated, where inputs are controlled constantly to obtain the maximum proportional increase in output levels. The two DEA methods can be calculated when the technology set is under two assumptions:

(i) CRS, which is represented by Charnes *et al*. (1978) on the assumption that all firms practice on an optimal scale, yet in real market conditions all firms cannot operate on the optimal scale. Thus, in amending that assumption, Banker *et al.* (1984) proposed the second option, which is as follows:

(ii) VRS as a modification for the CRS model, which covers the data more cohesively than CRS (Lovell, 1993: 30).

Both methods, input-orientated and output-orientated, when they are estimated under the former assumption give the same technical efficiency results, although they differ when they are measured under the latter assumption.

This study thus adopts an output orientation of the DEA form, which can be estimated at *t* period; y_{it} is M × 1 vector of output quantities for *i* firms (banks), *t* period of time, and Y is the M × $L_k T$ matrix of output quantities for all of the L_k firms. According to Coelli *et al.* (2005), the CRS equation can therefore be written as:

$$max_{\emptyset\, i,t, \lambda\, i,t}\ \emptyset_{i,t}$$

$$st. -\emptyset_{i,t} y_{i,t} + Y\lambda_{i,t} \geq 0,$$

$$-X_{i,t}\lambda_{i,t} + x_{i,t} \geq 0,$$

$$\lambda_{i,t} \geq 0. \qquad (2.4)$$

$\emptyset_{it}$ is a scalar, which solves the linear programing (LP) problems, and λ_{it} is a vector of $I \times 1$ of constants. In addition, $1 \leq \emptyset_{it} < \infty$ and $\emptyset_{it} - 1$ accounts for an unused growing rate of outputs, which would be obtained by i bank with the same level of inputs; technical efficiency (TE) scores for the output orientation model can be given for each bank by $1/\emptyset_{it}$. In relation to the CRS model, it would be easy to insert the constraint element ($l1'\lambda_{it} = 1$) in order to amend equation (2.4) so as to represent the VRS equation as:

$$max_{\emptyset\ i,t,\lambda\ i,t}\ \emptyset_{i,t}$$

$$st. -\emptyset_{i,t} y_{i,t} + Y\lambda_{i,t} \geq 0,$$

$$-X_{i,t}\lambda_{i,t} + x_{i,t} \geq 0,$$

$$l1'\lambda_{i,t} = 1 \quad and$$

$$\lambda_{i,t} \geq 0 \qquad (2.5)$$

The estimated efficiency levels with the input-orientated method do not differ other than in terms of output orientated function under the CRS assumption. Moreover, the CRS assumption has been disputed, because it is assuming that all firms are practicing at the optimal level. In the case of this study, however, this assumption can be relied on, because all banks operate in only one country; hence, in the same economic, market, and financial conditions. In addition, VRS will be obtained indirectly to examine the scale efficacy for each bank and to investigate the issue of scale efficiency. Further, the VRS and NRS models are estimated to ensure specifying the scale efficiency measurement, as described by Lovell (1993), if the restricted element ($l1'\lambda_{i,t} = 1$) in equation (2.5) is replaced by ($l1'\lambda_{i,t} \leq 1$), then the NRS model can be acquired.

2.4.2.1 Scale Efficiencies

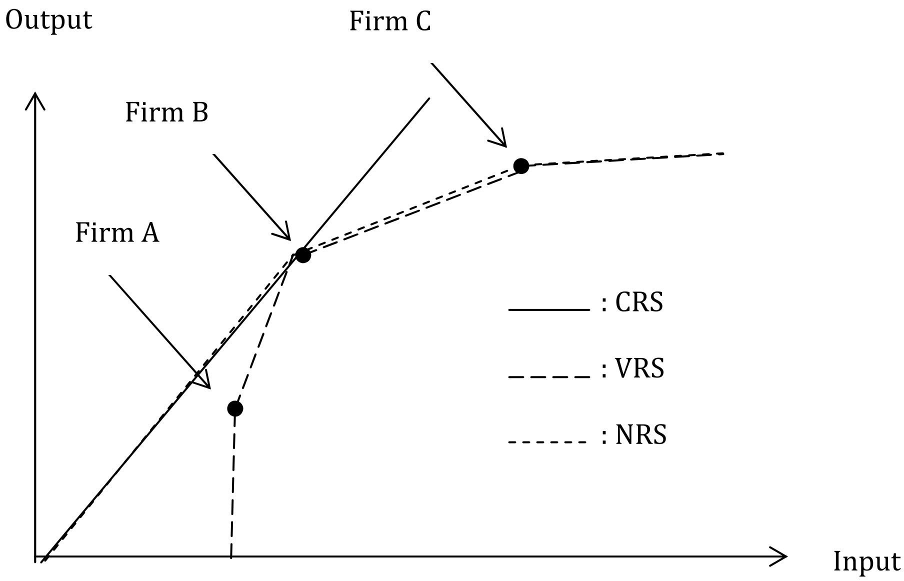
From the TE scores that were obtained from the CRS and VRS models scale efficiencies (SE) can be calculated by the proportion of the CRS score divided by the VRS score for each firm (bank), where the TE of the CRS can be decomposed into SE and "pure" TE or the TE score of VRS. This description of SE is illustrated by Coelli *et al.* (2005) as:

$$SE_{i,t} = \frac{TE_{CRS\ i,t}}{TE_{VRS\ i,t}} \quad (2.6)$$

$$TE_{CRS\ i,t} = TE_{VRS\ i,t} \times SE_{i,t} \quad (2.7)$$

The calculation of SE provides in which term of scale efficiency the firm is operating; for example, in decreasing or increasing returns to scale, or even in CRS. It is important to note that Coelli *et al.* (2005) have also indicated that most DEA studies have stated that TE scores for CRS measure the total improvement or change in the productivity of a firm, which makes this assumption more convenient in the long term. On the other hand, the TE scores of VRS denote what the firm is able to obtain in the short term, as the operation scales cannot ordinarily be changed in the short term.

Figure 2.9- The Nature of Scale Measurement in DEA



Source: Lovell (1993); Coelli *et al.* (2005).

As can be seen in Figure 2.9, the scale efficiency for each firm according to the TE scores of VRS and NRS can be estimated. For instance, at the point of firm A, the TE of VRS>NRS implies that in this case increasing returns to scale are applied in the firm. When VRS is, however, equal to NRS (as at point C), decreasing returns to scale appear. In addition, when VRS is equal to the CRS assumption, constant return to scale applies in this case.

2.4.2.2 Bootstrap Technique

As can be observed from the DEA model, the bootstrap technique is not based on statistical procedure as a result of not considering the random error in estimating the efficiency, for which this method is criticised by most efficiency examiners. To avoid such a problem in the DEA method, Simar and Wilson (1998 and 2000) provided a possible statistical solution by using the bootstrap approach in the DEA frontier to estimate the variation of efficiency scores in the sample.

The bootstrap method can be described as a statistical technique to simulate or mimic the distribution of the sample in order to acquire the confidence limits of the TE scores obtained by scaling the data randomly through generated scale factors. This adjusted data is then recalculated *n* times to estimate the confidence limits or intervals.

In the case of this study, the main reason for bootstrapping the sample is that the initial TE scores could not be correct; thus, the bootstrap process is applied to investigate and assess the location of the efficiency scores between the confidence limits. In relation to this case, Simar and Wilson (2000: 62) stated that the DEA studies applying bootstrap technique concentrate more on 'the efficiency scores of the observed units themselves'; besides, the corrected scores, could yield extra noise. In addition and most importantly, Simar and Wilson (2000: 63) emphasise that 'that the bootstrap is an asymptotic procedure', which is applied to investigate the location of efficacy scores.

2.4.2.3 Second Stage Regression of the DEA Model

In this particular study, the efficient level of output is evaluated through an output-oriented DEA model with the CRS model. There are, however, other factors that may have an impact on efficacy measures. Thus, it is crucial to take into account the influence of environmental factors, such as bank characteristics, on efficiency scores. In addition, to examine these influences there is a two-stage DEA model. In the first stage, the basic inputs and output elements are conducted to solve the DEA problem in order to obtain the TE scores. The second stage is used to regress those scores on the environmental variables, enabling the trends of their effects to be captured (Coelli *et al.*, 2005: 194).

Crucially, the two stages method has been criticised by researchers in terms of correlation, variance, or any other statistical problems in the estimated function (Assaf and Josiassen, 2011). In addition, Coelli *et al.* (2005) stated that a drawback of this method could appear in a high correlation level between the utilised variable in the first and second stages. To overcome this problem several statistical tests are therefore applied in this study so as to examine the validity of the estimated model and thus ensure that the results are without bias.

2.4.3 The SFA Model

As well as the DEA model, the current study adopts the SFA model with CD production function to examine the robustness of the employed environmental variables' direction on banks' efficiency in the DEA model, by using three inputs and only one output, as will be discussed further in section 4.4. A great variety of literature on efficiency prefers to adopt the *translog* function as it is more flexible than the CD form.

The SFA model is mainly proposed by Aigner *et al.* (1977), Meeusen and van den Broeck (1977) and Battese and Corra (1977). The SFA CD production function of output-oriented can be obtained by maximum likelihood estimation and given by taking the logarithms of output and input variables on both sides of this function, as is shown in equation 2.8.

$$ln\, Y_{i,t} = \beta_0 + \sum_{n=1}^{N} \beta_n ln\, x_{n,i,t} + v_{i,t} - u_{i,t} \qquad (2.8)$$

Here, β_0 and β_n are unknown parameters to be estimated; $v_{i,t}$ indicates noise impacts, which are assumed to be distributed separately than every $u_{i,t}$, with zero mean and variance $(0, \sigma_v^2)$, and $u_{i,t} > 0$ linked with inefficiency measures, it is assumed to be distributed with one side of u_i. Thus, to estimate efficiency through the SFA model, a number of assumptions are taken, such as half-normal, truncated, and gamma models (Coelli *et al.*, 2005: 252). This process is commenced by the half-normal specification to estimate the inefficiency from noise impacts, which is proposed by Aigner *et al.* (1977) in the following equation:

$$u_{i,t} \sim N\ (0, \sigma_u^2) \quad (2.9)$$

Therefore, by assuming that there are no inefficiency measures, the optimal SFA function is:

$$ln\, Y_{i,t} = \beta_0 + \sum_{n=1}^{N} \beta_n \ln x_{n,i,t} + v_{i,t} \quad (2.10)$$

In relation to functions 2.8 and 2.10, the technical efficiency of every individual firm (or bank) can be acquired by dividing the observation of the SFA function (2.8) with the optimal stochastic function (2.10):

$$TE_{i,t} = \frac{\ln Y}{Optimal \ln Y_{i,t}} = Exp\left(-u_{i,t}\right) \quad (2.11)$$

2.4.4 Econometric Specification

In this particular study, the efficient level of output is evaluated through output-oriented DEA with the CRS model, which is applied to compute the TE scores and the SE for each bank in the sample. The second stage regression of the DEA model is then used to examine the influence of environmental variables; the SFA production function is also used to investigate further and to ensure the effect of those variables. In addition, the investigation of these influences through the selected methods requires different processes, whether in the DEA or SFA estimations. This estimation process is described below.

Initially, with regard to the second stage estimation in the DEA model, the environmental variables are regressed on the obtained efficiency scores by applying ordinary least squares (OLS). In addition, to check the validity of the estimated model in terms of correlation between the used variables (multicollinearity) and constant variance (heteroscedasticity), two methods are applied to correct such a problem. These methods are generalised difference (feasible GLS) estimate (utilised by applying the Prais-Winsten model) and the ML estimate, which was produced by Beach and Mackinnon (1978). Therefore, the function of second stage regression can be estimated from this equation as:

$$TE_{CRS\ i,t} = \alpha + \beta Z_{it} + \varepsilon_{i,t} \quad (2.12)$$

Here, the dependent variables are the TE scores for the CRS models, and on the right hand side of the equation are the parameters of α (constant), and β parameter of the independent variables Z_{it}, which include the variables for the banks' characteristics.

Further, to investigate the direction of the environmental variables and their impact on bank performance in the SFA model, in contrast to the DEA method, all those variables are comprised directly in the CD equation that is estimated in only one step, which can be represented as:

$$ln\, Y_{i,t} = \beta_0 + \sum_{n=1}^{N} \beta_n \ln x_{n,i,t} + \sum_{n=1}^{N} \gamma_n z_{n,i,t} + v_{i,t} - u_{i,t} \quad (2.13)$$

$Y_{i,t}$ is the output variable, $x_{n,i,t}$, are the input variables, $z_{n,i,t}$ is an exogenous element of the environmental variables, which are illustrated in detail in section 4.4, and γ_n is the parameter of the variables that measure the direction and the influence on efficiency scores for each variable. The estimations of $v_{i,t}$ and $u_{i,t}$ are assumed to be uncorrelated with the independent variables. In addition, the SFA with CD model is re-examined by substituting for the half-normal specification, as described above in equation 2.9, the truncated normal assumption, which can be written according to Coelli *et al.* (2005) as:

$$u_{i,t} \sim N^{+} (\mu, \sigma_u^2) \quad (2.14)$$

Here the truncated specification is presented by Stevenson (1980), which differs from the half-normal specification in terms of flexibility. As pointed out by Greene (1993), in cross-sectional applications the half-normal model has, however, been considered to be the most convenient form. Therefore, to examine whether the estimated half-normal model or the truncated model is adequate, Coelli *et al.* (2005) indicate that likelihood ratio (LR), as a statistical test, is used:

$$LR = -2\, [\ln L_a - ln\, L_b] \sim x^2(J) \quad (2.15)$$

L_a is the log-likelihood value of the half-normal model; L_b is the log-likelihood of the truncated model; and J in this case is equal to one. The calculated LR value is compared with the critical value of x^2 at 95% significant level. Accordingly, the null hypotheses are H_0: μ = 0, which specifies that the half-normal model is not adequate, and H_1: μ ≠ 0, which illustrates that the simple half-normal model is adequate.

In most DEA research the two-step approach is preferred in order to address the influence of the environmental variables (Coelli *et al.*, 2005; Ben Naceur *et al.*, 2011). For SFA studies, these variables are, however, usually involved directly in the estimated equation to control the variances (Abdul-Majid, 2008). The obtained TE, after including environmental variables with the traditional input and output variables, could be more precise (Coelli *et al.*, 1999: 254).

2.5 THE EMPIRICAL APPROACH, DATA AND THE VARIABLES

2.5.1 Empirical Approach

This section describes the applied variables to estimate the TE scores. As identified by Berger and Humphrey (1997), most literature on the efficiency of banks, except bank branch studies, has applied an intermediation approach. In addition and as stated by Abdul-Majid (2008), this approach is considered to be a more accurate means of addressing IBF structures. Therefore, this study uses the intermediation approach in the selection of input and output variables.

2.5.2 Data

The inclusive set of cross-sectional data used in this study is sourced from the Bankscope database, which contains balance sheet and income statements for each bank. The bank sampling, as well as the data sampling, is based on the availability of the data. For instance, Alinma Bank is omitted from the sample because it began to operate in 2008. In addition, other foreign banks are also excluded from the sample as they operate on a branch level in Saudi Arabia.

The empirical sample consists of three fully-fledged *IB*, including the Al-Rajhi Bank, Bank Al-Jazira, Bank Albilad, and eight *CB* with *IW*; these include the NCB, the Riyad Bank, the Saudi British Bank (SABB), the Arab National Bank (ANB), the Banque Saudi Fransi, the Samba Financial Group, the Saudi Hollandi Bank and the Saudi Investment Bank. The annual reports of these banks covered the period from

2005 to 2010. Thus, the number of observations used in the DEA model and second stage regressions is 66.

2.5.3 Variable Definition

The specified variables in the sample of this study are adopted according to the existing body of knowledge in studies on bank efficiency (see: Yudistira 2004; Bouchaddakh and Salah, 2005; EI-Gamal and Inanoglu, 2005; Sufian, 2006; Bader *et al.* 2008; El Moussawi and Obied, 2010).

This study employs the intermediation approach, which considers the bank as an intermediary between savers and borrowers, wherein it transforms the monetary sources to loans. Consequently, it is assumed that each bank in the operating system is producing net loans (or financing in the case of *IB*), which are designated as *Y*. Following El-Gamal and Inanoglu (2005), this assumption exists because only one output is produced by employing three inputs: total deposits and short term funding (X_1), capital represented in the value of fixed assets (X_2) and labour, which is expressed in personal expenses, general and administration expenses (X_3). In addition, due to the small sample size of the current study, which covers 66 observations, it is more appropriate to use one output for some technical and statistical reasons associated with applying DEA and the econometrics models.

The second estimated function of second stage regression is comprised of the environmental variables. Initially, the dummy variable of *IB* (Z_1) is expressed by one and zero for *CB* (Abdul-Majid 2008; Al-Jarrah 2002). It is crucial to investigate the influence of bank-specific characteristics, which requires the identification of the type of bank, such as *IB* or *IW*, to determine which type is affecting the production of the output.

Recalling section 2.2.3, in terms of financial indicators, *IB* have performed slightly better than *CB*. For instance, when compared to *CB*, it is noticeable from the assets growth rate of *IB* that they have managed to recover their assets growth significantly from the effect of the global financial crisis in 2009. In addition, the ROAA ratio and the average ratio of equity to total assets were also higher at several points. On the other hand, this could be due to the number of *IB* being lower when compared to banks providing Islamic products. Therefore, the impact of variables for *IB* on bank efficiency cannot be estimated.

The second variable is that of the ratio of *NPL* to total loans (Z_2) (see: Abdul-Majid 2008). Berger and Mester (2000) state that problem loans can be caused by external and internal factors, such as a financial crisis or by central bank regulations and bad management. It is important for this study to take into account the impact of NPL in order to compute efficiency, because the net loans variable is used as an output element. In addition, for the current study this variable seems to be influenced by both internal and external factors. Indeed, it would be external factors due to the financial circumstances in 2006; so as to reduce the potential credit risk caused by increasing consumer loans, SAMA introduced some procedures in authorising those loans. Further, this variable could have been affected by the global financial crisis in 2008. Consequently, the prior expected sign for this coefficient is negative with efficiency.

The last environmental variable is the ratio of liquid assets to customer deposits and short-term funding (Z_3), which reflects the ability of the bank to face any risk posed by large unanticipated withdrawals or loan requirements. This variable is included in accordance with Ben Naceur *et al.* (2011), who pointed out that if there is a significant shortage in liquidity, it could oblige banks to be funded with very high costs. As noted in section 2.2.2, in this case study, the liquidity in the Saudi banking sector was affected by the liquidity boom in the period from 2005 to 2006, which led to increased consumer lending for real estate and stock market investment. In addition, the global financial crisis in 2008 could be the cause of the reduced liquidity ratio. Therefore, the expected impact of this coefficient is negative on the banks' efficiency.

Table 2.3- Statistical Summary for the Saudi Bank Sample

Variable	*Symbol*	*Mean*	*SD*	*Min.*	*Max.*
DEA					
Net Loans (Million SAR)	Y	54146.2	34602.2	4221.40	125597
Total Deposits (Million SAR)	X_1	77495.8	53734.6	3171.56	243492
Capital (Million SAR)	X_2	932.213	741.523	165.726	3394.90
Labour (Million SAR)	X_3	786.193	520.937	84.7260	2336.30
SFA					
(log) Net Loans	$Ln\ Y$	10.6441	0.858991	8.34792	11.7878
(log) Total Deposits	$Ln\ X_1$	10.9469	0.903782	8.06198	12.4028
(log) Capital	$Ln\ X_2$	6.58626	0.690563	5.11034	8.13003
(log) Labour	$Ln\ X_3$	6.44486	0.701394	4.43942	7.75632
Environmental Variables					
IB (Dummy)	Z_1	0.27273	0.448775	0.00	1.00
NPL/Total Loans (%)	Z_2	2.91776	1.38439	0.00	5.99617
Liquid Assets/Customer Deposits and Short-Term Funding (%)	Z_3	19.6685	10.8132	5.7753	65.5663

Table 2.3 depicts the statistical summary of the variables for both of the applied methods (DEA and SFA). It should be noted that all of the annual variables employed in this study are presented in Saudi Riyal, and they are converted to suitable real prices according to the GDP deflator in 2010. This deflator can be acquired from the World Databank through the website of the World Bank Organization.

2.6 EMPIRICAL FINDINGS

This section displays the results generated by the application of the DEA model to measure the TE of the *IB* and *CB*; it then presents the results of the environmental variables in the second stage regression. In addition, the findings generated by the SFA CD model are displayed in order to examine the robustness of the direction of these variables. Finally, the adjusted efficiency scores with the DEA application are compared with the initial scores.

2.6.1 Findings Generated by the DEA

The DEA results are depicted in Appendix to Chapter 2: Table 1, which is comprised of the TE evaluation with the CRS assumption for each bank. In addition, VRS is applied to estimate scale efficiency (SE) and the nature of SE. Furthermore, the table includes the confidence intervals, or the lower and upper limits, for the estimated TE scores from 1,000 bootstrap replications.

The averages of the TE estimates in all of the Saudi banks have generally fluctuated between approximately 80% and 76% during the period of the sample. To provide further details in relation to bank types, in 2005 the average of the TE scores in *IB* outweighed their counterparts with *IW*; similarly, in the years 2006 to 2007 the TE of *IB* was slightly higher than that of other banks by more than 1%. Conversely, there is a large gap between *IW* and *IB* in 2008, whereas the average for the TE of *CB* is 15% higher, which can be explained by the low performance of the Albilad and AlJazira banks, as their TE accounted for 58% and 64% when compared to the efficiency level of the AlRajhi bank, which was at 86%. Consequently, the observed difference in the average for the TE between these two bank types was sustained until 2010, which means that the performance of *IB* reached its peak in 2005. On the other hand, they dropped sharply until they reached the lowest level in 2008, which can be attributed to the trading activities in the Saudi capital market in 2006, as its index collapsed from 20,000 points to 8,000 points at the end of that year (EIU Country Report, May 2007). The effect can be observed in the case of the Al-Jazira Bank, as it appears to be the most inefficient bank from among all of the Saudi banks. Meanwhile, it can be observed that the performance of *IB* was influenced negatively by the effect of the global financial crisis in 2008. Interestingly, these findings are in line with the financial indicators analysis in section 2.2.3.

Bootstrapping results of the estimated TE scores specify that most efficiency scores are simulating around the lower confidence limit. It should be noted that the bias correction is not important in this result because it could involve a huge variance when compared with the original estimation of TE, as indicated by Simar and Wilson (2000). The main aim of the bootstrap process is to determine the location of the obtained efficiency scores with regard to the bounds of the lower and upper levels.

In terms of the SE results, most of the banks were performing under increasing and constant return to scale in 2005 and 2006, except Al-Rajhi (in 2006); the Riyad and NCB banks were operating under decreasing return to scale and they remained below the optimum level of scale until the end of the period. This could be explained by bad management. Surprisingly, small banks and the majority of banks with foreign partners, such as Al-Jazira, Saudi Investment, Saudi Hollandi, Saudi Fransi and SABB, seem to operate under increasing returns to scale during the period in question.

2.6.2 The Findings from the Second Stage Estimation of DEA

To assess the differences in the TE, specifically between the two types of bank, three variables were employed to investigate those variations by OLS regression. Initially, it is important to clarify the validity of the estimated models, which were examined in terms of multicollinearity and heteroscedasticity. As can be seen from Table 2.4, the multicollinearity or autocorrelation problem does appear in OLS estimation; the GLS and ML methods are therefore considered to be feasible for application. All of the parameters are significant in both estimators of GLS and ML. ML estimation is, however, preferred because of the value of log-likelihood[1].

The displayed results of the effects of the environmental variables reveal the coefficients with the expected signs. The first variable (Z_1) shows the influence of Islamic banking on bank efficiency to be positive, which signifies that *IB* are potentially more efficient at producing loans or financing (as output) than *CB* by 10.5%.

Table 2.4- Second Stage Regression of TE

	OLS		*Feasible GLS*		*ML*	
Variable	*Estimated Value*	*Std. Error*	*Estimated Value*	*Std. Error*	*Estimated Value*	*Std. Error*
Constant	0.9772***	0.0359	0.9422***	0.0452	0.9422***	0.0456
Z_1	0.07164*	0.0429	0.1045*	0.0603	0.1052*	0.0606
Z_2	-0.0417***	0.01024	-0.0353***	0.0074	-0.0353***	0.0074
Z_3	-0.00498***	0.00187	-0.0039***	0.0011	-0.0039***	0.0011
F-statistic	12.18***					
Adjusted R^2	0.34					
Log-Likelihood	56.34		80.739		80.741	

Notes: (***), (**), (*) are significant at a 99%, 95% and 90% confidence level.

The results in Table 2.4 also show that the estimated coefficients of *NPL* (Z_2) are negative, proving the expectations of the study, which in turn reflects that an increase in the *NPL* to total loan ratio leads to a decrease in the bank's efficiency by 3.5%.

[1] Gujarati (1988) and Greene (2007) stated that in a large sample (above sixty or seventy observations), the results of GLS or ML estimators are somewhat similar.

This result is in accordance with Abdul-Majid (2008), who suggested that robust measures are needed to control the default loans.

Finally, the estimate of liquid assets to customer deposits and short-term funding (Z_3) indicates the negative impact of this ratio on the output TE by approximately 0.4%. This relationship implies that less liquidity in banks is more associated with funding high-risk loans, which can perhaps lead to an increase in NPL.

2.6.3 The Findings from the SFA Application

This section presents the findings for the utilised environmental variables on the banks' efficiency by SFA with CD production specification. Table 2.5 presents the SFA estimation with half-normal and normal truncated models, where it was found that all of the employed variables (Z_1, Z_2, Z_3) are significant and determine the directional effects on Saudi banking efficiency. This result is consistent with the DEA application in the second stage estimation. It should be noted that the environmental variables are employed in SFA with CD model, as ratios, and not logarithms, in accordance with the study made by Good *et al.* (1995). Further, as indicated by Coelli *et al.* (1999) the environmental variables in this case are assumed to have a direct impact on the production technology and not the technical efficiency of a bank.

Table 2.5- Estimated SFA with CD Production Function

	Half-Normal		*Normal Truncated*	
Variable	*Estimated Value*	*Std. Error*	*Estimated Value*	*Std. Error*
Constant	-0.265	0.269	0.03981	0.3817
Ln X_1	1.094 ***	0.059	1.06903 ***	0.08933
Ln X_2	0.0791**	0.0395	0.07979 **	0.03678
Ln X_3	-0.2009***	0.0661	-0.18985 **	0.09317
Z_1	0.3659***	0.0671	0.32305 ***	0.1129
Z_2	-0.0531***	0.0103	-0.05224 ***	0.0115
Z_3	-0.00878 ***	0.0019	-0.00845 **	0.00382
Lambda	1.3077***	0.4191	132.668	5750.885
Sigma	0.14141	0.00162	0.1266	0.02118
Mu	-		0.1778	0.1073
Log-Likelihood	52.68994		55.34414	
LR ratio	5.3084			

Note: (***) and (**) are significant at a 99% and 95% confidence level.

The LR test is used to examine which of these models, whether half-normal or truncated, is more accurate to estimate efficiency when comparing the calculated LR value to the critical value of x^2 at a 95% significance level, which is equivalent to 3.84. In accordance with the results in Table 2.5, the null hypothesis H_0 is rejected, which means that the simple half-normal model is adequate. Nevertheless, the SFA model cannot be relied on entirely to evaluate the efficiency scores for each bank of the sample, given that the inefficiencies are involved with the random error in this model, which could lead to misleading results in a small sample. Thus, to avoid this problem, the SFA model requires a larger sample than the DEA model (Assaf and Josiassen, 2011). It is important to clarify that the SFA equation is only estimated to ensure the direction of the environmental variables.

2.6.4 The Rank of Saudi Banks

Table 2.6 shows the ranking of the Saudi Arabian *IB* and *CB* according to the TE average during the period in question, both before (Rank A), and after (Rank B), including the environmental variables with the DEA applications.

Table 2.6- The Rank of the Sampled Banks

Bank	*AlRajhi*	*AlJazira*	*Albilad*	*NCB*	*Riyad*	*Samba*	*SABB*	*Saudi Fransi*	*ANB*	*Saudi Hollandi*	*Saudi Investment*
Rank A	3	11	4	10	9	8	2	1	5	6	7
Rank B	6	11	1	8	4	9	3	2	5	7	10

Note: Rank A provides the bank's order according to the average for the TE (DEA) without the influence of the environmental variables; Rank B presents the bank's ranking after adjusting the DEA TE scores.

By looking at the results in Table 2.6 and from the ranking for the *IB*, it seems that the efficiency level of these banks is affected negatively by the independent variables (loan quality and liquidity ratio) more than *IW*. This finding can be observed from the ranking level of Al-Rajhi bank, as it has changed from three to six. The Albilad Bank appears to be the most efficient bank in Rank B; indeed, it is considered to be a new bank as it started to operate in 2005. Therefore, in this bank the NPL accounted for zero, and then took the lowest level of that ratio among other banks in the period from

2006 to 2007. Accordingly, the most efficient banks are the Saudi Fransi Bank and the SABB. This implies that *CB* with *IW* and foreign partnerships have a higher efficiency level than other banks. The differences in the efficiency scores can be explained in some cases by the bank management being better than Saudi banks with full ownership, such as is the case with the Al-Rajhi Bank and the NCB.

2.7 DISCUSSION AND CONCLUSION

This study has examined performance in the form of the efficiency of *IB* and *IW* operated by all *CB* in Saudi Arabia over the period of 2005 to 2010 through the use of some financial indicators. In endeavouring to locate the performance of the sampled banks, the DEA model, the SE and the bootstrap approach were employed. In addition, a number of environmental factors were included to capture their impact on the performance and efficiency of the sampled banks. The internal variables were used to explore their influence on the banks' efficiency in the second stage regression of DEA; these are the banks' characteristics or type, for which a dummy variable is used to signify fully-fledged *IB*, loan quality and liquidity ratio. Furthermore, banks are ranked according to the average of TE during the period, both before and after including the environmental variables with the DEA model.

The analysis of financial ratios suggests that the Saudi Arabian banking sector is influenced by several environmental variables, such as the economic and financial conditions. In general, the development stages in the Saudi Arabian capital market have had a great impact on the banks' performance, as well as the global financial crisis. Furthermore, the performance of *IB* is affected by such factors more than that of *CB*. This can be explained by the limited number of *IB* and also by the amount of their total assets, both of which are less than *IW*.

With regard to the results, the TE obtained from the DEA estimations are in accordance with the financial indicators analysed in the earlier part of this study, which indicates that the performance of *IB* reached its peak in 2005. They did, however, decrease sharply until they reached the lowest level in 2008, which can be attributed to the trading activities in the Saudi capital market during 2006. The findings also show that the performance of *IB* was influenced adversely by the effect of the global financial crisis in 2008. In terms of the nature of the SE findings, the majority of banks with foreign partners seemed to operate under increasing returns to scale during the period.

The findings of environmental variables reveal that *IB* are positively associated with the banks' efficiency. The estimated coefficient of *NPL* has a negative impact on the banks' efficiency, which indicates that further controls should be introduced to monitor borrowers with regard to developing management portfolios. Finally, the estimate coefficient of the liquidity ratio indicates a negative relationship with bank efficiency, as less liquidity in banks is more associated with funding high-risk loans.

The ranking of Saudi Arabian banks, after adjusting the DEA efficiency scores, shows that the efficiency of *IB* is adversely affected by the environmental variables more than the *IW*. In addition, the findings suggest that the performance of *IW* with foreign partnerships is better than that of *IB*, where the efficiency scores of these banks were almost not influenced by the independent variables.

Lastly, it should be noted that in terms of this study's limitations, it is only comprised of one output variable. Therefore, it is suggested that for future studies more input-output variables should be included, such as other earning assets as an output variable. In addition, the application of different methods should be considered, such as SFA with Gamma model, to advance the assessments of efficiency levels and obtain better results. Such methods do, however, require more observation. It is also recommended that future research expands the sample size and utilises panel data. Furthermore, to examine the variation in bank efficiency in greater detail, more environmental variables, which are related to bank-level and macro-level factors, need to be investigated; for example, banks with foreign ownership and the financial development factors, including market capitalisation and concentration.

CHAPTER 3

DETERMINING THE EFFICIENCY OF ISLAMIC AND CONVENTIONAL BANKS IN THE GCC: META-FRONTIER ANALYSIS

3.1 INTRODUCTION

The economic conditions of the GCC countries are very similar due to their dependency on oil exports, which provide a high level of earnings and a large contribution to the Gross Domestic Product (GDP). Four of these countries, namely Saudi Arabia, the UAE, Qatar and Kuwait, play a crucial role as members of the Organization of Petroleum Exporting Countries (OPEC). Bahrain should be considered separately as the country's economy and finances rely heavily on sectors other than oil, and its oil exports are not sufficient to consider it a member of the OPEC (EIU Country Report, March 2012). Although oil wealth helped these countries to develop, vicissitudes in oil prices have an influence on government budgets and financial sectors. Nevertheless, the authorities in the GCC countries such as Saudi Arabia and the UAE have made substantial efforts to support local and foreign investments and to enhance the GDP growth rate of non-oil sectors, but the oil sector still remains essential to these economies (EIU Country Report, May 2007; EIU Country Report, May 2005).

The banking sector, as an intermediary among other sectors, has a significant impact on the financial systems and economies of the GCC countries, and the GCC countries' financial sectors have responded positively to global developments and trends in the financial sectors, especially the developments related to the Islamic finance industry. As large economies within the Arab world, the GCC economies offer great potential for the development of the financial sector in general and for the Islamic finance industry in particular, due to the large capital accumulated with the ever-increasing oil prices. A number of fully-fledged *IB* have emerged over the years and started to operate in these countries even though the first commercial Islamic bank was established in the UAE in 1975. In response to the developments in Islamic finance, a substantial number of *CB* in the GCC countries have also opened *IW* to offer different levels of Islamic financial services.

This paper thus aims to investigate the efficiency and technology gap ratio (TGR) of the banking sector in the GCC countries on an empirical level. Given that all of the banks in these countries operate under different technologies and different bank groups, this research aims to compare these banks on two levels: between each country on an individual frontier (except Oman) and between three bank groups, which are *IB, IW*, and *CB*. These comparisons will be made using DEA, under the "variable returns to scale" (VRS) assumption in combination with the meta-frontier approach. In addition, this study also measures the total factor productivity (TFP) growth through the use of the Malmquist productivity index (MPI) in order to investigate the catch-up term, which measures how the frontiers of a country or bank group perform in terms of production points and productivity growth towards the meta-frontier from period *t* to period *t+1.* In the second stage, this study attempts to investigate the high potential influence of banks' characteristics, financial structures and rule-of-law variables on the technical efficiency (TE) scores that were obtained from the DEA meta-frontier method. This stage is applied through a two-stage approach in different models of the panel data set, which are panel random effect, with generalized least squares (GLS) and bootstrap estimators.

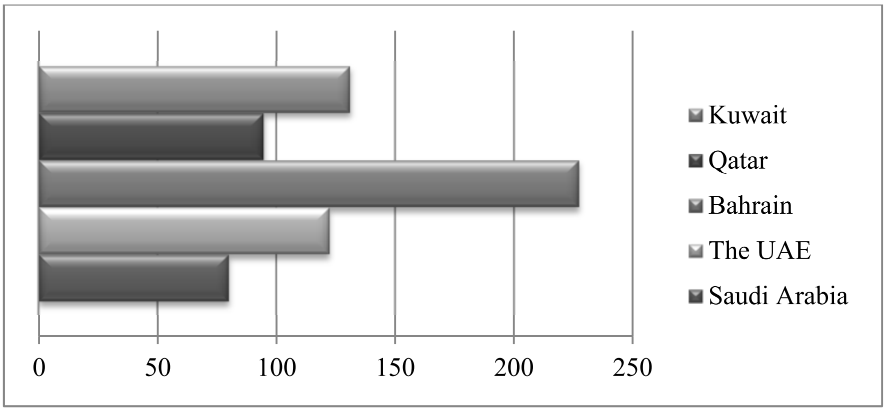
The rest of this paper is organised as follows: section 3.2 describes the environment of the financial and banking sectors in the GCC region by focusing on recent developments in these sectors for each country and each bank group. Section 3.3 reviews and discusses the "bank efficiency" literature; section 3.4 describes the methodology employed in the study, which includes an output distance function, the meta-frontier approach, the meta-technology ratios of the DEA method, and the MPI with meta-frontier and second-stage regression. Section 3.5 presents an empirical modelling and process; section 3.6 illustrates the findings of the study. Finally, section 3.7 offers a discussion and conclusion.

3.2 FINANCIAL AND BANKING SECTOR DEVELOPMENT IN THE GCC COUNTRIES

The oil boom in the GCC countries has had a substantial effect on the establishment and development of the financial sector, as well as on the launch and increased importance of IBF in the region. Although development trajectories have taken several stages, this section only intends to analyse recent developments in these sectors within the GCC countries.

In an attempt to understand the role of the banking sector in the GCC region, Figure 3.1 depicts the total assets ratio of the banking sector to GDP. Bahrain, where the total assets of the banking sector accounted for 224% of the GDP by the end of 2010, has clearly taken first place among the other countries, and the numbers here emphasise Bahrain's heavy dependency on its financial sector. For Kuwait, during 2010, its banking assets represented 131% of the GDP; the UAE, Qatar and Saudi Arabia exhibited commercial banking assets of approximately 122%, 94% and 80% of the GDP.

Figure 3.1- Total Assets of the Banking Sector to GDP in 2010 (%)



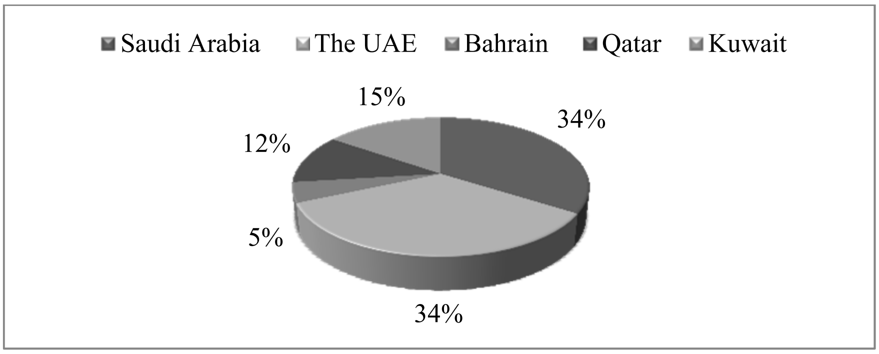
Data Source: Bankscope and the EIU.

Figure 3.2 shows the size of the share of assets in each country relative to the total assets of all countries during 2010, with Saudi Arabia and the UAE representing the largest percentage at 34%; Bahrain correspondingly represents the smallest percentage at 5%. In addition, the asset sizes of Kuwait and Qatar are 15% and 12%.

Figure 3.3 illustrates the share for each bank category in terms of their assets in the GCC countries, namely fully-fledged *IB*, *IW*, and *CB*. The assets of *IB* account for 19%, with sixteen *IB*; the assets of *IW* represent the largest portion of assets at around

56% in eighteen banks; and the assets for *CB* represent 25% of the total in twenty banks within the GCC region.

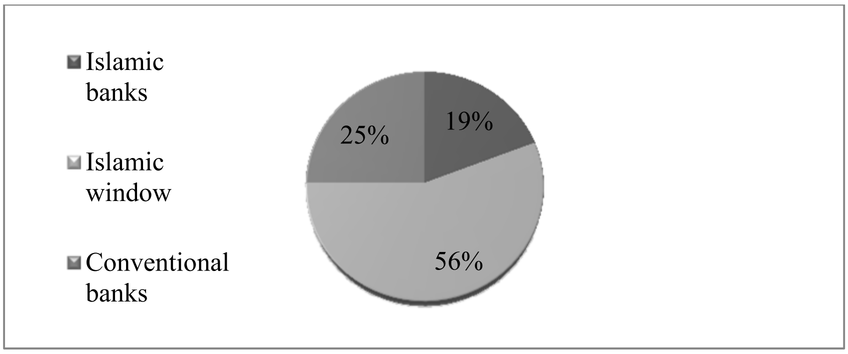
Figure 3.2- Total Assets of Banking Sector in the GCC countries (2010)



Data Source: Bankscope.

As can be seen in Figure 3.3, the largest banks in the Gulf region are *CB* offering Islamic products, such as the National Commercial Bank in Saudi Arabia, the National Bank of Abu Dhabi and the Qatar National Bank. Moreover and without exception, all of the *CB* in Saudi Arabia provide *IW*, which strengthens the assets of this bank group. In addition and according to Al-Hassan *et al.* (2010), the position of *IB* is significantly dominant with about 24% of the banking assets in the GCC region.

Figure 3.3- Total Assets of the GCC's Bank Groups (2010)



Data Source: Bankscope.

3.2.1 Financial Sector Indicators

Table 3.1 displays two indicators in order to describe the financial sector development of the five GCC countries included in this study over the period from 2005 to 2010. These indicators are market capitalisation ratio (to GDP) or MC/GDP, which demonstrates the development stage of the stock market, and private sector credit indicator, which can be described as the banks' claims on the private sector over GDP, or BCPS/GDP. Two factors influence the market capitalisation indicator: the income level of the country (Ben Naceur *et al.*, 2011) and the stock prices of listed companies (Beck and Demirguc-Kunt, 2009).

Table 3.1- Financial Growth Indicators in the GCC Countries

	Saudi Arabia		The UAE		Bahrain		Qatar		Kuwait	
Year	MC/ GDP	BCPS/ GDP	MC/ GDP	BCPS/ GDP	MC/ GDP	BCPS/ GDP	MC/ GDP	BCPS/ GDP	MC/ GDP	BCPS/ GDP
2005	206	35.6	124.9	42.7	129	49.6	202.9	44.1	161	62
2006	93.5	35.3	62.4	49	133.2	47	101.8	42	126.9	62.4
2007	134.8	38.6	87	60.1	152.3	56.5	118.2	50.1	163.9	68.8
2008	51.8	39.9	31.1	73.2	96.7	67.3	68.9	53.7	72	64.7
2009	85.5	50.7	40.5	97.5	82.2	79.3	89.4	75.7	87.5	84
2010	81.3	45.6	35.2	92.3	93.2	79.2	95.4	40.4	96.2	80.4

Data Source: Standard and Poor's (S & P) *Global Stock Markets Factbook* data and country authorities.
Note: MC/GDP presents the ratio of market capitalisation over GDP, and BCPS/GDP shows the ratio of the banks' claims on the private sector over GDP.

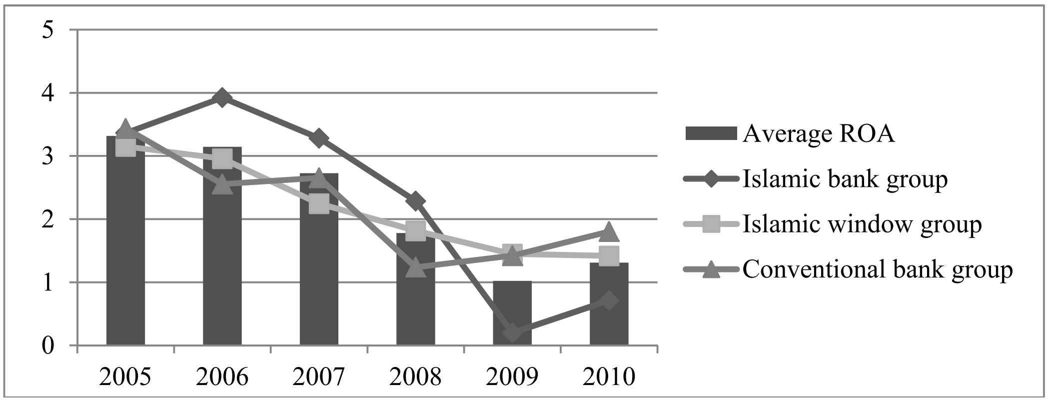
Trends in the market capitalisation ratio emphasise that it reached its highest level in 2005 for most of the GCC countries, especially in Saudi Arabia, the UAE and Qatar. Such a result can be attributed to the effect of the development stage of those markets, combined with the influence of stock prices. In 2008, however, it dropped sharply to 31% in the UAE and to 51.8% in Saudi Arabia, owing to the effect of the global financial crisis in 2008.

As for the second indicator, namely private sector credit, it depicts the development of the economic and financial sectors (Naceur *et al.*, 2011). Accordingly, this indicator increased gradually during the specified period in Table 3.1, and it decreased slightly during 2010 in all of the specified countries. This is especially noticeable in the case of Qatar, as the indicator declined by around 35% in 2010.

3.2.2 Banking Sector Indicators

The present study uses two financial indicators for financial sectors to assess the performance of the commercial banking sector in the GCC countries: the average of Return on Assets (ROA) and Return on Equity (ROE). The assessment is made by dividing these sectors into three groups. Figure 3.4, which presents the ROA ratios, demonstrates that the performance of the GCC's banking sector generally decreased gradually from 2005 to 2010, reaching a minimum in 2009 and recovering in 2010. Furthermore and according to bank groups, *IB* reached their peak in 2006; this result can probably be attributed to the investment and capital market activities described in Table 3.1.

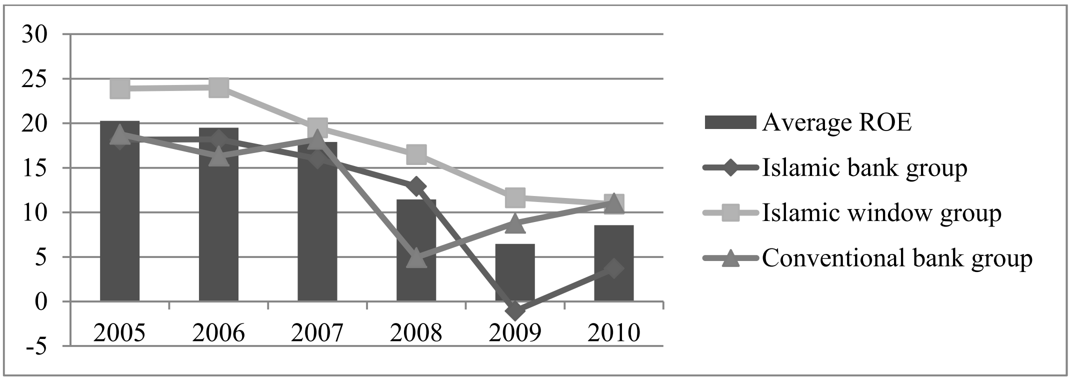
Figure 3.4- ROA of the GCC Bank Groups



Data Source: Bankscope.

The ROE average movement in Figure 3.5 is similar to the trend observed for ROA in Figure 3.4; the performance of the *IW* group is, however, slightly above average, and this group has not fluctuated as much as the groups representing *IB* and *CB* for ROA. The strength of this group is due to the banks' size in terms of ownership structure, as more than 70% of the actual banks are owned by the government in Saudi Arabia and the UAE (Al-Hassan *et al.,* 2010). In addition, it is clear that the financial crisis at the end of 2008 negatively influenced the financial system and the banks' performance, especially that of the *IB*.

Figure 3.5- ROE of the GCC Bank Groups



Data Source: Bankscope.

3.3 SURVEYING THE BANK EFFICIENCY LITERATURE

A review of the literature has been conducted to compute banking efficiency by employing both non-parametric and parametric methods. In addition, other studies also examine the influence of environmental factors related to bank and financial structures and regulations or economic conditions.

Among the available body of knowledge, Dietsch and Lozano-Vivas (2000) explore the efficiency of the French and Spanish banking sectors, focusing on the effect of environmental variables on the cost efficiency. The results show that as these variables are involved in the estimated function, the efficiency scores are notably reduced. Another study employing environmental factors is that by Bonin *et al.* (2005), who investigate the influence of ownership structure on the bank efficiency of eleven transition countries. The empirical results indicate that foreign banks have a significant and positive position in illustrating the variation of efficiency scores in those countries. Finally, Delis and Papanikolaou (2009) examine the determinants of bank efficiency, which include bank size and the financial and ownership structures of ten European countries. The results of the study demonstrate that bank size has a positive influence on bank efficiency, although bank concentration has a negative impact on efficiency.

In terms of developing countries, Chen (2009) investigates the effect of macroeconomic factors and financial development on the levels of bank efficiency, in addition to examining the relationship between market structure, legal framework, political surroundings, government effectiveness and efficiency in ten sub-Saharan African middle-income countries. The findings provide evidence that suggests that foreign banks are more efficient than the local banks; in addition, a steady macroeconomic situation and a high level of financial structures would advance bank efficiency levels.

With regard to developing economies, a study by Wezel (2010) analyses the bank efficiency of eighty-six domestic and foreign banks in six countries from the Central American region by measuring the productivity through the MPI. The results in this study demonstrate that efficiency in international banks is better than it is in domestic banks. On the other hand, in terms of productivity changes, the study found that local banks were better than foreign banks. A recent study using the same methodological framework was conducted by Ben Naceur *et al.* (2011) for some selected countries from the Middle East and North Africa in order to measure bank efficiency and investigate the impact of other factors related to policies, country development and financial and bank structures. They found that differences in efficiency levels are illustrated by the impact of those other factors.

All of these studies, whether in developed or developing countries, indicate the importance of environmental factors that could have an impact on bank efficiency. The latter study did, however, use the meta-frontier approach in measuring bank efficiency to investigate differences in production technologies in terms of efficiency levels, especially across different markets and regulations among countries. This approach is proposed by Battese and Rao (2002), and it is further developed by Battese *et al.* (2004) and O'Donnell *et al.* (2008).

With regard to the empirical studies related to *IB*, this study has followed the available literature in using econometric and statistical models to measure efficiency. Mokhtar *et al.* (2007) state that the IBF research has mostly concentrated on theoretical matters and that the analysis of empirical practices has primarily focused on descriptive statistics rather than statistical estimation.

In terms of comparing groups of countries by including GCC Islamic banking, Yudistira (2004) measured the efficiency of eighteen *IB* from the GCC, East Asia, the Middle East and African countries by applying DEA. The findings show that although *IB* were affected by the financial crisis of 1998 to 1999, they have recovered efficiently. In a further attempt at studying GCC banking, Al-Muharrami (2007) measured TE and productivity change in GCC banking by using DEA and the MPI. For statistical reasons, *CB* and *IB* are, however, used only on one frontier. Generally, the findings depict that there is a negative change in efficiency during the period and that the TE was reduced by 3%, along with a decrease in technology. It is indicated that the observed reduction could be due to provisional impact. Another study by Johnes *et al.* (2009) used DEA and the MPI to examine the efficiency of *IB* and *CB* in the GCC region from 2004 to 2007. The results suggest that the efficiency is notably higher among *CB* than *IB*. It also indicated that in producing the maximum outputs, *IB* are more efficient than *CB*, although they are not efficient at minimising the cost.

Other studies used the parametric techniques method when measuring efficiency and performance, such as Srairi (2010). He investigated the cost and profit efficiency of *CB* and *IB* in the GCC region by employing SFA and some factors that related to macroeconomic and banking structure to explore the variation in efficiency for the period from 1999 to 2007. Srairi concluded that cost and profit efficiency increased during the period in question, yet the progress was not steady, and the GCC banks were not as efficient at managing cost as they are in making profit. In addition, he indicates that under the condition of rising prices, it is better for the GCC banks to manage expenses of labour rather than expenses of interest (cost of fund). His study shows that in terms of the geographic evaluation of cost efficiency, Oman was the most efficient, whereas Kuwait was the least efficient.

According to bank types, Srairi (2010) found that *IB* are less efficient than *CB*, which could be due to many reasons, such as the assets size of *IB* being smaller than that of the *CB*; they have therefore not obtained the advantages of scale economies. Thus, he suggested that *IB* should improve their size by means of mergers to acquire economies of scale. In his more recent study, Srairi (2011) investigated the productivity change of both bank types in the GCC region by using the MPI, and his findings show that *IB* have underperformed in comparison to *CB*.

When reflecting on the empirical papers reviewed, this study distinguishes itself from the existing studies on banking efficiency in the Gulf region on two points. Initially, it uses the meta-frontier approach to obtain an accurate comparison between the GCC countries and between the three bank types, as this approach takes into account the technology differences across the group of countries and firms. In addition, the meta-frontier is employed with the DEA method, which helps to measure efficiency between different countries (Ben Naceur *et al.,* 2011). Further, it uses the MPI to evaluate productivity change over time and to obtain the catch-up rate (Chen and Yang, 2011). The second point is that to determine the variation in efficiency scores, which are produced from the meta-frontier, several environmental variables related to banks' characteristics, financial structures and regulations are employed with different models, including bootstrap procedure as derived from Simar and Wilson (2007). The application of this methodology can be found in Delis and Papanikolaou (2009), and it is further explained in the following section.

3.4 EMPIRICAL METHODOLOGY

This section delineates the methods and models that are used in the application to measure the performance within the GCC's banking sectors. Efficiency levels between each country and between the groups for *IB* relative to *IW* and *CB* are compared by applying the DEA meta-frontier method through an output distance function to obtain efficiency levels and TGR. In addition, to assess the variation in the TE, some environmental variables related to banks' characteristics, financial structures and the rule of law are investigated through the second-stage model of DEA. Therefore, this section aims to discuss the methodological issues in detail.

3.4.1 Distance Function and the Meta-Frontier Model

The concept of distance function is described in Chapter Two. To compare the TE of a number of firms with different structures between different countries, Battese *et al.* (2004) and O'Donnell *et al.* (2008) defined the meta-frontier approach as a frontier that encloses or envelops a group of frontiers. Accordingly, efficiency levels are measured in relation to the meta-frontier concept in two steps. Firstly, to compute the TE of output and input combinations in the group frontiers, for each country and each bank group. After that, to calculate the gap between the meta-frontier and the group frontiers in the first step. The evaluated gap can be defined as the "meta-technology ratio” or the TGR (O’Donnell *et al.,* 2008: 232–33). The section below considers the framework for the output distance function and the meta-frontier.

The current study aims to examine the efficiency of the GCC countries alongside bank groups using the meta-frontier model. Therefore, it is convenient to represent the group frontiers, output sets and output distance functions of a specific group A (>1), which can be characterised according to O’Donnell *et al.* (2008) as:

$$P^A(x) = \{y: (x, y) \in T^A\}, \qquad A = 1,2, \dots, A; \text{ and} \quad (3.1)$$

$$D^A\,(x, y) = inf\delta \left\{\delta > 0 : \left(\frac{y}{\delta}\right) \in P^A(x)\right\}, \quad A = 1,2, \dots, A. \quad (3.2)$$

Therefore, it is specified to group frontier by the boundaries of the specific group output sets.

3.4.2 TE and Meta-Technology Ratios

An observation $D\,(x, y)$ is considered efficient when equal to “1”. In addition and as is consistent with O’Donnell *et al.* (2008), for one observation (or one firm) an output-oriented measure of TE with regard to meta-technology can be identified as:

$$TE^*\,(x, y) = D^*\,(x, y). \quad (3.3)$$

For group A, the output-oriented measure of TE with regard to the technology of the group is defined as:

$$TE^A\,(x, y) = D^A\,(x, y). \quad (3.4)$$

For group A, the output-orientated meta-technology ratio can be specified as:

$$MTR^A\,(x, y) = \frac{D^*\,(x,y)}{D^A(x,y)} = \frac{TE^*\,(x,y)}{TE^A(x,y)} \quad (3.5)$$

Or as:

$$TE^{*}(x,y) = TE^{A}(x,y) \times MTR^{A}(x,y). \quad (3.6)$$

$MTR^{A}(x,y)$ measures the gap between the meta-frontier and the groups' A frontiers, and it can also be named the TGR.

Figure 3.6- Meta-Frontier Model and Meta-Technology Ratio

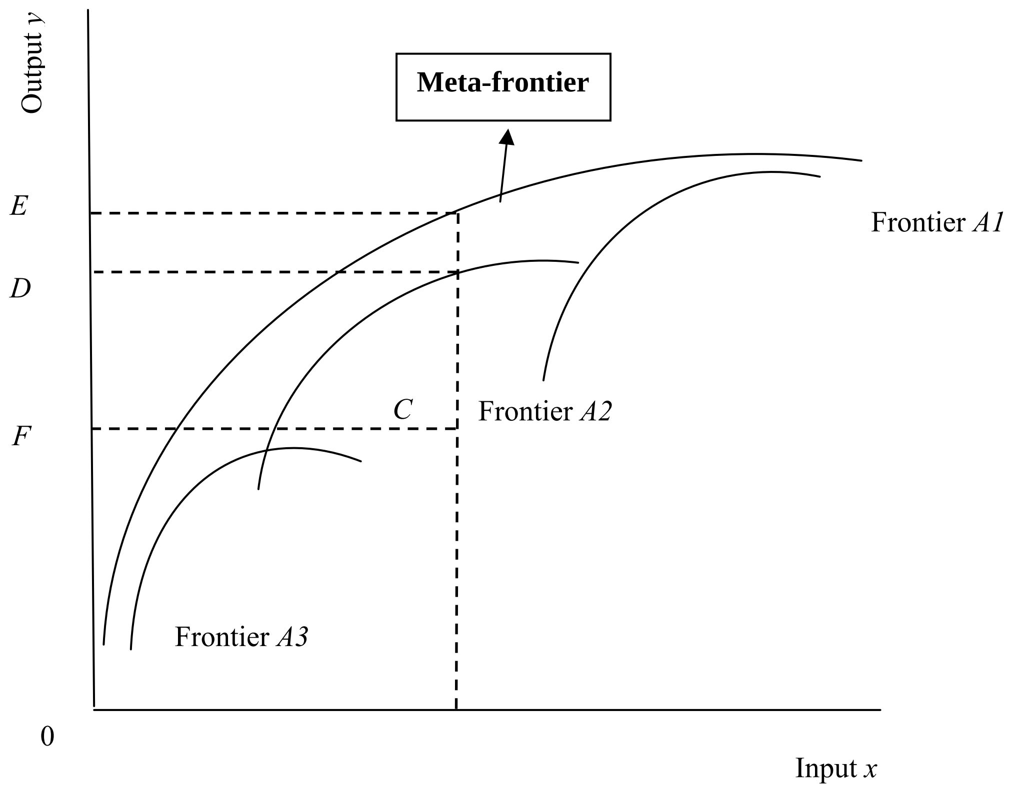


Figure 3.6 describes the meta-frontier function model and the meta-technology ratio, where the meta-frontier envelops the groups A 1, 2, 3 frontiers (or country frontiers), and the meta-technology ratio can be obtained by $\frac{0F/0E}{0F/0D}$, which is equal to $\frac{TE^{*}(x,y)}{TE^{A}(x,y)}$ in equation (3.5).

3.4.3 Data Envelopment Analysis (DEA)

The definition and concept of the DEA approach are described in Chapter Two. This study adopts a multi-output orientation of the DEA form, which can be estimated as t period, y_{it} is the $M \times 1$ vector of output quantities for i firms, and Y is the M × $L_k T$

matrix of output quantities for all L_k firms. The VRS equation is therefore written by Coelli *et al.* (2005) as:

$$max_{\emptyset\, i,t,\lambda\, i,t}\ \emptyset_{i,t}$$

$$st. -\emptyset_{i,t}y_{i,t} + Y\lambda_{i,t} \geq 0,$$

$$-X_{i,t}\lambda_{i,t} + x_{i,t} \geq 0,$$

$$l1'\lambda_{i,t} = 1 \quad and$$

$$\lambda_{i,t} \geq 0. \tag{3.7}$$

Here, $\emptyset_{it}$ is a scalar, which is described in Chapter Two.

3.4.4 The MPI and Meta-Frontiers

Initially, Malmquist (1953) suggested the structure of proportion calculation for distance functions by input indices; this technique was later developed and illustrated by Caves *et al.* (1982). The MPI is described by Coelli *et al.* (2005) as a component to calculate the total factor productivity variation between two time periods through the use of the output distance rate of every period and firm (bank) in relation to its technology. That component, which is also defined as a geometric mean of two ratios, is written by Coelli *et al.* (2005) as:

$$m(x_{i,t}, y_{i,t}, x_{i,t+1}, y_{i,t+1}) = \left[\frac{d^{i,t}(x^{i,t+1}, y^{i,t+1})}{d^{i,t}(x^{i,t}, y^{i,t})} \times \frac{d^{i,t+1}(x^{i,t+1}, y^{i,t+1})}{d^{i,t+1}(x^{i,t}, y^{i,t})}\right]^{1/2} \tag{3.8}$$

When m evaluation is greater or (less) than one this indicates an increase or (a decline) in *MPI* during the specified period (*t*) and firm (*i*). Furthermore, the above equation can be reorganised to comprise technical efficiency change (EC) and technical change (TC):

$$m(x_{i,t}, y_{i,t}, x_{i,t+1}, y_{i,t+1}) = \frac{d_{i,t+1}(x_{i,t+1}, y_{i,t+1})}{d_{i,t}(x_{i,t}, y_{i,t})}\left[\frac{d_{i,t}(x_{i,t+1}, y_{i,t+1})}{d_{i,t+1}(x_{i,t+1}, y_{i,t+1})} \times \frac{d_{i,t}(x_{i,t}, y_{i,t})}{d_{i,t+1}(x_{i,t}, y_{i,t})}\right]^{1/2} \tag{3.9}$$

The first part of the right-hand side of the equation evaluates the EC; the second part shows the TC, which measures the frontier shifting from period *t* to another period *t+1*.

It is worth noting that the aim of this study is to compute the MPI of each bank as a decision-making unit (DMU) through group and meta-frontiers in order to obtain the catch-up *t, t+1* rate, which is described by Rao and Dolan (2007) and by Chen and Yang (2011). Mathematically, the concept of catch-up *t, t+1* can be defined as the MPI of the frontiers for a group or country (*A*) (MPIG) divided by the MPI of the meta-frontier (MPIM); thus, the equation of MPIG can thus be written as:

$$MPIG = m^k\left(x_{i,t}, y_{i,t}, x_{i,t+1}, y_{i,t+1}\right) = \frac{d^k_{i,t+1}(x_{i,t+1}, y_{i,t+1})}{d^k_{i,t}(x_{i,t}, y_{i,t})}\left[\frac{d^k_{i,t}(x_{i,t+1}, y_{i,t+1})}{d^k_{i,t+1}(x_{i,t+1}, y_{i,t+1})} \times \frac{d^k_{i,t}(x_{i,t}, y_{i,t})}{d^k_{i,t+1}(x_{i,t}, y_{i,t})}\right]^{1/2} \quad (3.10)$$

MPIG can simply be expressed as:

$$MPIG = EC^k_{t,t+1} \times TC^k_{t,t+1} \quad (3.11)$$

The MPIM that is estimated through meta-frontier can be obtained from the equation below:

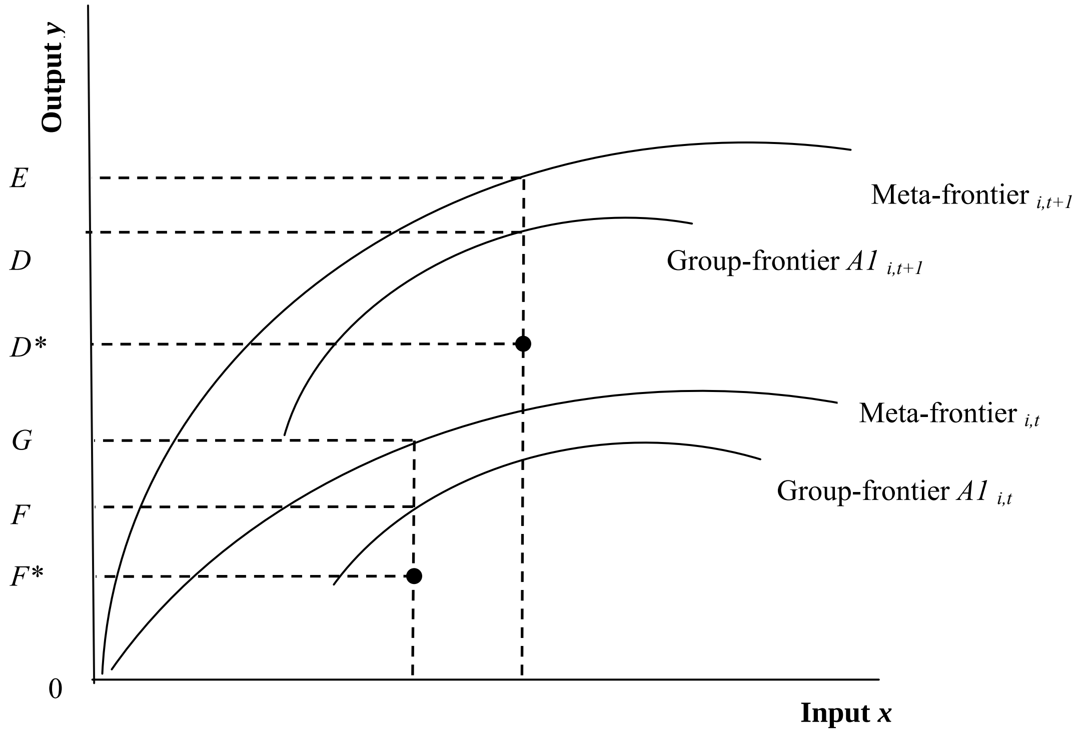
$$MPIM = m^*\left(x_{i,t}, y_{i,t}, x_{i,t+1}, y_{i,t+1}\right) = \frac{d^*_{i,t+1}(x_{i,t+1}, y_{i,t+1})}{d^*_{i,t}(x_{i,t}, y_{i,t})}\left[\frac{d^*_{i,t}(x_{i,t+1}, y_{i,t+1})}{d^*_{i,t+1}(x_{i,t+1}, y_{i,t+1})} \times \frac{d^*_{i,t}(x_{i,t}, y_{i,t})}{d^*_{i,t+1}(x_{i,t}, y_{i,t})}\right]^{1/2} \quad (3.12)$$

In terms of EC and TC, this can also be rewritten as:

$$MPIM = EC^*_{t,t+1} \times TC^*_{t,t+1} \quad (3.13)$$

Figure 3.7 illustrates the technical EC and the TGR for a firm during two time periods (*t, t+1*) by assuming that in the first period (*t*) the firm (*i*) is producing at point F^*; the group frontier is located at point *F*, and the TE^k would be measured by $\frac{0F^*}{0F}$ and the TE^* of the meta-frontier is $\frac{0F^*}{0G}$. In the second period (*t+1*), the TE^k is presented by $\frac{0D^*}{0D}$, where the TE^* is $\frac{0D^*}{0E}$. Therefore, the TGR for period *t* is $\frac{0F}{0G}$, and for period *t+1* it is $\frac{0D}{0E}$.

Figure 3.7- The Meta-Frontier Concept over Two Periods



According to the meta-frontier form, MPIM, by enveloping the entire group or country frontiers with dissimilar technologies, provides an evaluation of the productivity growth through time trend. Equation 3.14 provides a mathematical illustration representing the measurement of the MPIG term besides TGR change for group *A* from period *t* to period *t+1*. This measurement is associated with the catch-up component, as described by Chen and Yang (2011):

$$MPIM = EC^{k}_{t,t+1} \times TC^{k}_{t,t+1} \times \left[Catch - up_{t,t+1}\right]^{-1} \tag{3.14}$$

The catch-up component in equation 3.14 is defined by Chen and Yang (2011) as:

$$\left[Catch - up_{t,t+1}\right]^{-1} = \left[\frac{TGR^{k}_{i,t+1}(x_{i,t+1}, y_{i,t+1})}{TGR^{k}_{i,t}(x_{i,t}, y_{i,t})} \times \frac{TGR^{k}_{i,t}(x_{i,t+1}, y_{i,t+1})}{TGR^{k}_{i,t+1}(x_{i,t}, y_{i,t})}\right]^{1/2} \tag{3.15}$$

By replacing the two first elements of the right-hand side in equation 3.14 with equation (3.11) to acquire:

$$MPIM = MPIG \times \left[Catch - up_{t,t+1}\right]^{-1} \tag{3.16}$$

Here, catch-up terms can be measured as:

$$catch - up_{t,t+1} = \frac{MPIG}{MPIM} \quad (3.17)$$

As indicated by both Färe *et al.* (1994) and Kumbhakar and Wang (2005), the catch-up term evaluates how country or group frontiers perform in terms of production points and productivity growth towards the meta-frontier (Chen and Yang, 2011: 198). Practically, this is depicted in equation 3.17, where the catch-up value would mainly be affected by the value of MPIG, which is comprised of the EC and TC of group *K*.

3.4.5 Second-Stage Regression of the DEA Meta-Frontier Model

In this study, the efficiency level is evaluated through the meta-frontier DEA model to achieve a comparable assessment among the GCC countries and bank type groups. Other factors are, however, able to have an impact on efficiency measures. It is therefore crucial to take into account the influence of environmental variables on efficiency scores. In addition, the second stage is applied by the form identified in equation 3.18 to examine these effects:

$$TE_{i,t} = \alpha + \beta Z_{it} + \varepsilon_{i,t} \quad (3.18)$$

Here, the dependent variable is the TE scores for the meta-frontier; on the right-hand side of the equation are the parameters α (constant) and β (parameter of the explanatory or independent variables); Z_{it} includes internal variables related to banks' characteristics and external variables related to financial structure and the rule of law; the $\varepsilon_{i,t}$ element presents the error term.

Two models are applied in order to estimate the influence of environmental variables on banks' efficiency: panel random effect and bootstrap procedures.[2] The latter is derived from Simar and Wilson (2007), who observed that the two-stage or semi-parametric approach estimation and inference potentially involve two complications. Initially, the estimated parameters could suffer from a serial correlation problem, and the dependent variable is measured from the first stage, which relies on input and

[2] Panel random effect is preferred rather than fixed effect due to the explanatory variables in the estimated model that contain dummy variables, where the presence of such a variable is considered to be an obstacle to estimating the fixed effect model, as the latter is calculated by counting dummy variables of *N* groups in the model, which is indicated by Greene (2006).

output variables, and could lead to biased estimates. The second problem arises with the error element, which could be correlated with independent variables. Therefore, to overcome such problems and enhance the two-stage efficiency estimation and inference, Simar and Wilson (2007) proposed bootstrap procedure, which is conducted in the following steps:

(i) After obtaining the TE scores in the first stage, the parameters in the second stage are estimated through ML combined with the truncated regression of the TE_i on Z_i in equation 3.18; this step presents consistent estimates of the parameters, although it is without the common convergence level.

(ii) To acquire the bootstrap, the estimated model is replicated (2000 times) over three steps:

  (a) For each bank, calculate the standard error from the distribution with left-truncation.

  (b) Recalculate the dependent variable (TE) for each bank.

  (c) Apply the maximum likelihood approach to estimate the yielded parameters through truncated regression. This step is defined as a non-linear regression model of parametric bootstrap with specified properties, which were explored by several studies (Bickel and Freedman, 1981).

(iii) The bootstrap values are used and the former or basic estimates of each term to compute the confidence intervals. (For more details, see algorithm #1 Simar and Wilson, 2007: 41.)

It should be noted that at this stage, the purpose of using bootstrap procedure is to examine the robustness of the estimated equation. Therefore, the findings of the two models, namely panel random effect and bootstrap, are compared.

3.5 EMPIRICAL APPLICATION

This section determines the source of the applied data and defines it to assess the TE scores. To specify the input-output variables in the banks' efficiency estimation, the "intermediation approach" is used, as is highlighted by Berger and Humphrey (1997).

The relevant body of literature on bank efficiency indicates that, with the exception of bank branch studies, the intermediation approach has remained the main approach.

3.5.1 Data

The inclusive set of cross-sectional panel data is drawn from Bankscope, where the selected banks and time period depend on the availability of this data for all of the GCC countries except Oman, which is omitted because of the absence of *IB* in the country until recently. It should be noted that foreign banks are also excluded from the sample, as they operate as branches in the GCC region,

The empirical sample is limited to commercial banking, which consists of eleven banks in Saudi Arabia, eighteen banks in the UAE, nine banks in Bahrain, seven banks in Qatar and nine banks in Kuwait. In terms of bank type groups, the sample contains sixteen *IB*, eighteen *IW* and twenty *CB*. The study covered the period from 2005 to 2010. Furthermore, all of the annual variables are used in US dollars and are then converted to suitable real prices according to the GDP deflator in 2007. These deflators can be acquired from the World Databank through the website of the World Bank Organization. The input-output variables of the DEA meta-frontier model and explanatory variables are statistically described in Table 3.2.

Table 3.2- Statistical Summary of Variables

DEA Input and Output Variables	*Mean*	*SD*	*Min.*	*Max.*
Saudi Arabia				
Loans	15557.7	9891.14	1196.78	36506.5
Other Earning Assets	9033.91	7954.24	207.552	37173.3
Deposits	21626.5	14921.9	899.130	67528.4
Operating Expenses	398.418	293.180	60.1140	1650.89
Equity	3533.58	2499.98	665.812	9112.27
The UAE				
Loans	10273.2	13740.4	482.778	68253.3
Other Earning Assets	3662.38	4271.09	97.1425	18273.1
Deposits	11329.1	14382.7	453.120	68818.3
Operating Expenses	188.169	212.865	11.1813	1109.90
Equity	1913.19	2089.94	145.674	10292.6
Bahrain				
Loans	2371.22	3640.90	119.970	15593.2
Other Earning Assets	1788.20	2699.11	34.5950	10287.7
Deposits	3318.49	5313.66	49.1040	21017.2
Operating Expenses	61.7948	66.3891	3.82500	291.648
Equity	566.805	675.786	52.2660	2697.16
Qatar				
Loans	6406.31	7712.48	498.542	34781.6
Other Earning Assets	3404.53	3553.25	506.072	14192.7
Deposits	8116.33	10367.0	450.885	46929.7
Operating Expenses	105.210	86.6732	8.01000	337.015
Equity	1528.63	1438.77	194.154	6470.62
Kuwait				
Loans	8584.98	7437.35	43.5616	28006.5
Other Earning Assets	4200.19	3552.14	687.397	13072.6
Deposits	11473.9	9930.36	546.301	37519.5
Operating Expenses	188.463	206.943	11.5068	850.221
Equity	1839.30	1833.06	133.569	7472.06
IB Group				
Loans	5671.06	7811.00	43.5616	35510.6
Other earning Assets	2607.12	3109.56	34.5950	13072.6
Deposits	6829.77	9312.70	49.1040	41178.0
Operating Expenses	168.360	213.548	3.82500	895.951
Equity	1426.20	1807.62	52.2660	8578.11
IW Group				
Loans	15336.2	13161.9	400.775	68253.3
Other Earning Assets	8277.03	7051.03	148.297	37173.3
Deposits	20378.5	16419.6	498.244	68818.3
Operating Expenses	321.255	282.982	8.84000	1650.89
Equity	3074.24	2396.42	54.4850	10292.6
CB Group				
Loans	6635.68	8152.36	215.900	39361.8
Other Earning Assets	2616.14	2859.36	90.0160	12306.6
Deposits	7783.55	8817.43	203.490	37519.5
Operating Expenses	114.104	123.199	7.65000	621.027
Equity	1375.33	1615.28	113.490	7511.73
Average of Countries and Groups				
Loans	9250.03	10888.0	43.5616	68253.3
Other Earning Assets	4500.43	5429.48	34.5950	37173.3
Deposits	11699.3	13468.3	49.1040	68818.3
Operating Expenses	199.230	231.271	3.82500	1650.89
Equity	1956.71	2109.86	52.2660	10292.6
Explanatory Variables				
Net Loans/Deposits and Short-Term Funding	0.90520	0.79574	0.07422	7.43090

(*NLD*)				
IB (Dummy)	0.29630	0.45733	0	1
IW (Dummy)	0.33333	0.47212	0	1
Bank Size (*Size*) (Dummy)	0.51852	0.50043	0	1
Concentration (*CON*)	0.58277	0.13914	0.36406	0.856871
Foreign Ownership (*FO*) (Dummy)	0.38890	0.48824	0	1
Government Ownership (*GOV*) (Dummy)	0.42593	0.49525	0	1
Rule of Law (*RL1*) (PRS)	0.77780	0.07870	0.66670	0.83333
Rule of Law (*RL2*) (EIU)	0.60661	0.07032	0.52000	0.78000

Note: All input and output variables are presented in real values of million US dollars. SD shows the standard deviation of the variables; PRS is the Political Risk Service indicator; EIU is the Economist Intelligence Unit indicator.

3.5.2. Variable Definition

The specified input and output variables in this study are adopted from the available literature on banking efficiency studies (Abdul-Majid, 2008; Johnes *et al.*, 2009; Delis and Papanikolaou, 2009). The intermediation approach considers the bank as an intermediary between savers and borrowers that transforms monetary sources into output quantities. Consequently, the input variables used are total deposits, short-term funding, equity and operating expenses, which include non-interest and personal expenses; the output variables are total loans and other earning assets.

3.5.2.1. Bank Characteristics

The second-stage regression comprises the environmental variables. The variables for the banks' characteristics are the ratio of net loans to deposits and short-term funding (*NLD*), the dummy variable of bank size (size) and the dummy variables of bank types; fully-fledged *IB* and *IW*.

The internal factors are evaluated to explore the effect of the banks' operation management on performance. The *NLD* ratio is selected to examine the banks' ability to transform deposits into loans as an intermediate firm under specific and different regulations for each GCC country. A greater ability to produce loans from deposits leads to greater bank performance; thus, a positive relationship is expected between the intermediation ratio (*NLD*) and the banks' efficiency, and this variable is adopted by the literature on banks' efficiency (Carvallo and Kasman, 2005; Abdul-Majid, 2008).

With regard to the size variable, the majority of studies have chosen to explore which bank sizes could boost efficiency. It should be identified that Delis and Papanikolaou (2009), among others, found that the growth of bank size led to increased efficiency. In order to capture the size effect, two types of variables were used in this study to investigate the impact of a firm's size on efficiency: a non-linear variable, by applying the logarithm of total assets (Simar and Wilson, 2007), and a dummy variable, which symbolises large firms (Assaf and Josiassen, 2011). For some statistical reasons related to the validity of the data, the current study does, however, adopt the latter type of variable.

It is crucial for this study to investigate the impact of Islamic banking on the banks' performance; from the previous sections it has been observed that most banks within the GCC deliver Islamic products, whether it is through fully-fledged *IB* or as *IW* in *CB*. Dummy variables for *IB* and *IW* are therefore employed (see: Al-Jarrah 2002; Abdul-Majid 2008). By recalling section 3.2.1 and according to the financial ratio indicators, *IW* perform better than *IB*. Furthermore, most *IB* practice as venture capital providers and thus seem to be more at risk than traditional banks (Hussein, 2004). As a result, the estimated relationship between the banks' efficiency and being an *IW* is positive, while it is negative with *IB*.

3.5.2.2 Financial Structures and the Rule of Law

The second group of explanatory variables are concentration (*CON*), ownership structure, including dummy variables of foreign ownership (*FO*) and government ownerships (*GOV*), and the rule of law (*RL1* and *RL2*). Evidence from the literature indicates the importance of the *CON* variable on the banks' efficiency, which reflects the power of the financial sector and competition (see: Delis and Papanikolaou, 2009; Ben Naceur *et al.,* 2011). It is measured by the total assets of the three largest banks to the total assets of all banks, in this study sample, in each country. The assumption that *CON* has an effect on the banks' efficiency cannot be expected to be held due to the mixed findings in the literature, where it is highlighted that more concentrated sectors lead to increased profitability, which in turn may raise the efficiency, but in contrast, increasing *CON* could adversely affect competition, which decreases the efficiency level.

With regard to ownership structure, the authorised legislation for FO in the GCC's banking sectors is quite restricted. The percentage distribution of foreign banks within the GCC in 2007 was around 40%; 40% in Saudi Arabia and the UAE, and 49% in Qatar and Kuwait, with the exception of Bahrain at more than 65%, where the foreign assets represent 57% of the total assets (Al-Hassan *et al.,* 2010). In addition, *GOV* contributes a significant part of the total assets in the GCC countries; for instance, in the UAE by the end of 2007 the government's share was around 41% of the total assets (Al-Hassan *et al.,* 2010). Therefore, the importance of these variables, namely *FO* and *GOV*, does raise a question as to the direction in which the impact of those variables may drive the efficiency of the GCC banks. In accordance with the efficiency literature (for example, Bonin *et al,* 2005; Berger *et al.,* 2008), the *FO* variable has been chosen, which results in a positive effect for foreign banks when compared with domestic banks. In this case study, the direction of the *FO* variable is, however, unclear, which is to be expected, and tends to have a negative coefficient. This outcome is probably due to the limited share of *FO* and the restricted regulations in most of the GCC countries. The *GOV* variable reflects liquidity pumping and represents the oil revenue, which is expected to have a positive impact on the GCC banks' efficiency.

In terms of the legal system, the rule of law is selected from the World Wide Governance Indicators for each GCC country to examine the impact of it on the banks' efficiency. To this end, two variables are employed: *RL1* and *RL2*, which are taken from the *Political Risk Services International Country Risk Guide* (PRS) and the EIU. In addition, these indicators evaluate the implemented rules of society, such as the quality of contract enforcement and courts. Ben Naceur *et al.* (2011) stated that efficient regulation improves the financial sector and is hence expected to have a positive influence, indicating a higher level of TE in the GCC's banking sectors.

3.6 EFFICIENCY MEASURES IN GCC BANKING: A COMPARATIVE ANALYSIS OF THE FINDINGS

After identifying the detailed method and empirical procedure, this section aims to present the findings of the study. To this end, it is divided into three parts: the first part discusses the outcomes of the DEA meta-frontier results in the GCC countries and bank groups; the second section presents the MPI results of the meta-frontier and group frontiers; and the third part deals with the estimated results of the environmental variables on the banks' efficiency.

3.6.1 DEA Meta-Frontier Findings

The estimated efficiency scores are measured through DEA with VRS assumption and output distance function. Initially, it is worth noting that although the results are presented in the real values after using the GDP deflator, nominal values for the input-output data are used in order to account for the homogeneity matter in the DEA estimation, particularly when evaluating productivity through time (*t, t+1*), and to ensure that the data is not heterogonous. Thus, it is found that the meta-frontier results for both sets of data are very similar.[3]

For the estimation, the obtained results for the GCC countries of the panel data set are averaged for each year and presented within Table 3.3, in which the estimation of efficiency scores corresponds with the country frontier (CF), the meta-frontier (MF) and the technology gap ratio (TGR).

On examining the estimates for the TE of the CF in Table 3.3, the performance of Saudi Arabia, the UAE, Bahrain and Kuwait has generally declined from 2005 to 2010. In contrast, the TE scores for Qatari banks have shown an improvement during that period when compared to other countries. Thus, the average of the CF for all of the countries involved dropped from 95% to 91% in 2010.

The following TGR, in Table 3.3, further illustrates production technology in relation to the CF. In 2005, the average of the estimated TE from the CF in commercial Bahraini banks was 92.5%, which represented the possible average output by using a given level of inputs. Correspondingly, the TGR is 0.927, signifying that those banks could perform at the level of best practice by producing output at 93% with the same level of inputs. Conversely, the efficiency scores of the CF of Saudi banks in 2010 were about 96% when compared with the TGR at 0.847, revealing that the maximum output which can be produced by those banks with the same level of inputs in Saudi Arabia, and the technology provided by the GCC, is about 85% (O'Donnell *et al.*, 2008).

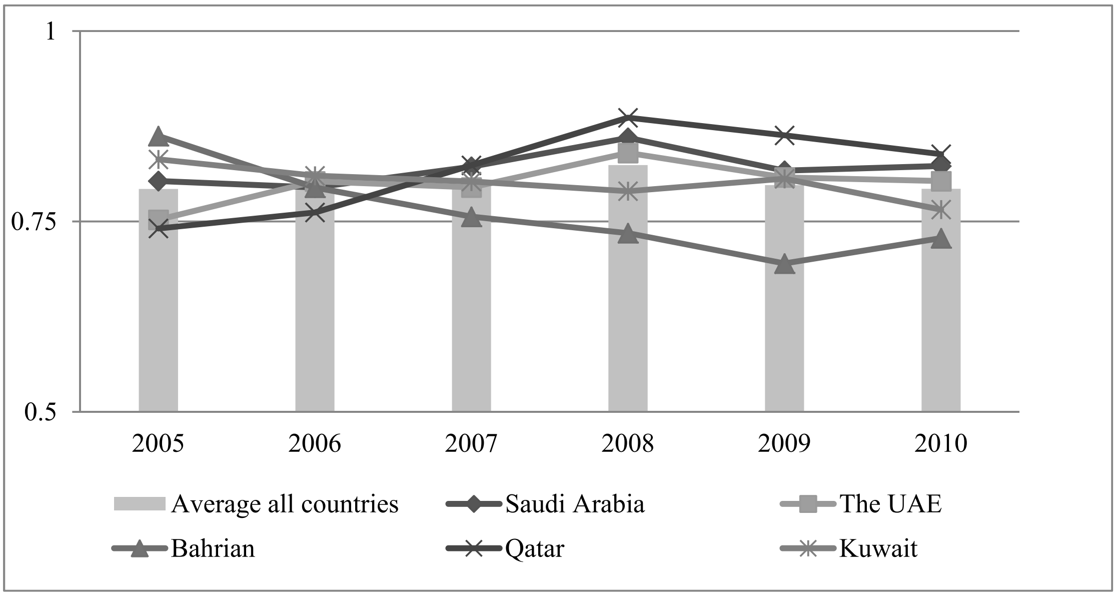
[3] See Table 1 in the appendices for the comparative statistical summary of the TE scores for the adjusted and nominal sets of data.

Table 3.3- TE and TGR of the DEA Meta-Frontier in the GCC Countries

Country	2005	2006	2007	2008	2009	2010	Average
Estimated TE Relative to the CF							
Saudi Arabia	0.997 (0.008)	0.983 (0.023)	0.971 (0.035)	0.978 (0.046)	0.977 (0.025)	0.966 (0.034)	0.95
The UAE	0.956 (0.076)	0.935 (0.082)	0.882 (0.102)	0.911 (0.077)	0.892 (0.073)	0.887 (0.084)	0.91
Bahrain	0.925 (0.137)	0.875 (0.190)	0.913 (0.070)	0.890 (0.108)	0.836 (0.140)	0.848 (0.174)	0.88
Qatar	0.869 (0.113)	0.875 (0.125)	0.912 (0.119)	0.957 (0.085)	0.949 (0.086)	0.929 (0.074)	0.915
Kuwait	0.984 (0.032)	0.955 (0.051)	0.938 (0.101)	0.942 (0.057)	0.962 (0.057)	0.940 (0.070)	0.95
All Countries	0.953 (0.088)	0.930 (0.106)	0.919 (0.091)	0.932 (0.080)	0.919 (0.094)	0.911 (0.101)	0.927
Estimated TE Relative to the MF							
Saudi Arabia	0.803 (0.136)	0.795 (0.091)	0.822 (0.111)	0.860 (0.124)	0.817 (0.114)	0.823 (0.114)	0.82
The UAE	0.752 (0.107)	0.803 (0.125)	0.795 (0.147)	0.840 (0.117)	0.808 (0.141)	0.803 (0.156)	0.80
Bahrain	0.862 (0.157)	0.795 (0.10)	0.755 (0.173)	0.735 (0.148)	0.695 (0.142)	0.727 (0.184)	0.762
Qatar	0.741 (0.131)	0.762 0.120)	0.824 (0.121)	0.885 (0.101)	0.863 (0.130)	0.837 (0.169)	0.818
Kuwait	0.832 (0.113)	0.810 (0.073)	0.801 (0.131)	0.790 (0.123)	0.806 (0.105)	0.766 (0.101)	0.801
All Countries	0.792 (0.130)	0.796 (0.122)	0.799 (0.135)	0.824 (0.129)	0.798 (0.133)	0.793 (0.147)	0.80
TGR							
Saudi Arabia	0.805 (0.135)	0.809 (0.093)	0.845 (0.098)	0.876 (0.096)	0.835 (0.108)	0.847 (0.094)	0.836
The UAE	0.790 (0.111)	0.858 (0.099)	0.896 (0.089)	0.919 (0.075)	0.901 (0.108)	0.899 (0.116)	0.877
Bahrain	0.927 (0.060)	0.902 (0.064)	0.822 (0.142)	0.823 (0.105)	0.832 (0.103)	0.858 (0.102)	0.861
Qatar	0.851 (0.078)	0.875 (0.098)	0.904 (0.072)	0.926 (0.060)	0.908 (0.091)	0.896 (0.122)	0.893
Kuwait	0.845 (0.110)	0.850 (0.089)	0.854 (0.087)	0.837 (0.103)	0.838 (0.089)	0.814 (0.084)	0.839
All Countries	0.832 (0.114)	0.856 (0.093)	0.866 (0.1001)	0.881 (0.094)	0.867 (0.104)	0.868 (0.107)	0.862

Note: Standard deviation is shown in brackets.

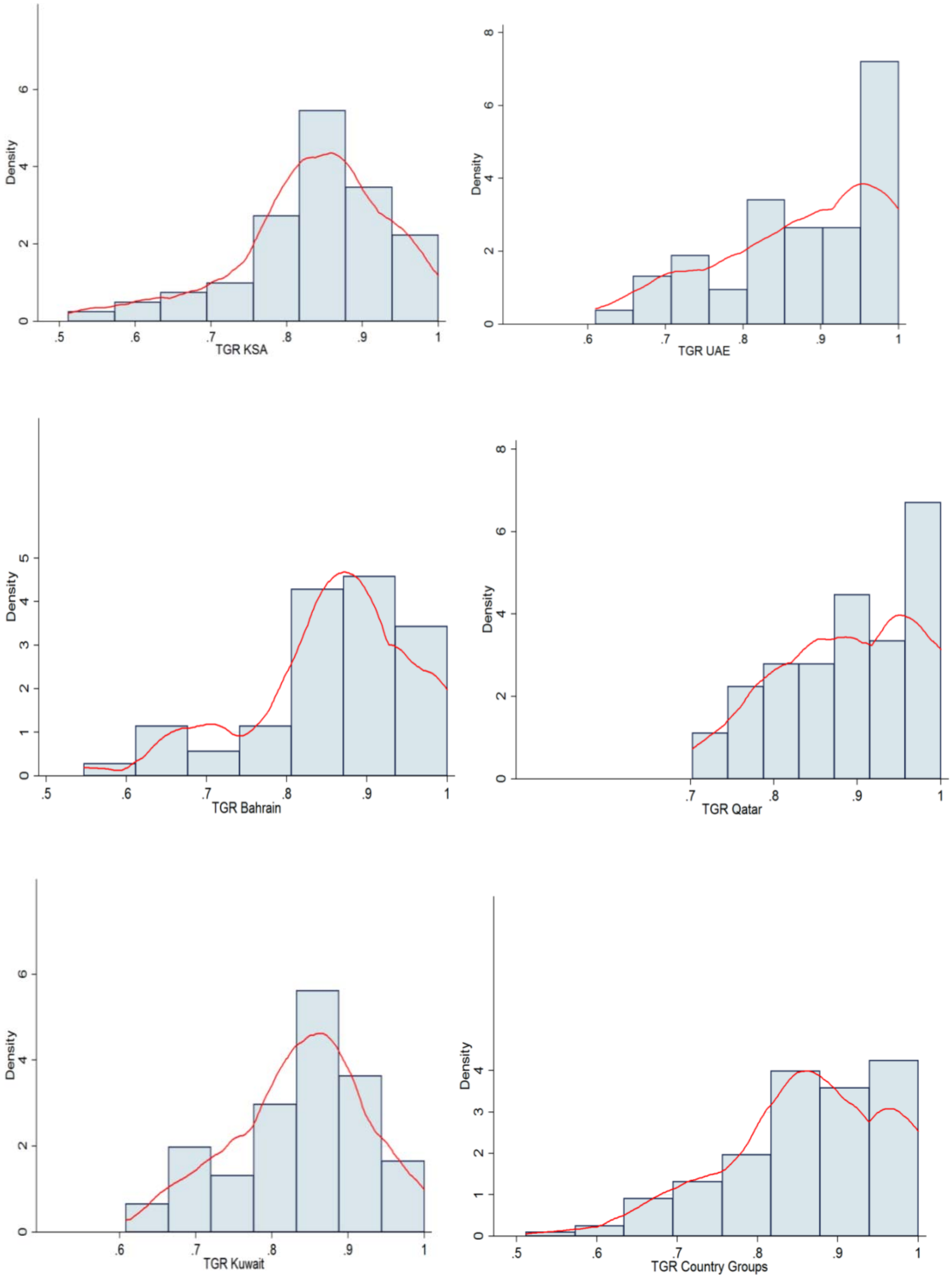
Figure 3.8- Efficiency Scores for the DEA-MF in the GCC Countries



Turning to the MF results, the TE scores for the CF are higher than the TE scores for the MF, where the MF envelops all of the countries' frontiers. The averages of the MF in Saudi Arabia and Qatar are 82% and 81.8%, which are the highest for the GCC region for that specified period, whereas Bahraini banks underperformed with an average of the MF at 76%. The performance of banks from the UAE and Kuwait was found to be fluctuating around the average of the MF at 80%. The scores for Kuwaiti banks were, however, below average in 2008.

In addition, Figure 3.8 displays the average trend of the MF as well as for each GCC country for the period from 2005 to 2010. It is observed that although Qatari banks were performing below the average of the MF, they improved significantly until 2008 and performed above the average. In contrast to the performance of the Qatari banks, Bahraini banks were found to be outperforming at the beginning of the period and then fell sharply until 2009, but they have recovered slightly during the period of the study.

Figure 3.9- Histogram and Kernel Density Estimate of the TGR in GCC Countries



The TGR results for the period in question show that on average the maximum TGR appears in Qatar at 89%, followed by the UAE at 88%. This means that Qatari banks were operating on the best level of available production technology among the GCC countries during the period in question. On the other hand, the TGR for the Saudi and Kuwaiti banks represent the lower ratios, indicating the presence of larger technology gaps.

As evidenced by the histogram and Kernel density estimate of the TGR for the five GCC countries depicted in Figure 3.9, the TGR pattern of Bahraini banks is considerably in accordance with the MF trend, where these banks seemed to use the best available technology in the region, yet Bahraini banks were underperforming during the years from 2007 to 2009.

At this stage an attempt has been made to examine the meta-frontier results according to bank groups that divided into three types, namely *IB*, *IW*, and *CB*. Table 3.4 displays the estimate of the efficiency scores relative to the group-frontier (GF), the MF and the TGR.

Starting with the analysis of the performance for the obtained TE scores through the GF and the MF, it is noted that the *IW* group has, on average for the selected period, shown the highest performance when compared to the other bank groups; it was followed by *CB* and then *IB*. This result is consistent with the trend of financial indicators (ROA and ROE) for each group of banks, as was described in section 3.2.2; it is also in line with Srairi's (2010) findings.

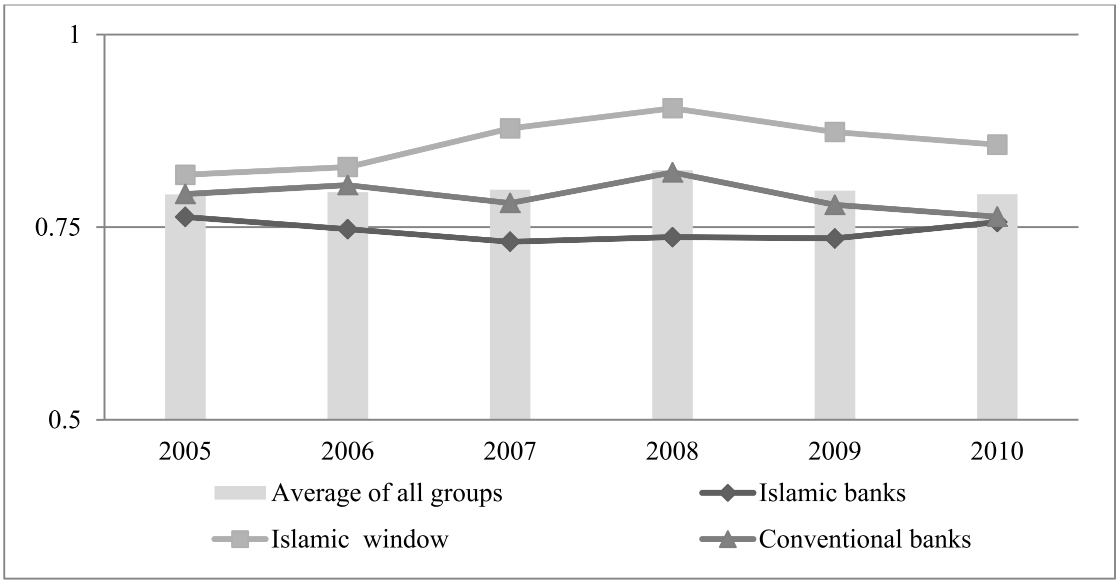
Table 3.4- The TE and TGR of the DEA Meta-Frontier in the GCC Bank Groups

Banks group	2005	2006	2007	2008	2009	2010	Average
Estimated TE Relative to the GF							
IB	0.835 (0.183)	0.818 (0.179)	0.808 (0.171)	0.824 (0.167)	0.833 (0.144)	0.849 (0.176)	0.827
IW	0.944 (0.053)	0.935 (0.046)	0.942 (0.055)	0.963 (0.030)	0.950 (0.054)	0.927 (0.076)	0.943
CB	0.946 (0.062)	0.923 (0.079)	0.874 (0.115)	0.899 (0.078)	0.883 (0.085)	0.863 (0.100)	0.90
All Groups	0.913 (0.120)	0.897 (0.121)	0.877 (0.129)	0.898 (0.115)	0.891 (0.108)	0.881 (0.124)	0.89.3
Estimated TE Relative to the MF							
IB	0.762 (0.171)	0.747 (0.169)	0.731 (0.151)	0.737 (0.147)	0.735 (0.122)	0.757 (0.156)	0.745
IW	0.818 (0.112)	0.828 (0.091)	0.877 (0.097)	0.903 (0.082)	0.874 (0.110)	0.857 (0.141)	0.86
CB	0.792 (0.106)	0.805 (0.096)	0.781 (0.123)	0.821 (0.104)	0.779 (0.137)	0.764 (0.129)	0.79
All Groups	0.792 (0.130)	0.796 (0.122)	0.799 (0.135)	0.824 (0.129)	0.798 (0.133)	0.793 (0.147)	0.80
TGR							
IB	0.917 (0.072)	0.915 (0.065)	0.908 (0.061)	0.898 (0.062)	0.887 (0.068)	0.894 (0.066)	0.903
IW	0.865 (0.094)	0.885 (0.081)	0.930 (0.062)	0.939 (0.076)	0.918 (0.090)	0.919 (0.095)	0.908
CB	0.837 (0.085)	0.870 (0.070)	0.894 (0.074)	0.914 (0.078)	0.883 (0.124)	0.886 (0.114)	0.881
All Groups	0.881 (0.174)	0.910 (0.240)	0.932 (0.224)	0.936 (0.213)	0.907 (0.178)	0.915 (0.206)	0.913

Note: Standard deviation is shown in brackets.

The trends of the TE scores, which are derived from the DEA-MF estimate for all of the groups, are presented in Figure 3.10. The *IW* group has dominated and *IB* have unfortunately lagged behind the average, yet *CB* appear to operate with an average trend of MF. The average efficiency score of MF for all of the groups is 80%, meaning that the banking sector of the GCC region could increase its output by 20% with the same levels of input.

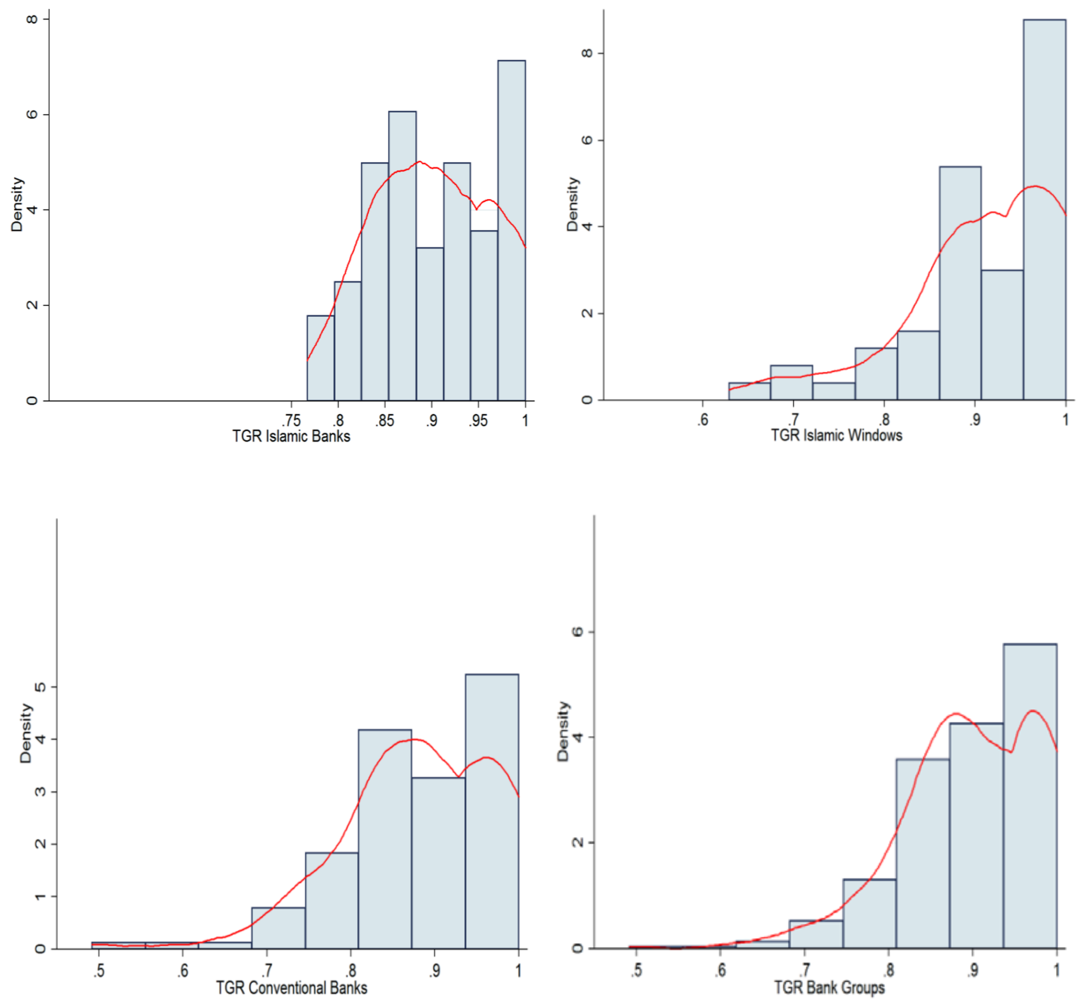
Figure 3.10- Efficiency Scores for the DEA-MF in the GCC Bank Groups



The results for the TGR in Table 3.4 reveal that the average for the *IB* group is about 90%, with an average of the GF at approximately 83%, indicating that the output level in the *IB* group is more restricted in terms of production technology than it is in other groups. Nonetheless, the average for the TGR proposes that *IB* could practice at the best level by producing at 90% while using the same levels of input and production technology provided by the GCC region. Consequently, it can be suggested that *IB* should expand their size in order to increase their performance and employ the best available technology.

Table 3.4, moreover, shows that despite *IB* having the highest TGR, they operated close to the MF; this ratio has, however, declined steadily and they appeared to perform below the average for the TGR. The TGR for *IW* has shown the highest ratio from 2007 until the end of the period. As Figure 3.11, the histogram and Kernel Density estimate of TGR for the three groups, reveals, on average the group for *IW* presents the highest ratio, which is about 91%.

Figure 3.11- Histogram and Kernel Density Estimate of the TGR for Bank Groups



3.6.2 MPI Results for the Meta- and Group Frontiers

The preceding section presented the findings for the DEA meta-frontier analysis; this section focuses on presenting the results for the MPI of the meta- and group frontiers (MPIM and MPIG). Table 3.5 sums up the MPIG, MPIM and catch-up values as calculated for five periods.

Ultimately, by observing the average of the productivity growth for the entire period (2005 to 2010), it can be seen that the MPIG value for Qatar indicates that it is the most productive country; it is followed by Kuwait and Bahrain. The scores for the UAE and Saudi Arabia appear to be less than "1", which means that their productivities declined during the period in question. Similarly and as the results show, in terms of the MPIM and the catch-up rate Qatar exhibits the highest productivity performance during most of the periods in question. Interestingly, these findings correspond with the average of TGR results. Qatar is then followed by Bahrain and Kuwait, which also managed to catch-up. It should be noted that the performance of the banks within the UAE and Saudi Arabia is at the lowest level.

The catch-up movement for each country is displayed in Table 3.5. Here, Qatar initially seems to be the only country that experienced a catch-up in productivity among the sampled countries. Meanwhile, during 2009 to 2010 the only country that failed to catch-up was Saudi Arabia.

Table 3.5- The Estimated MPIG, MPIM, and Catch-Up of Country Groups

Country	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	Average 2005-2010
Estimated MPIG						
Saudi Arabia	0.9702	1.0181	0.9880	0.9860	0.9765	0.9877
The UAE	1.0278	0.9467	0.9784	0.9929	1.0147	0.9921
Bahrain	1.0144	1.0891	0.9047	0.9497	1.0603	1.0037
Qatar	1.2233	1.0833	1.0367	0.9986	0.9964	1.0677
Kuwait	0.9547	0.9653	1.2644	0.9147	0.9732	1.0145
All Countries	1.0270	1.0058	1.0233	0.9720	1.0052	1.0067
Estimated MPIM						
Saudi Arabia	0.9837	1.040	0.9845	0.9761	0.9921	0.9953
The UAE	1.0520	0.9688	1.0480	0.9550	0.9868	1.0021
Bahrain	1.0466	0.9697	0.9330	0.9436	1.0399	0.9865
Qatar	1.1370	1.0612	1.0204	1.0040	0.9949	1.0435
Kuwait	0.9793	0.9742	1.2360	0.9628	0.9182	1.0141
All Countries	1.0361	0.9964	1.0437	0.9650	0.9863	1.0055
Catch-Up						
Saudi Arabia	0.9936	0.9793	1.0066	1.0162	0.9850	0.9961
The UAE	0.9828	0.9794	0.9296	1.0402	1.0276	0.9918
Bahrain	0.9671	1.1114	0.9772	1.0114	1.0148	1.0164
Qatar	1.0765	1.0209	1.0192	0.9951	1.0005	1.0224
Kuwait	0.9780	0.9913	1.0203	0.9665	1.0640	1.0040
All Countries	0.9937	1.0087	0.9799	1.0124	1.0193	1.0028

As the results in Table 3.5 show, countries with a higher TGR are generally more productive and have higher catch-up values, with the exception of the UAE. The UAE illustrated progress in its TGR, yet it only managed to catch-up for the last two periods and generally experienced a declining trend in productivity growth. Figure 3.12 depicts the relationship by means of a scatter plot, which shows that the TGR has a positive relationship with the lag/catch-up values, during the study period.

Figure 3.12- The Relationship between the TGR for GCC Countries and Catch-Up (2005 to 2010)

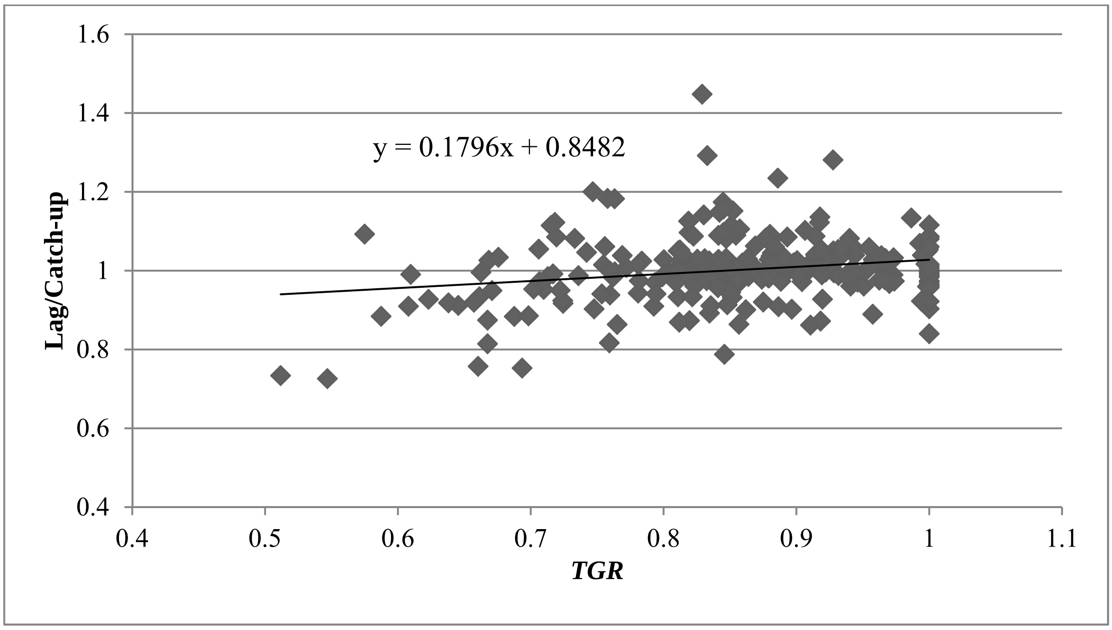


Table 3.6 depicts the performance of the MPIG, the MPIM and the catch-up values of each group. Although the TGR for *IW* represents the highest group, the recorded productivity growth of this group decreased during the period. Conversely, the TGR for *IB* appears to be lower than that for the *IW*, but the *IB* group emerges as the most productive group, as is shown in Table 3.6. Furthermore, the *IB* group has taken the highest value of MPIM; it is also the only group that has obtained the catch-up value for the whole period.

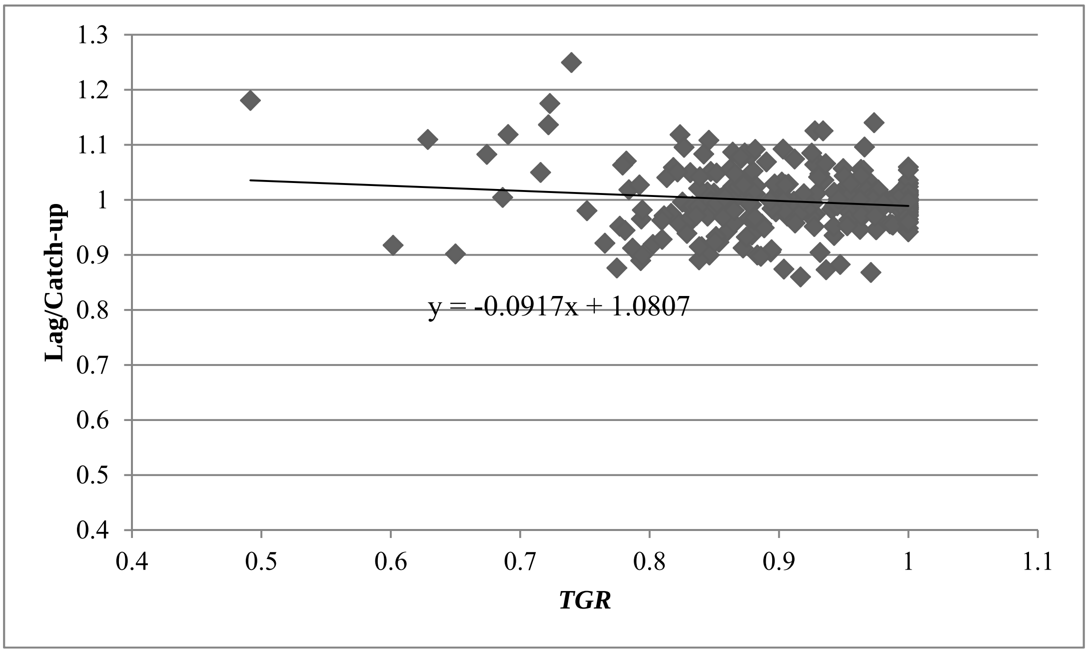
As the results in Table 3.6 reveal, *CB* managed to increase their productivity growth in only one period, and the average value of catch-up is less than “1”. It should be noted that this result is consistent with the TGR for the *CB* group. Indeed, the TGR for the various groups has a negative relationship with the catch-up values. Moreover, such analysis of bank groups results can also be observed in a scatter plot in Figure

3.13, which shows that TGR has a negative relationship with the lag/catch-up values during the period in question.

Table 3.6- The Estimated MPIG, MPIM, and Catch-Up for the Bank Groups

Bank Group	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	Average 2005-2010
Estimated MPIG						
IB	1.0530	0.9931	0.9710	1.0070	1.0650	1.0177
IW	1.0220	1.0050	0.9914	0.9863	0.9505	0.9910
CB	0.9931	0.9406	1.1445	0.9445	0.9772	1.0001
All Groups	1.0270	1.0058	1.0233	0.9720	1.0052	1.0067
Estimated MPIM						
IB	1.0596	0.9851	0.9586	1.0181	1.0398	1.0123
IW	1.0445	1.0354	0.9910	0.9695	0.9598	1.0001
CB	1.0095	0.9703	1.1590	0.9186	0.9675	1.0050
All Groups	1.0361	0.9964	1.0437	0.9650	0.9863	1.0055
Catch-Up						
IB	0.9975	1.0073	1.0107	0.9878	1.0217	1.0050
IW	0.9802	0.9736	1.0062	1.0199	0.9910	0.9942
CB	0.9873	0.9690	0.9786	1.0318	1.0108	0.9955
All Groups	0.9937	1.0087	0.9799	1.0124	1.0193	1.0028

Figure 3.13- The Relationship between TGR for Bank Groups and Catch-Up (2005 to 2010)



3.6.3 Second-Stage Regression Results for the Environmental Variables

Different explanatory variables are applied through four equations in order to investigate the variation in the obtained efficiency scores of the meta-frontier, which are presented in Table 3.7.

Initially, it is important to clarify that the validity of the estimated equations is examined in terms of multicollinearity (correlation between included independent variables), autocorrelation and heteroscedasticity (non-constant variance), yet the heteroscedasticity problem relates to the size variable.[4] Therefore, to avoid heteroscedasticity and to examine the robustness of the estimated equations, several models are applied, such as panel random effect, which includes GLS and bootstrap. These models are classified into two groups: in the first group size is included in the model, while in the second group it is excluded. This section thus provides the estimated results of four equations for the two specified types of environmental variables.

Table 3.7 presents the findings for the estimated coefficients of the variables for bank characteristics, both with and without the size variable. As the results show, the intermediation ratio or *NLD* is significant and positive with bank efficiency in all models, which provides evidence for the study's expectations and indicates that increasing *NLD* leads to a rise in the GCC banks' efficiency of around 5%.

[4] See Table 2 in the appendices, which presents the variance inflation factor (VIF) test.

Table 3.7- Second-Stage Estimates of DEA-MF

Variables	Panel RE GLS Robust SE	Bootstrap	Panel RE GLS Robust S.E	Bootstrap
With Size Variable	**Model 1**		**Model 2**	
NLD	0.0597***	0.0601**	0.0562***	0.0568*
	(0.0104)	(0.0294)	(0.0111)	(0.0297)
IB	-0.0522**	-0.0523**	-0.0522**	-0.0524**
	(0.0224)	(0.0227)	(0.0222)	(0.0227)
IW	0.0297	0.0298	0.0280	0.0281
	(0.0282)	(0.0291)	(0.0293)	(0.0302)
FO	-0.0411*	-0.0411*	-0.0438*	-0.0438*
	(0.0229)	(0.0233)	(0.0225)	(0.0230)
Size	0.104***	0.104***	0.114***	0.114***
	(0.0202)	(0.0214)	(0.0216)	(0.0228)
CON			0.123*	0.119
			(0.0694)	(0.0726)
Constant	0.714***	0.713***	0.642***	0.643***
	(0.0191)	(0.0299)	(0.0450)	(0.0528)
sigma_u		0.0572***		0.0575***
		(0.00829)		(0.00901)
sigma_e		0.0859***		0.0851***
		(0.00686)		(0.00730)
Wald chi2	68.52		70.53	55.78
Prob > chi2	0.000		0.000	0.000
Log likelihood function		300.47676		302.83282
Observations	324	324	324	324
Number of Banks	54	54	54	54
	Model 3		**Model 4**	
NLD	0.0624***	0.0628**	0.0561***	0.0567*
	(0.0106)	(0.0304)	(0.00951)	(0.0291)
IB	-0.0630***	-0.0632***	-0.0553***	-0.0555***
	(0.0189)	(0.0204)	(0.0197)	(0.0209)
GOV	0.0617***	0.0618***	0.0586***	0.0585***
	(0.0181)	(0.0191)	(0.0169)	(0.0173)
Size	0.127***	0.127***	0.143***	0.143***
	(0.0166)	(0.0181)	(0.0180)	(0.0188)
RL1	0.202	0.203		
	(0.126)	(0.137)		
RL2			0.374***	0.368***
			(0.132)	(0.130)
Constant	0.513***	0.512***	0.440***	0.443***
	(0.105)	(0.120)	(0.0839)	(0.0856)
sigma_u		0.0539***		0.0543***
		(0.00838)		(0.00892)
sigma_e		0.0859***		0.0845***
		(0.00687)		(0.00691)
Wald chi2	83.98	63.58	88.43	69.17
Prob > chi2	0.000	0.000	0.000	0.000
Log likelihood function		302.67216		307.06796
Observations	324	324	324	324
Number of Banks	54	54	54	54

Variables	Panel RE GLS Robust SE	Bootstrap	Panel RE GLS Robust S.E	Bootstrap
Without Size Variable	**Model 1**		**Model 2**	
NLD	0.0568***	0.0570**	0.0539***	0.0542*
	(0.0104)	(0.0284)	(0.0111)	(0.0293)
IB	-0.0635**	-0.0636**	-0.0644**	-0.0644**
	(0.0277)	(0.0276)	(0.0279)	(0.0281)
IW	0.0886***	0.0886***	0.0916***	0.0915***
	(0.0270)	(0.0275)	(0.0276)	(0.0283)
FO	-0.0815***	-0.0816***	-0.0866***	-0.0864***
	(0.0223)	(0.0225)	(0.0224)	(0.0228)
CON			0.0944	0.0905
			(0.0714)	(0.0794)
Constant	0.770***	0.770***	0.719***	0.721***
	(0.0202)	(0.0286)	(0.0434)	(0.0518)
sigma_u		0.0694***		0.0710***
		(0.00782)		(0.00852)
sigma_e		0.0859***		0.0852***
		(0.00687)		(0.00732)
Wald chi2	43.95	32.39	45.20	33.33
Prob > chi2	0.000	0.000	0.000	0.000
Log likelihood function		292.56904		293.76451
Observations	324	324	324	324
Number of Banks	54	54	54	54
	Model 3		**Model 4**	
NLD	0.0551***	0.0553*	0.0483***	0.0486
	(0.0120)	(0.0301)	(0.0117)	(0.0299)
IB	-0.110***	-0.110***	-0.105***	-0.105***
	(0.0282)	(0.0295)	(0.0295)	(0.0305)
GOV	0.0675**	0.0676**	0.0559**	0.0557**
	(0.0305)	(0.0314)	(0.0261)	(0.0263)
RL1	0.275	0.275		
	(0.209)	(0.219)		
RL2			0.300*	0.295*
			(0.161)	(0.167)
Constant	0.540***	0.540***	0.582***	0.585***
	(0.176)	(0.188)	(0.0988)	(0.104)
sigma_u		0.0801***		0.0850***
		(0.00735)		(0.00801)
sigma_e		0.0859***		0.0846***
		(0.00688)		(0.00697)
Wald chi2	26.91	16.63	28.27	18.63
Prob > chi2	0.000	0.002	0.000	0.001
Log likelihood function		286.26409		287.76391
Observations	324	324	324	324
Number of Banks	54	54	54	54

Notes: (1) SE indicates standard errors, which are shown in parentheses; *** p<0.01, ** p<0.05 and * p<0.1; (2) The bootstrap is estimated through ML, which combined the truncated regression of the TE scores as described in section 3.4.5.

As can be seen from the results, the impact of *IB* on efficiency is negative in that *IB* are approximately 6% to 10% less efficient at producing outputs than *IW*. The *IW* variable is positive and significant and it increases the banks' efficiency by around 8%. It is, however, significant only in the excluded *size* variable group, but insignificant with the size group, which reveals that this variable is highly correlated with *IW*, where most large banks are conventional with *IW*, and that in turn has an effect on the significance of this variable. Finally, the *size* coefficient positively improves the efficiency by more than 10% when it is included in the model, which indicates the important effect of size for growth through economies of scale on banks' efficiency. In addition, the influence of *IB*, *IW* and *size* variables on banks' efficiency meet the expectations of this study.

Further, the estimated coefficients of the variables for financial structure and rule of law, as are shown in Table 3.7, reveal that the coefficient of *CON* appears significant with the size group, although it is statistically irrelevant with the second group. Again this illustrates that size is associated with *CON*, and that more importantly most large banks in the GCC countries are *CB* that provide *IW*.

The other variables related to financial structure are foreign and government ownerships, which are significant in both groups; surprisingly, the FO coefficient produced a negative effect on the banks' efficiency of around 4% to 8%, while as expected the *GOV* variable seems to confer a positive influence that improves the GCC banks' efficiency by more than 5%.

Finally, the outcomes of the variables for the rule of law, namely *RL1* and *RL2*, confirm the expectations of this study, which are in accordance with the findings of Ben Naceur *et al.* (2011). The coefficient of *RL2* provides evidence for it having a substantially positive influence on the TE in most estimated models, whereby it could be stated that efficient rule of law advances the efficiency of the GCC's banking sector by around 30%.

3.7 DISCUSSION AND CONCLUSION

This paper aims to investigate TE by using the TGR, MPIM and catch-up rate for the banking sector in the GCC countries, whereby special attention is paid to bank types. Via empirical analysis, the DEA meta-frontier and MPI models were used over the period of 2005 to 2010. In addition, the study investigated the potential effect of specific factors related to three categories, which are bank characteristics, financial structure and rule of law, by applying two-stage semi-parametric models of the DEA meta-frontier.

The analysis of financial indicators, such as ROA and ROE, indicates that despite the decreasing performance in all of the bank groups of the GCC countries, *IW* seemed to perform more steadily when compared with the other groups. The performance of fully-fledged *IB* did, however, seem to fluctuate more than that of other groups over the period covered, which implies that *IB* are more at risk than their counterparts.

The results in terms of a country-level analysis show that in the case of the TGR, Bahraini banks used the best available technology in the region only during the beginning of the period; in the later years, namely 2007 to 2009, they were found to be underperforming. On average, the highest TGR score was found for Qatar followed by the UAE at approximately 89% and 88%. This result implies that Qatari banks operated at the best level of available production technology among the GCC countries over the period covered. As well as the TGR result, Qatar has reported the highest productivity performance in terms of MPIG and MPIM, wherein it has recorded the highest catch-up rate for the most periods of the study, while the UAE and Saudi Arabia have not managed to record any catch-up rate. Moreover, the findings show that the TGR for the country groups are positively associated with catch-up values.

The results of the meta-frontier analysis for the bank groups show that *IW* have dominated all of the bank groups, as the TGR of these banks reached the highest ratio since 2007 over the period covered. In addition, it was found that the output level of *IB* is more restricted in terms of production technology than that of other groups. Furthermore, it is worth noting that the average TGR indicates that *IB* can operate at the best level by producing at 90%, using the same level of inputs and production technology which is produced by the GCC countries. Despite the TGR results for the *IB* group, it managed to catch-up and is the most productive group for the majority of the period covered. Furthermore, the results suggest that the TGR of the bank groups is correlated negatively with the catch-up values.

As for the meta-frontier-based findings, the TGR and catch-up results of the bank groups showed that even though *IB* scored the highest ratio in terms of productivity growth, their performance in terms of TE appeared to be lower than that of *IW*.

It can therefore be recommended that *IB* should increase their size, either by mergers or by expanding their market share and clients, to take advantage of scale economies. Srairi (2010) also put forward such a recommendation as he located similar findings. In addition, policy makers should develop strategies and unite the regulation of *IB* within the GCC region in order to use the best available technology when strengthening their ability to compete with the other banks.

The findings of second-stage regression analysis indicate that the variables for bank characteristics influenced bank efficiency, showing that the GCC banks, as representatives of an intermediation sector, have an effective ability to transform deposits into loans and financing. It should be noted that bank size is found to be an important determining factor in enhancing efficiency. From the perspective of the bank groups, *IB* are less efficient at producing outputs than *IW*. Similarly and apart from CON, the GCC banks' efficiency is affected by other factors, such as financial structure and rule-of-law variables. In addition, the findings suggest that the *GOV* is essential to the performance of the GCC banks as it enhances liquidity.

The meta-frontier and TGR approaches thus seem very significant in illustrating dissimilarities among the GCC countries and bank groups. To improve the performance of *IB* in the region, Islamic financial and banking products should be improved to reduce the risk faced by *IB*, while authorities in the GCC region, as an economic and political union, should take a proactive position in developing regulatory structures to enhance the efficiency of *IB*.

In terms of methodological reflection, another version of the meta-frontier that is proposed by O'Donnell *et al.* (2008) is that of the Stochastic Frontier Approach (*SFA*), one of the parametric methods. This method should be considered for future research and applied with different environmental variables to investigate the variances in production or cost technology among the banks in the GCC.

CHAPTER 4

A SURVIVAL ANALYSIS FOR ISLAMIC AND CONVENTIONAL BANKS IN THE GCC: DISCRETE-TIME DURATION MODELS BASED EMPIRICAL ANALYSIS

4.1 INTRODUCTION

In recent years the global financial crisis has caused a downturn in the economies of both developed and developing countries. Accordingly, the Gulf Cooperation Council (GCC) countries, as the largest economies within the Arab world, were inevitably influenced by the effects of this crisis. Some financial system indicators of the banking sectors in those countries evidently witnessed a sharp decline during the crisis period. Indeed, the average of the market capitalisation to *GDP* ratio dropped significantly from 131% in 2007 to 64% in 2008.[5]

An important development in the financial systems of the GCC countries is the emergence and consolation of IBF since the mid-1970s. The GCC financial sectors have responded positively to global developments and trends in the Islamic finance industry, where a number of fully fledged *IB* have been operating in these countries. A substantial number of *CB* have also opened Islamic windows so as to offer different levels of Islamic financial services to their customers. The performances of both bank types have, however, been affected by the global crisis; for example, from 2007 to 2008 the average return on assets (*ROA*) in *CB* within the GCC, including Islamic windows, reached its minimum level, moving from 2.4% to 1.4%; in 2009 the average remained the same. Correspondingly, for the same period the *ROA* of *IB* experienced a more pronounced decline than *CB* (from 2.3% to 0.2%).[6]

It is then clear from this indicator that the financial crisis negatively influenced the banks' performance within the GCC region, especially with regard to the *IB*. This paper therefore aims to investigate empirically the survival time analysis of the commercial banking sector in the GCC countries, including continuous-time and

[5] Source: Standard and Poor's, Global Stock Markets Factbook, supplemental S&P data and author calculation.
[6] Source: Bankscope and author's calculation.

discrete-time models, by examining whether *IB* or *CB* are more susceptible to failure through two factors. Initially, this entails non-parametric unconditional analysis, or the life-table method, which is based on the observation of failure events (Kalbfleisch and Prentice, 2002). A further factor is that of the conditional analysis, which depends on the availability of data at a micro- and macro-level. In addition, the present study pivots on the application of Complementary Log-Log (cloglog) with unobserved heterogeneity in order to estimate the banks' failure; cloglog is again utilised to conduct a comparative analysis between *IB* and *CB*.

This paper begins by discussing some of the relevant literature on the subject before describing the methods that are employed to investigate survival time and failure in the banking sector in the GCC. These steps are followed by a preliminary survey of both the data and the definition of the covariates. The paper then proceeds to interpret the findings of the empirical application; the final section is dedicated to the conclusion of this study.

4.2 LITERATURE REVIEW

This section, firstly, presents a brief context in terms of literature on survival-time analysis, which is followed by a survey of the empirical studies related to survival-time and bank failure issues.

4.2.1 Concept and Method

'Survival analysis' is a statistical term utilized to analyse the consequences of historical events for a particular group of people or firms, such as marriage, education, smoking, nations that have experienced war or revolution, firm mergers and bankruptcy (Alisson, 1982). In terms of methodology, initially, survival analysis was implemented, through the maximum-likelihood and partial likelihood methods and mostly under the continuous-times assumption, by biomedical researchers (*e.g.* Gross and Clark, 1975; Elandt-Johnson and Johnson, 1980; Cox, 1972; Kalbfleisch and Prentice, 2002). However, later, the concept and procedure of discrete-time methods was proposed in arguing that, in certain situations, discrete-time methods could be more useful and adequate than continuous-times (Alisson, 1982:62).

It should be noted that exploring bank failure, through survival analysis, in banking related studies aims to provide empirical evidence to aid in identifying the most significant causes behind bank failure. These causes are classified into bank-level variables, which are attributed to factors related to mismanagement, and macro-level variables, which are caused by external risk factors. These are discussed in detail in the following sections.

4.2.2 Empirical Studies

A number of empirical studies have been conducted to investigate the causes behind the probability of a bank's failure. According to the existing body of literature on the topic, these causes can be categorised as follows: endogenous factors that are pertinent to bank-level or microeconomic variables such as inefficient management; and exogenous factors that are relevant to macroeconomic variables, such as financial structure, institutional development and the economic stability of the country.

To explore the factors behind a bank's failure requires a range of technical methods. Most of these methods are, however, based on probability and likelihood forms. For example, Lane *et al.* (1986) provide a comparative study between multiple discriminant analysis (MDA) and Cox Proportional Hazards (PH) models to estimate the probable survival time to failure of commercial banks in the USA from 1979 to 1984 or through the failure date of June 1984. The findings showed that although the MDA model was capable of suggesting bankruptcies, it could not provide an accurate estimation of an actual failure date when compared with the Cox model. However, in responding to estimations and observations, Cole and Gunther (1995) argued that the typical survival-time models assume that all banks which have experienced a failure event will ultimately fail. Thus, to differentiate between failures and survivors, Cole and Gunther (1995) applied a split-population survival-time model of listed commercial banks in the Federal Deposit Insurance Corporation (FDIC). Crucially, the results indicated that certain variables are required when estimating the failure, rather than the survival time, of banks. Evrensel (2008) further investigated the relationship between bank concentration and bank crisis in G-10 and non-G10 countries over the period from 1980 to 1997 by using the 'Weibull Model' of duration-time analysis. This investigation concluded that a higher bank concentration and more restricted banking system are linked to the appearance of a higher hazard rate in developing countries.

In terms of the study of *IB*, investigating survival-time and bank failure issues is not a common subject. However, a recent study by Pappas *et al.* (2012) presented a comprehensive comparative analysis between *IB* and *CB* that were at risk of failure; the study focused on 421 banks from twenty countries between 1995 and 2010, employing the Cox PH model as its principal method. This study suggested that on the micro-level of variables, the probability of the risk of failure is higher for *CB* than it is for *IB*, whereas the hazard rate of *IB* is greatly influenced by inflation. Such findings also indicated that *IB* are more affected by the cycle of macroeconomic variables than *CB* (Hasan and Dridi, 2010).

Apart from survival models, Demirguc-Kunt and Detragiache (1998) examined the factors that could lead to banking crises in a selection of developed and developing countries from 1980 to 1994 by applying the multivariate logit model. Their results suggested that countries which suffer from poor microeconomic conditions, the low growth of real *GDP* and high inflation are more prone to such crises. Duttagupta and Cashin (2011) further explored the probability of banking crises in emerging markets and developing countries over the period from 1990 to 2005 by using the binary classification tree model (BCT), a non-parametric approach which is designed to estimate whether the crises have occurred. The findings revealed that a low level of bank liquidity, low profitability, high inflation and unstable macroeconomic conditions stimulate crises.

Akin to non-survival models in the study of *IB*, Hasan and Dridi (2010) investigated the effect of the financial crisis of 2008 to 2009 on the performance (which included profitability and credit and asset growth) of 120 *CB* and *IB* in the GCC, Jordan, Turkey and Malaysia via the application of ordinary least squares (OLS). Their results indicated that the profitability in large *IB* helped to minimise the negative influence of the crisis, whereas some *IB* that suffered from the mismanagement of risks displayed a significant reduction in profitability when compared with *CB*. The performance of *IB* in credit and asset growth during 2008 to 2009 was also better than that of their counterparts. Another study by Parashar and Venkatesh (2010) observed the performance indicators (which included capital adequacy, efficiency, profitability, liquidity and leverage) of six *IB* and six *CB* in GCC countries before and during the financial crisis over the period from 2006 to 2009. The results of this study highlighted that the *ROA* and liquidity ratios in *CB* during the financial crisis had been adversely influenced more than those in *IB*, yet the ROE and leverage ratios in *IB* were more severely affected than those in *CB*.

Relevant bank failure studies have emphasised the importance of macro-level factors in evaluating the causes of this failure. With regard to micro-level variables, several studies, such as those by Cole and Gunther (1995) and Pappas *et al.* (2012), adopted CAMEL model variables, which identify key financial indicators for capital adequacy, asset quality, management, earnings and liquidity management. However, Rojas-Suárez (2001) claimed that the application of CAMEL indicators could not be accurate in a large observation of panel data that consisted of a wide range of developing countries because of the dissimilarities in framework supervision between those countries, which could result in misleading comparative findings.

4.3 RESEARCH METHODOLOGY

Duration, or survival, analysis can be defined as the process of failure time in firms (or banks in this particular study) that starts or occurs at any specific point. All those banks in the GCC countries, similar to any other bank in any other part of the world, are at risk, which means that each bank is likely to fail when a country experiences a bank crisis. Consequently, some banks survive and remain healthy after the crisis, but others might fail, which infers that some observations are censored in the sense of failures (Alison, 1982: 62-63).

This section commences by describing the survival data and using the continuous-time model; the discrete-time duration model is then utilised as long as the discrete-time model in grouped data is derived from the continuous-time process; survival times are identified in bands. The aim behind the adoption of this technique is to examine the validity of the research model, given that the discrete-time model may be flawed and lead to an inefficient estimation of the coefficients, especially when the time duration of the observation is of considerable size. Singer and Spilerman (1976) further demonstrated that an arbitrary selection of interval length could affect the parameters' inference; the discrete-time model that is derivative from the continuous-time model does not face such a dilemma. Furthermore, Allison (1982) noted that the estimated outcomes of both the discrete and continuous models should be very similar.

To examine the model's validity, unobserved heterogeneity in conjunction with a discrete-time model is employed. To discuss duration models, this section is therefore divided into four parts:

(i) Survival-time data presentation life-table method;

(ii) Continuous time model;

(iii) Discrete-time model;

(iv) Unobserved heterogeneity.

To begin analysing survival data for the discrete-time model, it would be of value to estimate hazard and survival functions by using the life-table method, which is an old, non-parametric technique of duration modelling (as demonstrated by Cutler and Ederer, 1958; Gehan, 1969). This technique presents life-tables for bank groups alongside the likelihood-ratio and log-rank tests for group homogeneity in survivor functions. Moreover, it is the most applicable descriptive method to estimate the distribution of survival times from grouped data, such as the cloglog model (Jenkins, 2008).

The life-table is computed by three basic formulae: survivor function (S_j), cumulative failure time (G_j) and hazard rate (λ_j). The mathematical form of this method takes the following steps, assuming that T_i represents censoring times or the duration variable to assess the time duration of bank failure; (t_j) indicates the intervals of aggregated data, where $j = 1, \dots, j$, and $t_{J+1} = \infty$ in every interval that includes quantities for $t_j \leq T < t_{j+1}$; d_j and m_j are the number of failures and censored observations in the interval; and N_j is the quantity of surviving banks at the beginning of the interval.[7] The modified number at risk at the beginning of the interval can be delineated as $n_j = N_j - m_j/2$. According to Kalbfleisch and Prentice (2002), survivor function is estimated from the following equation:

$$S_j = \prod_{k=1}^{j} \frac{n_k - d_k}{n_k} \tag{4.1}$$

[7] The duration variable of a bank is computed as the current year minus the established year; various banks have, however, started operating before the observation window begins, meaning that left censoring has to be controlled.

Thus, the cumulative failure time is described as one minus survivor function, where S_j can be graphed against t_{j+1}. The maximum likelihood estimate of hazard rate is as follows:

$$\lambda_j = \frac{f_i}{(1-f_j/2)(t_{j+1}-t_j)} \quad (4.2)^8$$

Here, f_i represents the probability of the number of failures when an event occurrence is divided by the probability of a non-occurrence event, of all observations, at the start of the interval $(f_i = d_j/n_j)$ [9].

As stated earlier, the life-table also presents the group homogeneity test through the likelihood-ratio; this ratio is crucial for the observation of whether groups in the current study sample differ, especially in terms of bank groups. Lawless (2003) measures likelihood-ratio as the following:

$$\mathcal{X}^2 = 2\left\{(\sum d_g)\log\left(\frac{\sum T_g}{\sum d_g}\right) - \sum d_g log\left(\frac{T_g}{d_g}\right)\right\} \quad (4.3)$$

where g symbolizes the sum of groups number; d_g denotes the total numbers of failures in g group; $T_g = \sum_{i \in g} T_i$, where i is the censoring times or the index of failures. The second test for homogeneity is the log-rank test, which estimates the equality of survivor functions between groups (Schoenfeld, 1981). When applying these tests, the null hypothesis of a group's equality will therefore be rejected if the value of chi-squared is significant according to the $\rho -$ value.

Both processes in duration models, whether continuous or discrete, rely on several basic functions: cumulative density function *F(t)*, survivor functions *S(t)*, probability density function *f(t)* and hazard functions *h(t)* or conditional probabilities. For all of these functions, *t* is the time duration variable that indicates the time elapsed since a bank was established to a particular year. In continuous-time models the spell length for units or banks is an implementing of a random variable *T*, where the cumulative density function can be represented by the following equation:

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[8] The likelihood form is designed to account for the right censoring assumption, as many banks have not yet failed by the period when the sample ends.
[9] To estimate the standard error and confidence intervals, see Cox and Oakes, 1984; Kalbfleisch and Prentice, 2002.

$$F(t) = \int_0^t f(r)dr = P(T \leq t) \quad (4.4)$$

This describes the probability of survival time *(T)* as less than or equal to *t.* Thus, the survivor function can be given by:

$$S(t) = 1 - F(t) = P(T > t) \quad (4.5)$$

The estimated value of $S(t)$ lies between 0 and 1; this value is a decreasing function towards 0 when time (*t*) is increasing to infinity. Accordingly, the probability density function can be written as:

$$f(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T \leq t + \Delta t)}{\Delta t} = \frac{\partial F(t)}{\partial t} = \frac{\partial S(t)}{\partial t} \quad (4.7)$$

where Δt denotes a small interval of time.

The hazard function or rate can then be expressed as:

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T \leq t + \Delta t | T \geq t)}{\Delta t} = \frac{f(t)}{S(t)} \quad (4.8)$$

The hazard rate evaluates the risk of a completed interval (at *T*=*t*) conditional probability density on survival at, or further than, time *t*, that is in a continuous-time model, while in a discrete-time model it measures the probability of an occurred event during the observed period, not conditional on an occurring event in previous time (Alt *et al*., 1997: 6).

Essentially, to adjust survivor and hazard functions for the influence of covariates in survival analysis, there are two key models: accelerated failure time (AFT) and proportional hazards (PH) or multiplicative effects on the hazard rate models. The form used in this study is the PH model, and it is given by:

$$h(t, x_{i,t}) = h_0(t) exp^{\beta x_{i,t}} \quad (4.9)$$

$x_{i,t}$ represents the independent variables (covariates); β stands for coefficients that have been obtained through some estimated regression at time t, all of which is a non-negative function ($g(x_{i,t}) = exp^{x_{i,t}\beta}$) of the explanatory variables; $h_0(t)$ is the baseline of the hazard function of a bank under certain conditions of explanatory variables. As stated previously, the discrete-time model, derived from the continuous-time-related model (Beck *et al.*, 1998), is more precisely derived from the semi-parametric Cox PH approach (1975). In such a model the baseline of hazard is unspecified or it has no restrictions.[10]

The Weibull model further corresponds to a parametric continuous-time model, but with the specified assumption of distribution for the baseline hazard, which is also examined in this current study. The baseline hazard function of this model can be written as:

$$h_0(t) = p\lambda t^{p-1} \qquad (4.10a)$$

$$h(t, x_{i,t}) = pt^{p-1}exp^{\beta x_{i,t}} \qquad (4.10b)$$

where λ is a multiplicative scale that measures the baseline hazard at every value of (t); an increase in this factor leads to a larger hazard rate. The processes of continuous-time and discrete-time models are, however, similar; as noted previously, they differ in terms of measuring the survival times, in that the latter model is measured as grouped duration (interval censoring) data, when deriving the discrete-time model from the Cox model (4.9) by considering the process of hazard form in continuous-time function yet with the data grouped into intervals. In the case of this study, it would be easy to apply a discrete hazard since it utilises annual data (which is time-series cross-sectional) (Jenkins, 1995). Assuming that this data consists of years (t) and banks (i), each bank may experience a crisis during the year and that could be $y_{i,t}$, w, which is a binary measure of any banks that are facing crisis. Hence, the probability of a discrete hazard can be estimated as $P(y_{i,t} = 1)$ (Beck *et al.*, 1998: 1267). The obtained function of a discrete-time hazard rate can then be expressed as:

$$P(y_{i,t} = 1, x_{i,t}) = h(t, x_{i,t}) = 1 - \exp(-e^{x_{i,t}\beta + j_{t-t0}}) \qquad (4.11)$$ [11]

Here, as equation (4.9) $x_{i,t}$ also denotes the covariates, the difference does, however, appear in the j_{t-t0} component of the interval, which indicates the length of the spell by utilising dummy variables, where $t_0 = 0$ specifies the first crisis and the length of prior spells for multiple failure events, and $t_0 - t$ evaluates the spell length from t_0

[10] The continuous- and discrete-time models are derived from the maximum likelihood form, with the exception of Cox's model, which is derived from partial likelihood.
[11] For the mathematical processes of the discrete hazard equation that is derived from Cox's PH model, see Beck *et al.* (1998: 1284-1285).

until t (the current year). Accordingly, to fit the discrete-time PH model or to solve the equation (4.11) into a distribution function, the complementary log-log or cloglog model is utilised (Prentice and Gloeckler, 1978):

$$cloglog(P) = cloglog(h_{i,t}) = \log[-\log(1 - h_{i,t})] = a_t + \beta' x_{i,t} \qquad (4.12)$$

Here, a_t, the log of integrated hazard over interval (j_{t-t0}, j_t), and the other components of the equation $(\beta' x_{i,t})$ are similar to equations (4.9), (4.10b) and (4.11). Thus, the cloglog model can be defined as a linear formula of duration-intervals added to the covariates that are related to bank characteristics, macroeconomic factors and the political economy. All these aspects are described in the next section. To make a clear statement based on the findings of this study, the estimated models of cloglog are further explored in terms of unobserved heterogeneity or frailty; such an examination is required to check the error term (u). To examine this term in the cloglog PH model, the model itself is generalised through the equation below:

$$cloglog[p(t, x|\beta, v)] = D(t) + \beta' X + u \qquad (4.13)$$

Here, v is equivalent to u, which is a random variable with zero mean, and $D(t)$ specifies the baseline hazard function. To estimate the aforementioned formula, the cloglog model needs to be transformed from pooled to random-effect panel data. In addition, distinctive values are used to identify the observations for the heterogeneity term (u) so that the processes of distribution are required to integrate error terms out of the likelihood estimation (Jenkins, 1995).

4.4 DESCRIPTION OF THE DATA AND COVARIATES

The annual reports of the financial statements of all the GCC countries over the period from 1995 to 2011 (with the exception of Oman due to the absence of Islamic bank applications in the country) are acquired from Bankscope; other foreign banks which have branches operating in the GCC region are excluded from the sample. The empirical sample is therefore limited to domestic banks that provide commercial, finance and trade services, which are comprised of three *IB* and nine *CB* in Saudi Arabia, four *IB* and fourteen *CB* in the UAE, six *IB* and five *CB* in Bahrain, two *IB* and five *CB* in Qatar, and three *IB* and six *CB* in Kuwait, totalling to 18 *IB* and 39

CB[12]. In addition, all of the annual financial information that is employed in this study is reported under the International Accounting Standard (IAS) in US dollars. Other macroeconomic variables are similarly drawn from the world data bank through the website of the World Bank Organization. There is also a selective variable corresponding to the quality of regulation for each GCC country that has been obtained from the Political Risk Services International Country Risk Guide (PRS).

To observe the influence of the financial crisis in 2008 on the banks' failure or survival (both Islamic and conventional) in the GCC countries, a bank is valued as 1 when the country has experienced a financial crisis and 0 (zero) if it has not experienced such an event. Furthermore, a bank is measured as failed if it has witnessed at least one of the following circumstances: substantially negative net income; a ratio of non-performing assets to total assets that extends to more than 10%; and the bank being forced to merge. For this reason, the failure variable is accounted for the crisis year (2008) and for any of the previous events if they occurred (Evrensel, 2008).

To examine the effect on the failures of GCC banks, a set of covariates are utilised that reflect micro- and macro-level factors, summary statistics for which are presented in Table 4.1. These covariates can be sub-classified as follows:

(i) Micro- or bank-level covariates that are comprised of bank type, income statement, balance sheet variables and other financial ratios which are based on CAMEL types, namely:

IB = an Islamic bank dummy takes 1 if the bank operates under *IB* specialisation and 0 if it operates under *CB* specialisation;

GNIR = the growth of net interest revenue (%);

OEA = other earning assets (in millions US$);

ROA = the return on average assets, an earnings indicator (%);

NIM = the net interest margin, an earnings indicator (%);

LLR/L = loan loss reserves / gross loans, an asset quality indicator (%);

[12]All listed banks in the sample are classified to *IB* and *CB* except Al-Jazeera bank, which was accounted to be *CB* providing an Islamic window from 1995 to 2004 and then in 2005 it was transformed into a fully-fledged *IB*.

NL/A = net loans / total assets, a liquidity indicator (%).

(ii) Macro-level covariates that involve sector concentration, government ownership, and macroeconomic and regulation quality variables, namely:

BC = bank concentration, or the total assets of the three largest banks to the total assets of all the banks in a sector;

Real GDP = growth of the real gross domestic product (%);

Inf. = the annual inflation rate, which is calculated by the consumer price index;

GOV = the government ownership dummy, which takes 1 if it has been involved in bank ownership and 0 if it has not been involved in such ownership;

RQ = the regulatory quality of the investment profile in a country.

Table 4.1- Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
		All Banks		
IB	0.246719	0.431385	0	1
GNIR	17.93	41.019	-329.78	647.22
OEA	3590.63	4685.035	17.9	37545.7
ROA	1.95122	2.902902	-44.35	15.29
NIM	3.511869	2.493332	-4.12	31
LLR/L	6.367087	8.495842	0	100*
NL/A	54.70189	14.60471	1.41	90.4
BC	50.96621	15.10172	27.49	80.95
Real GDP	5.369685	4.713747	-5.2	20.8
Inf.	3.722572	4.112171	-4.9	15.1
GOV	0.433071	0.495826	0	1
RQ	0.798451	0.184626	0.27	0.95
		CB		
GNIR	15.0726	20.66	-45.161	187.515
OEA	4141.59	5029.85	53.2	37545.7
ROA	1.997962	1.381324	-12.63	10.48
NIM	3.198688	1.037546	1.13	10.03
BC	48.8161	14.26448	27.49	80.95
LLR/L	6.680819	7.539471	0	55.69
NL/A	54.14777	13.12959	19.18	82.01
Real GDP	5.170906	4.740116	-5.2	20.8
Inf.	3.715331	4.110741	-4.9	15.1
GOV	0.437282	0.496484	0	1
RQ	0.77845	0.193591	0.27	0.95
		IB		
GNIR	26.655	73.741	-329.78	647.218
OEA	1908.442	2832.981	17.9	14646.1
ROA	1.808511	5.330985	-44.35	15.29
NIM	4.468069	4.558523	-4.12	31
LLR/L	5.409202	10.87805	0	100
NL/A	56.39372	18.3297	1.41	90.4
BC	57.5309	15.7195	27.49	80.95
Real GDP	5.976596	4.591597	-5.2	20.8
Inf.	3.744681	4.127438	-4.9	15.1
GOV	0.420213	0.494911	0	1
RQ	0.859521	0.137484	0.36	0.95

Note: (*) In 2011, the LLR appeared in Gulf Finance House with the same amount of gross loans.

4.4.1 Micro-Level Variables

It is essential for the current study to examine whether the distinction of being an *IB* or *CB* has any significant impact on survival time and on a bank's hazard rate. Before establishing further expectations with regard to the *IB* dummy, it is important to highlight that the financing operations of most *IB* consist of the venture capital type and therefore they seem to be more at risk than *CB* (Hussein, 2004). In addition, most large banks in the GCC region are *CB* and, as is stated in the relevant banking literature, large banks are also more likely to take advantage of economies of scale (Leung *et al.*, 2003). Furthermore, these banks indicate a healthier position in risk management than smaller banks (Fama, 1985). Thus, the estimated relationship between the conditional probability of bank failure hazard and *IB* is thus likely to be positive.

The other two covariates from the income statement and balance sheet (*GNIR* and *OEA*) are anticipated to reduce the risk of bank failure. There is, generally, no doubt that increasing net interest revenue results in a decrease of the risk of bank failure. Most *IB* in the GCC region obtain their *NIR* from two sources: *murabahah* (mark-up) contracts or sales instruments to create debt, which are deemed to be one of the asset side components and a substitute for interest-based loans. The observations from the data obtained through annual reports indicate that in addition to a large share of *murabahah*, there are still some *mudarabah* and *musharakah*, or PLS (profit loss sharing) financing, as investment or savings accounts, as an alternative to the deposit element on the liability side (Nagaoka, 2007).

While PLS contracts are preferred by Islamic economists due to being the essential representative of Islamic moral economy principles of an embedded economy, *murabahah* or 'cost-plus sale' models are not considered as desirable, due to being debt based contracts. However, since PLS contracts involve more risk than debt based contracts; *IB* have been heavily indulging in expanding their financing through *murabahah*. For this reason, most *IB* use *murabahah* as a substitute for credit in *CB* (Ayub, 2007). Furthermore, large *IB* may be more likely to utilise PLS contracts; these contracts are implemented to invest in infrastructure projects that belong to a government and as a means to develop substantial real estate projects. Small *IB* conversely have a tendency to employ contracts with a short duration, low administration costs and minimum risk (Khalil *et al.*, 2002). In terms of other earning assets, Pappas *et al.* (2012) found that increases in this particular variable will diminish the failure hazard of both *IB* and *CB*.

In relation to earnings ratios, it is believed that an increase in the *ROA*, which can be defined as the total of net income divided by the total assets, leads to a decreased hazard rate in both bank groups. *IB* are more involved with *murabahah* contracts, which provide more secure revenue than that which is offered by PLS instruments. Accordingly, it can be expected that the *ROA* has a specifically negative impact on the risk of bank failure for *IB*. Net interest margin represents the annual profit margin that banks can obtain – after excluding the cost of interest expenses from various activities and services (for example, loans, investment securities, short-term investments and brokerage) – divided by the average of earning assets (Golin and Delhaise, 2013: 77). Pappas *et al.* (2012) devised a positive link between the *NIM* and bank failure hazard in *CB*; they also suggested that if the *NIM* is high, a bank may lose its market share in a very competitive commercial sector. Thus, the *NIM* could have a positive influence on the risk of bank failure. This direction, however, cannot be predicted in this current study for each bank type; further, the mean and maximum of the *NIM* values for each bank group in Table 4.1 reveals that *IB* have a higher *NIM* when compared with *CB*. This finding poses a question as to the extent that the *NIM* ratio in *IB* could affect bank failure hazard and whether this influence is likely to be positive.

In reference to the asset quality ratio, *LLR/L* reflects the loans quality of the bank and measures the potential risk that could be associated with bank activities, such as lending and investing. A higher ratio means lower loans quality, thereby indicating a problematic situation for the bank that may necessitate the advancement of credit and risk management practices. Berger and Mester (2000) illustrated that this ratio may be affected by external conditions such as an economic crisis or by central bank regulations. It could, however, also be influenced by internal factors like incorrect decisions in portfolio management, which would result in a higher credit risk. In addition, the mean value of the *LLR/L* ratio (in Table 4.1) for both bank groups is notably similar at 6.68% for *CB* and 5.41% for *IB*. Consequently, the prior expected sign for *LLR/L* for all bank types with failure hazard is positive. The effect of this ratio for each bank group is not expected to be directed towards the risk of failure.

The final financial ratio reflects liquidity management, which is *NL/A*; this ratio depicts the banks' ability to meet any unanticipated changes in the market conditions, whether these are related to an excess or shortage in liquidity events. A capable bank's management should thus have contingency plans to arrange such changes in liquidity. Likewise, the previous ratio (*LLR/L*) and the mean rate of *NL/A* for both bank types are relatively similar at 54% for *CB* and 56.4% for *IB*. An increase in the *NL/A* ratio therefore signifies a critical bank position, which is expected to have a positive impact on bank failure risk. For an individual bank group, there is, however, no prior expectation.

4.4.2 Macro-Level Variables

The macro-level variables represent the level of institutional development in GCC countries; it is therefore essential to explore the impact of such variables on survival times and bank failure in this sector. *BC* variable effect on banks' failure cannot be expected due to the mixed findings in literature (*e.g.*, Beck *et al.*, 2006; Pappas, 2012), where it is highlighted that a more concentrated banking sector is likely to reduce failure risk. In addition, Evrensel (2008) demonstrates that *BC* decreases the bank hazard rate in developed countries, since they have an unrestricted banking system and the ability to gain greater profit at less expense in banks' administration and supervision. This situation is, however, different in developing countries, where *BC* is correlated positively with the hazard of bank failure.

The economic growth and stability of the country should absorb financial shocks that it may experience, which in turn decreases the risk of a bank's failure. A negative real *GDP* growth rate does, however, increase the probability of bank failure. It can therefore be predicted that increasing the rate of real *GDP* minimises the probability of a crisis affecting the banking system (for example, see: Demirguc-Kunt and Detragiache, 1998; Evrensel, 2008; Duttagupta and Cashin, 2011).

The *Inf.* rate variable shows the average level of prices in a country, and indicates that a higher *Inf.* rate is linked with a higher interest rate, which then affects a bank's performance when creating loans. This situation could result in a credit bubble, increasing the probability of bank failure risk (Demirguc-Kunt and Detragiache, 1998). Since *IB* work in a dual economy under a single conventional monetary policy, they will be affected by the change in the interest rates in terms of determining their internal rate of return and financing rate.

The dummy variable of *GOV* represents an indication of liquidity pumping, especially with regard to the oil revenue in the Gulf region, which is expected to have an adverse influence on bank failure risk. Finally, focusing on the legal framework, the regulatory quality indicator is utilised to capture the ability of the government and its restrictions on formulating policies and regulations that boost private sector development. This variable also helps to assess the business environment facing the banks that operate in the GCC countries; a higher level of *RQ* thus denotes a motivated environment and a strong banking sector, which in turn reduces the failure risk of the banks.

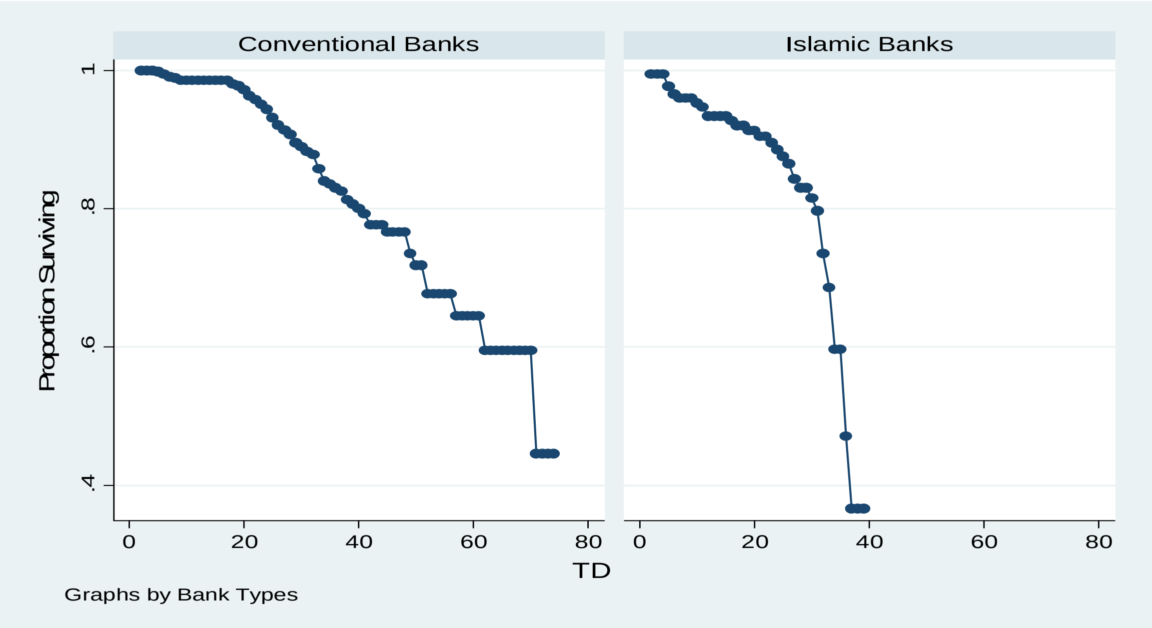
4.5 DETERMINING THE SURVIVAL OF THE GCC BANKS: FINDINGS

After presenting the model and the econometric strategy and data sources, this section of the study presents the findings in a tripartite structure: unconditional findings, conditional results that are related to hazard rate, and the hazard ratio findings, which are obtained by employing the previously described methods in survival-time analysis.

4.5.1 Unconditional Findings

The unconditional results are based on the life-table non-parametric method, where the survival-time data is assumed to be continuous but has been observed in grouped form; the baseline of hazard rate and survivor function depends on the previous time that has passed for each bank in the GCC region and the failure events. This method is applied to examine the hypothesis on whether the risk of failure is higher for *IB* than it is for *CB*, without controlling the differences for the covariates. Indeed, this method is also employed to verify that there are adequate events in each interval to derive the hazard rate for each bank's group. It is important to note that such a method implies that the longer the bank has operated in the country the less likely it is to fail (Zorn, 2000). Figure 4.1 shows the unconditional estimated survivor rates for each bank group.

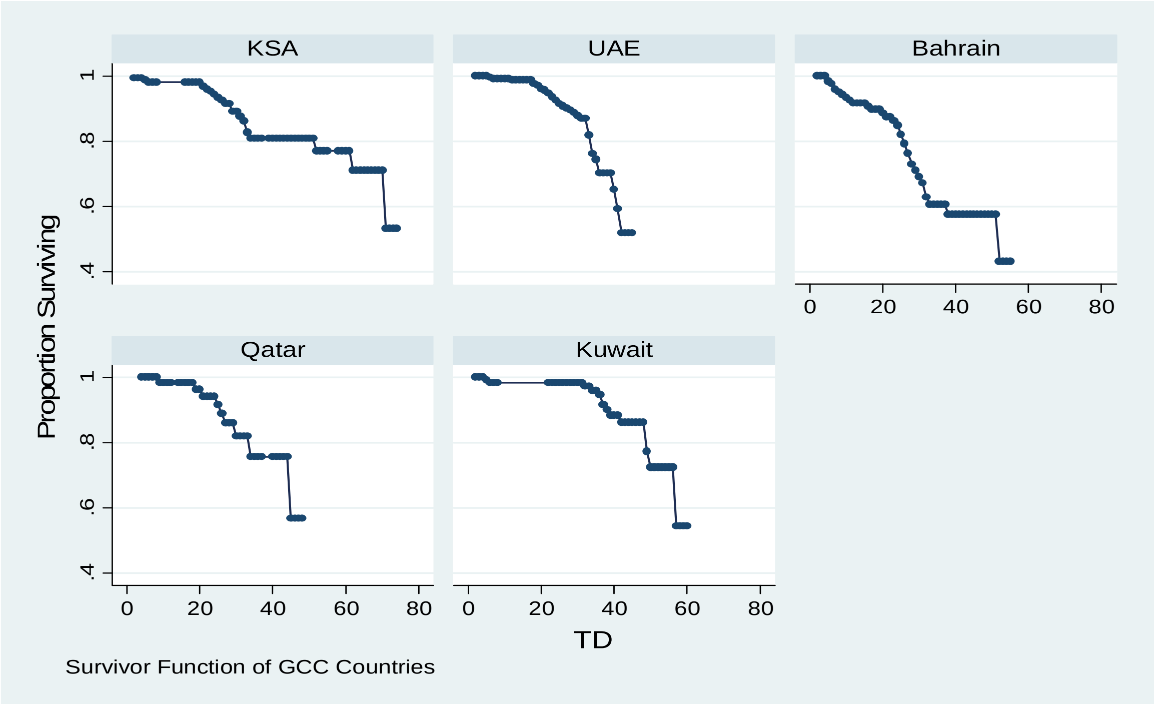
Figure 4.1- Survivor Function by Bank Types



Note: Derived Using the Life-Table Method.

As can be seen in Figure 4.1, the survival rate of *CB* is higher than that of *IB*; the line of proportion surviving rate in *IB* declines sharply with the lower duration of survival time when compared to the results for *CB*, indicating that *IB* are more likely to fail than *CB*. Statistically, the likelihood-ratio and log-rank tests for the homogeneity of bank groups are applied to further examine the data. The Chi-squared and *p*-values for these tests are presented as follows: 9.467 (0.002) and 23.18 (0.000) (the figures in parentheses are *p*-values). Thus, the null hypothesis of the equality of bank types is rejected; this finding boosts the motivation behind the employment of *IB* as a dummy variable to investigate its impact on the failure hazard rate.

Figure 4.2- Survivor Function by GCC Country (Derived Using the Life-Table Method)



Note: Derived Using the Life-Table Method.

In addition to the focus on bank groups, this study also intends to explore the survival rate of each GCC country that has been covered by the observation windows. As depicted in Figure 4.2, the Saudi banking sector has the longest survival time (above seventy years with a survival rate of approximately 0.5); Kuwait and Bahrain follow this statistic. Indeed, the oldest Saudi bank is NCB and its Kuwaiti counterpart is NBK. Conversely, the UAE and Qatar represent the shortest survival times at approximately forty-five years, but the latter country shows the highest proportion surviving at almost 0.6. Furthermore, the drawn line of survivor rate decreased gradually in KSA and Kuwait, whereas it dropped dramatically in the UAE.

In order to examine the significance of country-level differences, the findings of homogeneity tests show that the chi-squared and *p*-values for the likelihood-ratio and log-rank are 18.22 (0.001) and 33.39 (0.000) (the figures in parentheses are *p*-values). Consequently, the null hypothesis of country-level equality is rejected. Finally, given the obtained unconditional results, it can be noted that the longevity does matter in the analysis of the survival time of the GCC banking sector.

4.5.2 Conditional Findings

The empirical findings based on conditionality are derived from two estimated equations through three models; these are the Cox PH, Weibull, and cloglog models. The first equation is comprised of the income statement and balance sheet covariates in order to estimate failure hazard; the second equation includes the financial ratios covariates of failure hazard; both equations are associated with macro-level covariates. As is shown in tables 4.2, 4.3 and 4.4, the three models present very similar results for the estimated coefficients of each variable; this is especially true of the Weibull and cloglog findings, because these two models are fully parametric.

As stated previously, the aim of applying the continuous-time models is, however, to assess the validity of the cloglog estimation, and this model is preferred as long as the annual variables are pooled from unbalanced, time-series cross-sectional data. Further echoing the unobserved heterogeneity problem, another cloglog related model is estimated and the findings for both models (shown by the last four columns in tables 4.2, 4.3 and 4.4) are analogous, thereby emphasising that heterogeneity, or the frailty problem, is negligible.

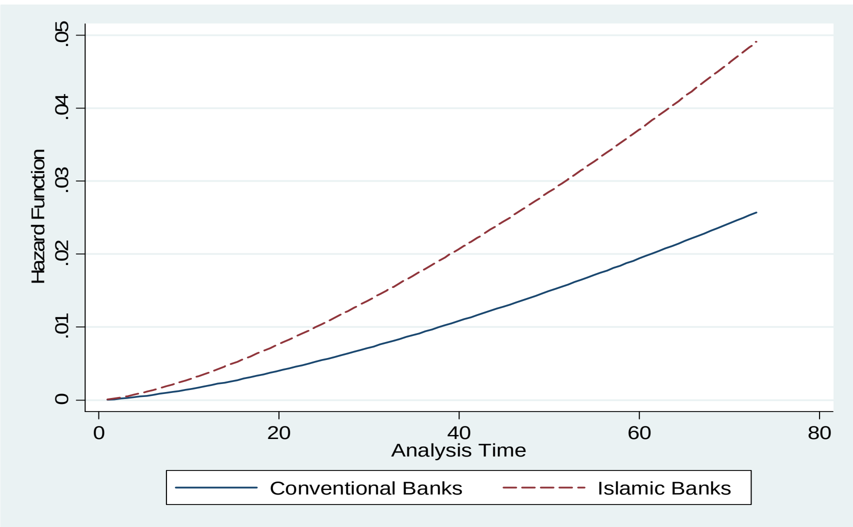
Table 4.2- Covariates of the Income Statement and Balance Sheet in Failure Hazard

Model	*PH Cox*		*Weibull*		*Cloglog*		*Cloglog with Unobserved Het.*	
Variables	*Micro*	*Micro+ Macro+*	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*
Log t					1.39***	1.393***	1.397***	1.393***
					(0.190)	(0.193)	(0.190)	(0.193)
IB	0.714***	0.645***	0.718***	0.647***	0.709***	0.636***	0.709***	0.636***
	(0.215)	(0.224)	(0.212)	(0.221)	(0.212)	(0.221)	(0.212)	(0.221)
GNIR	-0.003	-0.007***	-0.0036	-0.082***	-0.0036***	-0.00830***	-0.00367	-0.00830***
	(0.0033)	(0.0026)	(0.0034)	(0.003)	(0.0034)	(0.00276)	(0.00344)	(0.00276)
OEA	-0.0001***	-0.00019***	-0.0001***	-0.00013***	-0.0001***	-0.00013***	-0.0001***	-0.00013***
	(3.6 e-05)	(3.9e-05)	(2.9 e-05)	(3.19e-05)	(2.94e-05)	(3.18e-05)	(2.94e-05)	(3.18e-05)
BC		0.0275***		0.029***		0.0292***		0.0292***
		(0.0081)		(0.008)		(0.00805)		(0.00805)
Real GDP		-0.07244***		-0.079***		-0.0810***		-0.0810***
		(0.022)		(0.0217)		(0.0218)		(0.0218)
Inf.		0.191***		0.191***		0.193***		0.193***
		(0.025)		(0.0253)		(0.0254)		(0.0254)
GOV		-0.659***		-0.568***		-0.569***		-0.569***
		(0.213)		(0.208)		(0.209)		(0.209)
RQ		-1.11*		-1.002*		-0.984		-0.984
		(0.621)		(0.615)		(0.615)		(0.615)
Constant			-9.86***	-10.79***	-8.860***	-9.838***	-8.861***	-9.838***
			(0.67600)	(0.845)	(0.593)	(0.785)	(0.593)	(0.785)
Ln_p			0.89***	0.944***				
			(0.079)	(0.0803)				
P			2.44	2.43				
Lnsig2u							-12.23	-12.29
							(21.09)	(25.55)
Log L	-629.75	-594.47	-303.85	-268.17	-658.069	-621.78	-658.069	-621.785
LR chi2	59.88	130.43	50.88	122.24	101.66	174.23		
Wald chi2							17.51	135.19
Obs.	762	762	762	762	21106	21106	21106	21106
Id.							762	762

Note: Standard errors in parentheses; (***) denotes p<0.01, (**) p<0.05, * p<0.1.

Figure 4.3- The Conditional Probability of Hazard Rate by Bank Types and the Income Statement and Balance Sheet Specification

Weibull Regression



Starting with the income statement and balance sheet specification in Table 4.2, the baseline of the hazard rate is obtained from the shape of parameter *P* in the Weibull model at 2.4. In cloglog this baseline is instead computed through log (t) by assuming that it is similar to the Weibull model, which is approximately equal to 2.4, thereby indicating that the baseline hazard increases with elapsed survival time. As expected, the reported coefficient estimate of the *IB* dummy variable is significant and positive with bank failure hazard, which is in line with the life-table result, thus signifying that *IB* increase the failure risk by about 0.64 more than *CB*. In addition, Figure 4.3 reveals the line shape of the hazard rate for *IB* and *CB* from the regression of the Weibull micro- and macro-level estimate equation with regard to the other covariates; noticeably, the hazard line of *CB* rises steadily over the analysis time; the hazard line of *IB* conversely rises rapidly, increasing the gap between these lines over the analysis time.

Table 4.3- Covariates of the Balance Sheet and Income Statement for Bank Groups

Cloglog with Unobserved Heterogeneity				
	CB		*IB*	
Variables	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*
Log t	1.710***	1.713***	0.929***	0.873***
	(0.251)	(0.261)	(0.290)	(0.287)
GNIR	0.00556	-0.00636	-0.00668**	-0.00788***
	(0.00548)	(0.00629)	(0.00329)	(0.00295)
OEA	-0.000148***	-0.000151***	-7.02e-05	-0.000102
	(3.34e-05)	(3.69e-05)	(6.72e-05)	(7.32e-05)
BC		0.0280***		0.0317**
		(0.00955)		(0.0156)
Real GDP		-0.0618**		-0.129***
		(0.0251)		(0.0439)
Inf.		0.189***		0.197***
		(0.0314)		(0.0488)
GOV		-0.744***		-0.310
		(0.256)		(0.393)
RQ		-1.100		-1.022
		(0.672)		(1.609)
Constant	-9.922***	-10.68***	-6.885***	-7.765***
	(0.797)	(0.963)	(0.820)	(1.634)
Lnsig2u	-8.989	-12.52	-12.65	-13.92
	(17.74)	(32.45)	(47.24)	(338.2)
Wald chi2	52.67	98.42	13.63	32.15
Obs.	17159	17159	3947	3947
Id.	574	574	188	188

Note: Standard errors in parentheses; (***) denotes p<0.01, ** p<0.05, * p<0.1.

In terms of the other covariates of the cloglog estimated model with micro- and macro-level variables, the coefficients of *GNIR* and *OEA* variables are statistically significant and meet the study's expectation in reducing the failure risk. There is, however, a small magnitude influence at approximately -.01, and -.0001, illustrating that a rise in these covariates decreases bank failure hazard albeit by a very small degree. By further examining Table 4.3, which reveals the influence of the same covariates for bank groups separately, the growth of net interest revenue appears to be significant only for *IB*, that also with minor negative impact on the hazard rate.

Further, Table 4.4, which illustrates the financial ratios specification, displays the coefficients of selected financial ratios alongside the macro-level variables. The baseline hazard here (at approximately 2.6) is again computed through the Weibull and cloglog models, confirming that even given the presence of financial ratios variables, the baseline hazard rises with elapsed survival time. Moreover, the estimated coefficient of *IB* also emphasises the positive link with the risk of bank failure, indicating that *IB* have a 0.77 risk of failure greater than *CB*.

Table 4.4- Covariates of Financial Ratios in Failure Hazard

Model	*Cox PH*		*Weibull*		*Cloglog*		*Cloglog with Unobserved Het.*	
Variables	*Micro*	*Micro+ Macro+*	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*
Log t					1.553*** (0.190)	1.649*** (0.204)	1.553*** (0.190)	1.649*** (0.204)
IB	0.740*** (0.229)	0.774*** (0.235)	0.818*** (0.227)	0.804*** (0.232)	0.786*** (0.227)	0.774*** (0.233)	0.786*** (0.227)	0.774*** (0.233)
ROA	-0.0524*** (0.0150)	-0.0465*** (0.0149)	-0.0599*** (0.0150)	-0.0529*** (0.0148)	-0.0614*** (0.0150)	-0.0545*** (0.0148)	-0.0614*** (0.0150)	-0.0545*** (0.0148)
NIM	0.185*** (0.0348)	0.183*** (0.0350)	0.205*** (0.0379)	0.205*** (0.0378)	0.201*** (0.0374)	0.201*** (0.0373)	0.201*** (0.0374)	0.201*** (0.0373)
LLR/L	0.0839*** (0.00858)	0.0850*** (0.00902)	0.0811*** (0.00838)	0.0820*** (0.00870)	0.0801*** (0.00833)	0.0811*** (0.00865)	0.0801*** (0.00833)	0.0811*** (0.00865)
NL/A	0.0380*** (0.00831)	0.0368*** (0.00973)	0.0369*** (0.00801)	0.0337*** (0.00930)	0.0366*** (0.00801)	0.0336*** (0.00929)	0.0366*** (0.00801)	0.0336*** (0.00929)
BC		0.0262*** (0.00878)		0.0273*** (0.00868)		0.0275*** (0.00866)		0.0275*** (0.00866)
Real GDP		-0.0448** (0.0225)		-0.0530** (0.0224)		-0.0545** (0.0224)		-0.0545** (0.0224)
Inf.		0.182*** (0.0263)		0.185*** (0.0262)		0.187*** (0.0263)		0.187*** (0.0263)
GOV		-0.658*** (0.221)		-0.633*** (0.215)		-0.631*** (0.216)		-0.631*** (0.216)
RQ		-1.681** (0.670)		-1.452** (0.668)		-1.452** (0.667)		-1.452** (0.667)
Constant			-14.27*** (0.978)	-15.12*** (1.136)	-13.18*** (0.910)	-14.01*** (1.074)	-13.19*** (0.911)	-14.01*** (1.074)
Ln_p			0.952*** (0.0736)	0.989*** (0.0763)				
P			2.69	2.69				
Lnsig2u							-10.55 (13.68)	-12.56 (24.47)
Log L	-598.472	-566.0263	-267.279	-233.0862	-621.284	-586.697	-621.284	-586.697
LR chi2	122.44	187.33	124.03	192.42	175.23	244.40		
Wald chi2							186.11	232.23
Obs.	762	762	762	762	21106	21106	21106	21106
Id.							762	762

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Figure 4.4- The Conditional Probability of Hazard Rate by Bank Types and the Financial Ratios Specification

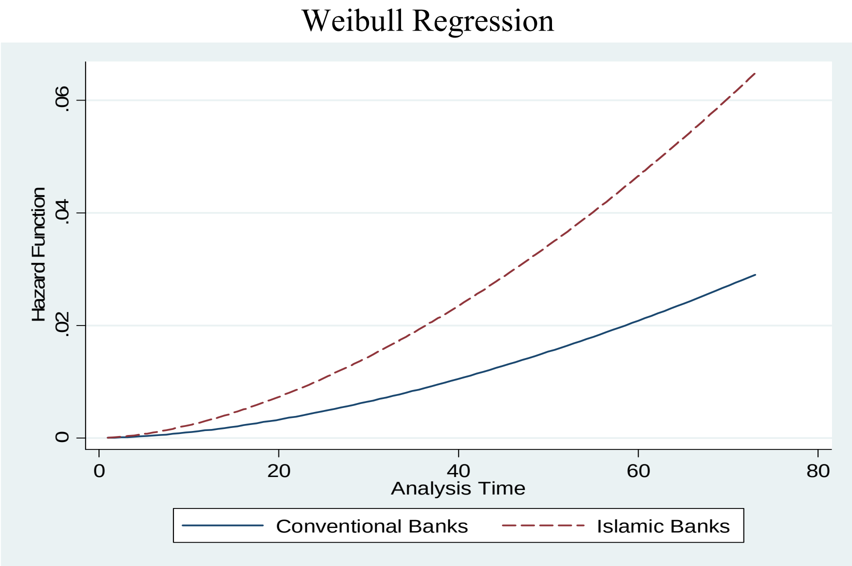


Figure 4.4 shows the line shape of the hazard rate for *IB* and *CB* from the regression of the Weibull financial ratios and the macro-level estimate equation in relation to the other covariates; the hazard line of *CB* also increases steadily, whereas that of the *IB* rises sharply over the course of the analysis time.

With regard to the financial ratios covariates of the cloglog estimated model with macro-level variables in Table 4.4 (commencing with the earnings ratios), the coefficient of *ROA* has a significant negative impact on hazard ratio at -0.05. It also has a similar effect for *IB*, in that it reduces the potential bank failure hazard by -0.3 (as is seen in Table 4.5), whereas it is not significant with the grouping for *CB*. This is a striking result for *ROA* with *IB*, given that the majority of the transactions of *IB* depend on asset-based contracts such as *murabaha*. Thus, it seems that an increase in *ROA* has decreasing impact on the failure risk in *IB*. In other words, reliance on the non-PLS or fixed-income creating debt contracts have lesser propensity for failure due to the contained risks associated with debt-based instruments as opposed to PLS type Islamic financial products. The *NIM* covariate (as was predicted) has a positive impact on hazard ratio by 0.2. In terms of bank type, Table 4.5 reveals that increasing the net interest margin tends to increase failure risk significantly, by about 0.23 (although this is only true for *IB*); such an obstacle appears in *IB* for a reason: some *IB* may have relatively more weight in their portfolios for PLS contracts, including *mudarabah* and *musharakah*, which account for more than 10% of total Islamic financing. Due to the nature of these instruments, the credit risk of *IB* increases, which in turn increases the risk that is expressed by the *NIM* ratio. As evidence for this situation, Nagaoka (2007) reports that the averages of PLS and debt-based contracts in the Dubai Islamic Bank over the period from 2001 to 2005 are 17% and 48.6% respectively.

To illustrate the distribution pattern of Islamic financing, Asutay (2012) demonstrates that the average of PLS contracts from 2006 to 2010 in the Bahrain Islamic Bank was approximately 17.5%; the average in the Dubai Islamic Bank was 21.7%, yet this figure is shown at less than 4% for the Qatar Islamic Bank. It is then difficult to establish a general pattern, as in the case of the Qatar Islamic Bank, because it is less associated with PLS contracts when compared with other Islamic banks. *IB* may also suffer in terms of managing credit risk, whereas opting to expand the PLS contracts implies greater risk and less profit than with debt-based contracts.

The other two estimated coefficients related to asset quality and liquidity ratios in Table 4.4 (*LLR/L* and *NL/A*) are significant and agree with this study's expectation that they would have a positive influence on the hazard rate (with statistics of .08 and .034). From the same covariates in Table 4.5, it can be further noticed that in *CB* a higher rate of *LLR/L* and *NL/A* increased the hazard ratio by .15 and .066; in contrast, for the *IB* an increase in *LLR/L* ratio decreased bank failure risk by 0.14. Such a finding implies that *IB* have some internal difficulties in asset quality management that could be ascribed to their practices in making new loan programs or in their evaluation of the potential risk factors in an investment portfolio, which, by extension, may have an effect on the adequacy level of allowances for loan and lease losses. *IB* may thus need to improve their management structure in order to make more efficient decisions related to credit risk.

Table 4.5- Covariates of the Financial Ratios for Bank Groups

Cloglog with Unobserved Heterogeneity				
	CB		*IB*	
Variables	*Micro*	*Micro+ Macro*	*Micro*	*Micro+ Macro*
Log t	1.833***	1.988***	1.272***	1.211***
	(0.247)	(0.276)	(0.337)	(0.333)
ROA	-0.0468	-0.0241	-0.248***	-0.277***
	(0.0513)	(0.0510)	(0.0605)	(0.0720)
NIM	-0.237*	-0.120	0.222***	0.227***
	(0.127)	(0.130)	(0.0502)	(0.0551)
LLR/L	0.148***	0.152***	-0.114**	-0.144***
	(0.0131)	(0.0149)	(0.0455)	(0.0555)
NL/A	0.0880***	0.0664***	-0.0226	-0.0320
	(0.0127)	(0.0145)	(0.0148)	(0.0200)
BC		0.0172*		0.0136
		(0.0101)		(0.0174)
Real GDP		-0.0220		-0.0923*
		(0.0275)		(0.0486)
Inf.		0.225***		0.177***
		(0.0355)		(0.0525)
GOV		-0.379		-0.642
		(0.282)		(0.421)
RQ		-1.080		-1.715
		(0.814)		(1.729)
Constant	-16.34***	-17.02***	-6.892***	-5.483**
	(1.306)	(1.475)	(1.449)	(2.543)
Lnsig2u	-10.55	-11.63	-12.26	-13.08
	(14.53)	(29.60)	(25.14)	(47.37)
Wald chi2	178.23	196.77	52.29	57.08
Obs.	17159	17159	3947	3947
Id.	574	574	188	188

Note: Standard errors in parentheses; (***) denotes p<0.01, ** p<0.05, * p<0.1.

In terms of macro-level variables which are involved in the two equations, as was described initially in this study, the coefficients of these covariates, shown in tables 4.2, 4.3 and 4.4, are significant and align with the expectations of this study. For the *BC* variable, a more concentrated banking sector leads to a rise in the hazard rate by approximately 0.03; as this study is based on developing countries, such a result is consistent with Evrensel's findings (2008). Even with the subgroups for *CB* and *IB* in Table 4.3, the influence of *BC* does not differ from both bank groups together in the first estimate equation (as is seen in Table 4.2), whereas in Table 4.5 it has a positive impact on hazard rate, but it is only significant with *CB* at 10%.

The estimated coefficient of real *GDP* growth signifies that increasing this variable will result in a decline of the hazard rate by approximately -0.06 for both equations.

For the bank groups in the first equation (and in relation to the covariates of the balance sheet and income statement), the reported effect of increasing real *GDP* growth is more significant and valuable in the *IB* group than it is for that of the *CB*, where it decreases the hazard rate by 0.12 and 0.04. In the second equation, this estimate is, however, only significant with *IB*, reducing the failure hazard ratio by 0.1. This finding indicates that although the size of *IB* is less than that of *CB*, they are instead more engaged with the real economy.

As regards the *Inf.* variable, it has a positive influence on hazard rate in all cases, including the models for both *CB* and *IB*; this rate increases failure hazard approximately by 0.2. The *GOV* covariate has a negative impact on hazard rate with a reading of -0.63; in terms of the bank groups, it is only significant in relation to the model for *CB*, which is related to the first equation with a value of -0.73, indicating that *GOV* is more associated with *CB* than *IB*, which, by extension, decreases the probability of failure hazard in these banks.

Lastly, as the results indicate, improving the *RQ* has an adverse impact on the hazard rate in both estimate equations, yet there are different values; it thus decreases the hazard rate by 1.1 and 1.5. For the bank groups, it is only significant in Table 4.3 with *CB* at approximately -1.2.

4.5.3 The Hazard Ratio Findings

It is, moreover, important to analyse the hazard ratio findings, as this sections aims to do. This ratio can be described as follows: a hazard ratio less than one implies a negative influence of the variable on failure hazard; other variables remain constant or, in other words, *ceteris paribus*. By looking at the reported findings in Table 4.6, the hazard ratio estimate of the *IB* dummy signifies that at each survival time the conditional probability of failure rates in those banks is almost twice as high as it is in *CB*, thus resulting in shorter survival time for *IB*. Tables 4.2 to 4.4 better emphasise the depiction of the estimate coefficient and the hazard ratio of the *IB* variable, which can be expressed as 1.9= *exp*(0.64) and 2.2= *exp*(0.77).

Table 4.6- Hazard Form Results of the Cloglog Model

Covariates of the Balance Sheet and Income Statement									
Variables	*Log t*	*IB*	*GNIR*	*OEA*	*BC*	*Real GDP*	*Inf.*	*GOV*	*RQ*
Hzd. Ratio	4.03	1.88	0.992	0.9998	1.029	0.922	1.21	0.566	0.373
Std. Err.	0.78	0.42	0.003	0.0000	0.008	0.020	0.03	0.118	0.229

Covariates of the Financial Ratios											
Variables	*Log t*	*IB*	*ROA*	*NIM*	*LLR/L*	*NL/A*	*BC*	*Real GDP*	*Inf.*	*GOV*	*RQ*
Hzd. Ratio	5.2	2.169	0.947	1.222	1.084	1.034	1.028	0.947	1.21	0.532	0.234
Std. Err.	1.06	0.504	0.014	0.045	0.009	0.009	0.008	0.021	0.032	0.115	0.156

Note: All covariates are significant at %99, %95 and %90.

In terms of micro-level variables, the hazard ratios of *GNIR* and *OEA,* which are related to the balance sheet and income statement, indicate a negative impact on hazard rate for banks. The hazard ratios for those variables are, however, almost equal to one, suggesting that the impact of these variables on hazard rate is slight. Similarly, the hazard ratio of *ROA* is presented as less than one (0.95= *exp*(-0.054)), but there is a minor negative effect. Conversely, the hazard ratio for *NIM* is shown as 1.22, thereby demonstrating that an increase in *NIM* by 1% is associated with a 22% higher hazard rate. Finally, the most notable macro-level output is that of a 1% rise in *BC* and *Inf*., which causes an increase in the hazard rate by 3% and 20%. The hazard ratio for banks that are involved with *GOV* is only 40% of the hazard rate when compared with those banks that are not involved with the aforementioned variable at each survival time.

4.6 CONCLUSION

Previous studies in *IB* have rarely produced empirical evidence on failure risk analysis or on the exploration of the factors that could affect a bank's failure. Thus, such a gap in the literature has inspired this study to examine the failure of *IB* and *CB* in the GCC region by employing the survival-analysis models. Initially, the unconditional model was employed by applying the life-table non-parametric method to address the trend of survival rates, both in *IB* and *CB* and within each country. Further, through the use of the discrete-time model, this study investigated the influences of some selected variables from micro- and macro-level data on the banks' failure, presenting a comprehensive comparative analysis between *IB* and *CB*.

The unconditional analysis supports the hypothesis that *IB* are more likely to fail than *CB*, without controlling the differences for the covariates; in terms of an individual country, Saudi banks have the longest survival time followed by those in Kuwait and Bahrain, whereas the UAE and Qatar represent the shortest survival times. From these results, it can be concluded that longevity is important in a survival-time analysis of the GCC banking sector.

Ultimately, the conditional findings reveal that, in terms of micro-level variables, the *IB* coefficient confirms the unconditional findings, suggesting that *IB* are approximately twice as hazardous as *CB*. Such a finding is obtained for the banks sampled from five GCC countries covered by this study; however, Beck *et al.* (2013) indicated that during the financial crisis *IB* have performed better then *CB*, in particular, in terms of asset quality and capitalisation, which means that *IB* were at less risk than *CB*. In addition, the study by Beck *et al.* comprised twenty-two countries, including Malaysia, Indonesia and Pakistan, and it took into account the local and global financial crisis. It should also be pointed that the business cycles of the countries in which Islamic banking has a reasonable position has not been effected by the financial crisis; which should be considered in interpreting Beck *et al.*'s (2013) results.

The link between the *GNIR*, *OEA* and failure hazard rate is negative; nonetheless they still have small magnitude influences. The financial earnings ratios show that a rise in *ROA* causes the hazard rate to decline, yet an increase in *NIM* leads to a similar increase in the hazard ratio. The asset quality and liquidity ratios, *LLR/L* and *NL/A,* are associated positively with failure hazard risk. Moreover, the findings depict that increasing *GNIR* decreases the failure risk for *CB* and *IB*, but it is significant only for *IB*. Similarly, with the ratios for *ROA*, which has a negative influence on hazard rate, and *NIM*, which has a positive influence on hazard rate, they are significant for *IB*. This outcome emphasises that the financing of most *IB* depends on non-PLS or asset-based contracts, in that they offer less risk and more profit than PLS contracts. For the group associated with *CB*, a higher ratio of *LLR/L* and *NL/A* increases the hazard rate, yet with *IB* an increase in *LLR/L* decreases bank failure risk. Such a finding implies that *IB* may need to improve their management structure, so as to make more efficient decisions related to liquidity and credit risk, especially when opting to expand their PLS contracts.

As the findings indicate, the failure risk is, however, more affected by macro-level variables; a more concentrated banking sector leads to an elevated hazard rate, since it has the same positive influence on both subgroups (*IB* and *CB*). Growth of the real *GDP* rate causes the failure risk to decline, and, more importantly, the effect of real *GDP* growth is of greater value for *IB* than it is for *CB*, suggesting that despite the smaller size of *IB* (in comparison to *CB*), they are better engaged with the real economy. Furthermore, for all scenarios, higher inflation considerably increases failure hazard. The involvement of the government in bank ownership reduces the probability of failure risk; in addition, *CB* are more associated with *GOV* than *IB*, which protects these banks against failure hazard. Finally, improving the regulatory quality has a pronounced and adverse impact on hazard rate.

The most striking finding regarding *IB* is that the higher probability of failure risk in this group does not necessarily signify weak performance. It is instead linked with the real economy growth indicator; it can thus be recommended that to enhance the role of Islamic finance, especially in the GCC, the financing models as well as the regulation should be improved in conjunction by policy makers.

Lastly, it is also important to note that the history of GCC banking in general and Islamic banking in particular is rather short; as these countries were founded mostly in the post-war period and their banks are even younger. Thus, having a longer time period would have enhanced the quality of the findings established in this study. However, this study is designed to take into account the realities of the region with the aim of shedding some light on this particular aspect, which has not previously been studied for the GCC's Islamic and conventional banking.

CHAPTER 5

NPL WITHIN THE GCC ISLAMIC BANKING AND ISLAMIC FINANCING CONTRIBUTING TO THE NPL IN THE GCC'S BANKING SYSTEM

5.1 INTRODUCTION

Financial stability is essential for the sustainable growth and enhanced performance of banks in general and for *IB* in particular. Although there are a number of determining factors for financial stability, problem loans can be considered as a source of worry in the banking system, whether that be in developed countries or in developing countries. Thus, the determinants of credit risk and *NPL* will be explored, especially within advanced countries.

In recent years, the expansion of the economies of the GCC countries has resulted in the expansion and development of the financial sector. This has been further enhanced by the development and expansion of *IB* in the region, which has contributed to the further growth of the bank credit system. Although akin to any banking system, these credit systems have been influenced by the microeconomic dynamics of the institutions concerned, by the macroeconomic environment and by their financial surroundings, which can, for example, be seen in the form of business cycles. This situation consequently implies that the financial market downturn in 2006 and the financial crisis in 2009 have had an effect on the performance of *IB* as well as on the general financial system (Khamis *et al*., 2010).

This paper aims to investigate the macro-level and micro-level factors that determine *NPL* in the GCC banks. In the process of completing this investigation the following objectives will be developed:

(i) To explore the impact of some selected sectors from Islamic financing and Islamic finance contracts on the *NPL* of both the Islamic banking and commercial banking systems of the GCC countries as a whole.

(ii) To identify the macro-level and bank-level factors that contribute to *NPL* in the GCC's Islamic banking system via means of the panel data econometrics model.

(iii) To examine the dynamic impact of those factors which determine the *NPL* of the GCC's banking sector by utilising dynamic panel data (GMM) models.

This paper therefore aims to identify the macro-level and bank-level factors contributing to *NPL* in the GCC's Islamic banking sector through the use of the panel data econometrics model for the period of 2005 to 2011. Further, and in order to circumvent the observed shortcomings in the size and nature of the issues and to substantiate the analysis, this paper simultaneously aims to examine the impact of these factors on the *NPL* of the GCC's banking system in general by utilising dynamic panel data (GMM) models. In addition, from among these factors this study will examine the impact of the sectoral distribution of Islamic financing and the distribution of Islamic financial methods on the observed trends of *NPL*, which enables the contribution of Islamic finance to the *NPL* of the Islamic banking sector and the GCC's commercial banking sector as a whole to be identified.

This paper is organised as follows: an overview of studies related to *NPL* in banking sectors is provided, followed by a description of the determinant factors of *NPL*, including macroeconomic, structural, organisational, product development and bank-level factors. The research methodology is displayed based on panel data, dynamic panel data (GMM) models and estimator and econometric specification; it is followed by the empirical findings for each stated method. Finally, the discussion and conclusion of the study is presented.

5.2 NPL: AN OVERVIEW OF THE SUBJECT LITERATURE

A bank, as an intermediation firm, is likely to face loan delays or default problems; after a specific period of time these defaulted loans thus become *NPL*. Therefore, increasing *NPL* in credit portfolios indicates inefficient behaviour or management within a bank. To avoid such a dilemma, authorities require banks to increase loan-loss provisions. Consequently, managing and determining factors that have an impact on *NPL* is a vital aspect of an individual bank's performance and the financial economy of a country (Li *et al.*, 2009).

The available body of knowledge on banking indicates that *NPL* or issues regarding problem loans have been examined from several perspectives. Initially, *NPL* were utilised as an indicator of asset quality within the relevant literature (*see*: Meeker and Gray, 1987). Some studies focused on investigating the causes that precipitate a bank's failure, including *NPL* and efficiency levels, where *NPL* are considered to be one of the key factors (for example, Demirgüç-Kunt, 1989; Whalen, 1991; Barr and Siems, 1994; and Wheelock and Wilson, 1995). The second trend in the literature focused on examining the link between bank performance and efficiency, such as productive and cost efficiency and *NPL*, by using strategies that included the Granger-causality method to explore the directions of the intertemporal relationship between these elements (*see*: Berger and DeYoung, 1997). The final and recent trends in the literature that are related to *NPL* seem to focus on investigating the determinants of *NPL* within banking sectors in the form of macroeconomic and microeconomic factors (*see*: Salas and Saurina, 2002; Lu *et al.*, 2005; Espinoza and Prasad, 2010; and Louzis *et al.*, 2012). Furthermore, some recent studies have investigated the relationship between *NPL*, macroeconomic factors and the business cycle (*see*: Nkusu, 2011 and Beck *et al.*, 2013). Despite the existence of such a rich array of literature on the subject, it should be noted that there is scarcely any research with regard to *NPL* in *IB*.

From among the literature relating to banking studies and on the subject of *NPL*, Berger and DeYoung (1997) reported four significant hypotheses when examining the relationship between *NPL*, cost efficiency and equity capital in US commercial banks from 1985 to 1994, which were 'bad management', 'bad luck', 'skimping' and 'moral hazard'. It was found that increasing *NPL* can decrease the measured cost efficiency. This result implies that reducing *NPL* by increasing administration expenses can lead to a decrease in the cost efficiency. On the contrary, *NPL* are considered to be increasing due to the lower cost effacing, indicating a low level of management.

The available empirical literature indicates that a number of papers investigated the determinants of *NPL* by utilising dynamic panel GMM methods. For instance, Salas and Saurina (2002) examined the determinants of credit risk within commercial and savings banks in Spain from 1985 to 1997, including factors related to both macro-level and bank-level variables by using GMM-difference. They concluded that there was a significant variance between commercial and savings banks in terms of financial risk management. For both bank types, they stated that bank-specific variables are, however, useful when utilised as timely warning pointers, such as when approaching *NIM* and bank size portfolio diversifications. Another empirical study which employed the GMM-system is that by Espinoza and Prasad (2010), who investigated the relationship between *NPL*, macroeconomic factors and some selected bank-level factors of the GCC's banking sector by focusing on non-oil *GDP* for the period of 1995 to 2008. Their findings also indicated that bank-level variables can be used as an early warning indicator for future problem loans, and they found that non-oil *GDP* is adversely related to *NPL*. Another of their findings suggested that the global financial surroundings have an impact on *NPL*. A more recent empirical study is that by Louzis *et al.* (2012) of the case of Greek banks over the period from 2003 to 2009; this study concluded that the problem loans in the banking sector are related to macro-level factors, including interest rate and unemployment, and subsequently by micro-level factors, especially those that reflect the quality of management, such as the ratio for the return on equity.

Some studies have focused on examining the impact of macroeconomic and business cycles on *NPL*. For instance, Nkusu (2011) investigated the relationship between *NPL* and macroeconomic factors by using two approaches. The first approach is that of signal-equation panel regressions, which is utilised to prove that a decrease in the development of macroeconomic factors are linked to increasing *NPL*. The second approach is that of a penal vector autoregressive, which is used to investigate the dynamic interaction of variables determining *NPL* towards a shock in the system, with particular focus on the global financial crisis in 2008. The sample consists of twenty-six advanced countries from the period from 1998 to 2009. It is found that regardless of the causes which are behind problem loans, a significant increase in *NPL* leads to a rise in the *NPL* themselves through a linear response that may continue from the first shock up until the fourth year. A recent empirical study by Beck *et al*. (2013) investigated the link between macroeconomic factors and *NPL* in 75 countries from 2002 to 2010 by utilising the dynamic panel data model. It concluded that the key factor affecting *NPL* is *GDP* growth, meaning that the impact of the global financial crisis, which affects the economic activity of each country, is the most risky factor for bank asset quality. Meanwhile, the concept of *NPL* or asset quality in those countries is influenced by additional factors, such as exchange rate, share prices and the lending interest rate.

In terms of developing countries, Farhan *et al.* (2012) investigated the macro-level factors, including *GDP* growth, interest rate, exchange rate, energy crisis, unemployment and inflation, on the determinant of the *NPL* of ten Pakistani banks through the use of a questionnaire survey that mainly targeted credit risk managers. They concluded that all of the noted variables have a positive impact on *NPL*, with the exception of *GDP* growth, which has a negative effect on *NPL*. In addition, this study indicated that the loan quality was significantly affected by the idea of an energy crisis.

There has been little effort made to investigate the determinants of *NPL*. Among the available studies, some investigations have explored the efficacy and financial stability of *IB* and the *CB* sector by using *NPL* as a proxy reflecting asset quality or financial stability. For example, Rahim *et al.* (2012) compared the *CB* and *IB* in relation to financial stability by employing *z*-score and *NPL* as indicators reflecting financial stability in Malaysia over the period from 2005 to 2010 through the use of the panel data FE model. Their analysis included some independent variables that related to bank-level, such as asset quality and cost-income ratio, which indicates efficiency, and macro-level variables, including market share, Herfindahl Index, inflation and real *GDP*. Rahim *et al.* found that the financial stability in *IB* was somehow more constant than in the case of *CB*, which were affected significantly by efficiency, the Herfindahl Index, inflation and real *GDP*. Nevertheless, they noted that those variables were not particularly significant with financial stability indicators in *CB*. In another study, Beck *et al.* (2013) examined the business orientation, bank efficiency and stability of *IB* and *CB* from 22 countries over the period from 1995 to 2009, utilising *NPL* as a proxy for asset quality. It was concluded that in general *NPL* are affected adversely by *IB* (as a dummy variable). Beck *et al.* noted, however, that during the global financial crisis the performance of *IB* was higher than that of *CB* in terms of asset quality and capitalisation.

In examining the link between a bank's efficiency and *NPL* in order to investigate the management quality through a comparative study of *CB* and *IB* in the Organisation of Islamic Cooperation (OIC) countries from 1993 to 2007, by applying the hypotheses that are suggested by Berger and DeYoung (1997), Setiwan *et al.*, (2013) found that an increase in *NPL* is largely determined by external factors. This notion supports the 'bad luck' hypothesis, and internal effects related to efficiency level, which is associated with the 'bad management' and 'skimping' hypotheses, specifically in the *IB* of the Middle East region, including Turkey.

Thus, it should be noted that the present study is distinct from other empirical studies which explored the *NPL* of the GCC's commercial banking sector by examining the link between bank efficiency and *NPL* but also, and most importantly, by investigating *NPL* in *IB* and *CB* with Islamic windows. In addition, among the macro-level and micro-level factors, this study also includes the effect of the financing for *IB* and Islamic financial methods on *NPL* or loan quality[13]. Furthermore, some studies have employed Z-score to investigate the impact of *NPL* on the financial stability of *IB* (*e.g.* Rahim *et al.*, 2012), however, the research aim of this study will be achieved by the use of sophisticated econometric tools so as to observe the dynamic impacts or time condition impacts on *NPL* via dynamic panel data (GMM) models.

5.3 DETERMINANTS OF NPL AND DESCRIBING THE VARIABLES FOR FORMING THE MODELS

After an extensive review of the available literature, the variables used in this study are defined when forming the empirical models to be tested. In doing so, the variables are classified as: macroeconomics variables, organisational- and structure-oriented variables, product-development-related variables and bank-level variables.

The relationship between the macroeconomic environment and *NPL* is investigated by a number of studies in banking literature (*see*: Salas and Saurina, 2002; Louzis *et al.*, 2012), which include factors such as the real *GDP* growth, non-oil *GDP* growth, sectoral financing, organisational structure and product-development factors. When reflecting on these factors, this study considers the following variables:

(i) Growth of financing by the banking sector for the real estate and construction sectors.
(ii) Growth of financing for the manufacturing and industry sectors.
(iii) Fully-fledged *IB* financing growth for the real estate and construction sectors.

[13] Some studies utilised *NPL* as an indicator for loan quality, such as those by Hughes and Mester (1993); *see* Berger and DeYoung (1997: 853).

(iv) Growth in the assets size of fully-fledged *IB* and Islamic windows (*IW*).

(v) The growth of *sharia*-compliant assets in *IB* and *IW*.

(vi) Asset growth of *CB*.

(vii) The growth of profit-loss-sharing (*PLS*) contracts.

(viii) The growth of fixed-income creating debt (*FID*) contracts.

The next factor, which is considered to have a determining impact on *NPL*, is that of bank structure and organisational development, which is in turn related to the bank type. Table 5.1 presents the definition of those variables, which include the growth rate of assets size of: fully-fledged *IB, IW* and *CB*. The link between the ratio of *NPL* and each of these variables is unclear in terms of its direction. Salas and Saurina (2002) and Louzis et al. (2012) stated, however, that bank size itself, without the growth rate, indicates a risk of diversification, implying that bigger banks have significant potential for additional opportunities in diversification, which is associated negatively with *NPL* . Such variables can therefore be utilised as a proxy to assess the link between the growth rates for each bank type. This notion is particularly true if they differ in risk-taking behaviour to diversify their portfolios between high-risk projects and low-risk projects with more conditions and restrictions, where a negative link with *NPL* signifies a lower risk of diversification in contrast to a positive relationship with *NPL*, which indicates a higher risk of diversification.

The last factor is product development, which is associated with the allocation of Islamic finance (IF) contracts according to its categories, which are *PLS* and *FID* contracts. As is recognised in IF literature, *PLS* modes of financing include *mudarabah* and *musharakah*; *FID* contracts are comprised of *murabahah* (mark-up pricing), and deferred sales, such as *ijarah* or leasing and hire purchase, *salam* and *istisna.* [14] It is essential for this study to investigate the influence of the financing of *IB* through both *PLS* and *FID* instruments on *NPL*. The growth rate of each category in each country will be calculated in order to examine the effect of these variables.

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[14] In the current study sample, Kuwait's *IB*, including the Kuwait Finance House, the Kuwait International Bank and the Boubyan Bank KSC, have not provided any *PLS* contracts.
Again, in this study sample and over the observed period, none of the *IB* have utilised a *salam* contract except the Dubai Islamic Bank, which has applied this instrument for the period of 2010 to 2011 with 2.45% and 6.15% of total Islamic financing modes.

After discussing the potential macro-level, organisational, structural and product-development-related determining factors of *NPL* as envisaged by the theory, this section focuses on micro-level or bank-specific factors, which include RWA, two selected financial ratios (ROE and *NIM*) to reflect upon the indicators of a bank's profitability, and efficiency scores.

Table 5.1- Definition of Variables and Hypotheses Test

Variable	Definition	Hypothesis Tested
NPL	NPL to gross loans (dependent variable NPL)	The prior NPL put more load on the current NPL (+)
RWA	Risk-weighted assets to assets	Credit risk capture (+)
ROE	Return on equity = $\frac{\text{Profits}_{it}}{\text{Total equity}_{it}}$	Bad management and bad luck (-)
NIM	Net interest margin = $\frac{\text{Profit margin (after excluding interest expenses)}_{it}}{\text{Average of earning assets}_{it}}$	Risky loan portfolio (-)
EFF^{DEA}	Efficiency scores obtained from DEA	Bad management, bad luck (-) and skimping (+)
EFF^{SFA}	Efficiency scores obtained from SFA	Bad management, bad luck (-) and skimping (+)
ΔGDP	Real growth of Gross Domestic Product	Prosperity (-)
$\Delta\ non-oil\ GDP$	Non-oil GDP growth	Prosperity (-)
ΔIM	Manufacturing and industry financing growth	Interaction with business cycle and real GDP (-)
ΔREC	Real estate and construction of GCC banks financing growth	Interaction with business cycle and real GDP (-)
$\Delta RECIB$	real estate, and construction financing growth of IB	Interaction with business cycle and real GDP (-)
ΔIBA	Fully-fledged assets of IB to total assets growth	Less risk in diversification (-), high risk in diversification (+)
ΔIWA	Islamic window assets to total assets growth	Less risk in diversification (-), high risk in diversification (+)
$\Delta IBIWA$	IB and Islamic window assets to total assets growth	Less risk in diversification (-), high risk in diversification (+)
ΔCBA	CB assets to total assets growth	Less risk in diversification (-), high risk in diversification (+)
ΔPLS	PLS contracts financing to total Islamic financing growth	Less concentrated in transactions of IB (Unknown)
ΔFID	FID contracts financing to total Islamic financing growth	More concentrated in transactions of IB (+)

With regard to *RWA* to gross total assets ratio, the *RWA* is measured according to the Basel II Accord, which reflects definite requirements, including lending policies from bank regulators. It thus captures the credit risk of bank portfolios when considering some aspects such as the sort of debtor and the actual collateral and guarantees. Repullo and Suarez (2013) suggest, however, that the capital buffers under Basel II are not sufficient to counteract any recession on the supply of credit to bank debtors. In addition, De Lis *et al*. (2001) highlight that credit is likely to rise faster during expansion and slower during recession than GDP. Such arguments demonstrate key evidence as to the effects of financial crises and downturn on the business cycle, wherein the *RWA* increases because it utilises the capital buffers as one of the requirements in Basel II; a rise in this ratio leads to an increase in the present or future value of *NPL*. The link between *RWA* ratio and *NPL* is shown by Berger and DeYoung (1997) to be positive, given that increasing the credit risk in bank portfolios leads to an increase in *NPL*. Therefore, the relationship between *RWA* and *NPL* is predicted to be positive.

Turning to performance and profitability ratios (including *ROE* and *NIM*), the *ROE* ratio is found to be negatively related to *NPL* in the study made by Louzis *et al*. (2012), which pointed out that due to the previous performance of bank management a negative link between *ROE* and *NPL* could be seen. This link reflects the management quality and the external effects of financial stability in the country which could have an influence on the bank performance, which is indicative of the 'bad management' and 'bad luck' hypotheses. In the short term, the *ROE* ratio may, however, have a positive relationship with *NPL*; for example, the bank may elevate the existing earnings at the cost of upcoming defaulted loans to enhance the profitability aspect in a market by utilising loan-loss provisions; such a credit policy is named a liberal policy or 'pro-cyclical or lending policy' (*see*: Gordy and Howells, 2004; Louzis *et al*., 2012; Repullo and Suarez, 2013; and Adrian and Song Shin, 2014). It should be noted that in this study the *ROE* ratio is examined in non-dynamic panel static models and in a dynamic model reflecting the effect of the previous year; this ratio is expected to have a negative sign with *NPL*.

The term of *NIM* ratio is based on the annual margin profits, which are attained from the difference between interest income and expenses subjugated by earning assets

(Golin and Delhaise, 2013). Salas and Saurina (2002) stated that if *NIM* has declined then the credit diversification policy could be modified, and these changes can make loan portfolios more risky, which in turn increases the probability of defaulted loans. The sign of this variable with no lag is unpredictable, yet with one lag the *NIM* ratio is anticipated to be negative with *NPL*.

As discussed in chapters three and four, the bank is considered to be an intermediary between investors and borrowers that transforms the input monetary sources to output quantities or products. The selected input-output variables to estimate efficiency scores are total deposits, short-term funding (*DSF*) and operating expenses (*OE*), including non-interest and personal expenses; the output variable is that of net loans (*NL*). In addition, bank efficiency is evaluated to detect how efficient the bank is at producing loans and, most importantly, to examine the relationship between efficiency and *NPL*. This in turn is instigated so as to investigate management behaviours when directing *NPL*, which can be explained by the terminology of Berger and DeYoung (1997): the 'bad management', 'bad luck', and 'skimping' hypotheses.

In the case of the 'bad management' and 'bad luck' hypotheses, the relationship between bank efficiency and *NPL* is negative for several reasons. For instance, with the former hypothesis as an internal cause, the absence of management quality in monitoring loans expenses and collateral results in decreasing the efficiency and increasing loan problems. The state of the 'bad luck' hypothesis is held to be due to external factors, such as a downturn in the macroeconomic aspects which may create additional costs in administrating *NPL*, which instils an adverse effect on bank efficiency. On the other hand, the 'skimping' hypothesis indicates a positive relationship between efficiency and *NPL*. In the skimping policy position the bank tends to reduce the administrative expenses that are related to monitoring and controlling the borrowers; such a procedure thus makes the bank efficient and the *NPL* appear to be not affected, especially in the short term. Over time the loan performance problem does, however, appear because of defaulted loans as a large number of debtors become negligent.

In the present study the influence of a bank's efficiency on *NPL* is investigated in the present and on previous occasions. The present (or not lagged variables) is conducted to examine the relationship between Islamic banking efficiency and *NPL*, through panel data models, whereas the dynamic panel (the effect of the previous year) is applied to examine the link between efficiency and *NPL* in the Gulf's commercial bank sectors as a whole. As noted by Berger and DeYoung (1997), a bank may be affected by all of these three hypotheses. For instance, bad luck could occur as a result of economic crisis; at the same time bank management may make bad decisions by adopting a skimping policy to reduce costs; all of these procedures could result in an increase to *NPL*.

5.4 RESEARCH METHODOLOGY AND EMPIRICAL PROCESS

This section describes the factors that are utilised in this study for GCC Islamic banking with panel data econometric specifications as the first stage. Given that the nature of the data does not allow sophisticated analysis to be conducted, the impact of Islamic financing on *NPL* in GCC commercial banking as a whole is investigated by utilising dynamic panel (GMM) models. The empirical modelling is detailed in the research methodology section.

After presenting the literature review of the available empirical studies and identifying the potential variables used in exploring and examining *NPL*, this section focuses on the research methodology of the study by detailing the empirical process, including the model selection.

5.4.1 Panel Data Estimator

The first aim of this study is to estimate the determinants of *NPL* for the *IB* and *CB* providing *IW* in the GCC region. In order to respond to this research question, the panel data method is considered to be the most efficient empirical econometrics model. The basic formula for the panel data method is shown in the following model as expressed in equation 5.1:

$$y_{it} = \alpha + \beta x_{it} + \eta_i + \nu_{it} \quad (5.1)$$

i denotes the number of banks $(i = 1, \dots, n)$, and t represents the time-series $(t = 1, \dots, s)$ of the panel data sample; the dependent variable is y_{it}, which represents the ratio of NPL to gross loans; this is suggested by Louzis *et al.* (2012).[15] In the modelling, a non-performing loan has occurred if it has been delayed up to ninety days by borrowers (Berger and DeYoung, 1997). The explanatory variables $k \times 1$ are symbolised by x_{it} and η_i, indicating the unobserved individual effects; ν_{it} is the error term.

During the empirical process in this study, both types of panel static models are applied: "fixed effects" (FE) models and "random effects" (RE) models. The difference between these two models is that in the FE model, the η_i component is estimated under fixed parameter assumption, a matrix of individual dummies, and the remaining variance effects are random with ν_{it}, which is distributed independently. In the RE model, the η_i is, however, presumed to be a random component and independent of ν_{it} (Greene, 2007; Baltagi, 2008). As an initial estimate, the econometric specification OLS model is also applied. Among the FE and RE models, the Hausman test is utilised to distinguish the favourable model (Hausman, 1978).

5.4.2 Dynamic Panel Data (GMM) Estimator

The dynamic panel approach or GMM model is utilised to estimate the micro and macro factors that may determine *NPL* over time, which is proposed as in the following studies:

(i) The GMM difference (GMM-DF) model developed by Holtz-Eakin *et al*. (1988), and by Arellano and Bond (1991).

(ii) The GMM system (GMM-SYS) model developed by Arellano and Bover (1995).

(iii) Estimating efficient dynamic panel data models for a small number of time-series observations (Blundell and Bond, 1998).

The general description of the dynamic panel model is defined in the following equation:

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[15] Many studies employed the transformed variable through truncated or logit transformation of *NPL* ratio as dependent variable (for example, Salas and Saurina, 2002 and Espinoza and Prasad, 2010). The present study does, however, utilise the numeral of *NPL* ratio without transformation because it shows more significant and precise results. Furthermore, Salas and Saurina (2002) pointed out that the transformation of dependent variable would not be suitable for the GMM process.

$$y_{it} = \alpha y_{i,t-1} + \beta(l)x_{it} + \eta_i + \nu_{it}, |\alpha| < 1 \quad (5.2)$$

$\beta(l)$ symbolises the lag of estimate parameters; α represents the coefficient of the lagged dependent variable; x_{it}, η_i, and ν_{it} are described in the previous part related to panel data.

The GMM model is based on the first difference transformation of equation 5.2, which can be rewritten as:

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \beta(l)\Delta x_{it} + \Delta \nu_{it} \quad (5.3)$$

Δ signifies that the first difference operator component and ν_{it} component are not correlated over time $[(E(\nu_{it}\, \nu_{i,t-1}) = 0]$. The dependent variable with one lag, $\Delta y_{i,t-1}$, is correlated with error term $\Delta \nu_{it}$, leading to a biased estimation of the model. The dependent variable with two lags or more, $\Delta y_{i,t-2}$, is, however, correlated with $\Delta y_{i,t-1}$ and not with $\Delta \nu_{it}$, which can be used as an instrument variable of equation three. This then proceeds to the orthogonality restrictions description, starting with the following equation of moment conditions:

$$E(y_{i,t-s}\Delta \nu_{it}) = 0 \; for \; t = 3, \ldots., T \; and \; s \geq 2 \quad (5.4)$$

The second case of moment conditions is when exploratory variables are *strictly exogenous*, which implies that over all time those variables are not correlated with the error term, as in the following formula:

$$E(x_{i,t-s}\Delta \nu_{it}) = 0 \; for \; t = 3, \ldots., T \quad (5.5)$$

For the case when explanatory variables are weakly exogenous or predetermined, such as $E(x_{it}\nu_{it}) \neq 0 \; with \; t < s$, then the x_{it} can be a valid instrument only with the specified lagged values, which involves the moment conditions as follows:

$$E(x_{i,t-s}\Delta \nu_{it}) = 0 \; for \; t = 3, \ldots., T \; and \; s \geq 2 \quad (5.6)$$

If Z_i is the matrix element of instrumental variables then according to Bond (2002) the equation (5.6) can be rewritten as:

$$E(Z'_i \Delta \nu_{it}) = 0 \quad (5.7)$$

The GMM model built on moment conditions that diminish the criterion as expressed in the following equation:

$$J_n = \left(\frac{1}{n}\sum_{i=1}^{n}\Delta v'_i z_i\right) W_n \left(\frac{1}{n}\sum_{i=1}^{n} z'_i \Delta v_i\right) \quad (5.8)$$

By utilising the weight matrix:

$$W_n = \left[\frac{1}{n}\sum_{i=1}^{n}(z'_i H z_i)\right]^{-1} \quad (5.9)$$

H is an individual specific matrix. The previous equations (5.4 and 5.9) form the basis of the GMM one-step estimator, which is efficient if the error terms are homoscedastic. Indeed, there are two types of GMM estimators: one-step and two-step estimates. In addition, Windmeijer (2005) pointed out that the GMM two-step estimate with corrected errors asymptotically could achieve better results than the one-step estimator. The data sample of this study is, however, relatively small; the one-step GMM model is therefore preferred in the present study. Thus, in such a sample, the standard errors do not allow for additional variations to construct the weight matrix (Bond, 2002; Bond and Windmeijer, 2005; Windmeijer, 2005).

In order to examine the autocorrelation, the Arellano-Bond approach is utilised with first-order (AR1) and second-order (AR2) serial correlation; the former is applied to detect the serial correlation in differenced error terms when given the following:

$\Delta v_{it} = v_{it} - v_{i,t-1}$, and (5.10a)

$\Delta v_{i,t-1} = v_{i,t-1} - v_{i,t-2}$ (5.10b)

Both previous equations, (10a) and (10b), share the $v_{i,t-1}$ term. The later test is used to check the serial correlation in levels for first-order. Further, Sargan/Hansen joint tests are applied and reported after the GMM estimation to indicate the validity of instrumental variables with the objective of making sure that they are not endogenous to the differences of the error term.[16]

In addition to applying the difference GMM estimator, this study applies the GMM system estimator; the latter differs from the former by exploiting additional moment

[16] Some lags are invalid as instruments; for example, if $y_{i,t-2}$ as an instrument is endogenous to the differences in the error term that leads to an invalid instrument (Roodman, 2009).

conditions, $T-2$, to the moment conditions in the first differences model. Blundell and Bond (1998) stated that the performance of the GMM system estimator could be less biased and more accurate, especially if α is large. The form of this estimator can be written in the following equation:

$$E(u_{it}\,\Delta y_{i,t-1}) = E\left((\eta_i + v_{it})\Delta y_{i,t-1}\right)$$

$$= E\left((y_{it} - y_{i,t-1})\Delta y_{i,t-1}\right) = 0 \qquad (5.11)$$

5.4.3 Econometric Specification

Table 5.1 describes the utilised variables that may affect and determine the *NPL* of the GCC banks, starting with the basic estimate model:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \eta_i + v_{it}, \quad \text{and}$$

$$|\alpha| < 1, i = 1, \ldots, 51, t = 1, \ldots, 7 \qquad (5.12)$$

NPL_{it} denotes the average of impaired or default loans to gross loans per year, and the estimated α of $NPL_{i,t-1}$ should be positive; RWA measures the ratio of RWA to total assets. This variable is utilised under the assumption of weak exogeneity with bank-level factors, which indicates that endogeneity and potential correlation matter with error term over time (Salas and Saurina, 2002; Louzis *et al.*, 2012). To avoid the correlation problem, such a variable is therefore computed with two lags or more for the first difference transformed form in equation 5.3. The last variable in the basic estimate model is that of the real *GDP* growth rate, and although ΔGDP is assumed to be strictly exogenous, the *GDP* growth and the other additional variables (treated as predetermined) in the following models are instrumented by themselves “IV-style” (Roodman, 2009).

A selection of variables was added to the basic model to account for the micro- and macro-level factors; initially, this is to investigate the relationship between bank efficiency and *NPL* in the effects on the present and previous year. The following equation is estimated:

$NPL_{it} =$
$\alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \beta_{3k} EFF^{DEA,SFA}{}_{it} +$
$\sum_{k=0}^{1} \beta_{4k} EFF^{DEA,SFA}{}_{it-k} + \eta_i + \nu_{it}$ (5.13)

$EFF^{DEA,SFA}$ separately represents the efficiency scores that are computed by utilising the output distance function via the DEA under the variable return to scale assumption. In addition, to justify the efficiency scores that are obtained through the DEA method and to conduct the robustness check, the stochastic frontier approach (SFA) is utilised by applying Cob-Douglas production function (*see* chapters two and three). After that and to examine the non-oil *GDP* growth impacts on *NPL*, the following formula is estimated:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{3k} \Delta GDP^{nonoil}{}_{it-k} + \eta_i + \nu_{it} \quad (5.14)$$

In order to test the hypothesis of a bank's profitability effect on *NPL*, bank-level variables are included with the basic model as follows:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \sum_{k=0}^{1} \beta_{3k} x^h{}_{it-k} + \eta_i + \nu_{it} \quad (5.15)$$

x^h represents bank-level variables, which are *ROE* and *NIM*. Accordingly and corresponding to the impact of bank-type and assets-size on *NPL*, other variables related to banking-sector development are tested in the econometric specification, which is written as:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \sum_{k=0}^{1} \beta_{3k} \Delta x^z{}_{it-k} + \eta_i + \nu_{it} \quad (5.16)$$

Δx^z denotes the asset growth of *IB*, *IW* and *CB*.

The equation 5.17 captures the dynamic effect of construction and real-estate sector financing on *NPL*:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \sum_{k=0}^{1} \beta_{3k} \Delta x^{REC,RECIB}{}_{it-k} + \eta_i + \nu_{it}$$

(5.17)

$\Delta x^{REC,RECIB}$ symbolises the growth of the real estate and construction aspects of the banking sector financing and *IB* financing for real estate and constructions.

Finally, in terms of Islamic finance modes, it is essential for this study to examine the relationship between *NPL* and Islamic finance contracts, such as *PLS* contracts and *FID* contracts. Thus, the following equation aims to investigate such a dynamic relationship between those variables:

$$NPL_{it} = \alpha NPL_{i,t-1} + \sum_{k=0}^{1} \beta_{1k} RWA_{it-k} + \sum_{k=0}^{1} \beta_{2k} \Delta GDP_{it-k} + \sum_{k=1}^{2} \beta_{3k} \Delta IFM^{PLS,FID}{}_{it-k} + \eta_{i} + \nu_{it} \tag{5.18}$$

$IFM^{PLS,FID}$ denotes the individual change in *PLS* and *FID* contracts.

5.4.4 Data Sample

The annual financial statements of all of the GCC countries for seven years from 2005 to 2011 (with the exception of Oman due to the absence of Islamic banking in the country for the period in question) were acquired from Bankscope under the International Accounting Standard (IAS) in US dollars. Other foreign banks that have branches which operate in the GCC region are excluded from the sample.

Table 5.2 displays the summary descriptive statistics of the variables utilised for the panel data and dynamic panel data (GMM) estimators.

Table 5.2- Descriptive Statistics of Variables

Variable	Mean	St. Dev.	Min.	Max.	Variable	Mean	St. Dev.	Min.	Max.
Panel data sample of IB and CB with IW					*Dynamic panel data (GMM) of all banks*				
NPL	3.51	3.83	0	23.72	*NPL*	4.90	7.60	0	56.86
RWA	72.76	23.40	0	110.04	*RWA*	72.27	24.99	0	133.37
ROE	14.76	11.51	-58.36	52.77	*ROE*	12.03	55.94	-946.11	52.77
NIM	3.41	1.4	1.2	13.53	*NIM*	3.49	1.37	1.2	13.53
DSF	20419.2	21482.2	98.4000	103478	*DSF*	17048.6	19062.6	98.40	103478
OE	360.076	359.622	4.50000	1914.47	*OE*	1069.52	4524.00	4.50	39960.1
NL	15250.3	16749.4	50.6800	89608.5	*NL*	13284.2	15251.5	50.68	89608.5
lnDSF	9.242	1.366	4.589	11.547	*lnDSF*	9.051	1.332	4.589	11.55
lnOE	5.355	1.141	1.504	7.557	*lnOE*	5.258	1.45	1.504	10.60
lnNL	8.952	1.364	3.925	11.403	*lnNL*	8.84	1.312	3.997	11.46
EFF^{DEA}	0.646	0.176	0.054	1	EFF^{DEA}	62.17	17.08	5.38	100
EFF^{SFA}	0.787	0.085	0.357	0.965	EFF^{SFA}	81.98	6.79	38.24	96.80
$\Delta RECIB$	30.374	26.97	-9.637	98.262	ΔIBA	5.19	16.33	-17.43	70.83
ΔPLS	286.356	1188.94	-46.345	5415.92	ΔIWA	71.92	147.40	-14.25	709.70
ΔFID	-0.523	2.845	-8.653	5.191	$\Delta IBIWA$	13.46	27.49	-10.74	143.13
ΔGDP	6.38	5.53	-5.2	18.8	ΔCBA	-0.50	2.30	-6.68	9.25
					$\Delta RECIB$	47.52	39.82	-26.23	135.60
					ΔREC	31.21	28.15	-9.64	98.25
					ΔIM	23.45	25.77	-16.11	134.80
					ΔPLS	174.10	936.62	-46.34	5415.93
					ΔFID	-0.318	2.231	-8.653	5.191
					ΔGDP	5.52	5.16	-5.2	18.6
					Δ*Non-oil GDP*	6.37	8.60	-7.2	36.1

Notes: *DSF, OE, NL* and the natural logarithm of their number (*ln*) are utilised to compute efficiency scores; they are presented in USD million. The minimum ratio of *ROE* is shown by the Gulf Bank (KSC) in Kuwait during 2008.

The empirical sample is therefore limited to fourteen domestic *IB* and thirty-eight domestic *CB*, which are comprised of:

(i) Three *IB* and nine *CB* that provide *sharia*-compliant windows in Saudi Arabia.

(ii) Four *IB*, three *CB* that provide *sharia*-compliant windows and eleven *CB* in the UAE;

(iii) Two *IB,* two *CB* that provide *sharia*-compliant windows and three *CB* in Bahrain.

(iv) Two *IB,* four *CB* that provide *sharia*-compliant windows and one conventional bank in Qatar.

(v) Three *IB* and five *CB* in Kuwait.

In addition, all of the annual variables utilised to compute efficiency scores are converted to suitable real prices according to the *GDP* deflator in 2005. Other micro- and macro-economic variables are drawn from the Economist Intelligence Unit, the Islamic Research and Training Institute (as a member of the Islamic Development Bank through its website), the world databank through the website of the World Bank Organization, and The Banker (various issues).

5.5 THE TRENDS OF NPL IN THE GCC COUNTRIES: DESCRIPTIVE INFERENCES

When understanding and contextualising the concept of problem loans, it is important to observe the magnitude of the problem. Thus, this section aims to determine the trends of *NPL* in the GCC countries covered by this study.

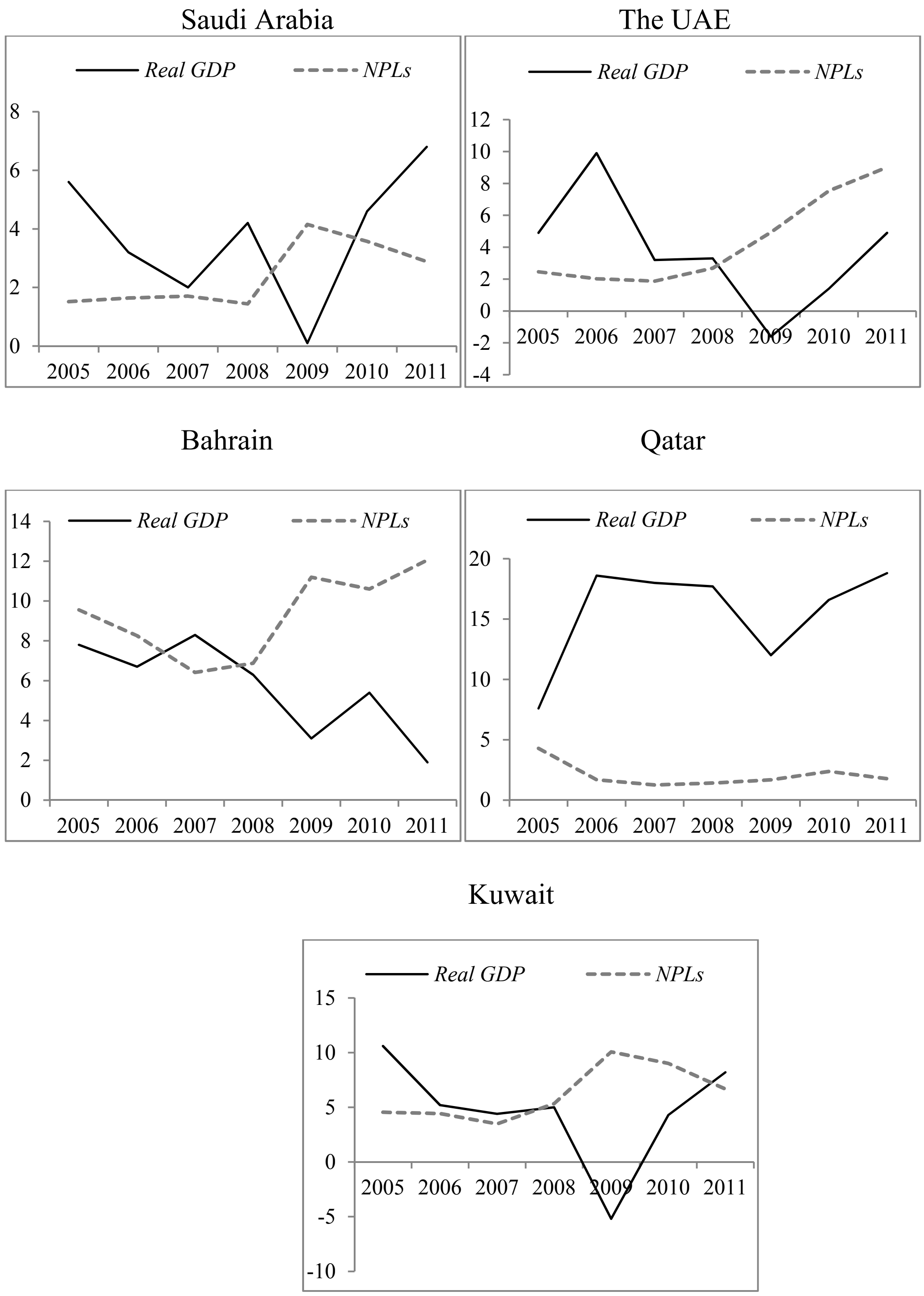
As can be seen in Figure 5.1, the *NPL*, as a ratio of *GDP* in each country, increased sharply, with the exception of Qatar, and it reached its peak in 2009. In particular, in the case of the UAE it reached its peak in 2009, which can be explained by the impact of the global financial crises. As indicated in the figures, *NPL* rose significantly in Kuwait during 2009 because of real estate financing and equities. In addition, from the perspective of an individual bank, the Gulf Bank in 2008 had higher losses due to derivatives transactions linked to clients. In the UAE, during 2009, the *NPL* increased, one of the main reason for this increase is that the Central Bank authorised instructions to classify loans to the Saudi Arabian conglomerates, namely the Algosaibi and Al-Saad groups, as bad loans (Khamis *et al.*, 2010: 5). However, the impact of the global financial crisis should also be considered on the increase in the *NPL*, as Dubai, one of the Emirates, went through financial difficulties and was bailed out by Abu Dhabi. With regard to the *GDP* trends, the real *GDP* growth declined dramatically in 2009 without exception, especially in Kuwait and the UAE. The initial observations from the figures indicate that *GDP* growth comparatively diminishes *NPL*.

When reflecting on the economic realities of the region, it should be noted that the non-oil *GDP* growth could have a significant impact on *NPL* in the GCC banks, for oil prices in the Gulf countries have remained constantly high over the period from 2005 to 2010 and have steadily increased the revenues (Khamis *et al.*, 2010: 6). In support of the previous statement, Espinoza and Prasad (2010) argued that non-oil

GDP would be a better selection criterion for *NPL*, given that the oil companies are owned by the government and loans are therefore not defaulted by them. In addition, the oil revenues spread to the non-oil channels in the economy, such as through public spending and household expenditures; they thus claimed that it would be better to investigate this impact through the real non-oil *GDP* growth. Consequently, the increase in non-oil real *GDP* is expected to result in a decline in NPL, meaning that the relationship between these two variables is expected to be negative.[17]

[17] The non-oil real *GDP* growth variable is taken from The Economist Intelligence Unit reports, through the real change in origin of *GDP* (%) in all sectors with the exception of industry, because this sector is heavily dependent on oil and petrochemical companies.

Figure 5.1- The Ratio of *NPL* and Real *GDP* Growth in the GCC

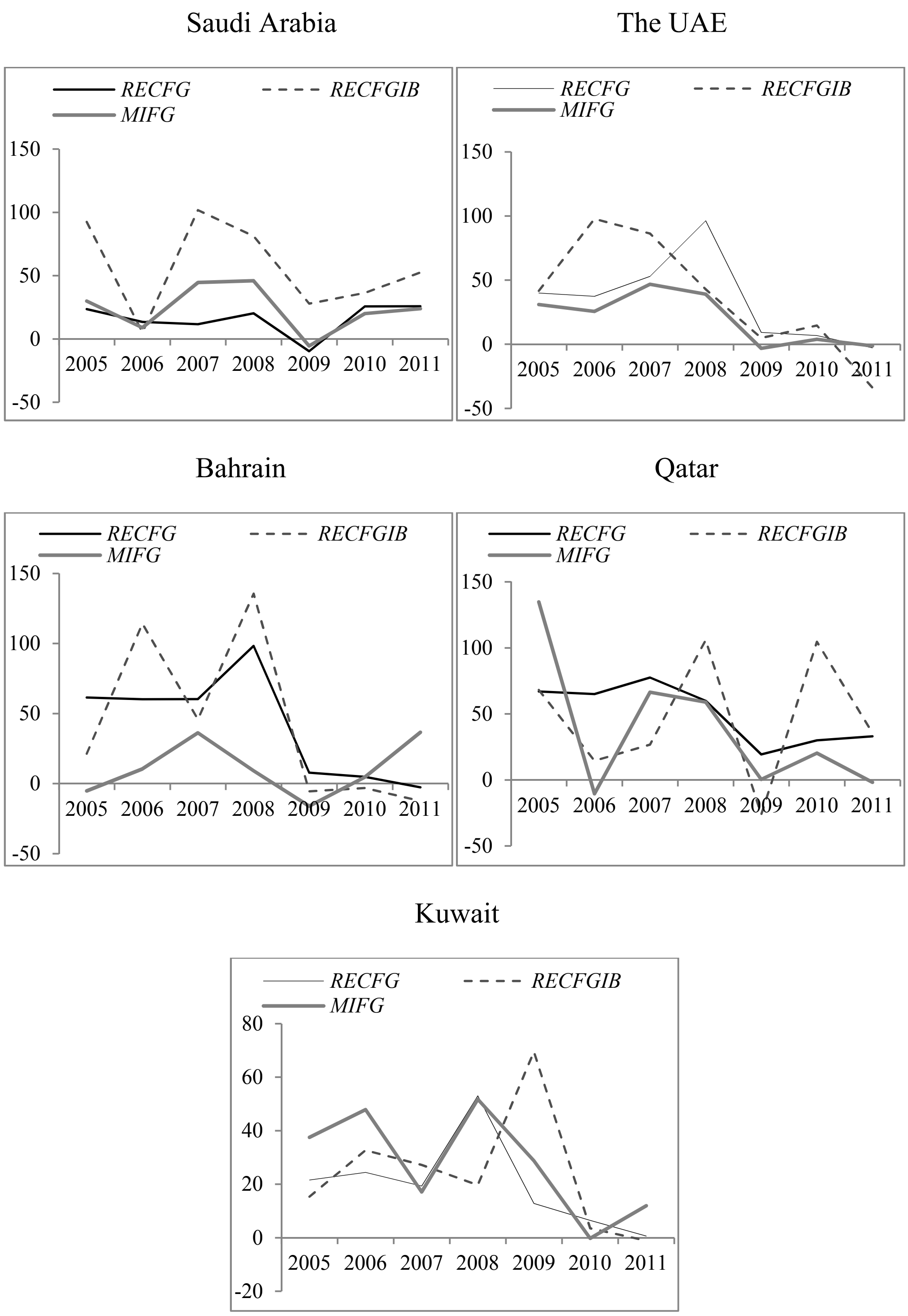


Data Source: Bankscope and the World Bank Group.

In general, *NPL* are systematically affected by macroeconomic performance and business cycles (Nkusu, 2011). For both Domowitz and Sartain (1999) and Salas and Saurina (2002), the risk level can be structured according to the type of loan, with the highest risk-level loans being for real estate and construction, followed by those for trade and industrial sectors, credit card debt and household loans and mortgages. When reflecting on a financing breakdown and its impact on *NPL* within the GCC, Figure 5.2 depicts the sectoral financing growth rates for the real estate and construction financing growth (RECFG), the *IB*' real estate and construction financing growth (RECFGIB), and the manufacturing investment financing growth (MIFG) for each country. Over the study period, the patterns for RECFG, RECFGIB and MIFG in each country indicate that they were influenced by the financial crisis in 2009. Furthermore, it can be seen that the observed trends in these sectors virtually correspond with the trends for the real *GDP* growth in Figure 5.1. Thus, the trend movements in these sectors show that they were affected by economic downturn and financial crisis, especially the RECFGIB. Indeed, in Saudi Arabia the RECFGIB was relatively higher than the RECFG and the MIFG, whereas in the UAE it was higher than other financial sectors over the period from 2005 to 2007, yet it has fluctuated more than the RECFG in Bahrain and Qatar.[18] Thus, the business cycle is an important determining factor of *NPL*. Despite the differences in the risk-taking level in each sector, increasing the bank financing for such sectors, which potentially is more related to the real *GDP* growth, is expected to have a negative relationship with *NPL*.

[18] The rationale for including Islamic financing in the real estate and construction industries can be attributed to the majority of the financing in the Islamic banking sector being allocated to this particular sector; for instance, the average percentage of this financing sector to the total financing of *IB* reached approximately 35% from 2008 to 2010. (*See* Figure 5 in the appendix).

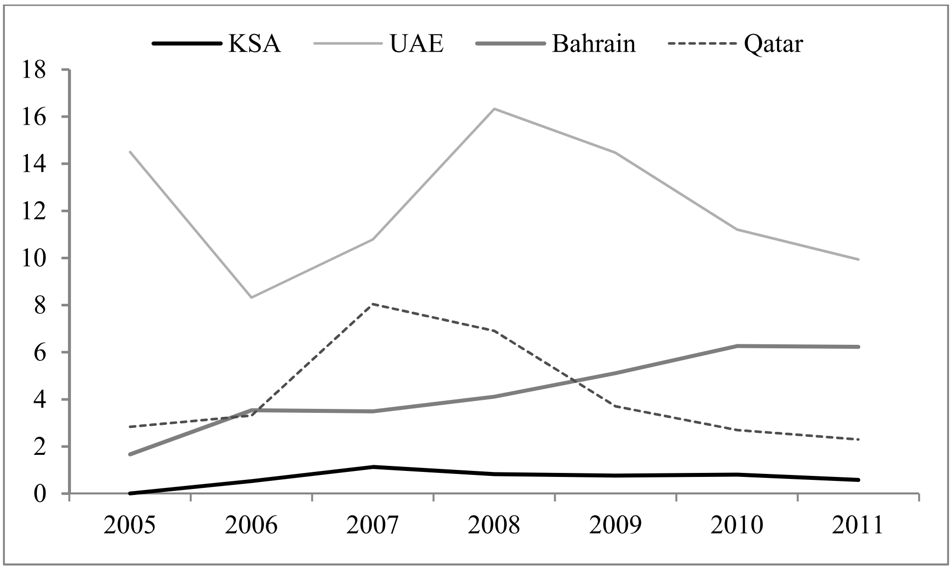
Figure 5.2- Sectoral Financing Growth in the GCC's Banking Sector



Data Source: The Central Bank of Saudi Arabia (SAMA), the Central Bank of the UAE, the Central Bank of Bahrain, the Central Bank of Qatar, the Central Bank of Kuwait and the Islamic Research and Training Institute.

It should be noted that the aggregate of *PLS* contracts which are operated by *IB* in the GCC is relatively small when compared with *FID* instruments, as there is a strong preference for *FID* due to their less risky nature. For instance, in 2011 the *PLS* contracts as a proportion of total Islamic financing contracts accounted for 0.6%, 9.9%, 6.2% and 2.3% in Saudi Arabia, the UAE, Bahrain and Qatar respectively. Thus, *IB* prefer to operate through cost-plus sale or *FID* instruments as a substitute for credit and loans in *CB* (Hassan and Lewis, 2007; Ayub, 2007; Ahmed, 2011). This trend can easily be observed in Figure 5.3.

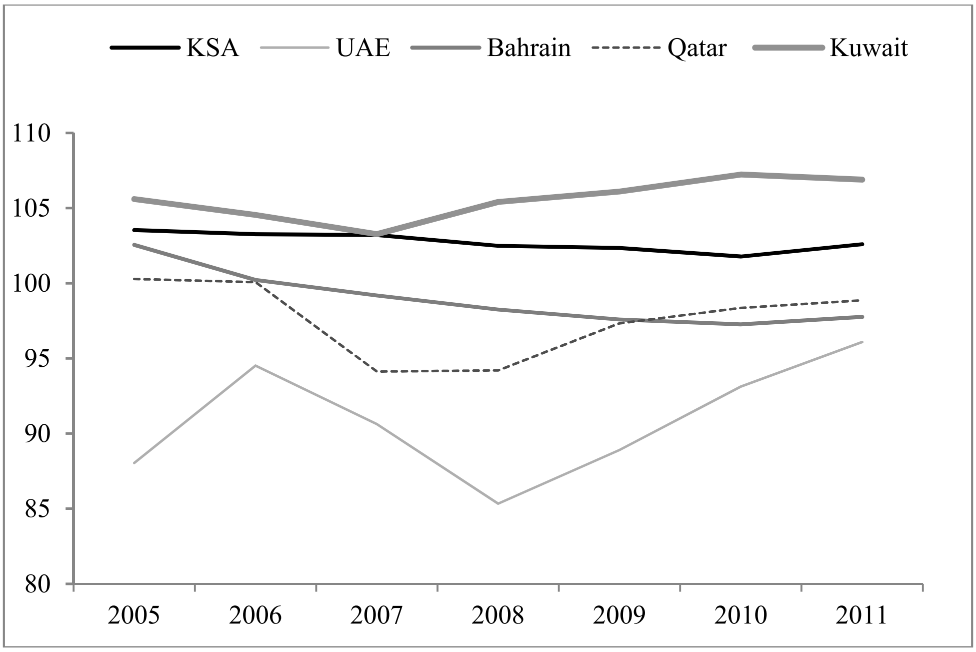
Figure 5.3- The *PLS* Contracts to Total Islamic Financing Contracts



Data Source: Islamic Research and Training Institute Database.

As displayed in Figure 5.3, the ratio of *PLS* financing to total financing for *IB* has not even reached 18% in the UAE; the lowest percentage appears in the (Kingdom of Saudi Arabia) KSA *IB* and it is only around 1%. In comparison, Figure 5.4 depicts the share of *FID* transactions in the total financing for each country. The share of *FID* generally fluctuated between 85% and above, which implies that *IB* in GCC countries have relied heavily on *FID* type financing instruments, particularly *murabahah* financing. From the financing portfolios in *IB*, it can be noted that the managers in *IB* do avoid higher levels of risk. Even in the presence of well-monitored credit policy, these *IB* may control the default loans by increasing the admission fees in such transactions. This action ultimately could have a negative impact on the business cycle and real *GDP* growth, which may then increase the *NPL*. Although *FID* contracts are more favoured in the operations of *IB* than *PLS* modes due to the less risky nature of these instruments, the impact of the former group could be positive with *NPL*, whereas the directional nature of *PLS* contracts on *NPL* cannot be predicted.

Figure 5.4- The Rate of *FID* Contracts to Total Islamic Financing Contracts



Note: At some points the rate of *FID* instruments has been over 100% because the total of IF modes is calculated after deducting the provisions, where most of those provisions are concentrated in *murabahah* transactions.
Data Source: Islamic Research and Training Institute Database.

5.6 DETERMINANTS OF NPL IN THE IB AND IW WITHIN THE GCC: EMPIRICAL ANALYSIS

After presenting the details of the empirical process, this section presents the findings by categorising them according to the particular method used for the estimation.

5.6.1 Panel Data Findings

This section presents the results to describe the relationship between *NPL* and explanatory variables in the sampled *IB* and *CB* that provide *IW* in the GCC countries via OLS (with cluster robust), FE models and RE models.[19]

Table 5.3 shows that the Hausman specification test clearly rejects the null hypothesis for Model 1, implying that the RE estimate significantly differs from the FE estimate. Therefore, the FE specification is preferred, yet in Model 2 the null hypothesis is accepted, meaning that both estimators, FE and RE, are consistent and that systematically there is no difference. Thus, in this case the RE estimator is preferred. Model 2 is, however, conducted to check the robustness of the Model 1 estimation, especially with regard to the direction of the obtained efficiency scores from the DEA and SFA methods. The coefficient of the *RWA* variable is statistically significant in all panel data estimators and positively related to *NPL*, which is in line with the study made by Berger and DeYoung (1997), which specifies that a rise in *RWA*, indicating a higher credit risk portfolio, leads to an increase in *NPL* of around 3%.

With regard to the estimated coefficients of performance and profitability ratios, *ROE* and *NIM*, the relationship between *ROE* and *NPL* is negative and significant in all of the estimated models. This result indicates that a decrease in *ROE* leads to an increase in the *NPL* by about 12%, suggesting that the short-term effect of the management of *IB* and *IW* may be not efficient enough when controlling the credit risk portfolios. This could verify the 'bad management' hypothesis, which is consistent with the study made by Louzis *et al*. (2012). Furthermore, in the contrary positions bank management seems to be efficient; this indicates that another potential case may occur which is illustrated by figures 5.3 and 5.4. Essentially, the financing portfolios of the GCC banks depend on *FID* contracts which account for more than 80% of total financing; in the short term the profits could thus increase dramatically due to the heavy reliance on these contracts, which could in turn lead to a rise in the *ROE*.

In the case of the *NIM* variable, the estimated coefficient shows a positive impact on *NPL*, implying that increasing the *NIM* boosts *NPL* by about 42%. Thus, the findings

[19] To detect for a multicollinearity problem, Variance Inflation Factor (VIF) is utilised in all of the panel data estimate models; according to this test it is found that in each of the explanatory variables the value of VIF is less than 1.30, which signifies that there is no multicollinearity (Greene, 2007: E5-18). This test is presented in the appendix section.

provide evidence that the transactions of *IB* and IF tend to be riskier than other counterparties, specifically when *PLS* contracts are involved, wherein these transactions could produce a significant profit, but they are riskier than *FID* and other financial contracts that lead to higher defaulted loans.

As can be seen in Table 5.3, the efficiency coefficient is significant in all of the panel data estimators and associated negatively with *NPL*, proving, in the short term, the 'bad management' hypothesis in *IB* and *CB* with *IW*. It should be noted that the observed negative relationship supports the 'bad luck' hypothesis resulting from the stock market downturn in 2006 within most of the GCC countries, in addition to the global financial crisis over the period from 2008 to 2009 (Khamis *et al.*, 2010). All of these external factors might have contributed to creating higher costs in administering bank solvency and problem loans, which have an adverse effect on efficiency.

Table 5.3- Panel Data Estimate Results for Models 1 and 2 (with Bank-level and Macroeconomic Variables)

	Model 1			*Model 2*		
Variables	*OLS robust* *NPL*	*FE* *NPL*	*RE* *NPL*	*OLS robust* *NPL*	*FE* *NPL*	*RE* *NPL*
RWA	0.0165	0.0368***	0.0319**	0.0146	0.0269*	0.0258**
	(0.0151)	(0.0140)	(0.0133)	(0.0145)	(0.0138)	(0.0130)
ROE	-0.114*	-0.145***	-0.123***	-0.128**	-0.146***	-0.131***
	(0.0562)	(0.0251)	(0.0230)	(0.0605)	(0.0254)	(0.0228)
NIM	0.185	0.792***	0.429*	0.199	0.775***	0.423*
	(0.221)	(0.282)	(0.227)	(0.231)	(0.286)	(0.226)
EFF^{DEA}	-4.341	-10.65***	-7.140***			
	(3.092)	(2.557)	(2.150)			
EFF^{SFA}				-10.19**	-18.71***	-14.76***
				(4.686)	(5.118)	(4.498)
ΔGDP	-0.0599*	-0.0213	-0.0541	-0.0473	-0.0387	-0.0550
	(0.0302)	(0.0655)	(0.0558)	(0.0310)	(0.0659)	(0.0557)
Constant	6.605**	7.473***	6.429***	12.04**	16.17***	14.02***
	(2.958)	(2.071)	(1.867)	(4.388)	(4.275)	(3.813)
Observations	198	198	198	198	198	198
R-squared	0.214	0.310		0.216	0.294	
Number of banks		31	31		31	31
Chi2(3)		10.53			6.5	
Hausman Prob>chi2		0.06			0.26	

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

The findings of Model 3 are depicted in Table 5.4. The Hausman test results indicate the acceptance of the null hypothesis, thereby illustrating that both estimators are consistent and that the RE estimator is favourable. By looking at the variables related to Islamic financing contracts and despite the coefficient of *PLS* growth rate being relatively small, it is statistically significant and it has a negative relationship with *NPL*. This finding demonstrates that the nature of *PLS* contracts is riskier than other Islamic financing contracts, and increasing transactions with such instruments in the short term may lead to a decline in *NPL*, given that a higher risk financing portfolio, namely *PLS*-oriented contracts, could bring higher revenue.

As the results in Table 5.4 show, the *FID* variable represents a significant and positive relationship with *NPL*, which corresponds to the expectations of this study, implying that due to risk-level-related reasons the financing portfolios of most of the *IB* in the GCC countries concentrate on *FID*-oriented contracts due to the high risk associated with *PLS* contracts.

In relation to macro-level factors, the results in Table 5.4 show that the real *GDP* growth coefficient illustrates a negative link with *NPL* (from 5% to 10%), supporting the 'prosperity' hypothesis and implying that the growth in real macroeconomic terms has a direct but adverse impact on *NPL*. In addition, the growth rate of *RECIB* financing has a significant and negative impact on *NPL*, signifying that an increase in financing such sectors by 1% led to a decline in *NPL* by about 3%. Such findings suggest the interaction between real *GDP* and the business cycle related to *RECIB* is high and that the growth of both variables decreases the *NPL*. This can be explained by the fact that *IB* in the GCC countries are more exposed to real estate market risk because they have heavily directed their financing to this particular sector[20].

[20] *See* Appendix Chapter 5 Figure 5, which illustrates the average of financing percentage for each sector to total financing in *IB* in GCC countries, where the proportion of the real estate and construction sector has increased gradually since 2005 and has remained at the highest level among other sectors in 2009 and 2010.

Table 5.4- Panel Data Estimate Results for the Model 3 (with Organisational, Product-Development and Macroeconomic Variables)

	Model 3		
	OLS robust	*FE*	*RE*
Variables	*NPL*	*NPL*	*NPL*
RWA	0.0086	0.0248*	0.0201
	(0.011)	(0.0140)	(0.0131)
Δ*PLS*	-0.00069***	-0.00043**	-0.0005***
	(0.00017)	(0.00018)	(0.00017)
Δ*FID*	0.210***	0.174**	0.187**
	(0.065)	(0.0752)	(0.0737)
Δ*RECIB*	-0.033***	-0.0250***	-0.0272***
	(0.0097)	(0.0054)	(0.0052)
Δ*GDP*	-0.111***	-0.105	-0.108**
	(0.0377)	(0.066)	(0.054)
Constant	5.361***	3.625***	4.112***
	(1.462)	(1.259)	(1.202)
Observations	198	198	198
R-squared	0.240	0.236	
Number of banks		31	31
Chi2(3)		3.12	
Hausman Prob>chi2		0.68	

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

5.6.2 Dynamic Panel Data (GMM) Findings

The GMM analysis is conducted to analyse the obtained findings that describe the relationship between *NPL* and the independent variables, which are bank-level and macro-level variables, including the impact of Islamic financing on *NPL* in the GCC banks, by estimating five dynamic econometric models. These models include OLS, two-stage least squares (2SLS), FE panel data, GMM-difference and GMM-system. All of these econometrics specifications are utilised in order to check the robustness test for each of the estimated coefficients in terms of direction and statistical significance.[21] In addition, the Arellano-Bond *p*-values test of autocorrelation, namely AR(1) for first-order, is conducted to detect the correlation of residuals through the differences in error terms, which must be less than 1% (0.1) to reject the hypothesis that the random error process is correlated through individual, and AR(2) for second

[21] 2SLS is preferred in order to maximise the sample size, especially in the case of short panel, with levels estimator through the Anderson and Hsiao (1981) estimator, because the instrumental variable is instrumented with lags rather than differences (Roodman, 2009: 105-106).Again as reported for panel data estimates, a multicollinearity problem is detected through VIF in all dynamic estimators and it is found that for each explanatory variable the value of VIF is less than 1.30, with the exception of efficiency scores as the values of VIF are about 4.50 for DEA estimate and around 2.80 for SFA estimate; this indicates that there is no multicollinearity (Greene, 2007: E5-18). The test is shown in the appendix.

order is estimated to test the autocorrelation in first-order levels. The *p*-value here must be more than 10% (1.0), thus, to accept the hypothesis that error terms are autocorrelated as a full disturbance but not through levels.[22] All of these *p*-values are reported in all of the estimated models, along with the *p*-value of the Hansen test, which is estimated for the validity of instrumental variables.

It should be noted that in this model, *NPL* and *RWA* are utilised as endogenous bank-level variables via 2SLS and GMM estimates with two and three lags. Thus, in the 2SLS estimate, the *NPL*-dependent variable with one lag is instrumented. Although in the GMM estimates (as described in section 5.4.3), *RWA* is assumed to be a weak exogenous bank-level variable, meaning that the decision-makers of a bank's management take into consideration the future expected amount of *NPL*; the other independent variables that relate to macro-level are treated as being under predetermined assumption. Variables associated with bank-specific or micro-level factors are therefore predetermined (Salas and Saurina, 2002; Louzis *et al.*, 2012). In other words, they are instrumented by themselves "IV-style" (Roodman, 2009).

In all estimated models from four to twenty, the coefficient of the lagged dependent variable is positive and statistically significant in most of these models; it has a coefficient of less than one, which is in line with the study made by Salas and Saurina (2002). Such findings imply that *NPL* are likely to be increased due to previous *NPL*.

In Table 5.5, Model 4 and Model 5 represent the baseline specification and the estimator model, including non-oil *GPD* growth as an independent variable. The baseline estimate shows a significant *p*-value of first-order autocorrelation and no serial correlation in the second-order, implying that the estimators are consistent; the Hansen test confirms the hypothesis that the instrumental variables are valid. The coefficients of explanatory variables have the anticipated sign, and they are significant in all estimators with the exception of the coefficient of *GDP* growth in the GMM-system estimator. The *p*-value of second-order serial correlation suggests, however, that the GMM estimators of Model 5 are not consistent; the findings of this model therefore cannot be relied on.

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[22] *See* Roodman (2009:119-121).

By looking at all of the estimators of variables for *RWA* and *GDP* in Table 5.5, it can be seen that the coefficient of *RWA* is positive with not more than 0.18 and that is significant in most specifications. The implication of this variable is that *NPL* are likely to increase due to increasing the previous credit risk of banks' portfolios. In terms of macroeconomic variables and as can be seen from the results, the *GDP* coefficient is negative and significant in several models, suggesting that a rise in the real *GDP* growth in the previous year leads to a decrease in the *NPL* from 10% to 20%. In addition, the relationship between the lagged variable of non-oil *GDP* growth and NPL is negative; it is also in line with the expectations of this study, yet this result could be biased and misleading.

In terms of bank-specific variables, Table 5.6 shows the results of models 6 and 7. As the results indicate, according to the *p*-values of AR(1) and AR(2) and the Hansen test, it is presumed that both models are consistent (at 10% for AR(1) in GMM-system model); the instrumental variables are also valid. The coefficient of the performance variable, namely *ROE*, is negative and significant with *NPL* at about 2%, which is in line with the expectations of this study. This result implies the presence of previous bad decisions on the part of bank management, which prompts a decrease in bank performance and thus results in an increase of *NPL*. Likewise, the profitability ratio *NIM* has a negative and significant impact of approximately 2% on *NPL*, suggesting that the modification in credit policy due to the previous decline in *NIM* could raise the risk-level in the loans portfolio, which in turn increases *NPL*.

With regard to the link between bank performance and *NPL*, the findings through banks' efficiency scores as modelled by Model 8 and Model 9 are presented in Table 5.7. AR(1) and AR(2) results guarantee the consistency of estimators; the Hansen test also asserts the validity of the utilised instrumental variables. The not-lagged coefficient of efficiency is negatively related with *NPL* and statistically significant in all of the estimated models, with the exception of the GMM-DF estimate, suggesting that a decline in a bank's efficiency contributes to an increase of around 10% in *NPL*. This finding indicates the 'bad management' hypothesis in the GCC's banks, which could reflect the management quality; this result in turn corresponds with the panel data findings in the earlier section. This adverse impact could point to the 'bad luck' hypothesis in the sense of external factors relating to macroeconomics affecting the

GCC's bank performance.[23] The one year lagged coefficient of efficiency is, however, linked to *NPL* with positive sign, which should be considered as an indication of the 'skimping' hypothesis, signifying bank policy in reducing credit administration expenses to increase the level of efficiency. The results do, however, indicate that a failure to monitor debtors in the previous year led to an increase in *NPL*. In addition, Model 9 is conducted to ensure the validity and direction of efficiency scores that were obtained via the DEA approach and utilised in Model 8. The coefficients of the SFA efficiency scores are not significant and slightly higher than the DEA coefficients; however, they are in the same directions.

[23] In 2006 the stock markets of Gulf countries dropped; they then recovered from 22% to 60% in 2007. As a result of the financial global crisis in 2008, the market declined by 29% to 73%. Furthermore, in 2008 the central banks pressed liquidity to the financial system directly through long-term government deposits and indirectly through repos (*see*: Khamis *et al.*, 2010: 10-29).

Table 5.5- Baseline Model (Model 4) and Estimated Model (Model 5) (including Non-Oil *GDP*)

	Model 4 (Baseline estimate)					*Model 5*				
	OLS	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*	*OLS*	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*
Variables	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*
NPL_{-1}	0.934***	0.948***	0.509***	0.427**	0.925***	0.946***	0.954***	0.946***	0.521***	0.933***
	(0.027)	(0.054)	(0.124)	(0.197)	(0.0501)	(0.0225)	(0.0529)	(0.0225)	(0.188)	(0.0468)
RWA_{-1}	0.0179**	0.0174*	0.034***	0.0652**	0.084***	0.0182**	0.0156*	0.0182**	0.083***	0.084***
	(0.008)	(0.0087)	(0.0082)	(0.0328)	(0.0241)	(0.0082)	(0.0085)	(0.0082)	(0.0309)	(0.0238)
ΔGDP_{-1}	-0.08***	-0.065**	-0.16***	-0.16**	-0.0494					
	(0.025)	(0.0277)	(0.0484)	(0.0671)	(0.0379)					
$\Delta non-oil\ GDP_{-1}$						-0.060**	-0.068**	-0.060**	-0.064**	-0.047*
						(0.0245)	(0.0303)	(0.0245)	(0.0266)	(0.0245)
Constant	-0.134	-0.0936	1.049		-5.15***	-0.274	0.118	-0.274		-5.23***
	(0.69)	(0.821)	(0.814)		(1.997)	(0.702)	(0.886)	(0.702)		(2.000)
Observations	283	232	283	232	283	283	232	283	232	283
R-squared	0.825	0.805	0.346			0.826	0.808			
Number of banks			51	50	51			51	50	51
No. of instruments				31	42				31	42
Hansen test p-value				0.29	0.41				0.13	0.29
A-B AR(1) test p-value				0.00	0.07				0.01	0.08
A-B AR(2) test p-value				0.17	0.17				0.08	0.12
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} $\Delta non-oil\ GDP_{-1}$ NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5.6- Bank-Level (Financial Ratio) Model 6 and Model 7

	Model 6					*Model 7*				
	OLS	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*	*OLS*	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*
Variables	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*
NPL_{-1}	0.913***	0.945***	0.473***	0.454***	0.907***	0.934***	0.949***	0.508***	0.420**	0.917***
	(0.038)	(0.0517)	(0.122)	(0.171)	(0.059)	(0.028)	(0.056)	(0.13)	(0.199)	(0.052)
RWA_{-1}	0.0167**	0.0174**	0.028***	0.0590**	0.079***	0.0190**	0.0196**	0.034***	0.0647*	0.076***
	(0.008)	(0.009)	(0.007)	(0.0282)	(0.023)	(0.0084)	(0.009)	(0.008)	(0.034)	(0.022)
ROE_{-1}	-0.019***	-0.019***	-0.021***	-0.018***	-0.017***					
	(0.0011)	(0.001)	(0.0012)	(0.0011)	(0.001)					
ΔGDP_{-1}	-0.072***	-0.0562**	-0.161***	-0.153**	-0.0424	-0.082***	-0.0694**	-0.160***	-0.157**	-0.0521
	(0.0246)	(0.0277)	(0.0486)	(0.067)	(0.038)	(0.024)	(0.0273)	(0.049)	(0.066)	(0.036)
NIM_{-1}						-0.161**	-0.235**	-0.193	-1.145***	-0.329**
						(0.0791)	(0.0947)	(0.262)	(0.343)	(0.144)
Constant	0.242	0.0615	1.867**		-4.555**	0.342	0.543	1.709		-3.431*
	(0.693)	(0.789)	(0.778)		(1.955)	(0.721)	(0.884)	(1.345)		(1.75)
Observations	283	232	283	232	283	283	232	283	232	283
R-squared	0.847	0.830	0.462			0.825	0.806	0.346		
Number of banks			51	50	51			51	50	51
No. of instruments				32	42				32	43
Hansen test p-value				0.30	0.50				0.31	0.56
A-B AR(1) test p-value				0.02	0.10				0.00	0.08
A-B AR(2) test p-value				0.31	0.19				0.14	0.16
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ROE_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} NIM_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5.7- *NPL* and Bank Efficiency (DEA and SFA) – Model 8 and Model 9

	Model 8					*Model 9*				
	OLS	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*	*OLS*	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*
Variables	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*
NPL_{-1}	0.923***	0.944***	0.503***	0.409**	0.908***	0.929***	0.949***	0.517***	0.387*	0.909***
	(0.0237)	(0.0554)	(0.113)	(0.195)	(0.0391)	(0.0258)	(0.0597)	(0.120)	(0.198)	(0.0387)
RWA_{-1}	0.0156*	0.0140	0.032***	0.0362	0.075***	0.0171**	0.0151*	0.030***	0.0343	0.081***
	(0.0088)	(0.0086)	(0.0084)	(0.0321)	(0.0236)	(0.0082)	(0.0084)	(0.0074)	(0.0345)	(0.0254)
EFF^{DEA}	-0.100**	-0.102*	-0.098*	-0.0629	-0.089**					
	(0.0407)	(0.0515)	(0.0512)	(0.0534)	(0.0450)					
EFF^{DEA}_{-1}	0.0908**	0.0930*	0.0738*	0.107**	0.0657					
	(0.0366)	(0.0508)	(0.0399)	(0.0455)	(0.0406)					
EFF^{SFA}						-0.198*	-0.192	-0.172	-0.164	-0.219
						(0.114)	(0.167)	(0.132)	(0.139)	(0.138)
EFF^{SFA}_{-1}						0.185*	0.183	0.222*	0.284*	0.136
						(0.106)	(0.168)	(0.132)	(0.168)	(0.108)
ΔGDP_{-1}	-0.078***	-0.0597**	-0.164***	-0.159**	-0.0539	-0.085***	-0.0687**	-0.155***	-0.173**	-0.0629*
	(0.0268)	(0.0291)	(0.0497)	(0.0693)	(0.0376)	(0.0247)	(0.0268)	(0.0492)	(0.0682)	(0.0372)
Constant	0.785	0.862	2.898		-2.743*	1.071	0.854	-2.857		1.999
	(0.940)	(1.302)	(3.305)		(1.552)	(2.274)	(2.951)	(5.453)		(3.009)
Observations	283	232	283	232	283	283	232	283	232	283
R-squared	0.834	0.814	0.379			0.832	0.811	0.382		
Number of banks			51	50	51			51	50	51
No. of instruments				33	44				33	44
Hansen test p-value				0.30	0.23				0.38	0.26
A-B AR(1) test p-value				0.00	0.06				0.00	0.05
A-B AR(2) test p-value				0.25	0.19				0.22	0.13
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} EFF^{DEA} EFF^{DEA}_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} EFF^{SFA} EFF^{SFA}_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

With regard to the macro-level sectoral financing variables, tables 5.8 and 5.9 present the estimated coefficients for growth rates of *MI* and the growth rates of *REC* and the *REC* of *IB*. These stated variables are utilised without lag, whereas Table 5.10 shows the estimation for a model with one-year lag variables. For GMM estimate models, the p-value of AR(1) is significant, indicating that there is no serial correlation in AR(2), except the GMM-difference estimated in Model 11. This lack of correlation demonstrates the consistency of the estimators, as given by the result of the Hansen test, which shows that the instrument variables are valid. It should be noted that the sign of all of the sectoral financing variables meets the expectations of the study, excluding the *REC* variable with one year lag in Model 14 in which coefficient direction varies over the five estimations. Thus, such a result could not be relied on. When comparing the coefficients of *MI* and *REC* in models 10 and 11, the results show that they are relatively similar, implying that increasing the *MI* and *REC* financing growth of GCC banks by 1% leads to a decrease of the *NPL* by about 2%. Similarly, in the GMM-DF estimate the coefficient of *RECIB* is statistically significant and has a negative impact on *NPL*.

These findings demonstrate that in the GCC countries there is a substantial interaction between real *GDP* growth and the business cycle in the economy, especially with the real estate and construction sectors. For instance, in 2008 the financing share of these sectors to total financing in the banking sector and in *IB* was as follows: 7.3% and 5.6% in the KSA; 12.9% and 25.7% in the UAE; 26.2% and 11.3% in Bahrain; 18.4% and 38.3% in Qatar; and 31.4% and 22.1% in Kuwait. Noticeably, the risk exposure level of *REC* in *IB* is higher in the UAE and Qatar than within the other countries (Khamis *et al.*, 2010: 69).[24]

With regard to the *RECIB* variable with one year lag in Model 13, the coefficient of *RECIB* has remained negative and significant in the GMM-DF estimate with approximately a 10% level of significance. The results of this variable, without lag and with one year lag, is in line with the earlier panel data findings, supporting the fact that the financing for *IB* is more related to the *REC* sector, which increases the

[24] Large banks in most of the GCC countries are more exposed to real estate and construction financing; further, there is a large concentration of real estate projects in investment funds (*see*: Khamis *et al.*, 2010: 10 and 57).

risk-exposure level. Furthermore, Khamis *et al*. (2010) stated that in 2009 the performance of *IB* had been affected by the crisis in the real economy in relation to the real estate market; deterioration in this market thus increases *NPL*. It is therefore suggested that diversification is a crucial step for *IB,* due to the objective of reducing their risk exposure, by focusing more on increasing the financing to other sectors that are more engaged with the real economy, such as the manufacturing and industry sectors, which relate to the real economy by creating added value through jobs and wealth. Hence, value-added-oriented sectors, including manufacturing industries, should remain an important financing area for *IB,* as expected from the aspirational view put forward by the Islamic moral economy. Given that such sectors relate to generating wealth via the embedding of financing in the real economy, it is believed that the propensity for failure is less than that of the real estate sector[25].

Table 5.8- Macro-Level Model 10 (Including Manufacturing and Industry Financing Variable of GCC Banks)

			Model 10		
Variables	*OLS* *NPL*	*2SLS* *NPL*	*FE* *NPL*	*GMM-DF* *NPL*	*GMM-SYS* *NPL*
NPL_{-1}	0.929***	0.945***	0.501***	0.369*	0.920***
	(0.0262)	(0.0538)	(0.127)	(0.189)	(0.0503)
RWA_{-1}	0.0153*	0.0119	0.030***	0.051	0.078***
	(0.0082)	(0.0085)	(0.0083)	(0.0336)	(0.0236)
ΔGDP_{-1}	-0.059**	-0.0327	-0.096**	-0.0999*	-0.0390
	(0.0232)	(0.0267)	(0.0444)	(0.0534)	(0.0378)
ΔMI	-0.0176*	-0.026***	-0.022***	-0.026***	-0.0121
	(0.0089)	(0.0095)	(0.0076)	(0.0080)	(0.0081)
Constant	0.318	0.713	1.392		-4.553**
	(0.677)	(0.786)	(0.874)		(1.930)
Observations	283	232	283	232	283
R-squared	0.827	0.810	0.360		
Number of banks			51	50	51
No. of instruments				32	43
Hansen test p-value				0.26	0.32
A-B AR(1) test p-value				0.01	0.08
A-B AR(2) test p-value				0.24	0.23
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔMI ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[25] Indeed, over the current study period the financing average to total financing of the manufacturing sector has presented the lowest level among other financing sectors, barely reaching 12% in 2008 (*see*: Figure 5 in the appendix of Chapter 5).

Table 5.9- Macro-Level Model 11 and Model 12

(Including the Real Estate and Construction Financing Variable of *CB* and *IB*)

	Model 11					*Model 12*				
	OLS	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*	*OLS*	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*
Variables	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*
NPL_{-1}	0.930***	0.948***	0.452***	0.105	0.921***	0.928***	0.942***	0.478***	0.290	0.922***
	(0.0294)	(0.0575)	(0.116)	(0.240)	(0.0512)	(0.0273)	(0.0567)	(0.118)	(0.234)	(0.0492)
RWA_{-1}	0.0140*	0.0137	0.024***	-0.016	0.074***	0.014*	0.014	0.026***	0.029	0.078***
	(0.0082)	(0.0091)	(0.008)	(0.054)	(0.022)	(0.0075)	(0.0085)	(0.0085)	(0.0518)	(0.0232)
ΔGDP_{-1}	-0.0366	-0.0284	-0.105**	-0.156***	-0.0164	-0.0625**	-0.0453	-0.119***	-0.156***	-0.0428
	(0.0304)	(0.0367)	(0.0426)	(0.0529)	(0.0409)	(0.0243)	(0.0298)	(0.0411)	(0.0582)	(0.0368)
ΔREC	-0.021***	-0.017**	-0.035***	-0.048***	-0.016**					
	(0.0067)	(0.0068)	(0.0096)	(0.0181)	(0.0068)					
$\Delta RECIB$						-0.0089**	-0.009*	-0.013**	-0.0153*	-0.0042
						(0.0044)	(0.0047)	(0.0059)	(0.0092)	(0.0039)
Constant	0.515	0.453	2.670***		-4.177**	0.422	0.426	2.053**		-4.638**
	(0.671)	(0.818)	(0.967)		(1.826)	(0.645)	(0.812)	(0.961)		(1.933)
Observations	283	232	283	232	283	283	232	283	232	283
R-squared	0.830	0.809	0.411			0.827	0.807	0.369		
Number of banks			51	50	51			51	50	51
No. of instruments				32	43				32	43
Hansen test p-value				0.09	0.22				0.19	0.41
A-B AR(1) test p-value				0.11	0.08				0.00	0.07
A-B AR(2) test p-value				0.17	0.20				0.17	0.16
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔREC ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} $\Delta RECIB$ ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5.10- Macro-Level Model 13 and Model 14

(Including the Real Estate and Construction Financing Variable of *CB* and *IB* with Lagged Variables)

	Model 13					Model 14				
	OLS	2SLS	FE	GMM-DF	GMM-SYS	OLS	2SLS	FE	GMM-DF	GMM-SYS
Variables	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL
NPL_{-1}	0.932***	0.948***	0.496***	0.382*	0.925***	0.935***	0.948***	0.508***	0.386**	0.924***
	(0.0288)	(0.0561)	(0.122)	(0.203)	(0.0520)	(0.0248)	(0.0488)	(0.124)	(0.195)	(0.0476)
RWA_{-1}	0.0175**	0.0170*	0.032***	0.0604*	0.084***	0.0165**	0.0131*	0.034***	0.0594*	0.077***
	(0.0086)	(0.0091)	(0.0083)	(0.0332)	(0.0249)	(0.0082)	(0.0076)	(0.0082)	(0.0309)	(0.0241)
$\Delta RECIB_{-1}$	-0.00310	-0.00141	-0.0065*	-0.0077*	-0.00071					
	(0.0044)	(0.005)	(0.0034)	(0.0043)	(0.0046)					
ΔGDP_{-1}	-0.075***	-0.063**	-0.14***	-0.147**	-0.0489	-0.12***	-0.12***	-0.15***	-0.15**	-0.083**
	(0.0252)	(0.0289)	(0.0474)	(0.0623)	(0.0382)	(0.0251)	(0.0271)	(0.0500)	(0.0630)	(0.0323)
ΔREC_{-1}						0.016***	0.024***	-0.000664	-0.0054	0.0107
						(0.00598)	(0.00684)	(0.00721)	(0.00602)	(0.00679)
Constant	0.0293	-0.0101	1.435*		-5.120**	-0.388	-0.244	1.063		-4.822**
	(0.811)	(0.985)	(0.785)		(2.171)	(0.708)	(0.758)	(0.822)		(1.985)
Observations	283	232	283	232	283	283	232	283	232	283
R-squared	0.825	0.805	0.351			0.828	0.812	0.346		
Number of Bank			51	50	51			51	50	51
No. of instruments				32	43				32	43
Hansen test p-value				0.19	0.50				0.29	0.24
A-B AR(1) test p-value				0.01	0.08				0.00	0.07
A-B AR(2) test p-value				0.19	0.18				0.18	0.18
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} $\Delta RECIB_{-1}$ ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔREC_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Turning to the macro-level factors of a bank's structural and organisational development, tables 5.11 and 5.12 represent the estimated results for the assets growth according to bank types as seen in models 15, 16, 17 and 18. As the results show, the *p*-values of first-order and second-order autocorrelations prove the consistency of these estimators. In addition, the Hansen test values illustrate the validity of instrumental variables. Starting with the asset growth of *IB*, the coefficient shows a positive and significant relationship between *IBA* and *NPL*, demonstrating that an increase in *IBA* produces a rise in *NPL* of about 3%. This implies that the IB may have less ability to diversify in financing portfolios, which results in an increased vulnerability to risk. The coefficient of the *IWA* (asset growth of *CB* with *IW*) is also positive but with a small coefficient and is not a statistically significant result. With regard to the *IBIWA* variable (*sharia*-compliant assets growth), this again shows a positive link with *NPL*; nonetheless, it is not significant in all of the estimators. In contrast to the adverse impacts, the relationship between *CBA* growth and *NPL* is negative and significant in terms of all of the estimators, which specifies that an increase in the growth of *CB* assets leads to a decline in *NPL* of around 30%. This result then implies that these *CB* have more capacity when it comes to diversification in financing projects, which in turn decreases the level of risk-taking.

Table 5.11- Model 15 and Model 16

Assets Growth for *IB* and *IW* Banks

	Model 15					Model 16				
	OLS	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*	*OLS*	*2SLS*	*FE*	*GMM-DF*	*GMM-SYS*
Variables	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*	*NPL*
NPL_{-1}	0.943***	0.935***	0.451***	0.323*	0.918***	0.947***	0.937***	0.492***	0.341*	0.920***
	(0.0351)	(0.0528)	(0.147)	(0.195)	(0.0500)	(0.0278)	(0.0446)	(0.131)	(0.187)	(0.0381)
RWA_{-1}	0.0219**	0.0205**	0.0390**	0.0872**	0.095***	0.0202**	0.0192**	0.039***	0.0782**	0.0812**
	(0.0095)	(0.0095)	(0.0158)	(0.0429)	(0.0358)	(0.0086)	(0.0093)	(0.0145)	(0.0367)	(0.0320)
ΔGDP_{-1}	-0.08***	-0.08***	-0.22***	-0.24***	-0.085**	-0.07***	-0.067**	-0.18***	-0.18***	-0.0653*
	(0.0257)	(0.0258)	(0.0744)	(0.0777)	(0.0399)	(0.024)	(0.0260)	(0.0513)	(0.0633)	(0.0361)
ΔIBA_{-1}	0.0252**	0.0289**	0.0171	0.0208	0.0346**					
	(0.0117)	(0.0122)	(0.0196)	(0.0150)	(0.0147)					
ΔIWA_{-1}						0.00274	0.00328	0.00217	0.00236	0.00298
						(0.003)	(0.0032)	(0.0039)	(0.0039)	(0.0034)
Constant	-0.441	-0.325	1.241		-6.025**	-0.458	-0.395	0.816		-5.07*
	(0.812)	(0.882)	(1.208)		(2.929)	(0.802)	(0.945)	(1.103)		(2.735)
Observations	239	232	239	188	239	246	232	246	195	246
R-squared	0.806	0.808	0.308			0.808	0.809	0.336		
Number of banks			51	50	51			51	50	51
No. of instruments				30	41				32	43
Hansen test p-value				0.19	0.27				0.33	0.49
A-B AR(1) test p-value				0.00	0.06				0.00	0.05
A-B AR(2) test p-value				0.84	0.90				0.82	0.49
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔIBA_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔIWA_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5.12- Model 17 and Model 18

***Sharia*-Compliant Assets to Total Assets Growth and Assets of CB to Total Assets Growth Models**

	Model 17					*Model 18*				
Variables	*OLS NPL*	*2SLS NPL*	*FE NPL*	*GMM-DF NPL*	*GMM-SYS NPL*	*OLS NPL*	*2SLS NPL*	*FE NPL*	*GMM-DF NPL*	*GMM-SYS NPL*
NPL_{-1}	0.935***	0.927***	0.421***	0.271	0.905***	0.943***	0.940***	0.399**	0.151	0.915***
	(0.0294)	(0.0423)	(0.134)	(0.196)	(0.0365)	(0.0424)	(0.0608)	(0.160)	(0.192)	(0.0594)
RWA_{-1}	0.0223**	0.0208*	0.0384**	0.0796*	0.0951**	0.0223**	0.0207**	0.036***	0.0413	0.096***
	(0.0107)	(0.0108)	(0.0158)	(0.0413)	(0.0389)	(0.0095)	(0.0095)	(0.0135)	(0.0430)	(0.0341)
GDP_{-1}	-0.09***	-0.09***	-0.23***	-0.29**	-0.093**	-0.07***	-0.07***	-0.27***	-0.36***	-0.077*
	(0.0314)	(0.0293)	(0.0887)	(0.116)	(0.0450)	(0.0259)	(0.0272)	(0.0774)	(0.102)	(0.0407)
$\Delta IBIWA_{-1}$	0.0185	0.0199	0.0351	0.0358	0.0246					
	(0.0198)	(0.0199)	(0.026)	(0.0268)	(0.0237)					
ΔCBA_{-1}						-0.195*	-0.199*	-0.38***	-0.49***	-0.279**
						(0.106)	(0.116)	(0.139)	(0.160)	(0.126)
Constant	-0.511	-0.39	1.24		-6.09*	-0.504	-0.395	1.784		-6.147**
	(0.93)	(1.01)	(1.191)		(3.242)	(0.831)	(0.896)	(1.120)		(2.823)
Observations	239	232	239	188	239	239	232	239	188	239
R-squared	0.807	0.809	0.337			0.807	0.807	0.349		
Number of banks			51	50	51			51	50	51
No. of instruments				30	41				30	41
Hansen test p-value				0.15	0.30				0.19	0.27
A-B AR(1) test p-value				0.00	0.04				0.05	0.08
A-B AR(2) test p-value				0.82	0.62				0.79	0.91
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} $\Delta IBIWA_{-1}$ ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔCBA_{-1} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

The product-development factor findings are presented as formulated in models 19 and 20, which can be seen in Table 5.13. In both models the *p*-value of AR(1) is significant and there is no serial correlation in AR(2), which shows the consistency of the estimated models. In addition, the Hansen test shows that the instrumental variables are valid.

By looking at Model 19, the *PLS* variables with one and two lag have a negative impact on *NPL*; the coefficient of *PLS* with two lag is significant in all of the estimators, but there is minor influence for both lagged variables (at about 0.02%), which is attributed to the very low level of financing with *PLS* contracts. These findings indicate that with two years lagged variable and despite the high risk-level involved with *PLS* instruments, increasing the *PLS* financing seems to decrease *NPL*. The other variable related to product-development is *FID*; the two coefficients, with one and two lag, are positively associated with *NPL* and they are significant with the GMM-difference model, which is in line with the expectations of this study. Consequently, it can be suggested that in the long term, increasing *FID* financing increases *NPL* by around 10%. This result thus indicates that although *FID* contracts are favourable and heavily utilised by GCC *IB* due to their low risk-level, the growth influence of *FID* contracts leads to more *NPL* than *PLS* instruments. In other words, it can be concluded that the propensity of credit risk or of generating *NPL* is higher in *FID* financing than it is for *PLS* financing.

Table 5.13- Macro-Level Model 19 and Model 20 (Including Product-Development Variables)

	Model 19					*Model 20*				
Variables	*OLS NPL*	*2SLS NPL*	*FE NPL*	*GMM-DF NPL*	*GMM-SYS NPL*	*OLS NPL*	*2SLS NPL*	*FE NPL*	*GMM-DF NPL*	*GMM-SYS NPL*
NPL_{-1}	0.945***	0.942***	0.437***	0.339*	0.910***	0.950***	0.946***	0.433***	0.375*	0.912***
	(0.0387)	(0.0583)	(0.150)	(0.198)	(0.0694)	(0.0372)	(0.0562)	(0.148)	(0.200)	(0.0657)
RWA_{-1}	0.0176**	0.0158*	0.0358**	0.136**	0.132**	0.0203**	0.0185**	0.0438**	0.184**	0.132***
	(0.00858)	(0.00869)	(0.0160)	(0.0680)	(0.0537)	(0.00866)	(0.0086)	(0.0173)	(0.0743)	(0.0504)
GDP_{-1}	-0.079***	-0.0753**	-0.215***	-0.174*	-0.0545	-0.0640**	-0.059**	-0.175**	-0.109	-0.0386
	(0.0272)	(0.0287)	(0.0703)	(0.0951)	(0.0577)	(0.0268)	(0.0280)	(0.0719)	(0.110)	(0.0571)
ΔPLS_{-1}	-0.0002***	-0.00017**	-0.000115	-0.000178	-4.77e-06					
	(5.69e-05)	(6.50e-05)	(8.58e-05)	(0.00018)	(0.0001)					
ΔPLS_{-2}	-0.0002***	-0.0002***	-0.0002***	-0.00038**	-0.0002*					
	(4.89e-05)	(5.78e-05)	(6.96e-05)	(0.00015)	(9.42e-05)					
ΔFID_{-1}						0.0994	0.0922	0.124*	0.195**	0.107
						(0.0729)	(0.0651)	(0.0618)	(0.0893)	(0.0657)
ΔFID_{-2}						0.00572	0.0358	0.108**	0.157*	0.0633
						(0.0372)	(0.0500)	(0.0432)	(0.0822)	(0.0578)
Constant	0.0970	0.226	1.691		-8.799**	-0.310	-0.158	0.880		-8.872**
	(0.769)	(0.871)	(1.270)		(4.439)	(0.740)	(0.823)	(1.295)		(4.100)
Observations	239	232	239	188	239	239	232	239	188	239
R-squared	0.806	0.807	0.309			0.805	0.806	0.314		
Number of banks			51	50	51			51	50	51
No. of instruments				23	32				23	32
Hansen test p-value				0.24	0.22				0.12	0.18
A-B AR(1) test p-value				0.02	0.09				0.00	0.07
A-B AR(1) test p-value				0.98	0.72				0.92	0.80
IV-2SLS	Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔPLS_{-1} ΔPLS_{-2} ΔGDP_{-1} NPL_{-2} RWA_{-2}					Instrumented: NPL_{-1} Instruments: RWA_{-1} ΔD_{-1} ΔD_{-2} ΔGDP_{-1} NPL_{-2} RWA_{-2}				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; the GMM style model with three lag.

5.7 DISCUSSION AND CONCLUSION

This paper utilises the panel data model to examine the macro-level and bank-level factors that determine *NPL* in the Islamic banking sector within the GCC. In addition, this paper uses dynamic panel data via means of GMM models to examine the impact of the sectoral distribution of Islamic financing on *NPL* in the GCC's banking system, which enables the contribution of Islamic financing and Islamic financial modes in the *NPL* of the GCC's commercial banking sector as a whole to be identified.

With regard to the results, the real *GDP* growth generally shows negative association with *NPL* in all of the estimators, which supports the 'prosperity' hypothesis and implies that the growth in real macroeconomic terms has a negative impact on *NPL*.

In terms of bank-specific factors, *RWA* play a vital role as an early warning indicator for increasing *NPL* for both Islamic banking, including *IW*, and the GCC's commercial banking sector as a whole, as it reflects the high-level risk of loans portfolio combination. In addition, the performance and profitability ratios show that the *ROE* has a negative impact on *NPL* in the *IB* and *IW*, and in the whole commercial banking sector for both the short term and long term, which indicates a low quality of management. In the case of short-term impact, *IB* may, however, seem to be efficient as the GCC banks appear to prefer *FID* contracts, which lead to high profits and an upsurge for the *ROE*. On the other hand, the *NIM* ratio presents the different impacts on *NPL* in both of the samples used. For the Islamic financing panel model it shows a positive impact on *NPL*, meaning that Islamic financial transactions tend to be riskier than conventional financial transactions, specifically the *PLS* contracts because *PLS* modes of Islamic financing could produce a significant profit, but these are riskier than *FID* contracts, which in turn increases *NPL*. For the GCC's banking sector, the findings from the GMM models show that the *NIM* has a negative association with *NPL*. The different findings on the profitability ratio can be explained by the dissimilarity in the loan portfolios of *IB* and the transactions of *CB*.

The association between non-lagged efficiency and *NPL* supports the 'bad management' hypothesis with the panel data and GMM models. This negative relationship could indicate the 'bad luck' case, which may be caused by external factors that create more costs in administering bank solvency and problem loans, such as the downturn in 2006 and the global financial crisis in the period from 2008 to 2009. The one year lag efficiency variable is, however, positively associated with *NPL*, suggesting the presence of the 'skimping' policy in reducing credit administration expenses; in addition and due to the previous year, there could be a shortage of monitoring borrowers, which increases *NPL*. Moreover, to ensure the validity and direction of efficiency scores that were obtained through the DEA approach, the SFA efficiency score is applied and the coefficients of these variables are in the same directions with the efficiency variables of DEA.

In terms of macro-level sectoral financing, the growth rates of *MI* and *REC* present a relatively similar adverse impact on *NPL*. For the panel data model the growth rate of *RECIB* financing is related negatively to *NPL*; the same is true for the dynamic panel models, and the *RECIB* financing shows a negative impact on *NPL*. These findings suggest that in the GCC countries there is a substantial interaction between the real GDP growth and the real estate and construction sectors. The *RECIB* variable with one year lag has a negative effect on *NPL*, supporting the notion that the financing of *IB* is more related to real estate and construction projects, which increases the risk exposure. Hence, it is suggested that diversification is a crucial step required for bank managers and policy makers in the GCC region. Indeed, they need to focus more on increasing the financing to other sectors that are embedded within the real economy such as manufacturing and other productive industries so that the risk of *NPL* can be reduced as the propensity of failure is less in these sectors than in the real estate sector.

The findings related to the banks' structural and organisational-development factors show that an increase in the assets growth for *IB* leads to an increase in *NPL*, indicating that *IB* could have less ability to diversify in financing portfolios. This would in turn mean that these banks are more at risk. On the other hand, the relationship between *CBA* growth and *NPL* is negative, suggesting that these *CB* are more capable of diversifying financing projects and hence decreasing risk taking.

The product development of *IF* factor demonstrates that in all of the estimated models (with and without lags) that the *PLS* growth shows negative impact on *NPL*, but with minor influence, which is attributed to the very low level of financing with *PLS* contracts. Such findings suggest that despite the high risk-level in *PLS* instruments, increasing the *PLS* financing could lead to a decrease in *NPL*. The *FID* variable in all of the estimators did, however, present a positive relationship with *NPL*, indicating that although *FID* contracts are favoured by *IB* within the GCC, the growth path of *FID* financings could harm the loan quality more than *PLS* instruments.

It should be noted that the causes behind *NPL* can be attributed to macroeconomic, financial or institutional factors (Nkusu, 2011). This study investigates several economic causations between *NPL* and some selected macro-level and micro-level factors, which are classified into endogenous and exogenous factors, by utilising the dynamic panel data (GMM) models. Furthermore, in the present Islamic banking literature on the subject of loan quality issues, no study has yet attempted to examine the impact of Islamic financing and Islamic finance contracts on *NPL*; this absence thus points to the significance of this study, which examines the effects on the loan quality of the GCC's commercial banking sector.

Future research could utilise other empirical techniques such as Granger causality in addition to the dynamic panel data models so as to examine the intertemporal relationships. Further, the relationship between Islamic financing, Islamic contracts and *NPL* could be equally explored by taking into account a longer time period, to examine longer dynamic effects by increasing the lag numbers, which enables the application of different estimates such as the panel vector autoregressive (Nkusu, 2011). Finally, future research could consider the impact of financing other sectors on *NPL*, such as Islamic financing for the manufacturing and consumer sectors.

CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

This chapter presents a summary of the study in relation to its main objectives. Briefly, it summarises the aims and findings of the study with regard to each essay presented in the previous chapters. It is notable that discussing the study's limitations helps to define its scope and offers some directions for future research. Section 6.2 provides a summary of the empirical findings; section 6.3 describes the implications of the findings for managers and policy makers. Section 6.4 presents some critical reflections on the theoretical and empirical models used to measure the efficiency and performance of *IB*. Section 6.5 discusses the limitations of the study and offers some recommendations for future research that are based on the current findings. Finally, section 6.6 brings the research to a conclusion.

6.2 SUMMARY OF THE RESEARCH AND FINDINGS

The current study investigates the concepts of efficiency, performance, survivability and credit risk or issues relating to *NPL* for *IB* within the GCC through four empirical essays. In these four essays, the key investigation is into the impact of several environmental variables that are related to the financial and economic environment, in addition to macro-level and bank-level factors. In particular, the factors related to bank-level were included to differentiate and compare the performance between *IB* and *IW*. The macro-level factors and the variables associated with the financial environment were also used to distinguish the response of *IB* and *IW* towards these factors, such as the real *GDP* growth and the global financial crisis. Further, by providing a selection of political economy perspectives, this study took into account the effects of government and foreign ownership, the rule of law and regulatory quality. This study therefore investigated extensively the performance of Islamic banking in the GCC within the larger macro-level context.

Examining the Efficiency of the Saudi Arabian Banking Sector

The first essay provides a comprehensive and comparative analysis of the efficiency levels of *IB* and *IW* in the Saudi Arabian commercial banking sector, through the DEA approach from

2005 to 2010. It examines the effects of a number of variables related to bank characteristics on the efficiency of Saudi banks by utilising the second stage regression of the DEA model; the variables were bank type (as a dummy variable) in the form of *IB* or *IW*, the quality of loans and liquidity ratios. Moreover, SFA is applied to examine the robustness of the estimated model of DEA second stage regression.

For the empirical analysis, the analysis of financial ratios concluded that the Saudi banking sector was affected by the development stages in the Saudi capital market, as well as the global financial crisis in 2008. In addition, the performance of *IB* was affected by such factors more than that of *CB*, which could be due to the number of *IB* and because the amount of their total assets was less than those of *CB*. Furthermore, the obtained TE scores from the DEA estimation are in line with the financial indicators, which suggested that the performance of *IB* reached its peak in 2005. These indicators decreased sharply until they reached their lowest level in 2008, which can be explained by the trading activities in the Saudi capital market during 2006. In addition, the Al-Jazira bank was greatly affected as it appears to be the most inefficient bank among the Saudi Arabian banks. In terms of the nature of the SE findings, small banks and the majority of banks with foreign partners unexpectedly seemed to operate under an increasing return to scale during the period in question, a result which can be attributed to good bank management (particularly in the area of loans management) so that they were able to avoid defaulted loans.

With regard to the findings related to environmental variables, the results indicate that *IB* are more efficient than *IW* in terms of producing loans. The estimated coefficient of *NPL* indicates a negative association with a bank's efficiency; in this case it would be suggested that more requirements are needed to monitor borrowers when controlling problem loans. Finally, the estimated coefficient of the liquidity ratio highlighted the negative impact on bank efficiency, as less liquidity in banks is more associated with funding high risk loans, which may cause an increase in *NPL*. Finally, the findings for Saudi banks' ranking presented after adjusting the DEA efficiency levels; as the results indicate, the performance of *IB* was affected by the environmental variables more than that of the *CB*. Moreover, the performance of some *IW* with foreign partnerships was higher than that for other banks.

Measuring Efficiency and its Determinants in the GCC Countries

The second essay measures the TE levels of *IB* and *IW* in the GCC countries through the meta-frontier analysis method so as to evaluate the gaps between efficiency levels from 2005 to 2010, as all of the banks in these countries operate under different technologies and different bank groups. This essay presents a comparative study on two levels: between each country and between three bank groups, which are *IB*, *IW*, and *CB*. In addition, this essay examines the total factor productivity through MPI form to measure the catch-up rate, which locates how the country's or group's frontiers perform in terms of production points and productivity growth towards the meta-frontier from period *t* to period *t+1*. In addition, it examines the high potential influence of banks' characteristics, financial structures and rule-of-law variables on the efficiency scores that were obtained from the DEA meta-frontier method, via panel data with the random effects model and bootstrap technique, which is proposed by Simar and Wilson (2007).

For the DEA meta-frontier, the analysis of TGR of GCC countries revealed that the highest TGR appears in Qatar followed by the UAE, indicating that Qatari banks have been operating at the best level of available production technology. In addition, Qatar has recorded the highest catch-up rate, whereas the UAE and Saudi Arabia have not managed to record any high level of catch-up rate.

The findings on the meta-frontier for bank groups illustrate that *IW* have dominated all bank groups; the TGR of these banks has also demonstrated the highest ratio since 2007. In addition, the average of TGR shows that IB could operate at the best level by producing at 90%, rather than at 83%, and by utilising the same levels of input that are provided by the GCC countries. Despite the TGR results for *IB*, they have managed to catch-up and have been the most productive group for the majority of that period.

The findings of the second stage regression model prove that GCC banks, as intermediation firms, have a good ability to transform deposits into loans; bank size is also considered to be an important factor in terms of enhancing efficiency. From the perspective of the type of bank, *IB* are less efficient at producing outputs than *IW*. In addition, the GCC's banking efficiency is affected positively by the rule-of-law variable. The government ownership enhances the liquidity and causes an increase in the production of output level, which reflects the importance of oil revenue to the GCC countries.

Measuring the Survival-Time Analysis of the IB and CB within the GCC

The third essay investigates the survival-time analysis and risk of failure for *IB* and *CB* by taking into account the impact of the global financial crisis and other circumstances; to this end, it employs duration models to investigate whether *IB* or *CB* are more susceptible to failure risk for the period of 1995 to 2011. This empirical analysis started with the life-table method, which is a non-parametric technique and unconditional analysis that depends on the observation of failure events. This stage of unconditional analysis was followed by the conditional analysis, which depends on the availability of data at a micro-level and at a macro-level. This essay pivots on the application of the cloglog model to estimate a bank's failure and to present a comparative analysis between *IB* and *CB*.

As the results in Chapter Four illustrate, the life-table findings or the unconditional analysis supported the hypothesis that *IB* are more likely to fail than *CB*, without controlling the differences for the macro-level and micro-level covariates. The conditional findings concluded that in terms of micro-level variables, the coefficient of the dummy variable for *IB* confirms the unconditional findings, which suggests that *IB* are approximately twice as hazardous as *CB*.

The financial earnings ratios showed that a rise in *ROA* causes the hazard rate to decline, yet an increase in *NIM* led to a similar increase in the hazard ratio. The asset quality and liquidity ratios (*LLR/L* and *NL/A*) are associated positively with the failure of hazard risk. Moreover, the findings demonstrated that increasing *GNIR* decreases the failure risk for *CB* and *IB*, but it is only significant for *IB*. Similarly, with the ratios for *ROA*, which has a negative influence on hazard rate, and *NIM*, which has a positive influence on hazard rate, they are significant for *IB*. This outcome emphasised that the financing of most *IB* depends on non-*PLS* or asset-based contracts, in that they offer less risk and more profit than *PLS* contracts.

The macro-level findings concluded that a more concentrated banking sector leads to an elevated hazard rate, since it has the same positive influence on both subgroups (*IB* and *CB*). The growth of the real *GDP* rate causes the failure risk to decline; furthermore, the effect of real *GDP* growth is of greater value for *IB* than it is for *CB*, suggesting that despite the smaller size of *IB* (in comparison to *CB*), they are better engaged with the real economy. It was found that the inflation rate considerably increases hazard rate, whereas the involvement of the government in bank ownership reduces the probability of failure risk; in addition, *CB* are more associated with *GOV* than *IB*, which protects *CB* against failure hazard. Finally, the results show that improving the regulatory quality has an adverse effect on hazard rate.

Determining Factors of NPL in Islamic and Conventional Banking within the GCC

The last essay examines the macro-level and micro-level factors determining *NPL* for *IB* and *IW* in the GCC countries via means of the panel data econometrics model. In addition, it investigates the factors contributing to *NPL* in the GCC's commercial banking sector as a whole through the use of dynamic panel data (GMM) models to observe the time condition impacts on *NPL* for the period of 2005 to 2011. Furthermore, this essay identifies the impact of the sectoral financing (the real estate sector in particular) of *IB* as well as Islamic financial contracts, including *PLS* and *FID* contracts, on the *NPL* of the Islamic banking sector and the GCC's commercial banking system as a whole.

In terms of bank-specific factors, the findings concluded that *RWA* play a vital role as an early warning indicator for increasing *NPL* for both Islamic banking, including *IW*, and the GCC's commercial banking sector as a whole, given that it reflects the high-level risk of loan portfolio diversification. The findings show that the *ROE* ratio has a negative impact on *NPL* in Islamic banking, including *IW*, and on the whole commercial banking sector, which is indicative of the low quality of management. *IB* could, however, seem efficient in the short-term as GCC banks seem to prefer *FID* contracts, which lead to high profits; this in turn causes an upsurge in the *ROE*.

The *NIM* ratio presented different influences on *NPL* in both the samples used; for the Islamic finance panel model, it showed a positive influence on *NPL*, suggesting that Islamic financial transactions tend to be riskier than transactions of *CB*, specifically the *PLS* contracts, because *PLS* modes of Islamic financing could produce a significant profit but they are riskier than *FID* and other financing contracts, which increases the *NPL*. For the GCC's banks, the findings from the GMM models showed that the *NIM* has a negative impact on *NPL*. The different findings for the profitability ratio can be explained by the dissimilarity in the loan portfolios of *IB* and the transactions of *CB*.

The findings in Chapter Five illustrate that the link between non-lagged efficiency and *NPL* support the 'bad management' hypothesis with the panel data and GMM models. This negative relationship could indicate the 'bad luck' case, which may be caused by external factors that create more costs in administering bank solvency and problem loans. The one year lag efficiency variable is associated with *NPL* positively, thereby suggesting the 'skimping' policy in reducing credit administration expenses. Furthermore and due to the previous year, there could be a shortage in monitoring borrowers, which increases the *NPL*.

In terms of the macro-level findings, the real *GDP* growth supported the 'prosperity' hypothesis, which implies that the growth in real macroeconomic terms has a negative impact on *NPL*. The sectoral financing findings emphasised that the growth rates of *MI* and *REC* relatively demonstrated similar negative impacts on *NPL*. In the panel data model the growth rate of *RECIB* financing was related negatively with *NPL*; likewise, in the dynamic panel models the *RECIB* financing showed a negative impact on *NPL*. These findings suggest that in the GCC countries there is a significant interaction between the real *GDP* growth and the real estate and construction sectors. In addition, the findings support the notion that the financing of *IB* is more related to real estate and construction projects, which increases the risk exposure.

The findings related to the banks' structure and organisational-development factors showed that an increase in the assets growth of *IB* leads to an upsurge in *NPL*, indicating that *IB* may have less opportunity to diversify their financing portfolios and that they are more at risk. On the other hand, the relationship between *CBA* growth and *NPL* is negative, suggesting that these *CB* are more capable of diversifying the financing portfolios and hence decreasing the risk taking.

The product development of Islamic finance factors suggests that the *PLS* growth showed a negative impact on *NPL*, although minor influence was present, which was attributed to the very low level of financing with *PLS* contracts. Such findings suggest that despite the high risk-level in *PLS* instruments, increasing the *PLS* financing could lead to a decrease in *NPL*. The *FID* variable in all of the estimators did, however, present a positive relationship with *NPL*, indicating that although *FID* contracts are favoured by *IB* within the GCC, the growth path of *FID* financings could harm the loan quality more than *PLS* contracts.

Overall summary

Each essay in this study utilises a different sample and model; this study will therefore extend the existing knowledge and understanding of studies related to IBF in the following ways:

(i) It closely examines the Saudi banks' efficiency by comparing the TE levels and scale efficiency between *IB* and *CB*.

(ii) It investigates the efficiency of *IB* and *CB* in GCC countries through a comprehensive and comparative study.

(iii) It applies a discrete-time model to investigate the risk of the bank in question; related covariates are also applied, which determine the hazard rate of *IB* and *CB* in the GCC countries.

(iv) It examines the link between a bank's efficiency and the *NPL* of *IB* and *CB*, and it is the first study to investigate the contributions of Islamic sectoral financing and Islamic finance contracts to the *NPL* of the GCC's banking sector as a whole.

6.3 IMPLICATIONS OF THE RESEARCH

The findings of this study provide some implications for managers, policy makers and researchers. In terms of a bank's efficiency, the Saudi Arabian banks need to enhance their bank management to monitor borrowers and control default loans. In terms of the efficiency of the GCC banks and meta-frontier analysis, the technology gap ratio approaches seemed very significant in illustrating dissimilarities among the bank groups. The efficiency level of *IB* appeared to be lower than it is for *IW*. To promote the performance of *IB*, it is therefore recommended that *IB* should increase their size, either by merging or by expanding their market shares and clients so as to take advantage of scale economies. In addition, the findings provided evidence that supported the importance of the rule of law to improve a bank's efficiency. It is thus recommended that policy makers, as one economic and political union, can develop the strategies and unite the regulations of *IB* within the GGC countries in order to utilise the best available technology.

Previous studies on Islamic banking have rarely proposed empirical evidence exploring the factors that could affect a bank's failure. Thus, in terms of bank-specific factors, which are related to asset quality and liquidity ratios, this study provided evidence for bank managers that *IB* need to improve their management structure so as to make more efficient decisions related to liquidity and credit risk, especially when opting to expand their *PLS* contracts. In addition, improving the regulatory quality enhances the role of Islamic finance, especially in the GCC. Therefore, the financing models as well as the regulations should be improved in conjunction by policy makers.

The study suggests a clear indication to bank managers and policy makers that diversification is a crucial step necessary in the GCC region. This step could be achieved by focusing more on increasing the financing to other sectors that are embedded within the economy, such as manufacturing and other productive industries, so that the risk of *NPL* can be reduced, as the propensity for failure is less in these sectors than it is in the real estate sector. Moreover, it suggests that despite the high risk-level in *PLS* instruments, increasing the *PLS* financing could lead to a decrease in *NPL*.

6.4 CRITICAL REFLECTIONS ON THE THEORETICAL AND EMPIRICAL MODELS

With regard to measuring efficiency and performance issues, a critical position may suggest different methods than those commonly used in the literature as well as in this chapter. Such novel and Islamic moral economy oriented methods and approaches are rationalised through the moral claims of IBF, which suggests that IBF should be risk-sharing, asset based, or embedded in the real economy, participatory financing, and should be in line with the *maqasid al-sharia* (the objectives of *sharia*) or human wellbeing. Thus, critics such as Hasan (2004) and Asutay (2012) argue that the assessment of the performance of IBF should not be limited to efficiency and profitability, and should also measure the performance in the areas mentioned. It is therefore claimed that using the common methods and variables is an indication that IBF is in the same line of operations as *CB*.

When reflecting on these issues, Hasan (2004) argues that those studies have presented unsatisfying information about the political economy and its impact on the financial sector. He also states that the nature of the inputs and outputs, and the limitations of data, have affected the findings of those studies, as they suffered from a lack of description and remain unclear. Finally, in terms of social accountabilities he states that *IB* 'hardly have the structure, aptitude, environment, or personnel to do what we think they must to do. And discussion on the crucial structural issues is rare in the literature' (Hasan, 2004: 23). To illustrate this point, Hasan (2004) argues that the objectives of cost minimisation and profit maximisation are not vital for *IB*, and that the performance of those banks should be evaluated with an indication of the level at which they help to build and develop society. In what manner IBF could be assessed when the majority of them are planned to be commercial banks in their operations and hence questioning their intentions, which are socially aspirational, remains an important question. In actuality, to fulfil such potential social objectives, *IB* should modify their structure and operational nature so that they not only incorporate the interests of the shareholders and the Board of Directors (BoD), but also the policy objectives of the countries in which they are operating. Thus, a nation's banking regulations, political conditions and social and developmental needs must be identified so that gauging the comprehensive performance in terms of the banks' success at achieving social objectives can be assessed. Antonio (2013) therefore provides a fresh look into performance measurement by measuring the *maqasid al-sharia* outcomes of a number of IBF operations; Beduiddine (2012) also provides an alternative theoretical construct to measure *maqasid al-sharia* outcomes. It is hoped that such models, mainly located in social accounting, can be extended to research in IBF.

6.5 LIMITATIONS AND FUTURE RESEARCH

When addressing the study's findings, some limitations were encountered. The first empirical essay only comprised one output variable; it is therefore suggested that future studies should include more input-output variables, such as other earning assets, and they should also apply different methods, such as SFA with Gamma model, to improve the assessment between the performances of *IB* and *CB* in Saudi Arabia. This recommendation does, however, require a larger sample; it is thus also recommended that future research expands the sample size and utilises panel data. In addition, more varieties of environmental variables need to be examined to study the variation in a bank's efficiency; for instance, banks with foreign ownership and financial development factors, including market capitalisation and bank concentration.

The second empirical essay applied meta-frontier and technology gap ratio approaches, which seemed to be very significant in illustrating dissimilarities among the Gulf countries or groups of banks. The other form of meta-frontier proposed by O'Donnell *et al.* (2008) is that of the Stochastic Frontier Approach (SFA), one of the parametric methods. This method is recommended for future research and should be applied with different environmental variables to investigate the variances in production or cost technology among regional banks within the GCC.

With regard to the particularities of survival analysis, the study was designed around the realities of the region with the aim of shedding some light on this particular aspect, which has not been studied for the subject of Islamic and conventional banking within the GCC. It is, however, important to note that the history of banking in the region in general and Islamic banking in particular is rather short, given that these countries were mostly founded in the post-war period and that their banks are even younger. Thus, it is recommended that any future studies encompass a longer period, utilising different explanatory variables such as credit growth and capital regulation, which would enhance the quality of the findings established in this study (Evrensel, 2008).

Further, this study investigated the factors that determine the *NPL* of the GCC's banking sector through GMM models. Thus, it is recommended that future research should utilise other empirical techniques, such as Granger causality, to examine the intertemporal relationships. In addition, the relationship between Islamic financing, Islamic contracts and *NPL* could also be explored by taking into account the longer time period needed to increase the lag numbers so as to examine the dynamic impacts. Moreover, it is recommended that future research applies different estimates such as the panel vector autoregressive (PVAR), which is more applicable for a long-term period of panel data (Nkusu, 2011). Furthermore, future research could consider the impact of other financing sectors on *NPL*, such as Islamic financing for manufacturing and consumer sectors.

6.6 EPILOGUE

The aim of this research was to investigate the efficiency, performance, survival analysis and *NPL* of the GCC's banking sector in a comparative manner through four essays.

Chapter Two presented evidence which suggested that the performance of *IB* is different from that of *IW*. Chapter Three showed evidence that *IW* have dominated all of the bank groups; also the TGR of these banks has demonstrated the highest ratio. *IB* have managed to catch-up and become the most productive group for the majority of that period (2005-2010). In addition, improving the rule of law enhances the efficiency of the GCC's banking sector. Chapter Four provided evidence which indicated that *IB* are more at risk than *CB*, yet *IB* are shown to be more engaged with the real economy than *CB*. Chapter Five presented evidence which suggested that the Islamic financing of the real estate sector and Islamic finance contracts, especially *PLS* instruments, have a significant impact on the *NPL* of the GCC's banking sector.

Finally and as evidenced by the contents of the empirical chapters (which include an extensive literature review of the relevant aspects of the research as well as econometric modelling relevant to each chapter), it can be concluded that this research has fulfilled the aims, objectives and research questions established at the beginning of the study.

APPENDIX - CHAPTER 2

Table 1- DEA TE Results with Confidence Limits

Bank Name	Year	TE	SE	RTS	Bias	S.D	LL	UL
Al-Rajhi	2005	1	1	-	0	0	1	1
Al-Jazira	2005	0.561	0.913	IRS	0.0419	0.022	0.560	0.642
Albilad	2005	1	1	-	0	0	1	1
Av. Islamic	2005	0.854						
NCB	2005	0.670	0.920	DRS	0.0204	0.013	0.674	0.719
Riyad	2005	0.642	0.996	DRS	0.0448	0.024	0.650	0.739
Samba	2005	0.800	0.986	IRS	0.0223	0.019	0.804	0.864
SABB	2005	0.850	0.950	IRS	0.0114	0.01	0.851	0.881
Saudi Fransi	2005	0.901	0.935	IRS	0.0526	0.034	0.908	1
ANB	2005	0.783	0.916	IRS	0.0205	0.019	0.787	0.842
Saudi Hollandi	2005	0.770	0.819	IRS	0.0154	0.012	0.770	0.810
Saudi Investment	2005	0.745	0.744	IRS	0.0768	0.049	0.757	0.906
Av. Conventional	2005	0.770						
Av. All Banks	2005	0.794						
AlRajhi	2006	0.820	0.934	DRS	0.0495	0.028	0.8283	0.917
AlJazira	2006	0.491	0.997	IRS	0.0274	0.02	0.483	0.555
Albilad	2006	1	1	-	0	0	1	1
Av. Islamic	2006	0.770						
NCB	2006	0.650	0.883	DRS	0.0168	0.012	0.649	0.688
Riyad	2006	0.633	0.961	DRS	0.0532	0.024	0.631	0.727
Samba	2006	0.773	0.998	IRS	0.0248	0.022	0.773	0.846
SABB	2006	0.774	0.970	IRS	0.0118	0.011	0.777	0.811
Saudi Fransi	2006	0.920	0.973	IRS	0.0522	0.028	0.926	1
ANB	2006	0.856	0.975	IRS	0.0131	0.012	0.857	0.892
Saudi Hollandi	2006	0.750	0.865	IRS	0.0254	0.019	0.750	0.812
Saudi Investment	2006	0.710	0.868	IRS	0.0325	0.021	0.715	0.785
Av. Conventional	2006	0.758						
Av. All Banks	2006	0.760						
AlRajhi	2007	0.853	0.883	DRS	0.0516	0.031	0.849	0.950
Al-Jazira	2007	0.552	0.965	IRS	0.0194	0.015	0.555	0.605
Albilad	2007	0.923	0.994	DRS	0.0513	0.024	0.920	1
Av. Islamic	2007	0.776						
NCB	2007	0.557	0.753	DRS	0.0176	0.011	0.550	0.597
Riyad	2007	0.670	0.904	DRS	0.043	0.018	0.670	0.745
Samba	2007	0.743	0.922	DRS	0.0386	0.031	0.745	0.848
SABB	2007	0.904	0.988	IRS	0.0361	0.026	0.907	0.998
Saudi Fransi	2007	0.882	0.987	IRS	0.0801	0.039	0.880	1
ANB	2007	0.860	0.995	DRS	0.0146	0.012	0.861	0.896
Saudi Hollandi	2007	0.730	0.895	IRS	0.0197	0.018	0.730	0.786
Saudi Investment	2007	0.700	0.945	IRS	0.0297	0.022	0.703	0.775

Av. Conventional	2007	0.756						
Av. All Banks	2007	0.761						
AlRajhi	2008	0.860	0.860	DRS	0.0136	0.031	0.812	0.915
AlJazira	2008	0.643	0.921	IRS	0.0294	0.019	0.647	0.705
Albilad	2008	0.580	0.980	DRS	0.0314	0.022	0.580	0.651
Av. Islamic	2008	0.693						
NCB	2008	0.624	0.649	DRS	0.0152	0.011	0.627	0.662
Riyad	2008	0.823	0.830	DRS	0.0434	0.025	0.820	0.913
Samba	2008	0.820	0.816	DRS	0.0628	0.043	0.826	0.963
SABB	2008	1	1	-	0	0	1	1
Saudi Fransi	2008	1	1	-	0	0	1	1
ANB	2008	0.810	0.907	DRS	0.028	0.018	0.813	0.868
Saudi Hollandi	2008	0.813	0.977	IRS	0.0291	0.019	0.818	0.879
Saudi Investment	2008	0.810	0.898	IRS	0.0874	0.049	0.815	0.985
Av. Conventional	2008	0.838						
Av. All Banks	2008	0.798						
AlRajhi	2009	0.847	0.872	DRS	0.0325	0.031	0.814	0.917
AlJazira	2009	0.590	0.918	IRS	0.0276	0.019	0.591	0.649
Albilad	2009	0.724	0.904	IRS	0.0245	0.021	0.726	0.792
Av. Islamic	2009	0.723						
NCB	2009	0.564	0.683	DRS	0.0121	0.009	0.567	0.596
Riyad	2009	0.835	0.885	DRS	0.0405	0.029	0.830	0.934
Samba	2009	0.672	0.898	DRS	0.0548	0.038	0.670	0.804
SABB	2009	0.921	0.985	IRS	0.0484	0.027	0.929	1
Saudi Fransi	2009	0.992	0.991	IRS	0.0078	0.000	1	1
ANB	2009	0.750	0.955	DRS	0.0292	0.017	0.754	0.811
Saudi Hollandi	2009	0.783	0.953	IRS	0.0176	0.013	0.785	0.826
Saudi Investment	2009	0.821	0.953	IRS	0.0329	0.029	0.825	0.919
Av. Conventional	2009	0.792						
Av. All Banks	2009	0.773						
AlRajhi	2010	0.827	0.829	DRS	0.0141	0.027	0.782	0.873
AlJazira	2010	0.654	0.918	IRS	0.0286	0.016	0.650	0.714
Albilad	2010	0.670	0.861	IRS	0.0271	0.021	0.672	0.736
Av. Islamic	2010	0.717						
NCB	2010	0.583	0.588	DRS	0.0129	0.011	0.584	0.619
Riyad	2010	0.833	0.842	DRS	0.0408	0.027	0.830	0.927
Samba	2010	0.620	0.815	DRS	0.0552	0.035	0.621	0.735
SABB	2010	0.950	0.989	IRS	0.0369	0.017	0.956	1
Saudi Fransi	2010	1	1	-	0	0	1	1
ANB	2010	0.711	0.911	DRS	0.03	0.017	0.716	0.771
Saudi Hollandi	2010	0.845	0.956	IRS	0.0225	0.016	0.849	0.898
Saudi Investment	2010	0.815	0.965	IRS	0.0282	0.024	0.819	0.896
Av. Conventional	2010	0.795						
Av. All Banks	2010	0.773						

Notes: RTS shows the returns to scale estimates, where IRS means increasing returns to scale; DRS illustrates decreasing returns to scale; the blank cell indicates CRS; LL and UL reflect the lower and upper limits of bootstrap replication at the ninety-fifth percentile confidence intervals.

Re-assessing the Second Stage Regression of the DEA Model

1- **Multicollinearity**

There are two types of tests to investigate the multicollinearity, which are the correlation matrix for the employed variables and the variance inflation factors.

I. Correlation Matrix for Listed Variables

	TE Scores	*Z2*	*Z1*	*Z3*
TE Scores	1	-0.5458	-0.1037	-0.3788
Z2	-0.5458	1	0.12169	0.3277
Z1	-0.1037	0.1217	1	0.7195
Z3	-0.3788	0.3277	0.7195	1

Note: DEAEFF_O signifies the TE efficiency (Y); CLONQ2 indicates the quality of the loans (Z_2); BANKT represents the dummy variable for *IB* (Z_1); and CLQTUS shows the liquidity ratio (Z_3). The dependent variable is included here as a result from the first stage of the DEA model to clarify the correlation degree with the employed variables in the second stage regression of the DEA.

II. Variance Inflation Factor (VIF)

Matrix VIF has five rows and one column.

Z2| 1.46441
Z1| 2.23476
Z3| 2.62921
TE Scores| 1.58949

It can be noticed that none of these variables have a VIF value above ten, where if the VIF is more than ten then a multicollinearity problem exists.

2- **Heteroscedasticity**

To examine the non-constant variance the Breusch-Pagan chi-square test is used, which was produced by Cook and Weisberg (1983).

Non-constant Variance Test:

The hypotheses for this test are H0: constant variance, H1: non-constant variance

Non-Constant Variance Score Test:

Variance formula: ~ fitted.values

Chi-square = 0.4856757 Df = 1 p = 0.4858626

The null hypothesis is therefore accepted and the variance of this model is constant.

3- Autocorrelation

According to the Durbin-Watson test, the autocorrelation problem does exist, hence several regressions (Prais-Winsten or feasible GLS and ML) have been applied to avoid this problem, which are related to first order autocorrelation.

```
+-----------------------------------------------------+
| Ordinary    least squares regression                |
| Model was estimated Jan 29, 2012 at 00:47:45AM      |
| LHS=DEAEFF_O Mean                 =   .7773126      |
|              Standard deviation   =   .1309184      |
| WTS=none     Number of observs.   =         66      |
| Model size   Parameters           =          4      |
|              Degrees of freedom   =         62      |
| Residuals    Sum of squares       =   .7009024      |
|              Standard error of e  =   .1063244      |
| Fit          R-squared            =   .3708667      |
|              Adjusted R-squared   =   .3404248      |
| Model test   F[  3,    62] (prob) =  12.18 (.0000)  |
| Diagnostic   Log likelihood       =   56.33642      |
|              Restricted(b=0)      =   41.04382      |
|              Chi-sq [  3]  (prob) =  30.59 (.0000)  |
| Info criter. LogAmemiya Prd. Crt. =  -4.423681      |
|              Akaike Info. Criter. =  -4.423829      |
| Autocorrel   Durbin-Watson Stat.  =   .5594047      |
|              Rho = cor[e,e(-1)]   =   .7202977      |
+-----------------------------------------------------+
```

Variable	Coefficient	Standard Error	t-ratio	P[|T|>t]	Mean of X
Constant	.97732579	.03588695	27.233	.0000	
Z2	-.04170471	.01023908	-4.073	.0001	2.91775816
Z3	-.00497592	.00187390	-2.655	.0101	19.6684667
Z1	.07164587	.04297757	1.667	.1005	.27272727

```
+----------------------------------------------+
| AR(1) Model:     e(t) = rho * e(t-1) + u(t)  |
| Initial value of rho       =         .72030  |
| Maximum iterations         =            100  |
| Method = Prais-Winsten                      |
| Iter=  1, SS=       .332, Log-L=  80.617232  |
| Iter=  2, SS=       .330, Log-L=  80.735786  |
| Iter=  3, SS=       .330, Log-L=  80.739697  |
| Final value of Rho    =             .760326  |
| Iter=  3, SS=       .330, Log-L=  80.739697  |
| Durbin-Watson:   e(t) =             .479348  |
| Std. Deviation:  e(t) =             .112361  |
| Std. Deviation:  u(t) =             .072983  |
| Durbin-Watson:   u(t) =            2.060015  |
| Autocorrelation: u(t) =            -.030007  |
| N[0,1] used for significance levels          |
+----------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Constant	.94222271	.04515804	20.865	.0000	
Z2	-.03525603	.00738877	-4.772	.0000	2.91775816
Z3	-.00390087	.00108842	-3.584	.0003	19.6684667
Z1	.10447502	.06027298	1.733	.0830	.27272727
RHO	.76032585	.08056575	9.437	.0000	

```
+----------------------------------------------+
| AR(1) Model:      e(t) = rho * e(t-1) + u(t) |
| Initial value of rho        =         .72030 |
| Maximum iterations          =            100 |
| Method = Maximum likelihood                  |
| Iter=  1, SS=        .332, Log-L=  80.617232 |
| Iter=  2, SS=        .330, Log-L=  80.739067 |
| Iter=  3, SS=        .330, Log-L=  80.740791 |
| Final value of Rho     =             .763668 |
| Iter=  3, SS=        .330, Log-L=  80.740791 |
| Durbin-Watson:   e(t) =              .478303 |
| Std. Deviation:  e(t) =              .113033 |
| Std. Deviation:  u(t) =              .072975 |
| Durbin-Watson:   u(t) =             2.065883 |
| Autocorrelation: u(t) =             -.032941 |
| N[0,1] used for significance levels         |
+----------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Constant	.94222183	.04556562	20.678	.0000	
Z2	-.03526458	.00738033	-4.778	.0000	2.91775816
Z3	-.00389791	.00108671	-3.587	.0003	19.6684667
Z1	.10519075	.06059493	1.736	.0826	.27272727
RHO	.76366828	.08007792	9.537	.0000	

Note: all of the tables showing findings have been attained by employing LIMDEP econometric software.

APPENDIX - CHAPTER 3

Table 1- Comparative statistical summary of the TE scores for adjusted and nominal data

DEA	*Real (Adjusted data)*				*Nominal data*			
	Mean	*SD*	*Min.*	*Max.*	*Mean*	*SD*	*Min.*	*Max.*
Saudi Arabia								
2005	0.803	0.136	0.512	0.927	0.812	0.134	0.526	0.941
2006	0.795	0.091	0.586	0.946	0.798	0.091	0.587	0.951
2007	0.822	0.111	0.595	1	0.820	0.113	0.586	1
2008	0.860	0.124	0.592	0.969	0.839	0.121	0.578	0.940
2009	0.817	0.114	0.618	1	0.824	0.116	0.620	1
2010	0.823	0.114	0.631	1	0.821	0.115	0.628	1
The UAE								
2005	0.752	0.107	0.594	0.973	0.756	0.110	0.595	0.979
2006	0.803	0.124	0.598	1	0.806	0.124	0.597	1
2007	0.795	0.146	0.568	1	0.795	0.146	0.569	1
2008	0.840	0.118	0.601	1	0.835	0.118	0.591	1
2009	0.808	0.141	0.566	1	0.808	0.142	0.567	1
2010	0.803	0.156	0.535	1	0.798	0.156	0.531	1
Bahrain								
2005	0.862	0.156	0.528	1	0.863	0.156	0.530	1
2006	0.794	0.200	0.370	1	0.808	0.197	0.397	1
2007	0.755	0.174	0.486	1	0.771	0.180	0.495	1
2008	0.735	0.147	0.561	1	0.733	0.150	0.560	1
2009	0.695	0.141	0.491	0.895	0.694	0.140	0.493	0.893
2010	0.727	0.184	0.463	1	0.730	0.182	0.462	1
Qatar								
2005	0.741	0.131	0.601	1	0.748	0.127	0.599	1
2006	0.762	0.120	0.615	1	0.764	0.119	0.617	1
2007	0.824	0.120	0.603	0.964	0.825	0.122	0.600	0.976
2008	0.885	0.101	0.736	1	0.880	0.109	0.709	1
2009	0.863	0.130	0.710	1	0.869	0.128	0.715	1
2010	0.837	0.168	0.608	1	0.839	0.168	0.608	1
Kuwait								
2005	0.831	0.114	0.608	1	0.840	0.108	0.622	1
2006	0.810	0.074	0.656	0.902	0.812	0.074	0.659	0.901
2007	0.801	0.131	0.593	1	0.801	0.131	0.592	1
2008	0.790	0.122	0.600	1	0.792	0.122	0.598	1
2009	0.806	0.105	0.700	1	0.807	0.104	0.696	1
2010	0.766	0.101	0.641	0.896	0.770	0.103	0.642	0.90
IB Group								
2005	0.762	0.171	0.512	1	0.767	0.169	0.526	1
2006	0.747	0.168	0.370	1	0.753	0.166	0.397	1
2007	0.731	0.151	0.486	1	0.731	0.152	0.495	1
2008	0.737	0.147	0.562	1	0.726	0.148	0.560	1
2009	0.735	0.122	0.520	1	0.738	0.123	0.523	1
2010	0.757	0.156	0.463	1	0.755	0.158	0.462	1
CB-IW Group								
2005	0.818	0.111	0.594	1	0.829	0.110	0.595	1
2006	0.828	0.091	0.643	1	0.831	0.091	0.644	1
2007	0.877	0.096	0.695	1	0.880	0.098	0.696	1
2008	0.903	0.081	0.666	1	0.891	0.082	0.652	1
2009	0.874	0.108	0.629	1	0.878	0.109	0.627	1
2010	0.857	0.141	0.527	1	0.855	0.141	0.525	1
CB Group								
2005	0.792	0.105	0.609	1	0.795	0.106	0.611	1
2006	0.805	0.097	0.598	1	0.810	0.098	0.597	1
2007	0.781	0.122	0.569	1	0.785	0.123	0.569	1
2008	0.821	0.103	0.651	1	0.824	0.098	0.657	1
2009	0.779	0.136	0.491	1	0.779	0.136	0.493	1
2010	0.764	0.128	0.573	1	0.766	0.127	0.579	1

Table 2- Variance Inflation Factor (VIF) Multicollinearity Test

(With Size Variable)	*Model 1*		*Model 2*		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NLD	*1.09*	*0.916071*	*NLD*	*1.12*	*0.895883*
IB	*1.35*	*0.740340*	*IB*	*1.35*	*0.740321*
IW	*1.81*	*0.552223*	*ISW*	*1.81*	*0.551405*
FO	*1.30*	*0.769843*	*FO*	*1.31*	*0.765692*
Size	*1.77*	*0.565580*	*Size*	*1.87*	*0.535307*
			CON	*1.15*	*0.866210*
Mean VIF	*1.46*		*Mean VIF*	*1.43*	

(With Size Variable)	*Model 3*		*Model 4*		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NLD	*1.11*	*0.904102*	*NLD*	*1.12*	*0.895266*
IB	*1.23*	*0.811789*	*IB*	*1.20*	*0.836756*
GOV	*1.38*	*0.724582*	*GOV*	*1.09*	*0.913851*
Size	*1.16*	*0.862938*	*Size*	*1.23*	*0.811725*
RL1	*1.38*	*0.722530*	*RL2*	*1.19*	*0.839054*
Mean VIF	*1.25*		*Mean VIF*	*1.17*	

(Without Size Variable)	*Model 1*		*Model 2*		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NLD	*1.09*	*0.919004*	*NLD*	*1.12*	*0.896242*
IB	*1.33*	*0.750071*	*IB*	*1.33*	*0.749332*
IW	*1.31*	*0.764376*	*ISW*	*1.32*	*0.756908*
FO	*1.05*	*0.956822*	*FO*	*1.08*	*0.922159*
			CON	*1.09*	*0.915196*
Mean VIF	*1.19*		*Mean VIF*	*1.19*	

(Without Size Variable)	*Model 3*		*Model 4*		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NLD	*1.10*	*0.912820*	*NLD*	*1.11*	*0.899537*
IB	*1.10*	*0.907527*	*IB*	*1.08*	*0.927266*
GOV	*1.38*	*0.725803*	*GOV*	*1.09*	*0.918342*
RL1	*1.37*	*0.727420*	*RL2*	*1.11*	*0.898029*
Mean VIF	*1.24*		*Mean VIF*	*1.10*	

APPENDIX - CHAPTER 5

Table 1- Variance inflation factor (VIF) Multicollinearity test

Model 1			Model 2			Model 3		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
RWA	1.04	0.9631	RWA	1.02	0.9778	RWA	1.02	0.9813
ROE	1.27	0.7879	ROE	1.15	0.8717	ΔPLS	1.08	0.9288
NIM	1.11	0.9045	NIM	1.09	0.9166	ΔFID	1.05	0.9506
EFF^{DEA}	1.16	0.8608				$\Delta RECIB$	1.12	0.8965
			EFF^{SFA}	1.07	0.9343			
ΔGDP	1.07	0.9331	ΔGDP	1.10	0.9125	ΔGDP	1.03	0.9667
Mean VIF	1.13		*Mean VIF*	1.09		*Mean VIF*	1.06	

Model 4			Model 5		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.03	0.9752	NPL_{-1}	1.01	0.9872
RWA_{-1}	1.02	0.9804	RWA_{-1}	1.01	0.9920
ΔGDP_{-1}	1.01	0.9900	$\Delta nonoil\ GDP_{-1}$	1.01	0.9929
Mean VIF	1.02		*Mean VIF*	1.01	

Model 6			Model 7		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.04	0.9587	NPL_{-1}	1.03	0.9752
RWA_{-1}	1.01	0.9895	RWA_{-1}	1.02	0.9763
ROE_{-1}	1.02	0.9805	NIM_{-1}	1.02	0.9828
ΔGDP_{-1}	1.02	0.9794	ΔGDP_{-1}	1.02	0.9779
Mean VIF	1.02		*Mean VIF*	1.02	

Model 8			Model 9		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.17	0.8565	NPL_{-1}	1.14	0.8738
RWA_{-1}	1.05	0.9541	RWA_{-1}	1.08	0.9277
EFF^{DEA}	4.50	0.2222	EFF^{SFA}	2.80	0.3572
EFF^{DEA}_{-1}	4.51	0.2217	EFF^{SFA}_{-1}	2.79	0.3582
ΔGDP_{-1}	1.02	0.9792	ΔGDP_{-1}	1.03	0.9707
Mean VIF	2.45		*Mean VIF*	1.77	

Model 10			Model 11		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.06	0.9453	NPL_{-1}	1.04	0.9596
RWA_{-1}	1.02	0.9835	RWA_{-1}	1.01	0.9946
ΔIBA_{-1}	1.08	0.9290	ΔIWA_{-1}	1.02	0.9809
ΔGDP_{-1}	1.07	0.9366	ΔGDP_{-1}	1.03	0.9732
Mean VIF	1.05		*Mean VIF*	1.02	

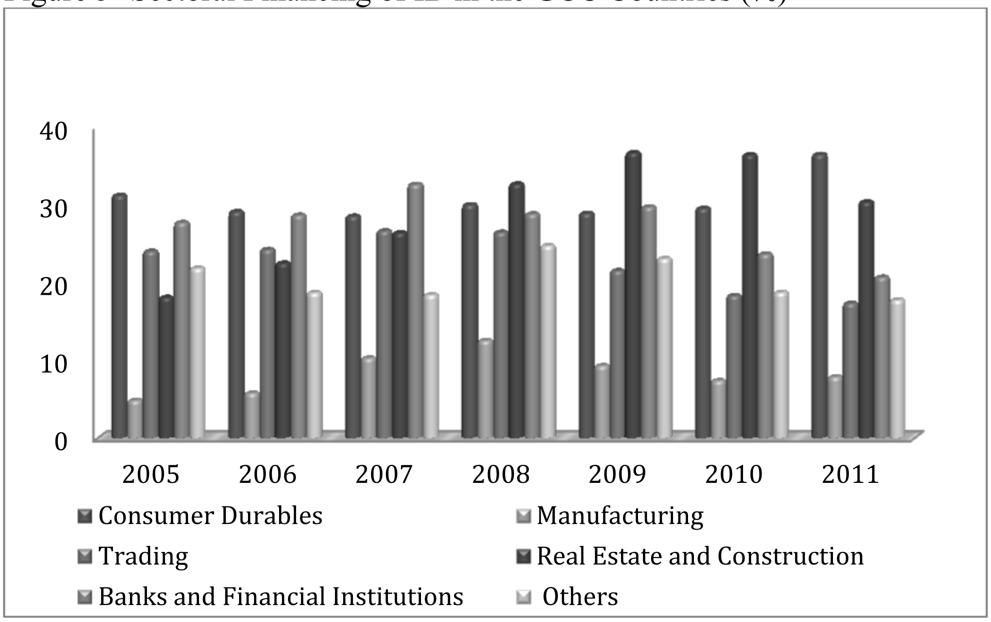
Model 12			Model 13		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.10	0.9130	NPL_{-1}	1.05	0.9495
RWA_{-1}	1.02	0.9850	RWA_{-1}	1.02	0.9810
$\Delta IBIWA_{-1}$	1.13	0.8841	ΔCBA_{-1}	1.05	0.9482
ΔGDP_{-1}	1.10	0.9116	ΔGDP_{-1}	1.04	0.9584
Mean VIF	1.08		*Mean VIF*	1.04	

Model 14			Model 15			Model 16		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	1.04	0.9658	NPL_{-1}	1.03	0.9732	NPL_{-1}	1.04	0.9614
RWA_{-1}	1.03	0.9671	RWA_{-1}	1.03	0.9679	RWA_{-1}	1.06	0.9450
ΔMI	1.13	0.8810	ΔREC	1.20	0.8299	$\Delta RECIB$	1.13	0.8864
ΔGDP_{-1}	1.11	0.8994	ΔGDP_{-1}	1.19	0.8398	ΔGDP_{-1}	1.08	0.9276
Mean VIF	1.08		*Mean VIF*	1.11		*Mean VIF*	1.08	

Model 17			Model 18		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	*1.03*	*0.9750*	NPL_{-1}	*1.04*	*0.9624*
RWA_{-1}	*1.02*	*0.9851*	RWA_{-1}	*1.02*	*0.9851*
ΔREC_{-1}	*1.21*	*0.8243*	$\Delta RECIB_{-1}$	*1.05*	*0.9486*
ΔGDP_{-1}	*1.23*	*0.8139*	ΔGDP_{-1}	*1.05*	*0.9519*
Mean VIF	*1.12*		*Mean VIF*	*1.04*	

Model 19			Model 20		
Variables	*VIF*	*1/VIF*	*Variables*	*VIF*	*1/VIF*
NPL_{-1}	*1.06*	*0.9460*	NPL_{-1}	*1.04*	*0.9580*
RWA_{-1}	*1.01*	*0.9886*	RWA_{-1}	*1.01*	*0.9904*
ΔPLS_{-1}	*1.03*	*0.9693*	ΔFID_{-1}	*1.05*	*0.9547*
ΔPLS_{-2}	*1.03*	*0.9702*	ΔFID_{-2}	*1.03*	*0.9722*
ΔGDP_{-1}	*1.06*	*0.9466*	ΔGDP_{-1}	*1.05*	*0.9538*
Mean VIF	*1.04*		*Mean VIF*	*1.04*	

Figure 5- Sectoral Financing of IB in the GCC Countries (%)



Data Source: Islamic Research and Training Institute.

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