# Technical Efficiency in Persian Gulf Banking

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## Abstract

This paper investigates a comparison between public, private and foreign banks efficiencies in the banks of Persian Gulf region. In Persian Gulf Countries (PGC), financial sector had grown over the past years. Banking sector particularly grew very rapidly and investor enjoyed high return. This study finds that whether banking sectors in PGC are efficient or not. For this purpose, a sample of 103 commercial banks of Emirates, Oman, Qatar, Saudi, Kuwait, Iran and Bahrain is taken from the period of 1996-2010. The data envelopment analysis (DEA) is applied to compute the efficiencies of the respective banks. The result shows that the efficiency decreased in PGC's banks after increasing the assets in banking system from year 2003. Therefore, although foreign banks don't have any sensible change in efficiency but public and private banks decline. It cans show ownership of banking has important role in banking industries in PGC, therefore this study investigate that government ownership is less efficient than the other types. In PGC, the governments didn't work efficient in toward private sectors as owner of banking system.

## Introduction

Based on more diversified economies and high oil prices, the Persian Gulf countries (PGC) (Saudi Arabia, UAE, Kuwait, Qatar, Bahrain, Oman and Iran) are currently witnessing one of the highest GDP growth rates worldwide, with a related development of domestic financial markets. A population growth has caused a boom in consumer markets; local real estate and multibillion investments are needed. From oil up and downstream projects to heavy industries, power plants, transport, water desalination and waste treatment, there is hardly a sector that does not need an increase of financial services, financing, and insurance. (International Monetary Fund (IMF)-2008). Rapid economic growth in the Persian Gulf countries (PGC) has led to large and variant financing needs, which in turn meet a relatively underdeveloped financial sector. The economies of the country members of the PGC share a number of commonalities. All PGC countries are large oil exporters with fixed exchange rate regimes, which expose them to the vagaries of international oil prices. However, the PGC banking systems had some vulnerability that were revealed by the recent global crisis and the impact it had on the economies of the PGC countries. Among those are increased reliance on external financing, and high exposures to the real estate and construction sectors and equity prices. During the 2003–2008 oil price booms, pro cyclical government spending, abundant banking sector liquidity, and bullish consumer and investor sentiments spurred non-oil real sector and rapid credit growth with associated build-up of domestic imbalances (e.g., asset price bubbles). While credit growth was essentially funded by a relatively stable domestic deposit base, more volatile external funding became increasingly important.

The moderate impact of the global financial crisis on the PGC banking has generally showed the soundness of these banks. Banking in the PGC countries continues to be correctly capitalized across-the-board, with capital adequacy ratios well above minimum standards and at comfortable leverage ratios by international comparisons. There are, however, risks of a possible worsening of asset quality as the fallout from the crisis continues to materialize on banks' balance sheets. This risk is increased in countries with the highest credit growth rates before the crisis, and in systems that have a significant concentration in construction and real estate, as these have been hit hard throughout the PGC. The rise in available bank liquidity, and

the consequent increase in lending rates, has been indirectly related with higher oil prices. This relation presents risks and introduces significant liquidity volatility for banks. International experience indicates that rapid credit growth in periods of high real economic growth is likely to result in high levels of asset injury once economic conditions reverse. Nowadays, in Arabic countries especially in Persian Gulf area the growing financial system through banking development is one of the main policies in financial systems. Consensus exists on the relationship between the size and depth of the financial market and the supply and improves of financial services that are important funders to economic development. This relationship happens because the asset (size) of financial markets is viewed as a main determining factor of investment and savings. The total assets of the financial system also matters because the larger it is, the greater its ability to benefit from economies of scale, given the significant fixed costs prevailing in banking industries. A larger banking tends to relieve credit constraints. Borrowing by firms and further develops the process of savings and the linking of savings to investors. Given that a large banking system should allocate capital efficiently and better monitor the use of funds, improved accessibility to financing will tend to amplify the resilience of an economy to shocks. In the other hand, "Too big to fail" is a technical term in regulation and public policy that refers to businesses dealing with market complications related to moral hazard, macroeconomics, economic specialization, and monetary theory. Due to being too big bank's size, it is might monitoring and banking activity do not operate well and it is defined by comparing banking efficiency and total assets of banks. A main aspect of the banking is its efficiency. Measures of efficiency are aggregate operating ratios, such as output to the input of banking. The relation of efficiency and ownerships in banks of Persian Gulf Countries is the main purpose of this study.

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## Literature Review

There is a large volume of published studies describing the efficiency in banking system. Especially in recent years, there has been an increasing amount of literature on this subject. In literature are a large number of studies that used DEA method to investigate the efficiency.

To review of the efficiency in banking industries, Bauer and Berger [1] measured inefficiencies in U.S banking for 1984 using the thick frontier version of the stochastic cost frontier approach. Their results seem to suggest that there are significant inefficiencies in the banking systems which are operational (stemming from overusing physical inputs) rather than scale or scope inefficiencies. The operational inefficiencies reached 20 to 25 percent compared with 4.2 to 12.7 percent for scale inefficiencies. Based on these findings, Berger and Humphrey argued that banks would face substantial pressure to cut their costs following the moves to deregulate the banking market. Alternatively, banks would have to merge with more efficient institutions or exit the market if they could not compete in an ever increasing competitive environment.

The other studies of the U.S banking market [2-4] suggest that there exist significant X-inefficiencies over all bank sizes and banks can considerably reduce their costs by eliminating them. They also present evidence pointing to the existence of both scale and scope economies of significantly smaller importance. Studies that have used the stochastic cost frontier approach include Berger and Humphrey [5], Mester [6,7], Cebenoyan et al. [8], Elyasiani and Mehdian [9], Altunbas et al. [10-12], Drake and Weyman-Jones [13] and Berger et al. [2] while studies that have used the DEA approach include Sherman and Gold [14], Parkan [15], Vassiloglou and Giolis [16], Elyasiani and Mehdian [17] and Berg et al. [2].

In study of Altunbas et al. [10] was evaluated inefficiencies for the German banking market, while in their later study (1994b) [11] examined the Italian credit cooperative banking sector. The methodology used in both studies was the stochastic cost frontier approach. Altunbas et al. [10] distinguished between five categories of German banks: private commercial banks, public savings banks, mutual cooperative banks, central organisations and mortgage banks. Their results indicated that the mean inefficiency score for all banks was 24 percent suggesting that German banks could produce the same output with 76 percent of their inputs if they were operating efficiently. They also found that mortgage banks and central organisations were less efficient than the other categories of banks, whereas different ownership characteristics did not seem to have a significant impact on the absolute level of bank inefficiencies in the German market.

Rangan [18] and Elyasiani and Mehdian [9] tried to break down banking inefficiencies into two distinct groups; pure technical inefficiencies and scale inefficiencies. Rangan [18] analysed the cost structures of 215 U.S banks and found that the average measure of inefficiency (almost all of which is attributed to pure technical inefficiency) was 30 percent, which means that banking output could be produced with only 70 percent of the inputs. Elyasiani and Mehdian [9] used a sample of 144 U.S banks and estimated that scale inefficiencies reached a very significant value of 38.9 percent, while pure technical inefficiencies were measured at only 11.7 percent, thus attributing vital importance to scale inefficiencies in contrast to Rangan's findings.

Two other studies undertaken by Field and [13] Drake et al. applied the DEA methodology to the building societies sector in the U.K. Field

(1990) examined 71 building societies in 1981 and concluded that 61 of them were operating inefficiently primarily due to scale inefficiencies confirming Elyasiani and Mehdian's [9] result. Moreover, Field showed that the overall technical efficiency of banks was negatively related with bank size, in contrast to the findings of most U.S studies that seem to indicate that technical efficiency is actually positively associated with bank size.

In this decade Chen [19] examines the cost, technical and allocative efficiency of 43 Chinese banks over the period 1993 to 2000. The goal of this analysis is to identify the change in Chinese banks' efficiency following the program of deregulation initiated by the government in 1995. Results show that the large state-owned banks and smaller banks are more efficient than medium sized Chinese banks. In addition, technical efficiency consistently dominates the allocative efficiency of Chinese banks. The financial deregulation of 1995 was found to improve cost efficiency levels including both technical and allocative efficiency.

Wu et al. [20] integrates data envelopment analysis (DEA) and neural networks (NNs) to examine the relative branch efficiency of a big Canadian bank. The results are compared with the normal DEA results. On the whole they are comparable. Furthermore, the guidance on how to improve the branch performance is given. Neural networks are also applied to do short-term efficiency prediction. Finally, the comparison between these two approaches is presented.

In 2008, the study of Pasiouras [21] uses data envelopment analysis (DEA) to investigate the efficiency of the Greek commercial banking industry over the period 2000–2004. The results indicate that the inclusion of loan loss provisions as an input increases the efficiency scores, but off-balance sheet items do not have a significant impact. The differences between the efficiency scores obtained through the profit-oriented and the intermediation approaches are in general small. Banks that have expanded their operations abroad appear to be more technical efficient than those operating only at a national level. Higher capitalization, loan activity, and market power increase the efficiency of banks. The number of branches has a positive and significant impact on efficiency, but the number of ATMs does not. The results are mixed with respect to variables indicating whether the banks are operating abroad through subsidiaries or branches.

Staub et al. [22] in 2010 investigated cost, technical and allocative efficiencies for Brazilian banks in the recent period (2000–2007). They use Data Envelopment Analysis (DEA) to compute efficiency scores. Brazilian banks were found to have low levels of economic (cost) efficiency compared to banks in Europe and in the US. For the period with high macroeconomic volatility (2000–2002) the economic inefficiency in Brazilian banks can be attributed mainly to technical inefficiency rather than allocative inefficiency. State-owned banks are significantly more cost efficient than foreign, private domestic and private with foreign participation. There is no evidence of differences in economic efficiency due to type of activity and bank size. These results may provide some useful guidance for financial regulators and bank managers.

The relative efficiency of 14 commercial banks in China is studied based on DEA model with the data of the year 2009 by Wang in 2012 [23], then the factors that influence the relative efficiency are analyzed. The results show that the Non-DEA efficient commercial banks should streamline redundant employees, carry out high-tech transformation, improve management and product innovation, and reduce operating expenses to adapt to social development and to strength their

competitive power so as to remain in an invincible position in the financial industry's global competitiveness.

## Methodology

This study measures banking efficiency by using DAE approach under constant return to scale. The constant return to scale is advantageous as it allows for comparison between ownership of banks in a situation where the frequency distribution is skewed due to presence of bank's ownerships in the sample [24]. Farrell's original non-parametric approach where piecewise-linear convex isoquant is constructed so as no observed point lie left or below it known as mathematical programming technique for frontier. Later, this methodology was generalized and extended by Charnes et al. [25], Banker et al. [26]. This technique now is widely known as "data envelopment analysis (DEA)". It is a non-parametric to construct cost and revenue frontier of banking sector. It based on linear programming technique to measure the relative efficiency and management performance of banks where multiple inputs and outputs are present which makes the comparison difficult.

Banks under the DEA approach are referred to a decision making unit (DMUs). Data Envelopment Analysis (DEA) is used to estimate output frontier. Distance functions are estimated under constant return to scale (CRS) assumption. The overall bank efficiency can be decomposed into scale efficiency and pure technical efficiency. However, the frontier obtained through DEA approach is sensitive to extreme observations and measurement errors. An output-oriented model implies that the efficiency is estimated by the output of the firm relative to the best practice level for a given level of inputs. In order to specify the mathematical formulation of the output oriented, let us assume

K decision-making units (DMU) use N inputs to produce M outputs. Inputs are denoted by $x_{jk}$ (j = 1,……..,n) and the outputs are represented by $y_{ik}$ (i=1,…….,m) for each bank k (k=1,…….,K). The efficiency of DMU can be measured as Leong et al. [27]:

$$TE_k = \sum_{i=1}^{m} u_i y_{is} \bigg/ \sum_{j=1}^{n} v_j x_{jk}$$

Where $y_{ik}$ is the quantity of the $i_{th}$ output (Income, Return of assets (ROA)&Return of equity (ROE)) produced by the $k_{th}$ DMU bank, $x_{js}$ is the quantity of $j_{th}$ input (Total Assets and Equity) used by the $s_{th}$ firm, and $u_i$ and $v_j$ are the output and input weights respectively.

## Results and Analysis

This study considers 103 banks for 15 years, during 1996-2010. This

study computes the efficiency by using data envelopment analysis (DEA) method and MAX DEA computer software, version 5.5, constructed by Cheng Ganhgin. In the DEA methodology, formally developed by Charnes, Cooper and Rhodes [25], efficiency is defined as a ratio of weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. Data Envelopment Analysis is a powerful technique for measuring the relative efficiency of organizational units with multiple inputs and outputs. This technique describes how well a production process transforms resources into useful outputs. So the first step in a DEA study is to determine the inputs and outputs or each bank to be specified (Table 1). This involves two key conceptual questions, the answers to which may not be at all obvious.

Table 2 identifies correlation among input and output variables. However, total assets and equity which have been used as input in the specification show high correlations with total income, ROA and ROE.

In statistics, dependence refers to any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence. The correlation matrix of n random variables $X_1$, ...,$X_n$ is the n×n matrix whose i,j entry is corr($X_i$, $X_j$). If the measures of correlation used are product-moment coefficients, the correlation matrix is the same as the covariance matrix of the standardized random variables $X_i/\sigma$ ($X_i$) for i=1, ..., n.

The recorded high correlation of assets and equity with income, ROA and ROE may have more effect on the efficiency. As explained by Avkiran [27,28], correlation coefficients among input and output variables can be used to show the appropriateness of such variables. The recorded high correlation coefficients between input and output variable in Table 3, confirm that selected input and output variables for performance evaluation are suitable for data envelop analysis.

A bank can be efficient if it can create relatively high volume of income producing and liabilities for a given capital. A technical efficiency can be creating a relatively high volume of income from its services and intermediation operations with the given inputs.

Tables 4 and 5 and Figure 1 until Figure 7 present the results of efficiency scores derived from the estimation under constant to scale (Technical efficiency). Tables 4 and 5 also summarized the results of average efficiency in both categories of ownership of the bank and specific countries, obtained from DEA model. The aim of these figures and tables is to demonstrate difference in efficiency among different types of banks due to ownership and region.

| | Outputs | | | Inputs | |
|---|---|---|---|---|---|
| | **Income (Per Unit US $)** | **ROA (Percentage)** | **ROE (Percentage)** | **Total Assets (Per Unit US $)** | **Equity (Per Unit US $)** |
| **Saudi** | 303364545.41 | 3.35 | 19.29 | 14429790964.66 | 588932233137.49 |
| **Emirates** | 137055779.76 | 2.52 | 16.19 | 7662467986.00 | 141231538305.02 |
| **Iran** | 127927793.34 | 3.62 | 16.33 | 16896388206.26 | 179477513053.66 |
| **Qatar** | 127352944.96 | 3.13 | 16.39 | 4909398303.62 | 191845961179.87 |
| **Kuwait** | 115825445.82 | 4.39 | 11.52 | 5658473912.30 | 259827597710.91 |
| **Bahrain** | 43874687.23 | 2.55 | 6.56 | 4512596017.50 | 165823595052 |
| **Oman** | 40853435.19 | 3.13 | 12.94 | 1925676640.85 | 41067698890.24 |
| **PGC** | 123206095.55 | 3.02 | 13.16 | 7724363927.29 | 221627138514.26 |

Note: ROA is return on assets

ROE is return on equity

**Table 1:** Average of inputs and outputs in PGC banking industry from years 1996-2010.

|  | Income (Percentage) | ROA (Percentage) | ROE (Percentage) |
|---|---|---|---|
| **Assets (Percentage)** | 68.0858 | 73.6345 | 69.5167 |
| **Equity (Percentage)** | 91.9983 | 80.9136 | 77.8917 |

Note: ROA is return on assets

ROE is return on equity

**Table 2:** Correlation matrix of Inputs and Outputthat used in DEA model.

|  | Outputs | | | Inputs | |
|---|---|---|---|---|---|
|  | Income (Per Unit US $) | ROA (Percentage) | ROE (Percentage) | Total Assets (Per Unit US $) | Equity (Per Unit US $) |
| **Means** | 1.28E+08 | 3.241429 | 9.171186 | 8E+09 | 2.24E+11 |
| **Std. Dev.** | 87230497 | 2.645597 | 7.107833 | 5.55E+09 | 1.74E+11 |
| **Coefficient of variation (Pooled Sample Data)** | | | | | |
| **Coefficient** | 0.681295 | 0.816057 | 0.785805 | 0.693591 | 0.775652 |

Note: ROA is return on assets

ROE is return on equity

**Table 3:** Coefficient of variation for Inputs and Outputs.

|  | All Banks | Public | Private | Foreign |
|---|---|---|---|---|
| **1996** | 0.52 | 0.52 | 0.55 | 0.49 |
| **1997** | 0.48 | 0.46 | 0.54 | 0.44 |
| **1998** | 0.43 | 0.43 | 0.46 | 0.39 |
| **1999** | 0.43 | 0.42 | 0.45 | 0.41 |
| **2000** | 0.48 | 0.50 | 0.50 | 0.41 |
| **2001** | 0.48 | 0.49 | 0.50 | 0.41 |
| **2002** | 0.59 | 0.60 | 0.62 | 0.48 |
| **2003** | 0.49 | 0.51 | 0.48 | 0.47 |
| **2004** | 0.46 | 0.45 | 0.47 | 0.47 |
| **2005** | 0.42 | 0.38 | 0.50 | 0.42 |
| **2006** | 0.37 | 0.35 | 0.40 | 0.39 |
| **2007** | 0.38 | 0.31 | 0.45 | 0.38 |
| **2008** | 0.38 | 0.35 | 0.39 | 0.42 |
| **2009** | 0.39 | 0.40 | 0.40 | 0.39 |
| **2010** | 0.40 | 0.38 | 0.42 | 0.41 |
| **Average 1996-2002** | 0.48 | 0.48 | 0.51 | 0.43 |
| **Average 2003-2010** | 0.41 | 0.40 | 0.43 | 0.42 |
| **Average 1996-2010** | 0.44 | 0.43 | 0.48 | 0.42 |

**Note:** Computed measures are average of technical efficiency (TE), 0<TE<1

**Table 4:** Technical efficiency for PGC banking from 1996-2010, based on banking ownership.

Based on the results as shown in Table 4, total average of technical efficiency (TE) in PGC private banks is more than public and foreign banks during 1996-2010. In this period, TE in public banks is less than the average of TE for all the PGC countries and average of TE in foreign banks is less than the other types of ownerships. These results are shown in Figure 1. Based on the results, banks with private ownership are (0.48–0.43=0.05), 5% more efficient than public banks. Therefore, through comparing the average of efficiency from 1995-2002 by this average from 2003-2010, it is concluded that the efficiency of PGC banks decreased ((0.41-0.48)/0.48=0.145), 14.5% after increasing the assets in banking from year 2003. Result shows that although foreign banks do not have any sensible change in average of efficiency between these two periods, but public and private banks decline 16.6% and 15.6%, respectively. The results show ownership of banking has important role in banking industries in PGC, therefore this study find out that government ownership is less efficient than the other types of ownerships. In these countries, the government owned banks are

inefficient compared to private sector as owner of banking industries. Despite the investors encouraged to invest in financial sectors by high-level of liquidity in financial sectors after oil price boom during 2003-2008, the low-level of outputs related to the inputs shows all types of banking are not operating efficiently during 2003-2010 (Figure 1).

As stated before, based on the results of Table 4, the average of TE in all types of PGC banking ownership (Public, Private and Foreign) is decreased for the periods 1996 to 2010. Public bank reduced 38% in TE from 1996 to 2010. The result shows that the TE decreased 23% in private banks and reduced 16% in foreign banks of PGC from 1996 to 2010. Public banks with 38% change in TE have more decreasing among other ownerships. Average curves of technical efficiency on PGC banking ownerships from years 1996-2010 are shown in Figure 2. The time lines depicted in Figure 3 show the technical efficiency in foreign banks had decreased in gentle slope, while the TE in PGC banks from 1996 to 2010 had reduced strongly in both of private and public ownerships (Figure 2).

Table 5 and Figure 4 report the result of technical efficiency for PGC banking from years 1996-2010, based on country specific. The slopes of
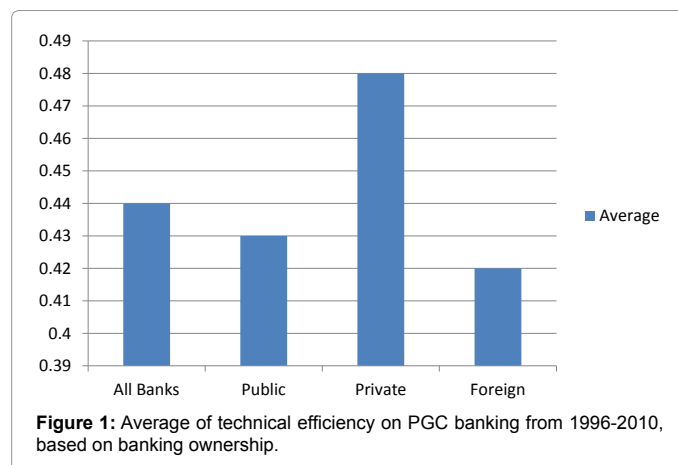


**Figure 1:** Average of technical efficiency on PGC banking from 1996-2010, based on banking ownership.
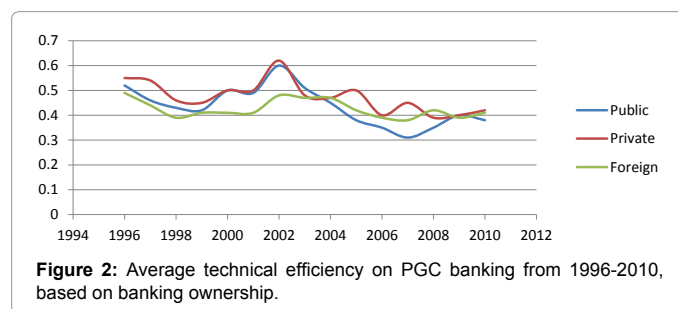


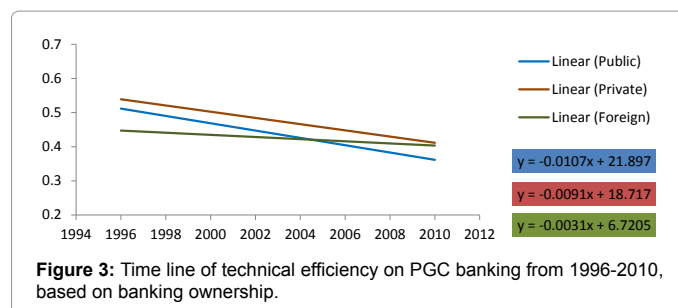**Figure 2:** Average technical efficiency on PGC banking from 1996-2010, based on banking ownership.



**Figure 3:** Time line of technical efficiency on PGC banking from 1996-2010, based on banking ownership.

$y = -0.0107x + 21.897$

$y = -0.0091x + 18.717$

$y = -0.0031x + 6.7205$

TE trend time in Kuwait, Iran, Bahrain, Oman, Emirates, Saudi and Qatar are negative from years 1996 to 2010. The result shows that the average of TE in Saudi banking is more than the other countries in PGC, and Iran has the lowest average in TE in this region. Banking TE decreased in all Persian Gulf countries. Qatar and Kuwait have the lowest and highest slope, respectively, in changing of TE (Table 5).

Figures 5 and 6 indicate the TE in all the PGC during 1996-2010. In this period, TE in Kuwait, Iran and Bahrain have reduced strongly from 1996 to 2010. As well as in Oman and Emirates, TE has decreased from 1996 to 2010. However there is not any perceptible change in TE
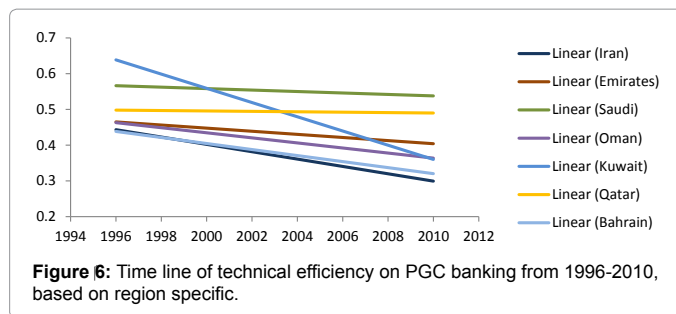
|  | Iran | Emirates | Saudi | Oman | Kuwait | Qatar | Bahrain | PGC |
|---|---|---|---|---|---|---|---|---|
| **1996** | 0.4 | 0.51 | 0.5 | 0.56 | 0.59 | 0.57 | 0.49 | 0.52 |
| **1997** | 0.32 | 0.45 | 0.51 | 0.53 | 0.56 | 0.65 | 0.39 | 0.48 |
| **1998** | 0.36 | 0.4 | 0.5 | 0.41 | 0.53 | 0.41 | 0.36 | 0.43 |
| **1999** | 0.36 | 0.42 | 0.43 | 0.34 | 0.55 | 0.42 | 0.41 | 0.43 |
| **2000** | 0.4 | 0.48 | 0.57 | 0.41 | 0.55 | 0.39 | 0.47 | 0.48 |
| **2001** | 0.48 | 0.46 | 0.64 | 0.35 | 0.53 | 0.47 | 0.43 | 0.48 |
| **2002** | 0.62 | 0.54 | 0.74 | 0.6 | 0.62 | 0.7 | 0.43 | 0.59 |
| **2003** | 0.5 | 0.42 | 0.69 | 0.42 | 0.61 | 0.53 | 0.35 | 0.49 |
| **2004** | 0.53 | 0.4 | 0.65 | 0.33 | 0.57 | 0.39 | 0.36 | 0.46 |
| **2005** | 0.31 | 0.44 | 0.57 | 0.3 | 0.57 | 0.42 | 0.29 | 0.42 |
| **2006** | 0.21 | 0.35 | 0.65 | 0.3 | 0.45 | 0.37 | 0.3 | 0.37 |
| **2007** | 0.19 | 0.35 | 0.4 | 0.36 | 0.55 | 0.34 | 0.35 | 0.38 |
| **2008** | 0.3 | 0.37 | 0.47 | 0.38 | 0.28 | 0.53 | 0.4 | 0.38 |
| **2009** | 0.31 | 0.46 | 0.47 | 0.48 | 0.27 | 0.62 | 0.31 | 0.39 |
| **2010** | 0.28 | 0.47 | 0.49 | 0.43 | 0.26 | 0.6 | 0.35 | 0.4 |
| **Average** | 0.37 | 0.44 | 0.55 | 0.41 | 0.50 | 0.49 | 0.38 | 0.44 |
| **Slope** | -0.0103 | -0.0044 | -0.002 | -0.0071 | -0.0199 | -0.0006 | -0.0084 | -0.0086 |

**Note:** Computed measures are average of technical efficiency (TE), 0<TE<1
**Table 5:** Technical efficiency for PGC banking from 1996-2010, based on region specific.



**Figure 4:** Average technical efficiency of PGC banking from 1996-2010.



**Figure 5:** Average technical efficiency of PGC banking from 1996-2010.



**Figure 6:** Time line of technical efficiency on PGC banking from 1996-2010, based on region specific.
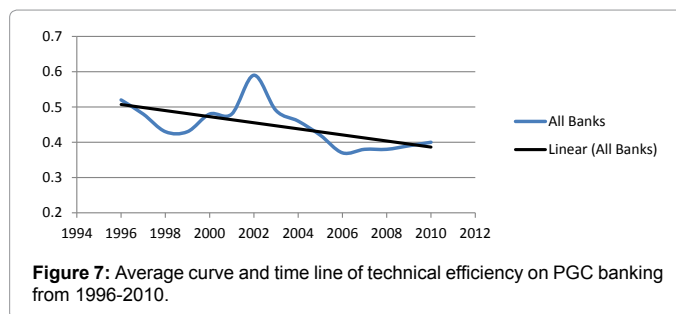


**Figure 7:** Average curve and time line of technical efficiency on PGC banking from 1996-2010.

for Qatar and Saudi, the TE indicate slightly increase and decrease in both countries, respectively.

Figure 7 shows the estimated technical efficiencies have a descending time line in PGC region in periods 1996-2010. Although the average TE curve shows a rising trend from 1999, there is a descent after 2002. It can be related to high injection of money in financial systems after boom in oil price in year 2003. Banking in PGC could not create outputs from the given level of inputs in period years 2003 to 2006. While after year 2006 onwards, TE has increasing trend in PGC.
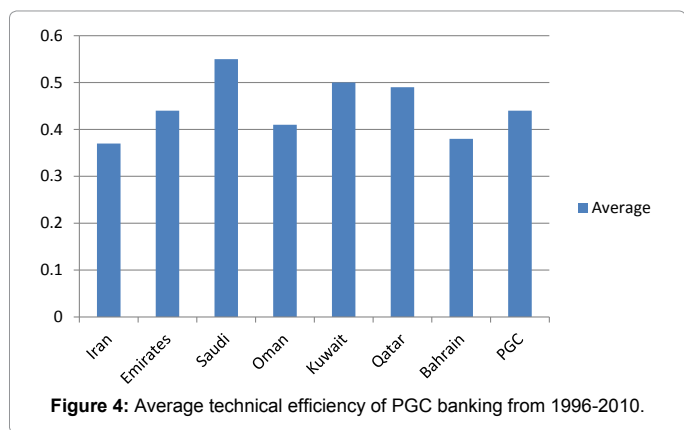
## Conclusion

The Data Envelope Analysis (DEA) technique is employed to examine the efficiency of the banks. The concept of technical efficiency used in this study was based on the definition presented by [29] Assaf et al. Efficiency was defined as a ratio of a weighted sum of outputs to a weighted sum of inputs, where the weight's structure is calculated by mathematical programming and constant returns to scale (CRS) are assumed. However, total assets and equity have been used as inputs and the selected outputs are total income, ROA and ROE.

In general, the total average of technical efficiency in private banks is 48%, and it is greater than public and foreign banks. Technical efficiency in public banks is 42%, which is less than the average for technical efficiency in PGC banking. Therefore the average for technical efficiency in foreign banks at 42% is less than the other types of ownerships.

Technical efficiency in all types of PGC banking ownership (Public, Private and Foreign) decreased from 1996 to 2010. Technical efficiency in public banks was reduced to 38%. According to the results, technical efficiency decreased to 23% in private banks and reduced to 16% in foreign banks. Technical efficiency in public banks with a 38% has decreased the most. Technical efficiency in foreign banks decreased in a gentle slope, while the technical efficiency was reduced strongly in both of private and public banks.
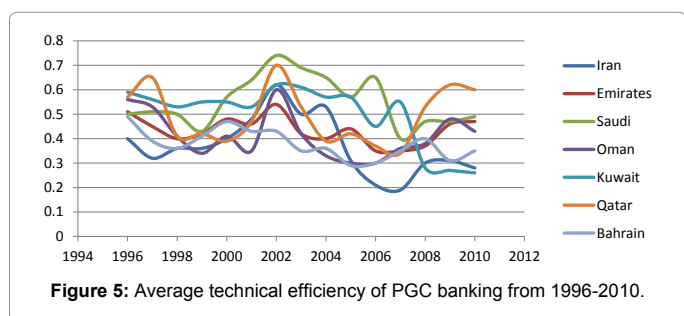
In the period of 1996-2010, technical efficiency in Kuwait, Iran and Bahrain decreased strongly. Technical efficiency decreased in Oman and Emirates from 1996 to 2010 as well. There was no perceptible change in technical efficiency for Saudi and Qatar, but technical efficiency had a small increase in Qatar and small decrease in Saudi.

Therefore, through comparing the average efficiency from 1995-2002 by this average from 2003-2010, it shows that the efficiency decreased in PGC banks after increasing the assets in banking from the year 2003. Results show that although foreign banks did not have any sensible changes in their average of efficiency between these two periods, public and private banks declined. Therefore this study found out that government ownership is less efficient than other types of ownership. Despite the investors being encouraged to invest in financial sectors by a high-level of liquidity after the oil price boom between 2003 and 2008, the low-level of outputs related to the inputs showed that all types of ownership were not operating efficiently between 2003 and 2010.

In PGC banking, the average technical efficiency increased starting in 1999, but decreased after 2002. This can be related to the high injection of money in financial systems after the boom in oil price in 2002 and 2003. The banking system in PGC could not generate outputs from the given level of inputs in between the years of 2002 and 2006. From 2006 to now, technical efficiency increased in PGC.

Overall, the banking system is not efficient enough in Persian Gulf countries. Technical efficiency in Iran, Oman, and Bahrain is especially lower than the PGC efficiency in average. Therefore, efficiency in PGC banks has fallen from 1996 to 2010. Banking managers in this region need to improve their productivities by strengthening distribution and using an effective allocation of inputs in the financial process. The government needs to have more control on public banks than before. Besides, public ownerships are supported by their political influence in banking, so the governments must expect them to perform well. It is realized when the government employs managers who are educated and engaged with the rules in public banking. On the other hand, private banks ownerships have to develop regulatory units in the banking system.

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