# Productivity and Efficiency of Banks in Pakistan: Measuring and Decomposing


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## *DEDICATON*

Dedicated to my loving parents, brothers and sisters.

# *DECLARATION*

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## Abstract

The main objective of this study is to measure the productivity and efficiency of banking sector using the annual data covering the period 2007-2013. The study employed the data envelopment analysis-based Hicks-Moorsteen TFP index developed by O'Donnell (2010) for attainment of all estimates. The estimates show that conventional banks during the examined period, have been fully technically, mix, and scale efficient. The results further illustrate that Islamic banks are technically and mix efficient during the examined period. However, scale efficiency results indicate that Islamic banks in the beginning years are not fully scale efficient but in later years Islamic banks become fully scale efficient as well. In addition, the estimates show that in general, the TFP of banks increases over time in Pakistan. Furthermore, the results demonstrate that on average, the TFP of conventional banks is greater than Islamic banks. Finally, the estimates show that changes in technology have a significant impact on the TFP. Our analysis recommends that scale efficiency has a vital role behind efficiency progress in the banking sector. Therefore, Islamic banks would need to increase their size to reap sustained productivity gains. Their performance would be more efficient through institutional growth and an increased number of branches. Further, government should encouraged banks to adopt new cost effective technologies to help the banking industry in overcoming the problem relating to inefficiency and increase productivity further.

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# Chapter 1

# Introduction

## 1.1. Background of the Study

Banks are intermediary. They lubricate the channeling of funds from the surplus to deficit part of the economy. Further, they also assure the fund availability and control the payment system of the economy. In all over the world, researchers have growing consensus that financial services provided by banks help to attain higher and sustainable economic growth. In the literature, there exist several theories that justify and demonstrate that the presence of financial institutions is very significant for an economy (King and Levine (1993)). Indeed, an economy cannot work without a well-functioning banking system. In the presence of well-functioning banking sector, the economy as a whole becomes more efficient and productive by utilizing scarce resources effectively. Therefore, all the countries around the world have focused on the efficiency and performance of banking system (Haque and Tariq (2012)).

Banks' productivity is depicted as the capacity of bank produce maximum potential output with given resources. On the other hand, efficiency is depicted as a measurement of the banks' performance in a normative sense by evaluating it with competitors. There is a co-movement in productivity and efficiency, but many times it may be diverge. The banks' productivity may improve over an examined period and at the same time its efficiency mainly decline due to slower productivity of bank with its competitors. The main components of productivity change are technical change and efficiency change (O'Donnell

(2012)). The technical change such as innovations and technological advances[1] in the banking industry shift the production possibility set from one time period to another time period. However, the efficiency change is a movement along the production function (Arjomandi et al. (2012)).

The extent at which financial institutions contribute to the economic productivity and efficiency is related to the amount of productivity and efficiency through which the financial institutions works. Arjomandi et al. (2012) described that the foundations of an increasing economy, depends upon the efficient utilization of resources. Efficiency helps to attain optimal allocation of resources and attain higher level of output with the existing resources. Inefficient performance of financial institutions arise numerous implications. For example, inefficiency not only affects the firm's profitability but also impacts its survival in a competitive market. Similarly, due to inefficiency resources are not being utilized properly and financial institutions cannot get optimal level of productivity.

Reviewing the empirical literature, we find that several studies have been carried out to evaluate the performance of banks. Performance can be measured in term of productivity, profitability, efficiency, credit risk performance, liquidity, and solvency. The prior empirical studies that examined the productivity and efficiency change in banking sector computed without price data either adopt Malmquist productivity index or Hicks-Moorsteen productivity index. We observe that all the researches that estimate the total factor productivity (TFP) progress of banking sector mostly use Malmquist productivity index. (Berg et al. (1992), Worthington (1999), Rizvi (2001), Yeh (2008), Figueira et al.

[1] These innovations and advances, include the increasing number of automated teller machines, credit cards, debit cards, and online- branches.

(2009), and Sufain (2010)), which shows its prevalent dominance in the literature to examine TFP growth. However, there are several studies in the literature showing that Malmquist productivity index (MPI) has some drawbacks in their implementation. For example, Grifell-Tatje and Lovell (1995) illustrate that under the variable return to scale, the MPI may not precisely measure change in productivity. Similarly, Glass and McKillop (2000), Yoruk and Zaim (2005), and Coelli and Rao (2005) argue that there is the probability of obtaining infeasible results. Further, Simar and Wilson (1998), Lovell (2003), and Coelli and Rao (2005) show that the DEA approach, for assessing distance functions, by using Malmquist indices is problematic. Furthermore, Ray and Desli (1997), Wheelock and Wilson (1999), and O'Donnell (2010b) show that the Malmquist index decomposition proposed by Fare et al. (1994) has no reliability. Finally, Grifell-Tatje and Lovell (1995), and Arjomandi et al. (2012) elaborate that Malmquist productivity index (MPI) leads to biased estimations. According to the above inadequacies, prevailing in the MPI discussion, there is a growing interest for employing Hicks-Moorsteen productivity index to measure productivity of banks. (O'Donnell (2010a, 2012a, 2012b), Epure et al. (2011), Arora and Arora (2012, 2013), and Arjomandi et al. (2012, 2014)).

Although exploring the determinants of banks efficiency and productivity is worthwhile; research on this topic with respect to Pakistan is very scarce. There are only few studies that have examined this issue in Pakistan. For example, Rizvi (2001) examined the TFP change by using Malmquist index in case of Pakistan. His results show that both productivity and efficiency declined after the reform, which could be attributed largely to poor performance of foreign banks. However, domestic banks performance increased due to reform, because, it increases competition. His results further shows that with regard to

efficiency, domestic banks are better than foreign bank. Another study by Akhtar et al. (2005) scrutinized the liberalization impact on efficiency of commercial banks. Their results indicate that private banks are more allocative and technically efficient as compared to public and foreign banks. The results further support the ongoing process of privatization. Haque and Tariq (2012) have compared the efficiency of Islamic and conventional banks. They found that Islamic banks are less inefficient as compared to their conventional counterparts

### 1.2. Gap in the literature

Despite several studies have attempted to compare the performance of Islamic banks with conventional banks, none of the study examines the productivity change in Pakistan's banking sector by using Hicks-Moorsteen total factor productivity index. However, it is important to know that whether the total factor productivity of banks is increasing over time. It is also worthwhile to know whether changes in total factor productivity are attributed to changes in technology and/or changes in technical efficiency.

### 1.3. Objectives of the study

The main objective of this study is to measure the change in total factor productivity (TFP) of banks in Pakistan over the period 2007-2013. By doing this, we observe whether the TFP is increasing over time or decreasing. The study also compares the total factor productivity of Islamic banks with their conventional counterparts. The study aims to decompose the TFP into the technological change, technical efficiency, mix efficiency, and scale efficiency. Last but not least, the study examines the relationship between different segments of the TFP.

### 1.4. Hypotheses

On the basis of our discussion in the above sub-section of objectives and reviewing the literature we formalized the following hypothesis to examine the change in productivity.

H1: The TFP of banks increases over time in Pakistan.

H2: The TFP of Islamic banks is greater than conventional banks.

H3: Changes in technology affect the TFP.

### 1.5. Significance of the study

The present study helps the investors, proprietors, depositors, and policy maker as banks play a major role in the formation and execution of monetary policy. It helps the management of banks to find the reasons behind their low productivity as compared to overall banking industry. Investors would also take benefit from this study as this helps them in their investment decisions and to create a profitable portfolios. Depositors may also benefit from this study by knowing efficient and productive banks which offer them best facilities. Further, total factor productivity decomposition allows a broad understanding regarding a change in productivity and related polices to management and policies makers. Regulatory authorities know which component is the reason of low productivity and help them to make policy in this regard as their objective is to improve it.

### 1.6. Contributions of the study

This study contributes into the literature in several aspects. First, it uses Hicks-Moorsteen total factor productivity index first time in Pakistan's banking sector. Second, it uses a new linear programing methodology developed by O'Donnell to measure and decompose the TFP into technical change and efficiency change. The efficiency change is further

decomposed into three components: technical efficiency, mix efficiency, and scale efficiency. Third, by scrutinizing the different components of change in TFP, this study tries to fill out significant gap in banking sector, which have importance for policy makers and management, for the efficient utilization of resources in production. Because, decompositions allows a broad understanding of change in productivity and related policies.

### 1.7. Organization of the study

The organization of the study is as follows. Second chapter presents a review of literature regarding the productivity and efficiency. The existing empirical studies are distributed into four different portions: 1) studies those compare both stream of banks (Islamic and conventional); 2) studies which adopt Malmquist productivity index; 3) studies those criticize on Malmquist productivity index; 4) studies which adopt Hicks-Moorsteen productivity index. In third chapter, we present research methodology. Which illustrate a framework for measurement of productivity and efficiency by employing Hicks-Moorsteen productivity index, it also describe data and it sources. Fourth chapter presents the productivity and efficiency results, and their interpretations. Finally, the last chapter presents a brief summary of the study, policy recommendations, and limitation and suggestion for future research.

# Chapter 2

# Literature Review

## 2.1 Introduction

The literature review of this study is structured by reviewing the existing literature on the productivity and efficiency of financial institutions around the world. First, the study reviews the literature about the comparison of both stream of banks (Islamic and conventional). Secondly, the study reviews the literature demonstrating the productivity and efficiency of financial institutions, employing Malmquist productivity index. These studies are further classified into two categories. First category includes those studies that relate changes in productivity to some relevant issues, like reforms, deregulation, liberalization, mergers, etc., while the second category includes those studies which explore productivity changes in banking sector over the time. Thirdly, the study reviews the literature that criticizes the Malmquist productivity index as an accurate index to measure the productivity. Finally, the study reviews the literature regarding those studies which measure the productivity and efficiency of financial institutions by employing Hicks-Moorsteen productivity index.

## 2.2 Comparison of Islamic and conventional banks

Several studies have been carried out to measure the performance of banks. Some studies used productivity and efficiency as a proxy to compare the performance of Islamic and conventional banks and concluded with contradicting results. Some of these studies concluded that conventional banks are more efficient as compared to Islamic banks (Samad (1999), Rosly and Bakar (2003), and John et al. (2012)), while some others concluded that

Islamic banks are more efficient as compared to conventional banks (Yudistira (2004), and Haque and Tariq (2012)). However, Bader et al. (2008) found no efficiency difference between both the streams.

Samad (1999) evaluated the productivity and managerial efficiency of conventional and Islamic banks in Malaysia. He found that both productive and managerial efficiency of conventional banks are higher than Islamic banks. Similarly, Rosly and Bakar (2003) found that mainstream (conventional) banks have more efficiency as compared to Islamic banking developed on interest-like products (e.g. Murabaha) in Malaysia. Their results further show that returns on assets of Islamic banking scheme are higher. One possible explanation of this is that they are utilizing existing overheads carried by mainstream banks. Further, John et al. (2012) showed that mainstream (conventional) banks are more efficient as compared to Islamic banks using Meta-frontier analysis approach. On the flip, they found that there is no efficiency difference between both streams when they use the DEA approach.

On the other hand, Yudistira (2004) using the DEA found that Islamic banks are less inefficient as compared to their conventional counterparts. His results also suggest that merger should be encouraged and that Middle East region Islamic banks are more inefficient as compared to their counterparts outside the region. Haque and Tariq (2012) showed the same results for Pakistan by taking a sample of 22 banks including both Islamic and conventional banks, covering the period from 2006 to 2010. However, by applying a Stochastic Frontier approach, Bader et al. (2008) found that with regard to efficiency, there is no disparity between conventional banks and Islamic banks during the period 1996-2005.

Their findings also show that bank size and age disparities have no significant effects on the performance of both streams of banks.

## 2.3 Studies using Malmquist index

Caves et al. (1982) were the first who presented the MPI as a theoretical index. Later, Fare et al. (1992) merged the productivity measure developed by Caves et al. (1982) with the measure of efficiency developed by Farrell (1957), and thus, developed the MPI which measures changes in productivity. Fare et al. (1992) subsequently demonstrated that the developed TFP index could be easily decomposed into the components of technical and efficiency change. Further, Fare et al. (1994) showed that the efficiency changes can be decomposed into scale efficiency changes and technical efficiency changes. Due to this development, Malmquist index ultimately became the most frequently used index to measure changes in productivity.

The prior empirical studies that examined the productivity change in banking sector are classified into two groups. The first group includes those studies which relate changes in productivity to some pertinent issues, like reforms, deregulation, liberalization, mergers, etc.. The second group includes those studies which explore productivity changes in banking over the time. Below we review both types of studies.

Several studies have attempted to explore the influence of regulatory reform on the productivity and efficiency of banks. However, the results of these studies significantly vary. Majority of the studies clearly inferred that deregulations enhance the productivity of banking industry. On the contrary, some studies also inferred that deregulation leads to deterioration in productivity and efficiency of banks. Berg et al. (1992) investigated the

impact of deregulation on Norwegian banks. A DEA approach and Malmquist indices were employed to analyze the productivity and efficiency of banks covering the period 1980-1989. Their findings show that with regard to productivity and efficiency, banks show improvement after deregulation. They also found that productivity level dispersion is less within the sector due to deregulation. Similarly, Worthington (1999) examined the impact of deregulation on the productivity change in Australian credit unions by using Malmquist TFP index. His results revealed that most of credit unions show productivity and technological progress trend after deregulation. His results further show that progress in productivity growth is mostly attributed to increases in technical efficiency rather than scale efficiency.

In the same way, Sturm and Williams (2004) examined the impact of foreign banks entry and deregulation on banking efficiency by employing DEA, Malmquist indices, and stochastic frontier analysis using data covering the period from 1988 to 2001. They found that with regard to efficiency, foreign banks are performing better than domestic banks. Their results further indicate that efficiency enhances in banking sector due to competition resulting from deregulation. Similarly, Ataullah and Li (2004) analyzed the impact of liberalization on banking efficiency of Pakistan and India by using DEA. Their results indicate that overall commercial banking sector experience technical efficiency in both countries. They also show that in case of public sector, banks scale efficiency improved in both countries, while India also exhibits progress in pure technical efficiency of public bank. Furthermore, they show that banks are less efficient in generating income as compare to generating earning assets, which is mainly due to high level of non-performing loan. Finally, they documented that efficiency and size of bank have a positive relationship.

However, this relationship become weaker after implementation of liberalization. Another study by Akhtar et al. (2005) also investigated the X-efficiency of banks in Pakistan after liberalization. Their results indicate that with regard to technical and allocative efficiency, private banks are performing better as compared to public and foreign banks. Thus, their results support the ongoing process of privatization.

Likewise, Zaho et al. (2008) investigated the impact of regulatory reform on productivity of Indian banks by using DEA-based Malmquist TFP index for the period from 1992 to 2004. They found that productivity growth have been experienced by Indian banks mostly attributed to technological progress. Further, they showed that foreign banks increase competitive pressure in banking industry and appeared as a technological innovators in market. Similarly, by employing DEA-based Malmquist index, Hang (2008) analyzed the productivity of Taiwanese banks using annual data for period 2001-2004. His results reflect an improvement in average productivity of Taiwan commercial bank over the period. The major progress in productivity growth emerged through technical progress relative to efficiency change. His result further suggest that productivity growth is emerged to some extent due to reduction in the non-performing loan ratio and change in capital adequacy ratio over the period.

Cox et al. (2012) analyzed the impact of reforms on the efficiency of both countries (Pakistan and India). They found that financial sector efficiency decline have been observed for both countries during the initial years after the reforms, but it is found that after initial year's efficiency levels have increased in both countries. Recently, Casu et al. (2013) analyzed the impact of regulatory reforms on productivity growth of Indian banks by using Divisa and Malmquist index. Their results indicate productivity enhancement

during the study period, which is mostly attributed to technological progress and different approaches have consistent in their results. The further use of a metafrontier approach is to measure technology heterogeneity among different ownership types. Their empirical results indicate that the response of changes in operating environment is different for different ownership types. Their results further indicated that foreign banks have dominant position in the industry due to their superior production technology.

On the contrary, some studies concluded that deregulation leads to deterioration in productivity and efficiency of banks. Rizvi (2001) found that both productivity and efficiency declined after the reform, which could be attributed largely to poor performance of foreign banks. However, domestic banks performance increased due to reform, because, it increases competition. Finally, he showed that with regard to efficiency, domestic banks are better than foreign banks. Chen (2005) found that during the financial crises period productivity level enhance which is mostly attributed to progress in technical change rather than to efficiency change.

Several researches have attempted to evaluate the impact of merger on the productivity and efficiency of banks. Although the results of these researches contradictory, some studies clearly inferred that merger enhance the productivity of banking industry. On the contrary, some studies documented that mergers lead to deterioration in productivity and efficiency of banks. Yeh (2008) analyzed the impact of merger on the productivity of Taiwanese banking sector by using DEA. His empirical results seem to indicate that Taiwanese banks experienced progress in productivity and technical efficiency after the merger period. His results further show that bank surviving merger revealed progress in technical efficiency due to scale economies. His results further reveal that productivity growth and size of bank

have a positive association. Furthermore, his results support the ongoing process of merger in banking sector because it increase bank size, and banks with larger size can easily participate in fee-based activities, which produce higher return level. Those banks which involved in that activities, achieve higher productivity growth.

On the other hand, Liao (2009) investigated the change of productivity and efficiency of banking sector in Taiwan by adopting DEA. His empirical results seem to indicate that domestic banks have decreasing returns to scale and that Taiwanese banking industry are experiencing oversize phenomenon. Bank managers should have mission to work until he adjust firms' size to achieve efficient level. Further, with regard to efficiency, the domestic banks are performing better than foreign banks. However, their productivity progress level is lesser as compared to foreign banks. His findings further show that adoption of new technology gives more incentives to less efficient banks to improve efficiency.

Several studies in literature attempt to explore the productivity and efficiency change in banking over the period. Even though the results of these researches significantly vary, Majority of studies clearly inferred that over the period productivity enhance in banking sector. On the other hand, some studies also documented that over the period productivity and efficiency show regress in banking sector.

Grifell-Tatje and Lovell (1997) attempted to explore the productivity change of Spanish saving and commercial banks. They found that saving banks have higher productivity growth as compared to commercial banks. However, commercial banks have higher potential of productivity growth. Commercial banks have lower level of productivity due to lower technical change, managerial, and institutional efficiency, and the adverse impact of scale diseconomies as compared to saving banks. Likewise, Sufian (2008) found that

productivity increases in non-bank financial institutions due to technological development during the period (2000-2004) in Malaysia. Similarly, Figueira et al. (2009) investigated the efficiency and productivity of banks in Portugal and Spain during the period 1992-2003. Their findings recommend that banks located in Spain are performing better as compared to those located in Portugal. However, with the passage of time, the banks performance enhanced in both countries, which can be attributed to the improvement of the technological change in both countries.

In the same way, Sufain (2010) attempted to examine the sources of productivity change of China banks by using MPI. His empirical results indicate that China's banks examined productivity enhancement, which can be attributed to increase in efficiency. However, State owned commercial banks have experienced more productivity progress as compare to joint stock commercial banks. His results further suggest that capitalization, profitability, income diversification and loan intensity leads toward higher TFP, technological and efficiency change. While negative relation exist between technological change and risk. Likewise, Akhtar (2010) also used the same approach in Saudi Arabia. His results indicate that, on average, banks productivity enhances over the examined period. However, the major contribution in productivity enhancement is due to technological progress rather than efficiency progress. His findings further show that in Saudi Arabia, banks have succeeded to adopt technological change. However, he failed to achieve optimal technical efficiency level.

Similarly, Chang et al. (2012) conducted a performance analysis to estimate the source of bank productivity change. Their empirical findings reveal that TFP growth in Chinese banking industry has an upward trend which is attributed to technological gains. The

dominant factor behind total factor productivity change and technical change is technical progress in capital productivity. More recently, Neupane (2013) also empirically estimated the change in productivity and efficiency of banks in Nepal over the period 2007-2012. His findings indicate that productivity has improved in commercial banks during the sample period which is mostly attributed to technical enhancement rather than efficiency. He further show that efficiency decline is due to scale and pure efficiency change. Further, the Tobit regression model results indicate that debt to equity ratio and capital adequacy has positive relationship with efficiency. He also report that profitable banks with higher capital adequacy ratio and lower leverage are found to be more efficient.

On the other hand, Wheelock and Wilson (1999) found that the inefficiency in US banking sector, can be mainly due to banks failure to accept technological enhancements. Their results also suggest that on average, large size bank experienced productivity growth while small size bank experienced productivity declined over the period. In the same way, Sathye (2002) estimated the productivity changes in Australian banks from 1995 to 1999. His results indicated that TFP and technical efficiency declined during the study period. However, TFP and technical efficiency show positive mean score. Furthermore, it was found that bank size and productivity have no correlation. Finally, the results suggest that banks must bring down their operating expenses and continue to rationalize their fee structure. Moreover, Ariss et al. (2007) showed that banks on average experienced productivity decline which is largely attributed to technological regress and to some extent due to decline in technological efficiency. Recently, Cheng et al. (2013) empirically showed that the productivity of banks in Kyrgyz have declining trend over the study period. In addition, they showed that those banks which have medium sized and foreign capital are

major contributor in productivity growth. While the productivity of banks having large size decrease over the time. Further, their studies suggest that sustain productivity growth can be achieved by technological improvements in banking sector.

## 2.4 Criticism on Malmquist index

In spite of the MPI as a dominant approach and its popularity for assessment of productivity change, the unfavorable and favorable aspects of employing MPI have been widely debated. For example, Grifell-Tatje and Lovell (1995) demonstrated that employing MPI does not accurately assess changes in TFP when we adopt variable return to scale (VRS). Therefore, imposition of constant return to scale (CRS) becomes imperative for the estimations of MPI. Otherwise, the resulting estimate of MPI lead toward inaccurate TFP change due to scale economies. Further, the DEA estimation has possibility of infeasible results. Ray and Desli (1997) and Wheelock and Wilson (1999) discussed that the MPI decomposition achieved by Fare et al. (1994) has no reliability. Ray and Desli (1997) demonstrated the importance of implementation of CRS technology, which indicates the shift in the frontier under CRS which is express by the term technical change but it may not assess the scale effects exist at all. Contrary to this, implementation of VRS assumptions may not correctly demonstrate the autonomous frontier shift. Hence, internal consistency problem appears when the same MPI decomposition implies to both CRS and VRS. Thus, Ray and Desli (1997) proposed another decomposition but the problem with such decomposition is that it may not appropriately measures scale efficiency change which is experienced between different time period by firm. Simar and Wilson (1998) indicated that the model presented by Fare et al. (1994) does not provide a beneficial measurement of technical change and their estimates revealed that all the assessed means

of technical change have no significant, whereas "mostly inaccuracies in Fare et al. (1994) is mainly due to their misunderstanding between unknown quantities and evaluations of these quantities". Wheelock and Wilson (1999) expressed that when a location of firm remain the same in different time period, than scale efficiency variation is completely attributed to change in the VRS, while CRS assumption imposition would indicate no technical change. Under such situations the CRS evaluation of technology is unreliable. Coelli and Rao (2005) demonstrated the significance of holding CRS assumption for the estimate of a MPI, their exploration reveals that without CRS assumption in MPI we may not appropriately assess change in TFP due to scale economies. Epure and Prior (2007) indicated that popular MPI, which employed as a dominant approach in literature, is multiplicatively incomplete, and its estimate for TFP change is biased.

Further, O'Donnell (2012a) also created ambiguity on the MPI as a measure of TFP index and indicated that except from special cases, it cannot be used as a reliable measure of changes in TFP. O'Donnell's views are similar to those of Kerstens et al. (2010), who indicated that reliable TFP indices not included the Malmquist index in it.

## 2.5 Studies using Hicks–Moorsteen index

According to the above inadequacies, prevailing in the MPI discussion, there is a growing interest for employing Hicks-Moorsteen productivity index to measure productivity of banks. (O'Donnell (2010a, 2012a, 2012b), Epure et al. (2011), Arora and Arora (2012, 2013), and Arjomandi et al. (2012, 2014)).

Epure et al. (2011) measured the productivity growth of 73 private and saving banks functioning in Spain from the period 1998–2006 by employing intermediation approach. Their results show that savings banks which have functioning outside from their original

markets attained higher productivity growth. They further show that at the end of the deregulation increasing trend of TFP has been observed for the banking sector. In the same way, Arora and Arora (2012) used HM index approach to compare productivity enhancement results for SBIG and nationalized banks. His results indicate that, on average, Indian public sector banks have examined enhancement in productivity after liberalization. His results further show that, with regard to productivity growth, significant difference exists between SBIG and NBs. NBs experienced higher productivity growth as compare to SBIG, which is mostly due to higher level of technological enhancement in NBs rather than higher level of efficiency. Similarly, Arora and Arora (2013) measured and decompose productivity change in Indian banks by using HMI number for post liberalization period. His results show that Indian banks observed no significant productivity change difference in three sub period and experienced stagnant productivity over the entire study period. However, in sub period 3 (2003-2007), significant difference is observed in term of productivity change and efficiency change in Indian private sector and public sector banks. Which shows ownership difference in Indian banks has an influence on scale efficiency. Further, Indian banks has experienced stagnant productivity, mainly due to technological regress. So policy should be reformed towards productivity enhancement.

Using Hicks-Moorsteen index, Arjomandi et al. (2012) investigated the impact of reform on the Efficiency and productivity of Iranian banking industry covering the period 2003-2008 and finds that overall TFP declines after the reform which is mostly attributed to scale efficiency change and changes in production possibility set. Their results further show that technical efficiency which was improving over time deteriorated after the reforms. Furthermore, they show that private banks become less efficient as compared to public

banks after reform. More recently, Arjomandi et al. (2014) examined the performance of Iranian banking sector by applying intermediation and operating approach. Their result are similar to Arjomandi et al. (2012) when the use intermediation approach, but when the use operating approach, they found that private banks are more technically and mix efficient.

## 2.6 Summary

At the beginning, the study reviews of literature demonstrate a vast number of empirical studies about the comparison of both stream of banks (Islamic and conventional). The findings of these studies also significantly vary. Some of them concluded that conventional banks are more efficient as compared to Islamic Banks, while some others concluded that Islamic banks are more efficient as compared to conventional banks. However, there are some studies that found no efficiency difference between both streams. Subsequently, we review those studies that examine the productivity and efficiency of financial institutions by employing Malmquist productivity index. These studies are further classified into two groups one group include those studies which relate change in productivity to some pertinent issue, like reforms, deregulation, liberalization, mergers, etc., while the other group includes those studies which explore productivity change in banking over the period. Several researches in literature attempt to explore the influence of regulatory reform on the productivity and efficiency of banks. Although the results of these researches significantly vary, Majority of studies clearly inferred that deregulation, liberalization, mergers, etc. enhance the productivity of banking industry. On the contrary, some explorations also inferred that deregulation, liberalization, mergers, etc. lead to deterioration in productivity and efficiency of banks.

Thirdly, the review of the literature describe those studies which criticize on the Malmquist productivity index as an accurate index to measure the productivity. Their results show that the results obtained from Malmquist index leads to biased, unreliable inaccurate and statistically inconsistent results. Further, it is demonstrated that Hicks-Moorsteen index is more reliable index for estimations as compared to popular Malmquist index. Finally, the study reviews the literature regarding those explorations which measure the productivity and efficiency of financial institutions by employing Hicks-Moorsteen index.

After reviewing the literature in this section, we conclude that none of the study examine the productivity change in Pakistan banking sector by employing Hicks-Moorsteen index. To fill this gap, this study aim to examine the productivity and efficiency of banking sector in Pakistan and examine what are the major factors that contribute in TFP change.

# Chapter 3

# Methodology and Data

## 3.1 Introduction

When we review the existing literature we find that there is no consensus among the researchers about the preferred approach to assess the financial institutions performance. Traditional approach to assess the financial institutions performance mainly relies on financial ratios. However, the long-term performance of institution is not capture by this approach. In later years, the frontier analysis approach has been developed to assess the financial institutions performance. Under this approach, financial institution that have superior performance are distinguish from those institution which have inferior performance. Both parametric and non-parametric frontier analysis approaches can be applied for this type of division and both approaches have some advantages and disadvantages.

In this study, we employ a non-parametric DEA approach. The main reason to adopt this approach is that the sample size include only 24 banks and this approach works well when the sample size is small. On the contrary, parametric analysis approach is mostly used for analysis when the sample size is relatively large, such as, in the case of developed countries like the United States. Non-parametric DEA approach has also some other advantages. It does not require any restrictive assumption regarding the behavior of banks, no restriction on the functional form of the technology or efficiency distribution. It also uses various outputs and inputs data and indicates the magnitude of inefficiency.

This chapter is structured as follows. Section 3.2 presents TFP index introduced by O'Donnell (2008, 2010b). Section 3.3 presents a review of efficiency concepts, which includes technical efficiency, scale efficiency, mix efficiency, and residual scale efficiency. Section 3.4 presents the decomposition of productivity change. In Section 3.5, we describe data. Summary of this chapter is given in Section 3.6.

## 3.2 Total Factor Productivity Index

The definition of TFP employed as following Jorgenson and Grilliches (1967) and O'Donnell (2010) in this study is $TFP_{nt} = Q_{nt}/X_{nt}$ where $TFP_{nt}$ denotes the TFP of firm 'n' in period t, $Q_{nt} = Q(q_{nt})$ denotes an aggregate output, and $X_{nt} = X(x_{nt})$ indicate aggregate input. A same equation may be hold for another firm 'n' in period s. Then, the index number which relates the TFP of firm 'n' in period t with the TFP of firm 'm' in period s is defined as

$$TFP_{ns,nt} = \frac{TFP_{nt}}{TFP_{ns}} = \frac{Q_{nt}/X_{nt}}{Q_{ns}/X_{ns}} = \frac{Q_{nt}/Q_{ns}}{X_{nt}/X_{ns}}$$

where $Q_{ns,nt} = Q_{nt}/Q_{ns}$ and $X_{ns,nt} = X_{nt}/X_{ns}$ are output and input quantity index. This definition permits us to define the index number that measures TFP changes as the ratio of an output to an input quantity index. The Hicks-Moorsteen TFP proved by O' Donnell (2008) is the only index that consisted with the above definition and can be calculated without price data.

Specifically, the Hicks-Moorsteen TFP index can be described as

$$TFP^{HM}_{ns,nt} = \left(\frac{D^t_o(x_{nt}, q_{nt})D^s_o(x_{ns}, q_{nt})}{D^t_o(x_{nt}, q_{ns})D^s_o(x_{ns}, q_{ns})} \times \frac{D^t_I(x_{ns}, q_{nt})D^s_o(x_{ns}, q_{ns})}{D^t_I(x_{nt}, q_{nt})D^s_o(x_{nt}, q_{ns})}\right)^{1/2}$$

where $D_o^T(x,q) = min(\delta > 0: (x, q/\delta) \in P^T)$ represents output distance function, $D_I^T(x,q) = max(\rho > 0: (x/\rho, q) \in P^T)$ denotes input distance function, and $P^T$ represents the period T production possibilities set. We adopt the non-parametric DEA method proposed by O'Donnell (2010a, 2012a, and 2010b), Arora and Arora (2012, 2013), and Arjomandi et al. (2012, 2014), to compute these distance function. The DEA as a nonparametric does not need any obstructive expectations concerning the behavior of banks, and efficiency dissemination.

## 3.3 Efficiency concepts

O'Donnell's (2010b) explained various components of the decomposition of multiplicatively complete TFP indices. We describe efficiency concepts as the ratio of output and input aggregate same as defined by O'Donnell (2010b). O'Donnell (2010b) described the proportion measure of technical, mix, and scale efficiency for a bank that chooses the output and input mixture $(q_t, x_t)$ from the particular PPS in period t. Consequently, pure scale and technical efficiency measures will be explained in term of technically feasible output and input vectors that can be describe as a scalar multiple of $q_t$and $x_t$ that assure the output and input mixes are being held fixed. Hence, the measure of mix efficiency will be describe as a output and input vectors that are technically possible while the output and input mixes are free to vary.

### 3.3.1 Technical efficiency

Technical efficiency is defined by Farrell (1957) as a measure of the ratio of observed aggregate output to the maximum aggregate output possible, while holding fix the amount of output mix and input vector. Hence, $Q_t = Q(q_t)$ and $X_t = X(x_t)$ represent scalar

aggregate of vectors $q_t$ and $x_t$, and they are positive linearly homogeneous functions. Consequently, the maximum aggregate output that is technically possible to produce a scalar multiple output by utilizing $x_t$ is $\bar{Q}_t = Q_t / D_o^t(x_t, q_t)$, it can also be denoted as

$$OTE_t = \frac{Q_t}{\bar{Q}_t} = D_o^t(x_t, q_t)$$

These concepts are also graphically represented by O'Donnell (2010b). He first considers a case that the firm can produce $q_t = (q_{1t}, q_{2t})'$ by utilizing $x_t = (x_{1t}, x_{2t})'$ and both output and input aggregator are linear

$$X(x_t) = \beta_1 x_{1t} + \beta_2 x_{2t}, \text{ and, } Q(q_t) = \alpha_1 q_{1t} + \alpha_2 q_{2t}$$

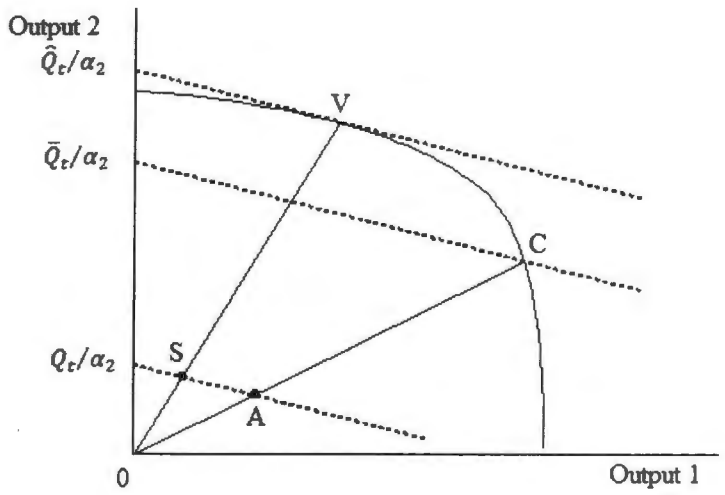


Figure 3.1 Output-Oriented Mix Efficiency for a Two Output Firm

Souce: O'Donnell (2010a, p.534), edited by author

Figure 3.1 represents this case in two output space, where PPF is the arched line which is passing through point C, while dotted line represents all points which have the combination of similar aggregate output for firm A which is passing through point A. Aggregate of firm

can be boost up by expanding its outputs until it achieves point C. Mathematically, it is represented as

$$OTE_t = \frac{Q_t}{\bar{Q}_t} = \frac{A}{C}$$

The technical efficiency measure can be viewed in Figure 3.1 in case of two output. However, the graphical representation of a firm which produces many outputs by utilizing many inputs is required. Thus, such feasible output and input combinations are mapped by O'Donnell (2010b). Figure 3.2 graphically represents such output and input combinations by points A and C. RPPS is represented by arched line which is passing through point C and output and input combination $(q_t, x_t)$ are represented by point A. Technical efficiency can be measured by the vertical space from point A to C.

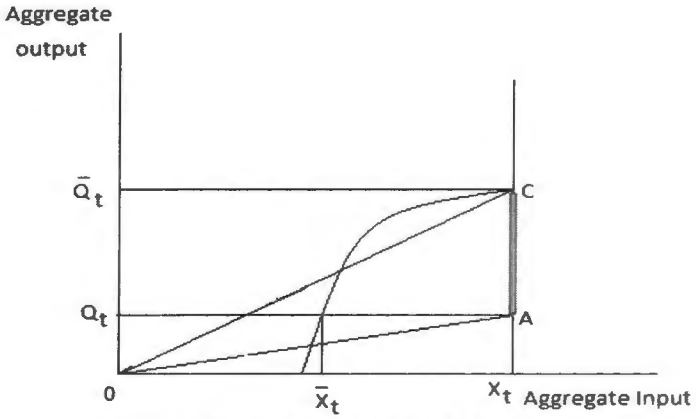


Figure 3.2 Output oriented technical efficiency for a multiple input and outputn firm.
Souce: O'Donnell (2010a, p.535), edited by author.

As in O'Donnell (2010b), Figure 3.2 is important because firstly it explains processes of technical efficiency which can be described as a proportions of measure of TFP and also as a proportions of tangent function of angles, this idea of TFP decomposition is

represented by O'Donnell (2010b). Another importance which it has for us is that in a single graph it represents different production choices which can be attain by multiple output and multiple input firm.

### 3.3.2 Scale efficiency

It is observe from Figure 3.2 that enhancement in technical efficiency implies improvements in TFP. Although, the maximization of bank TFP is not achieved by moving to point C. If the output-input combinations remained unchanging, its TFP maximization can be achieved by moving to the point D, where RPPF and the straight line through the origin both are tangent. This is mention in Figure 3.3, and denoted by O'Donnell (2010b) as the point of MIOS. Subsequently, scale efficiency indicates a difference of quantity between TFP at the technically efficient point denoted by C, and TFP at the MIOS point denoted by D. O'Donnell's used the term pure because input-output mixes remained fixed. Hence, the TFP change is referred as a scale effect. Hence, an output-oriented scale efficiency (OSE) is denoted as

$$OSE_t = \frac{\bar{Q}_t / X_t}{\tilde{Q}_t / \tilde{X}_t}$$

where $\tilde{Q}_t$ and $\tilde{X}_t$ point out the aggregate output and input quantities at the MIOS point. It can be observed from Figure 3.3 that these measures of scale efficiency may be describe as a proportion of TFP measures.

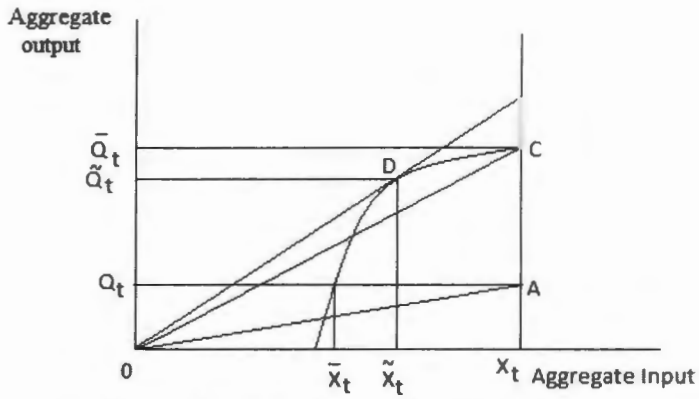


Figure 3.3 Output oriented scale efficiency for a multiple input and outputn firm.

Souce: O'Donnell (2010a, p.536), edited by author.

### 3.3.3 Mix efficiency

So far, the efficiency measures have been described relating to a RPPF. Mix efficiency can be defined by the measure of the productivity change when the selection of output mixes and input mixes are free from any boundaries. To avoid confusion, the term mix efficiency is used by O' Donnell (2008) instead of allocative efficiency.

The expansion in the production possibilities set is achieved by relaxing restrictions of input or output mix. The boundary of new expanded PPS is known as an UPPF that encloses RPPF. To demonstrate the way that the PPS develops, we consider bank A that produces $q_t = (q_{1t}, q_{2t})$ by utilizing $x_t = (x_{1t}, x_{2t})'$ and both output and input aggregator function are linear. Picture of similar expansion in output space is shown by Figure 3.1 where touching to point C is the optimal point that bank A can achieved when output mix and input vector are assumed to be fixed. Contrary to this, bank A can further expand its aggregate output by moving to point V by relaxing its restriction on output mix. As shown

by Figure 3.1. Which represent a vertical movement towards a points that lies somewhere above the point C in figure 3.2. Figure 3.4 representing a curved line which is passing through point V is known as an UPPF.

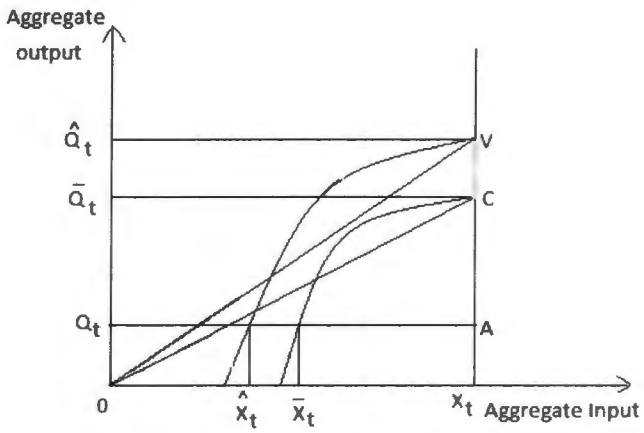


Figure 3.4 Output oriented mix efficiency for a multiple input and outputn firm.

Souce: O'Donnell (2010a, p.535), edited by author.

O'Donnell (2010b) described pure mix efficiency as a measure of the gap between TFP at the UPPF point and RPPF point. Here, the term pure again is used to represent that input vector is held fixed and TFP change is pure mix effect. As shown in Figure 3.4, the gap between point C and V shows pure mix efficiency. Mathematically, we can show as

$$OME_t = \frac{\bar{Q}_t}{\hat{Q}_t}$$

where $Q_t^* = Q(q_t^*)$ and $X_t^* = X(x_t^*)$ are aggregate of$\hat{q}_t = \underset{q>0}{\arg max}\{Q(q): (x_t, q) \in T^t\}$,

where $T^t$ denotes production possibility set of period t.

### 3.4.4 Residual scale efficiency

As in Figure 3.4, any enhancement in mix efficiency infers expansion of TFP. Although, the full maximization of banks TFP is not achieved by moving to points V. Rather, its TFP maximization will be achieved by touching the point E, where UPPF and the straight line through the origin both are tangent (see Figure 3.5). Point E is also referred as the maximum productivity point. Residual scale efficiency, as presented by O'Donnell (2010b), is measured by the gap between the TFP volume at a mix efficient point and TFP volume at the maximum productivity point. Subsequently, what is essentially a measure of scale efficiency may consist of a residual mix effect. A measure of residual output-oriented scale efficiency (ROSE) is

$$ROSE_t = \frac{\hat{Q}_t / X_t}{Q_t^* / X_t^*}$$

where $Q_t^* = Q(q_t^*)$ and $X_t^* = X(x_t^*)$ are aggregate of

$$(x_t^*, q_t^*) = \underset{x > 0, q > 0}{\arg max} \{Q(q)/X(x) : (x, q) \in T^t\}$$

Maximum productivity point of TFP is denoted as $TFP_t^* = \frac{Q_t^*}{X_t^*}$, where $X_t^*$ and $Q_t^*$ indicate the aggregate input and output quantities, respectively, at this point.

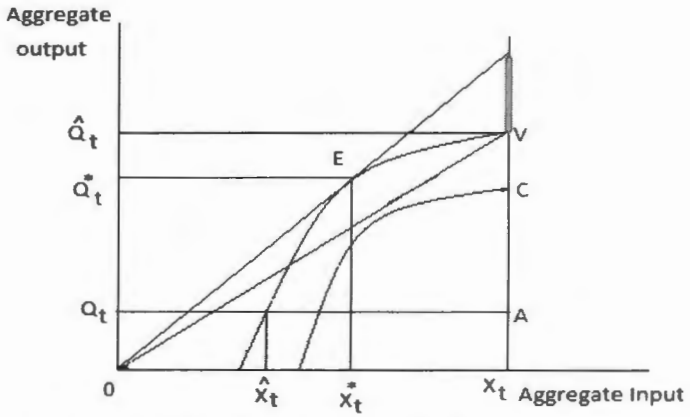


Figure 3.5 Residual output oriented scale efficiency for amultiple input and outputn firm.

Souce: O'Donnell (2010a, p.535), edited by author.

## 3.4 Decomposing productivity change

O'Donnell (2010b) demonstrated that overall production efficiency of a bank is described as the fraction of apparent TFP to maximum TFP that is attainable by spending the available technology in period t. Hence, the TFP efficiency of bank 'n' in period t can be described as:

$$TFPE_t = \frac{TFP_{nt}}{TFP_t^*} = \frac{Q_{nt}/X_{nt}}{Q_{nt}^*/X_{nt}^*}$$

where $TFP_t^*$ represent the maximum TFP and $Q_{nt}^*$ and $X_{nt}^*$ represent maximum point of aggregate output and input. O'Donnell (2010b) showed that various efficiency measures can be used for the decomposition TFP efficiency. However, the TFP efficiency decomposition can be defined as

$$TFPE_{nt} = \frac{TFP_{nt}}{TFP_t^*} = OTE_{nt} \times OME_{nt} \times ROSE_{nt}$$

This can be simplified as

$$TFP_{nt} = TFP_t^* \times OTE_{nt} \times OME_{nt} \times ROSE_{nt}$$

An identical equation may be hold for another bank like m in period s. Then, the index quantity which relates the TFP of bank 'n' in period t with the TFP of bank 'n' in period s in defined as

$$TFP_{nt} = \left(\frac{TFP_t^*}{TFP_s^*}\right)\left(\frac{OTE_{nt}}{OTE_{ns}} \times \frac{OME_{nt}}{OME_{ns}} \times \frac{ROSE_{nt}}{ROSE_{ns}}\right)$$

The first parenthesis of the right side of above equation describes the technical change since the time period s to t, measuring the differences of the maximum TFP possible by using the technology possible in periods t and s. respectively, contingent on whether $TFP_t^*/TFP_s^*$ is less or greater than 1. We can enumerate the technical decline or technical improvement. The remaining of the right side parenthesis measure technical efficiency, mix efficiency, and Residual scale efficiency change.

## 3.5 Data

There is no harmony amongst the researchers as how to stipulate inputs and outputs for financial institutions. However, to define inputs and outputs, mainly three approaches are used in the literature. (Arjomandi et al, (2012, 2014), Sufian (2007), Giokas (2008), and Akhtar (2010). These approaches are production approach, operating approach, and intermediation approach. In this study, we employ intermediation approach in which banks are regarded as intermediary of financial services. The value of loans and securities are measured as output, whereas capital, labor and deposits as inputs. This approach has proposed by Sealey and Lindley (1977) and used by many researches for example Wheelock and Wilson (1999), Sufian (2007), Akhtar (2010), Sufian and Habibullah (2010), and Arjomandi et al. (2012). This approach includes three inputs and three outputs. Three

inputs include: labor ($X_1$), we measured it by number of fulltime employees on payroll at the end of each period; physical capital ($X_2$), we measured it by the book value of premises and fixed assets; and purchase funds ($X_3$), we included in it borrowed fund, time, and saving deposits. Three outputs include: demand deposit ($Y_1$); publicly owned loan ($Y_2$), we included in its loans for agriculture, manufacturing, mining and services; and private loan ($Y_3$). Data are obtained from banks' annual reports. All the amounts used for inputs and outputs are in Pakistan thousand rupees. This study covers the period 2007-2013. Our selection of banks and time period depends upon the availability of data. The sample includes 4 Islamic banks and 20 conventional banks. We use the software named DPIN developed by O'Donnell in 2010b for attainment of all estimates.

## 3.6 Summary

In this study, the DEA approach is used because it fulfils the objectives of study and differentiates among different efficiency types, such as, technical, scale, and mix efficiency. This approach is not only valuable to measure the efficient boundary and represent the role models for inefficient banks, but it also provides useful information to operating banks for managing their performance, such as: efficiency decomposition into altered management layers and agents those involved in the operation of the units, optimal scale size measurement, and productivity measurement over the time.

In this chapter, we elaborated the productivity analysis concept. Hence, details are provided to measure change in productivity by applying Hicks-Moorsteen TFP index. Our study is an important contribution into the literature as it uses the Hicks-Moorsteen TFP index new decomposition develop by O'Donnell to analyze change in productivity and efficiency for the first time in Pakistani banking sector. Further, regarding software and data, we use the

software named DPIN developed by O'Donnell in 2010b for attainment of all estimates. Data are obtained from banks' annual reports. The present study covers the period 2007-2013. The sample includes 4 Islamic banks and 20 conventional banks. Our selection of banks and time period depends upon the availability of data.

# Chapter 4

# Results and Discussion

## 4.1 Introduction

This chapter presents the empirical results of total factor productivity change and efficiency change for different banks in Pakistan. In previous chapter various efficiency scores and new decomposition of the Hicks-Moorsteen index by O'Donnell's (2008) was discussed. In Section 4.2 and 4.3 of this chapter, we addressed efficiency estimates and different components of the Hicks-Moorsteen TFP index by using new decomposition of the Hicks-Moorsteen index developed by O'Donnell's (2008).

The empirical analysis is carried out by using intermediation approach. This approach defines the inputs and outputs of the institutions. The empirical results are classified into two main groups; Islamic banks, and conventional banks. The results achieved in this chapter help us to address the following research question indicated in Chapter one.

1. Is the TFP of banks increases over time in Pakistan?
2. Are the TFP of Islamic banks is greater than conventional banks?
3. Is changes in technology affect the TFP?

In particular, this chapter is organized as follows. Section 4.2 presents the finding of efficiency scores by employing Hicks-Moorsteen approach and Section 4.3 presents the finding of change in productivity by employing Hicks-Moorsteen approach, respectively. Summary of the major outcomes of this chapter is given in Section 4.4.

## 4.2 Efficiency scores of banks under Hicks-Moorsteen approach

As the Hicks-Moorsteen approach is a distance based index, the DEA methodology introduced by O'Donnell (2010b, 2010c) is applied for estimating the distance under variable return to scale. Bank performance has been examined by the intermediation approach. The estimates of output-oriented efficiency levels for various types of bank efficiencies over the seven years are described in Table 4.1, which lies between 0 and 1. The interpretation is straightforward as efficiency estimate of one shows that the bank lies on the frontier of the production set and thus is relatively efficient. An estimate lower than unity shows that the bank is to be found under the frontier and is technically inefficient. A bank that has technical efficiency equal to 1 and has scale and mix efficiency less than 1 is still on the frontier but at a relatively lower point on the frontier. Summary of the results of different estimated output-oriented efficiency levels are presented in Table 4.2. In this table, the results are categorized into three groups: Islamic banks, conventional banks, and mean efficiency for the banking industry over the period 2008 and 2013. Below we discuss our results in details.

Table 4.1 demonstrates that a numerous banks in certain years have been fully technical, mix, and scale efficient under intermediation approach, e.g. Burj bank, First Women Bank (FWBL), Bank of Khyber (BOK), Bank of Punjab (BOP), National Bank of Pakistan (NBP), Habib Metropolitan Bank (HMB), and Alfalah Bank in 2008. FWBL, BOP, and NBP in 2009, FWBL, NBP, HMB, Standard Chartered and Allied Bank in 2010, FWBL, BOP, NBP, Summit Bank and United Bank limited (UBL) in 2011, FWBL, BOP, NBP, HMB and UBL in 2012, and FWBL, BOP, NBP, HMB, Samba Bank, Standard Chartered

Bank, and NIB in 2013. This specifies that these banks produced more of output per unit of input than their competitors.

As can be seen in Table 4.1 that FWBL, BOP, and NBP, were the only fully efficient banks in term of the provision of intermediation service during the selected years. The interesting finding is that all of these banks are public banks. A possible explanation of this is that first priority of public bank is to provide services to public. These results are in accordance with the existing literature, particularly that of Arora and Arora (2012) and Arjomandi et al. (2012), which found similar results for India and Iran, respectively. Our results further indicate that with regard to output oriented technical efficiency, banks are more technically efficient in 2007 and 2008 as compared to remaining years of the sample.

In relation to banks mix efficiency, the results indicate that in 2007 all the banks were fully mix efficient but in later year mix inefficiency increase in these banks. However, in 2012 and 2013 banks to some extent again achieve their mix efficiency level.

*Table 4. 1* : ***Measures of output-oriented efficiency levels for individual banks (2007-2013)***

| Financial Institutions | 2007 | | | 2008 | | | 2009 | | |
|---|---|---|---|---|---|---|---|---|---|
| | OTE | OME | OSE | OTE | OME | OSE | OTE | OME | OSE |
| Bank Islami | 0.2879 | 1.0000 | 0.8962 | 0.3859 | 0.9996 | 0.9895 | 0.5590 | 0.9216 | 0.9500 |
| Burj bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9789 | 1.0000 | 0.7213 | 0.7143 |
| Dubai Islamic bank | 0.5800 | 1.0000 | 0.8741 | 0.8264 | 0.9756 | 0.9294 | 0.9380 | 1.0000 | 0.8146 |
| Meezan bank | 0.8527 | 1.0000 | 0.9950 | 0.8133 | 0.9258 | 0.9984 | 1.0000 | 1.0000 | 0.9013 |
| Alfalah bank | 1.0000 | 1.0000 | 0.7890 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8895 | 1.0000 |
| Allied bank | 1.0000 | 1.0000 | 1.0000 | 0.9236 | 0.9731 | 0.9693 | 0.9794 | 0.9834 | 0.9962 |
| Askari bank | 0.8017 | 1.0000 | 0.9625 | 0.7659 | 0.9937 | 0.9955 | 0.7257 | 0.9805 | 0.9966 |
| Bank Al Habib limited | 0.9878 | 1.0000 | 0.9979 | 0.8669 | 0.9937 | 0.9896 | 0.9111 | 0.9914 | 0.9420 |
| Bank of Khyber | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8188 | 0.8737 | 0.6930 |
| Bank of Punjab | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Faysal bank | 1.0000 | 1.0000 | 0.9710 | 0.9024 | 0.9990 | 0.9980 | 1.0000 | 0.9912 | 1.0000 |
| First Women bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Habib Metropolitan bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9670 | 1.0000 |
| JS bank | 0.8963 | 1.0000 | 0.8369 | 0.9884 | 1.0000 | 0.9269 | 0.5283 | 0.8755 | 0.9123 |
| KASB bank | 0.9383 | 1.0000 | 0.9608 | 0.7167 | 0.9992 | 0.9934 | 0.6743 | 0.9438 | 0.9203 |
| Muslim Commercial bank | 0.8612 | 1.0000 | 0.8074 | 0.8328 | 0.9978 | 0.9569 | 0.7631 | 1.0000 | 0.9993 |
| National bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| NIB bank | 0.8045 | 1.0000 | 0.9390 | 0.8351 | 0.9975 | 0.9989 | 1.0000 | 0.8705 | 0.9225 |
| Samba bank | 0.4482 | 1.0000 | 0.8510 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.6689 | 0.7465 |
| Silk bank | 0.7879 | 1.0000 | 0.9254 | 0.7596 | 0.9872 | 0.9749 | 0.7148 | 0.9937 | 0.8985 |
| Soneri bank | 0.7872 | 1.0000 | 0.9281 | 0.7866 | 0.9971 | 0.9826 | 0.7577 | 0.9944 | 0.9631 |
| Standard Chartered bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9954 | 1.0000 | 0.8717 | 0.8942 | 0.9866 |
| Summit bank | 0.8230 | 1.0000 | 0.9895 | 1.0000 | 0.7373 | 0.8647 | 1.0000 | 1.0000 | 0.9364 |
| United Bank limited | 1.0000 | 1.0000 | 0.7600 | 1.0000 | 1.0000 | 0.8375 | 0.8565 | 0.9667 | 0.9988 |

| Financial Institutions | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|
| | OTE | OME | OSE | OTE | OME | OSE |
| Bank Islami | 0.5353 | 0.9794 | 0.9490 | 0.4898 | 0.9998 | 0.9691 |
| Burj bank | 1.0000 | 1.0000 | 0.4923 | 0.6719 | 1.0000 | 0.9672 |
| Dubai Islamic bank | 0.9334 | 1.0000 | 0.8595 | 0.7459 | 1.0000 | 0.9937 |
| Meezan bank | 0.9738 | 0.9719 | 0.7854 | 0.6675 | 0.9600 | 0.9310 |
| Alfalah bank | 0.9941 | 0.9465 | 0.9995 | 0.8572 | 0.9389 | 0.9953 |
| Allied bank | 1.0000 | 1.0000 | 1.0000 | 0.8553 | 0.9749 | 0.9983 |
| Askari bank | 0.7527 | 1.0000 | 0.9769 | 0.7224 | 1.0000 | 0.9954 |
| Bank Al Habib limited | 0.8825 | 0.9975 | 0.9984 | 0.6156 | 0.9605 | 0.9876 |
| Bank of Khyber | 0.6842 | 0.9305 | 0.9882 | 0.673 | 0.9968 | 0.9779 |
| Bank of Punjab | 1.0000 | 0.8629 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Faysal bank | 0.8651 | 0.8228 | 0.9935 | 0.8221 | 1.0000 | 0.9956 |
| First Women bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Habib Metropolitan bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9422 | 1.0000 |
| JS bank | 0.5828 | 0.9947 | 0.9621 | 0.6412 | 0.9629 | 0.9286 |
| KASB bank | 0.7257 | 1.0000 | 0.9696 | 0.7205 | 0.9951 | 0.9725 |
| Muslim Commercial bank | 0.7967 | 0.9850 | 0.9969 | 0.6054 | 0.9766 | 0.9992 |
| National bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| NIB bank | 1.0000 | 0.9132 | 0.9963 | 0.9823 | 0.9833 | 0.9906 |
| Samba bank | 0.9002 | 0.9841 | 0.8456 | 1.0000 | 1.0000 | 0.9460 |
| Silk bank | 0.9916 | 1.0000 | 0.9942 | 0.7323 | 1.0000 | 0.9876 |
| Soneri bank | 0.7423 | 1.0000 | 0.9858 | 0.8337 | 1.0000 | 0.9507 |
| Standard Chartered bank | 1.0000 | 1.0000 | 1.0000 | 0.9648 | 0.9822 | 0.9990 |
| Summit bank | 1.0000 | 0.8023 | 0.9193 | 1.0000 | 1.0000 | 1.0000 |
| United Bank limited | 1.0000 | 0.9728 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

| Financial Institutions | 2012 | | | 2013 | | |
|---|---|---|---|---|---|---|
| | OTE | OME | OSE | OTE | OME | OSE |
| Bank Islami | 0.5049 | 1.0000 | 0.9951 | 0.5671 | 1.0000 | 0.9956 |
| Burj bank | 0.8468 | 1.0000 | 0.9906 | 0.9135 | 1.0000 | 0.9913 |
| Dubai Islamic bank | 0.7078 | 1.0000 | 0.9931 | 0.9211 | 0.9647 | 0.9836 |
| Meezan bank | 0.6651 | 0.9991 | 0.9241 | 0.8333 | 0.9923 | 0.9530 |
| Alfalah bank | 0.8761 | 1.0000 | 0.9958 | 0.9759 | 1.0000 | 0.9618 |
| Allied bank | 0.8780 | 1.0000 | 0.9969 | 0.9363 | 1.0000 | 0.9927 |
| Askari bank | 0.6752 | 1.0000 | 0.9995 | 0.8351 | 1.0000 | 0.9993 |
| Bank Al Habib limited | 0.6541 | 0.9788 | 0.9641 | 0.9604 | 1.0000 | 0.9953 |
| Bank of Khyber | 0.6899 | 0.9932 | 0.9654 | 0.6663 | 0.8461 | 0.9487 |
| Bank of Punjab | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Faysal bank | 0.8594 | 1.0000 | 0.9992 | 0.9386 | 1.0000 | 0.9716 |
| First Women bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Habib Metropolitan bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| JS bank | 0.6509 | 0.9634 | 0.9701 | 0.7515 | 0.9613 | 0.9764 |
| KASB bank | 0.7534 | 0.9269 | 0.9623 | 1.0000 | 1.0000 | 1.0000 |
| Muslim Commercial bank | 0.5597 | 1.0000 | 0.9985 | 0.6388 | 1.0000 | 0.9937 |
| National bank | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| NIB bank | 0.9561 | 1.0000 | 0.9735 | 1.0000 | 1.0000 | 1.0000 |
| Samba bank | 1.0000 | 1.0000 | 0.9835 | 1.0000 | 1.0000 | 1.0000 |
| Silk bank | 0.7575 | 1.0000 | 0.9331 | 0.9257 | 1.0000 | 0.9525 |
| Soneri bank | 0.7199 | 1.0000 | 0.9981 | 0.9181 | 1.0000 | 0.9822 |
| Standard Chartered bank | 0.9048 | 0.9797 | 0.9931 | 1.0000 | 1.0000 | 1.0000 |
| Summit bank | 0.7057 | 1.0000 | 0.8864 | 0.7233 | 1.0000 | 0.9659 |
| United Bank limited | 1.0000 | 1.0000 | 1.0000 | 0.8363 | 0.9951 | 0.9973 |

As to the scale efficiency estimates (reported in Table 4.1), a number of banks were found to be fully scale efficient during the selected years. These banks include FWBL, BOP, NBP, and HMB. However, some other banks also show full scale efficiency level in different years e.g. Standard Chartered Bank and Allied Bank in 2007, while both Samba and Alfalah Banks in 2008. However, majority of banks shows scale inefficiency and they have significant room for scale optimization to facilitate higher level of services.

Table 4.2 reveals that the conventional banks during the selected years have been fully technically, mix, and scale efficient. This indicates that conventional banks are producing more of any output per unit of any input, than any other banks. Our results are supporting the existing literature, particularly, the findings of John et al. (2012), Rosly and Bakar (2003), and Samad (1999), who found same responses for Malaysian banks. As far as Islamic banks, the results indicate that Islamic banks are technically and mix efficient during the whole examined period. However, scale efficiency results indicate that Islamic banks in the beginning years are not fully scale efficient but in later years Islamic banks become fully scale efficient. The scale efficiency value less than 1 in the beginning year for Islamic banks indicates that the banks are on the boundary of the production set but at a relatively unproductive point on the frontier. Thus, with respect to current scale of operation, Islamic banks particularly producing less than their optimal output level. These sub-optimal levels of banks efficiency can be attributed to lack of freedom of these banks from the government intervention in terms of handling their inputs and outputs and the inefficient scale size of banks.

*Table 4.2* : ***Measures of output-oriented efficiency levels for bank categories (2007-2013)***

| Financial Institutions | Year | OTE | OME | OSE |
|---|---|---|---|---|
| Islamic banks | 2007 | 1.0000 | 1.0000 | 0.8469 |
| | 2008 | 1.0000 | 1.0000 | 0.8832 |
| | 2009 | 1.0000 | 1.0000 | 0.8960 |
| | 2010 | 1.0000 | 1.0000 | 0.8764 |
| | 2011 | 1.0000 | 1.0000 | 0.8673 |
| | 2012 | 1.0000 | 1.0000 | 1.0000 |
| | 2013 | 1.0000 | 1.0000 | 1.0000 |
| Conventional banks | 2007 | 1.0000 | 1.0000 | 1.0000 |
| | 2008 | 1.0000 | 1.0000 | 1.0000 |
| | 2009 | 1.0000 | 1.0000 | 1.0000 |
| | 2010 | 1.0000 | 1.0000 | 1.0000 |
| | 2011 | 1.0000 | 1.0000 | 1.0000 |
| | 2012 | 1.0000 | 1.0000 | 1.0000 |
| | 2013 | 1.0000 | 1.0000 | 1.0000 |
| The banking industry | 2007 | 1.0000 | 1.0000 | 0.9235 |
| | 2008 | 1.0000 | 1.0000 | 0.9416 |
| | 2009 | 1.0000 | 1.0000 | 0.9480 |
| | 2010 | 1.0000 | 1.0000 | 0.9382 |
| | 2011 | 1.0000 | 1.0000 | 0.9337 |
| | 2012 | 1.0000 | 1.0000 | 1.0000 |
| | 2013 | 1.0000 | 1.0000 | 1.0000 |

## 4.3 The decomposition of the Hicks-Moorsteen TFP index

Table 4.3 presents the measure of total factor productivity change and also elaborates its components, which include technical change and change in efficiency for Islamic banks and their counterpart's conventional banks. Changes in efficiency are further divided into three components. These components are: (1) output-oriented technical efficiency change, (2) output-oriented mix efficiency change, and (3) the residual scale efficiency change. These all components are also elaborated in Table 4.3. Once again, the estimated values greater than 1 depicts an improvement in productivity and on the contrary, estimated values

less than 1 depicts deterioration in productivity. Summary of different estimated TFP indices are presented in Table 4.3. In 2008/2007, Islamic banks indicate TFP deterioration which is mainly attributed to technological regress in 2008/2007. However, TFPE increases by 3.2 percent during the year 2008/2007, which is due to improvement in ROSE. However, contrary to this, conventional banks show TFP progress. This progress is mainly attributed to technological progress, on the other hand, TFPE is deteriorated in 2008/2007. The results of 2009/2008 indicate that technological regress is a major reason behind TFP shortfall in Islamic banks and their conventional counterparts. ROSE progress is a major reason behind TFPE progress of both streams of banks but its progress does not offset the effect of technological regress.

The score of changes in TFPE reveals that overall there is regress in the efficiency change during the period of 2010/2009 which is mainly due to a decline in ROSE. The estimates show that Islamic banks are 4.72 percent, while conventional banks are 11.58 percent less efficient over the examined period. However, the progress observed in the productivity is mainly attributed to huge technological progress and it offsets the effect of regress in efficiency. Once again, in 2011/2010, the estimates of change in TFPE indicates that there is a regress in the efficiency change which is mainly attributed to a sharp decline in ROSE. In particularly, Islamic banks are 15.29 percent and conventional banks are 2.68 percent less efficient over the examined period. The value observed from the table indicates that there is technological progress over the period in both stream of banks. The technological progress of conventional banks offsets the effect of efficiency regress, and overall, there is considerable growth in productivity over the time. Contrary to this, the technological progress of Islamic banks does not offset the effect of efficiency regress and as a whole

productivity declines during the examined period. In case of Islamic banks, the estimates of 2012/2011 indicate a significant positive technological progress as well as efficiency progress, which ultimately indicates a considerable progress in productivity of Islamic banks. The values given in the table also indicate that conventional banks observed huge technological progress, in particular 11.12 percent over the examined period, which offsets the efficiency regress of 5.14 percent over the period.

*Table 4.3* : ***Changes in total factor productivity and its components assuming VRS***

| Financial Institutions | Period | dTFP | dTech | dTFPE | dOTE | dOME | dROSE |
|---|---|---|---|---|---|---|---|
| Islamic banks | 2008/2007 | 0.9840 | 0.9528 | 1.0328 | 1.000 | 1.000 | 1.0328 |
| | 2009/2008 | 0.9790 | 0.8617 | 1.1361 | 1.000 | 1.000 | 1.1361 |
| | 2010/2009 | 1.0564 | 1.1088 | 0.9528 | 1.000 | 1.000 | 0.9528 |
| | 2011/2010 | 0.9862 | 1.1642 | 0.8471 | 1.000 | 1.000 | 0.8471 |
| | 2012/2011 | 1.0705 | 1.0131 | 1.0566 | 1.000 | 1.000 | 1.0566 |
| | 2013/2012 | 1.2700 | 1.0339 | 1.2283 | 1.000 | 1.000 | 1.2283 |
| conventional banks | 2008/2007 | 1.0427 | 1.0872 | 0.9591 | 1.000 | 1.000 | 0.9591 |
| | 2009/2008 | 0.9937 | 0.9864 | 1.0074 | 1.000 | 1.000 | 1.0074 |
| | 2010/2009 | 1.1309 | 1.2790 | 0.8842 | 1.000 | 1.000 | 0.8842 |
| | 2011/2010 | 1.0269 | 1.0545 | 0.9738 | 1.000 | 1.000 | 0.9738 |
| | 2012/2011 | 1.0542 | 1.1112 | 0.9486 | 1.000 | 1.000 | 0.9486 |
| | 2013/2012 | 1.0014 | 1.0213 | 0.9805 | 1.000 | 1.000 | 0.9805 |
| The banking industry | 2008/2007 | 1.0134 | 1.0200 | 0.9960 | 1.000 | 1.000 | 0.9960 |
| | 2009/2008 | 0.9864 | 0.9241 | 1.0718 | 1.000 | 1.000 | 1.0718 |
| | 2010/2009 | 1.0937 | 1.1939 | 0.9185 | 1.000 | 1.000 | 0.9185 |
| | 2011/2010 | 1.0066 | 1.1094 | 0.9105 | 1.000 | 1.000 | 0.9105 |
| | 2012/2011 | 1.0624 | 1.0622 | 1.0026 | 1.000 | 1.000 | 1.0026 |
| | 2013/2012 | 1.1357 | 1.0276 | 1.1044 | 1.000 | 1.000 | 1.1044 |

The scores of TFPE change reveal that overall there is considerable efficiency progress during the study period for Islamic banks. Specifically, Islamic banks exhibit 22.83 percent efficiency progress during the period 2013/2012. However, it has been observed that conventional banks show only 1.45 percent efficiency regress during the same period. As far as technological progress is concerned, both streams of banks indicate a technological

progress over the period, which in turn indicates productivity progress for both types of bank. However, Islamic banks show huge productivity progress (27 percent) as compared to their conventional counterparts, showing only 0.14 percent productivity growth during the same period.

Our results also suggest that Islamic banks are less productive over the period 2008/2007, 2009/2008, and in 2011/2010. However, it has been indicated that Islamic banks show productivity growth in 2010/2009, 2012/2011, and in 2013/2012. One of the interesting finding is that Islamic banks show more productivity growth in 2012/2011, and in 2013/2012, as compared to their conventional counterparts. During the study period, it has also been observed that conventional banks show considerable growth in productivity in over all the duration except in 2009/2008 in which they show regress in productivity. Our results (given in Table 4.3) suggest that conventional banks are more productive as compared to Islamic banks over the entire period of time. Our findings regarding productivity of Islamic and conventional banks are consistent with previous empirical work of Samad (1999), who found the similar results for Malaysian banks.

Table 4.3 further indicates that as a whole, the banking industry shows productivity growth during the examined period except in 2009/2008 in which it shows productivity regress which is mainly attributed to technological regress during the period. These findings are in accordance to the findings of Casu et al. (2013), Arora and Arora (2012), Akthar (2010), Sufain (2008), Figueria et al. (2009), Sufain (2008), Zaho et al. (2008), and Chen (2005). The results further indicate that main reason behind the productivity growth (regress) that should be elaborated is technological progress (regress). It has been observed from the Table 4.3 that in 2008/2007, 2010/2009, 2011/2010, 2012/2011, and in 2013/2012, the

progress in productivity has been observed and the important component behind this was technological progress. These findings are in harmony with our expectation as per Hypothesis 3, in which, a positive association was predicted between technological change and banks productivity performance. This finding is also in accordance with the existing literature, particularly Casu et al. (2013), Arora and Arora (2012), Akthar (2010), Figueria et al. (2009), Sufain (2008), Zaho et al.(2008), and Chen (2005). These studies found similar results for Indian, Malaysian, Saudi Arabian, and European banks. Hence, the change in production possibilities set can be attributed to any change in the environments. Thus, technological change captures the effect of technological change as well as the impact of central bank policies and government regulations. Table 4.3 further shows a considerable expansion of efficient frontier, which can be attributed to technological advances in the banking industry. These advances include the increasing number of automated teller machines, credit cards, debit cards, and online branches.

## 4.4 Summary and conclusion

This chapter empirically analyzed the efficiency and productivity of financial institutions in Pakistan by employing DEA-based approach. In Sections 4.2 and 4.3 of this chapter, empirical findings of Hicks-Moorsteen indices and efficiency scores have been presented and discussed. The empirical analyses is carried out by employing intermediation approach, which defines the inputs and outputs of the financial institutions.

Our results suggest that as a whole, the banking industry efficiency level has been enhanced during the years of 2012 and in 2013. Further, the finding also indicate that efficiency level of Islamic banks rose during the same period. On the other hand, the significantly lower scale efficiency of Islamic banks for the period 2007-2011 could be attributed to their poor

management of deposits, lack of professionals, untrained staff, and due to the fact that Islamic banks in Pakistan are obliged to obey government guidelines for the management of inputs and outputs in the banking system and in the lending process. Our findings further indicate that production possibility frontiers shift upward due to technological changes and government regulations. Furthermore, the negative scale efficiency changes have dramatically contributed to diminishing efficiency but it does not affect the TFP change because its effect is offset by technological progress. Scale inefficiency indicates that there is a significant room for improvement in the Pakistan banking system. Our results also suggest that the estimates of banking industry for productivity change reveal almost same fluctuations as exhibit by technological change. Hence, on average, productivity changes over the period 2008/2007-2013/2012 can be observed same as followed by technological change. Since changes in the production possibilities set have been observed can be attributed to any factors change such as technological change. Hence, the overall technological improvement in the industry was mainly due to technological advances in the banking industry. These advances include the increasing number of automated teller machines, credit cards, debit cards, and online branches. In general, it appears that government control of Islamic banks have a tendency to bounds the ability of managers to perform his function efficiently.

According to our results, three public banks, namely FWBL, BOP, and NBP, were the only fully efficient bank in term of the provision of intermediation service during the examined years. Our findings further reveal that conventional banks during the selected years are fully efficient in all aspects. This implies that conventional banks are producing more of any output per unit of any input, as compared to their counterparts Islamic banks. Thus, we

show that conventional banks are performing more efficiently as compared to Islamic banks. We also observed that conventional banks show TFP progress in more years as compared to Islamic banks. Finally, our results suggest that as a whole, TFP of banking industry improves with the passage of time except in 2009/2008, which is mainly due to technological regress.

# Chapter 5

# Conclusion and Policy Implications

## 5.1 Major findings

In this study DEA was employed to empirically assess the change in productivity and efficiency of banks in Pakistan. For this purpose, we adopted the Hicks-Moorsteen TFP index decomposition proposed by O'Donnell (2010b). The advantage of employing this approach which makes it superior than MPI is that it does not require any restrictive assumption regarding the behavior of banks, the market structure, return to scale in multiple output and input case.

The main findings of our empirical explorations be summarized as follows. First, conventional banks during the selected have been fully mix, technical, and scale efficient. Second, Islamic banks are mix and technical efficient throughout the whole selected year, however, scale efficiency result indicate that Islamic banks in the beginning years are not fully scale efficient but in later years Islamic banks become fully scale efficient. Third, overall, the TFP of banks enhance over time in Pakistan. Fourth, the TFP of conventional banks is greater than Islamic banks. Finally, the empirical explorations demonstrate that change in technology have significant impact on TFP, and they are positively correlated with each other.

## 5.2 Policy implications

The regulatory authorities is required to regulate the banks in such a way that it should have positive impact on the economic health, because banks is generally considered as an important component of the economic development. An effective public policy unambiguously desires the identification of the most vital components of the productivity progress. In financial sector, two essential components of productivity enhancement includes technical enhancement and efficiency progress. Technical improvement primarily represents the production possibilities set expansions that originate through adoption of new innovated technology, while efficiency progress demonstrate the progress in output–input ratios made possible, due to mistakes elimination in the production process. Public policies empirically planned for enhancement in productivity of banking sector can be targeted at these different components.

Our analysis recommends that scale efficiency has a vital role behind efficiency progress in the banking sector. Therefore, Islamic banks would need to increase their size to reap sustained productivity gains. Their performance would be more efficient through institutional growth and an increased number of branches. Further, government should encouraged banks to adopt new cost effective technologies to help the banking industry in overcoming the problem relating to inefficiency and increase productivity further.

## 5.3 Limitations of the study

The study can be empirically enhanced on numerous grounds. First, there is one problem with the Hicks-Moorsteen TFP index is that it is not suitable for multi-temporal and multi-lateral comparisons because it fails to do transitivity test. Another problem face by

employing this approach is that it makes no room from specification error because it is based on DEA approach for their empirical analysis.

## References


Akhtar, M. H. (2010). Are Saudi banks productive and efficient? *International Journal of Islamic and Middle Eastern Finance and Management, 3*(2), 95-112.

Akhtar, M. H., Bokhari, H., & Director, J. J. (2005). X-efficiency analysis of commercial banks in Pakistan: A preliminary Investigation. *European Journal of Scientific Research, 10*(2), 78-91.

Ariss, R. T., Rezvanian, R., & Mehdian, S. M. (2007). Cost efficiency, technological progress and productivity growth of banks in GCC countries. *International Journal of Business, 12*(4), 471-487.

Arjomandi, A., Harvie, C., & Valadkhani, A. (2012). An emperical analysis of Iran's banking performance. *Studies in Economics and Finance, 29*(4), 287-300.

Arjomandi, A., Valadkhani, A., & O'Brien, M. (2014). Analysing banks' intermediation and operational performance using the Hicks-Moorsteen TFP index: The case of Iran. *Resarch in International Business and Finance, 30*, 111-125.

Arora, H., & Arora, p. (2012). Bank productivity measurement using Hicks-Moorsteen indices: Evidence from Indian public sector banks. *International Journal of Business Performance Management, 13*(3), 386-407.

Arora, H., & Arora, P. (2013). Measuring and decomposing productivity change using Hicks-Moorsteen index numbers: Evidence from Indian banks. *International Journal of Productivity and Quality Managment, 11*(1), 73-95.

Ataullah, A., Cockerill, T., & Le, H. (2004). Financial liberalization and bank efficiency: A comparative analysis of India and Pakistan. *Applied Economics, 36*(17), 1915-1924.

Bader, M. K., Mohamad, S., & Hassan, T. (2008). Efficiency of conventional versus Islamic banks: International evidence using the Stochastic Frontier Approach (SFA). *Journal of Islamic Economics, Banking and Finance, 4*(2), 107-130.

Bashir, A. H. (1999). Risk and profitability measure in Islamic banks: The case of two Sudanese banks. *Islamic Econonic Studies, 6*(2), 1-24.

Berg, S. A., Forsund, F. R., & Jansen, E. S. (1992). Malmaquist indices of productivity growth during the deregulation of Norwegian banking, 1980-1989. *Scandinavian Journal of Economics, 94*, 211-228.

Brown, K., & Skully, M. (2005). Islamic banks: A cross-country study of cost efficiency performance, Accounting, Commerece & Finance. *The Islamic Perspective Journal, 8*(1-2), 43-79.

Casu, B., Ferrari, A., & Zhao, T. (2013). Regulatory reform and productivity change in Indian banking. *Review of Economics and Statistics, 95*(3), 1066-1077.

Caves, D. W., Christensen, L. R., & Diewert , W. E. (1982). The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity. *Journal of the Econometric Society, 50*(6), 1393-1414.

Chen, T. Y. (2005). A measurement of Taiwan's bank efficiency and productivity change during the Asian financial crisis. *International Journal of Services and Management, 6*(6), 525-543.

Cheng, H., Lu, Y. C., & Mukashev, U. (2013). Productivity of the banking sector: A case study in Kyrgyz Republic. *Innovative Computing Technology (INTECH), 2013 Third International Conference on*, 173-180.

Coelli, T. J., & Rao, D. S. (2005). Total factor productivity growth in agriculture: A Malmquist index analysis of 93 countries, 1980-2000. *Agriculture Economics, 32*(1), 115-134.

Cox, J., Ghulam, Y., & Jaffry, S. (2013). Trends in efficiency in response to regulatory reforms: The case of Indian and Pakistani commercial banks. *European Journal of Operational Research, 226*(1), 122-131.

Epure, M., Kerstens, K., & Prior, D. (2011). Technology-based total factor productivity and benchmarking: New proposals and an application. *Omega-international Journal of Management Science, 39*(6), 608-619.

Fare, R., & Grosskopf, S. (1992). Malmquist productivity indexes and Fisher ideal indexes. *The Economic Journal, 102*(410), 158-160.

Fare, R., Grosskopf, S., Norris, M., & Zhang, Z. (1994). Productivity growth, technical progress, and efficiency change in industrialized countries. *The American Economic Review, 84*(1), 66-83.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society, 120*(3), 253-290.

Figueira, C., Nellis, J., & Parker, D. (2009). Banking performance and technological change in non-core EU countries: A study of Spain and Portugal. *Studies in Economics and Finance, 26*(3), 155-170.

Giokas, D. I. (2008). Assessing the efficiency in operations of a large Greek bank branch network adopting different economic behaviors. *Economic Modelling, 25*(3), 559-574.

Glass, J. C., & McKillop, D. G. (2000). A post deregulation analysis of the sources of productivity growth in UK building societies. *Manchester School, 68*(3), 360-385.

Grifell-Tatje, E., & Lovell, C. A. (1995). A note on the Malmquist productivity index. *Economics Letters, 47*(2), 75-169.

Grifell-Tatjé, E., & Lovell, C. K. (1997). The sources of productivity change in Spanish banking. *European Journal of Operational Research, 98*(2), 364-380.

Haque, A., & Tariq, A. (2012). Efficiency of banks in Pakistan: A non parametric approach. *Business and Economic Research, 2*(1), 1-12.

Hoang, V. N. (2011). Measuring and decomposing changes in agricultural productivity, nitrogen use efficiency and cumulative exergy efficiency: Application to OECD agriculture. *Ecological Modelling, 222*(1), 164-175.

Huang, L. H., Hsiao, H. C., Cheng, M. A., & Chang, S. J. (2008). Effects of financial reform on productivity change. *Industrial Management & Data Systems, 108*(7), 867-886.

Johnes, J., Izzeldin, M., & Pappas, V. (2014). A comparison of performance of Islamic and conventional banks 2004 to 2009. *Journal of Economic Behavior & Organization, 103*, 93-107.

Jorgenson, D.W. and Grilliches, Z. (1967). The explanation of productivity change. *The Review of Economic Studies, 34*(3), 249-283.

Kerstens, K., Hachem, B. A., & Woestyne , I. V. (2010). Malmquist and Hicks-Moorsteen productivity indices: An empirical comparison focusing on infeasibilities.

King, R. G., & Levine, R. (1993). Finance, entrepreneurship and growth. *Jouranl of monetary Economics, 32*(3), 513-542.

Liao, C. S. (2009). Efficiency and productivity change in the banking industry in Taiwan: Domestic versus foreign banks. *Banks and Bank Systems, 4*(4), 4-84.

Lovell, C. A. (2003). The decomposition of Malmquist productivity index. *Journal of Productivity Analysis, 20*(3), 437-458.

Neupane, B. (2013). Efficiency and productivity of commercial banks in Nepal: A Malmquist index approach. *Asian Journal of Finance & Accounting, 5*(2), 220-243.

O'Donnell, C. J. (2010a). Measuring and decomposing agricultural productivity and profitability change. *Australian Journal of Agricultural and Resource Economics, 54*(4), 527-560.

O'Donnell, C. J. (2010b). DPIN version 1.0: A program for decomposing productivity index numbers. Working Paper. Center for Efficiency and Productivity analysis, university of Queensland.

O'Donnell, C. J. (2012a). An aggregate quantity framework for measuring and decomposing productivity change. *Journal of Productivity Analysis, 38*(3), 255-272.

O'Donnell, C. J. (2012b). Nonparametric estimates of the components of productivity and profitability change in U.S. agriculture. *American Journal of Agricultural Economics, 94*(4), 873-890.

Percin, S., & Ayan, T. Y. (2006). Measuring efficiency of commercial banks in developing economy: The case of Turkey. *Investment Management and Financial Innovation, 3*(2), 217-231.

Ray, S. C., & Desli, E. (1997). Productivity growth, technical progress, and efficiency change in Industrialized countries: Comment. *The American Economic Review, 87*(5), 1033-1039.

Rizvi, S. F. (2001). Post-liberalisation efficiency and productivity of the banking sector in Pakistan. *The Pakistan Development Review, 40*(4), 605-632.

Rosly, S. A., & Bakar, M. A. (2003). Performance of Islamic and mainstream banks in Malaysia. *International Journal of Social Economics, 30*(12), 1249-1265.

Said, A. (2012). Efficiency in Islamic banking during a financial crisis: An empirical analysis of forty-seven banks. *Jornal of Applied Finance & Banking, 2*(3), 163-197.

Samad, A. (1999). Comparative efficency of the Islamic banks vis-a-vis conventional banks in Malaysia. *IIUM Journal of Economics and Finance, 7*(1), 1-27.

Sathye, M. (2002). Measuring productivity changes in Australian banking: An application of Malmquist Indices. *Managerial Finance, 28*(9), 48-59.

Sealey, C. W., & Lindley, J. (1977). Inputs, outputs and a thorey fo production and cost at depository financial institutions. *Journal of Finance, 32*(4), 1251-1266.

Simar, L., & Wilson, P. W. (1998). Sensitivity analysis of efficiency scores: How to bootstrap in nonparametric frontier models. *Management Science, 44*(1), 49-61.

Simões, P., & Marques, R. C. (2012). Influence of regulation on the productivity on the productivity of waste utilities: What can we learn with the Portuguese experience? *Waste Management, 32*(6), 1266-1275.

Sturm, J. E., & Williams, B. (2004). Foreign bank entry, deregulation and bank efficiency: Lessons from the Australian experience. *Journal of Banking & Finance, 28*(7), 1775-1799.

Sufain, F. (2008). Revenue shifts and non-bank financial institutions' productivity: Empirical evidence from Malaysia. *Studies in Economics and Finance, 25*(2), 76-92.

Sufian, F. (2007). Determinants of bank efficiency during unstable macroeconomic environment: Empirical evidence from Malaysia. *Research in International Business and Finance, 23*(1), 54-77.

Sufian, F. (2008). Revenue shifts and non-bank financial institutions' productivity: Empirical evidence from Malaysia. *Studies in Economics and Finance, 25*(2), 76-92.

Sufian, F. (2010). Productivity, efficiency and technological change in banking: Empirical evidence from the Chinese banking sector. *International Journal of Economics and Business Research, 2*(5), 427-445.

Sufian, F. (2011). The impact of risk on banks' total factor productivity change: Empirical evidence from the Chinese banking sector. *International Journal of Business and emerging Markets, 3*(2), 109-136.

Sufian, F., & Habibullah, M. S. (2010). Does forign banks entry fosters bank efficiency? Emperical evidence from Malaysia. *Inzinerine Ekonomika-Engineering Economics, 21*(5), 464-474.

Wheelock, D. C., & Wilson, P. W. (1999). Technical progress, inefficency, and productivity change in U.S. banking,1984-1993. *Journal of Money, Credit, and Banking, 31*(2), 212-234.

Worthington, A. C. (1999). Malmquist indices of productivity change in Australian financial services. *Journal of International Financial Markets, Institutions and Money, 9*(3), 303-320.

Yeh, T. L. (2008). Efficiency and productivity growth in Taiwanese banking. *International Journal of Financial Services Management, 3*(3), 269-282.

Yoruk, B. K., & Zaim, O. (2005). Productivity growth in OECD countries: A comparison with Malmquist indices. *Journal of Comparative Economics, 33*(2), 401-420.

Yudistira, D. (2004). Efficiency in Islamic banking: An empirical analysis of eighteen banks. *Islamic Economic Studies, 12*(1), 1-19.

Zhao, T., Casu, B., & Ferrari, A. (2008). Deregulation and productivity growth: A study of the Indian commercial banking industry. *International Journal of Business Performance Management, 10*(4), 318-343.