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Kuwaiti Banks Efficiency: An examination of technical and Allocative Efficiency over the period 1994-2009

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Using a stochastic frontier approach, the paper investigates technical and allocative efficiency of the Kuwaiti commercial banks over the period 1994-2009, and tests whether labor market policies exert a significant impact on this efficiency. The empirical results show that overall efficiency is on average equal to 80%, but experienced two major declines during the period between 2000 and 2003, and since 2007. The decomposition of overall efficiency into technical and allocative reveals that the source of efficiency decline was different in each period. In the first period only technical efficiency fell, however both technical and allocative fell since 2007, calling for Kuwaiti banks to react consequently in order to stop wasting productive resources. Furthermore, the results indicate that bank efficiency increases with size, and employing more Kuwaiti does not hinder their efficiency when adequate skills and training are ensured.

JEL classification: G2, C6.

Keywords: Technical efficiency; Allocative efficiency; Stochastic Frontier methodology; Kuwaiti banks.

1. Introduction

Financial institutions around the world, particularly commercial banks, are facing mounting challenges since the 1980's. Indeed, financial liberalization and market deregulation urged policy makers, especially in developing countries, to engage structural reforms aiming at improving banks' efficiency and implementing competing practices. Also, the performance of the banking system has been widely recognized theoretically and empirically[i] as an important prerequisite for economic growth and for enhancing the economic and financial system resiliency in facing financial crisis. As a result, inquiring about banks efficiency has become a prominent issue during the last two decades. Unfortunately, most of the studies focus on the banking system of the USA and other developed countries. See for example Rangan et al. (1988), Noulas et al. (1990), Hassan et al. (1990), Elyasiani and Mehdian (1990, 1995) and Berger et al. (1993). Berger and Humphrey (1997) surveyed 130 studies over 21 countries. Casu and Molyneux (2003) conducted a comparative study of efficiency of European banks. More recently, Emrouznejad et al. (2008) surveyed the 30 years of scholarly literature using data envelopment analysis (hereafter DEA).

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Only few studies on bank efficiency relate to Arab countries. We can cite, among others, Al Shamsi et al. (2009) for the case of the UAE, Al-Shammari and Salimi (1998) for the case of Jordan, Al Khathlan and Malik (2010) for the case of Saudi Arabia, Abdmoulah (2009) for the case of Tunisia. Olson and Taisier (2010) estimated the efficiency of banks for Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and the UAE over the period 2000-2008 using a parametric method. Furthermore, Mostafa (2007a, b) investigated the efficiency of 85 top Arab banks using DEA and neural networks. Ben Naceur et al. (2009) investigated the efficiency of banks from Egypt, Jordan, Morocco, Lebanon and Tunisia, using DEA and a meta-frontier approach over 1994-2008 period. They also employed second-stage regressions to investigate the impact of institutional, financial, and bank specific variables on efficiency. More recently, Jreisat and Paul (2010) provide a review of the banking efficiency in the Middle East economies with a special emphasis on measuring the efficiency of banking sector in Jordan.

With respect to Kuwaiti banks, only few and already outdated papers attempted to analyze their efficiency. For example, Limam (2001) used a stochastic cost frontier approach to estimate the technical efficiency of eight Kuwaiti banks over the period of 1994-1999. Darrat et al. (2003) investigated the efficiency and productivity growth of Kuwaiti banks over 1994-1997 period using DEA and Malmquist index. Their results suggest that Kuwaiti banks have improved their efficiency levels and experienced some gains in productivity over the period, although having failed to optimally utilize their resources. For instance, smaller banks were found to be more efficient than larger ones. Likewise, Burki and Dashti (2002) used DEA to assess efficiency scores under intermediation and production approaches using data from 1991 to 1999. Besides, they regressed computed cost, allocative and technical efficiency scores on a set of explaining variables comprising liquidity risk (proxied by liquid assets over total assets), total deposits, and number of local and foreign branches. They found that larger banks are more likely to diverge from their optimal resource allocation path, while cost efficient and allocative efficient banks appear to have fewer foreign branches.

As data before 1994 is not readily available, our study could not equally estimate bank efficiency during the periods of shocks (Al-Manakh crisis and the Iraqi invasion of 1990). However our study develops an intermediation approach that measures both cost and technical efficiency. The study goes further by testing labor market policies on such efficiency. Our results extend beyond the period covered by previous studies.

Actually, these previous studies do not account for most of the reform measures that were implemented during the last few years, which prompted commercial banks to liberalize and modernize their services. Also Kuwaiti Banks are required by the 2001 labor market law to employ nationals no less than 50 % of their overall staff. Given the wage and productivity differential between nationals and expatriates, it is legitimate and important to inquire on the impact of this law on banks' efficiency. Thus, we employ a stochastic frontier model applied to both production and cost functions in order to measure and decompose the overall efficiency into allocative and technical of six Kuwaiti

commercial banks using available data from 1994 to 2009. Moreover, this study tried to explore whether bank size had any impact on efficiency.

Estimating a stochastic frontier production and cost functions enabled us to decompose overall efficiency into technical and allocative. The estimation results show that the banking system in Kuwait is facing a serious downtrend in efficiency since 2007, which calls Kuwaiti banks either to reallocate their portfolios toward local markets, or adjust the mix of their inputs. Moreover, it has been found that the stringent legislation in the labor market as well as banks' size positively affect their efficiency.

The rest of the paper proceeds as follows. Section 2 explains the methodology. Section 3 presents the data. Results are discussed in section 4. Section 5 concludes.

2. Literature Review and Methodology

Production economics stipulates that a firm is technically efficient (TE) if it produces outputs along its production possibility frontier. Production frontiers describe maximum output (s) attainable from each input. The firm is also said allocative efficient (AE) if it is able to choose the right mix of inputs, given their market prices, which produces a given output at a minimum cost (or maximum profit). The overall efficiency is only the product of technical and allocative, i.e EE=TE*AE. Since the publication of the seminal paper of Farrell (1957) on efficiency, different methods were developed in order to estimate the production frontiers from observed sample data on production, inputs, and prices data. Data Envelopment Analysis (DEA) methods were introduced by Charnes, Copper and Rhodes (1978)[ii], based on the work of Farrell (1957), use linear `programming methods to construct a non-parametric piece-wise frontier over the data. The method is attractive because it does not require explicit functional form of the frontier, and also it can easily handle the case of multi-output production processes. This flexibility comes with a cost being a non-parametric method. The second line of efficiency measurement is based on econometric estimation of the production frontiers. Aigner and Chu (1968), and Aigner, Lovell and Schmidt (1977), and Meeusen and van der Broeck (1977) developed the estimation of stochastic frontier models. Although stochastic models permit the estimation and conducting various hypothesis testing on the parameters of the production frontiers, the assessment of economic efficiency as a product of allocative and technical efficiency as demonstrated by Schmidt and Lovell (1979) is only valid if the cost function is derived analytically using Shepherd's Lemma. In fact only Cobb Douglas technology has a derived cost and profit functions that are derived from duality theorems. In the case of multiple output technology, production frontier is better represented by a distance function (Fare and Primont, 1995). This function permitted the estimation of flexible functional forms such as Translog production distance function. Also multiple output cost and profit functions are easily derived, however direct estimation of both technical and allocative efficiency from cost functions involve a system estimation of both cost function and factor demand functions. The numerical optimization of the suggested likelihood function is highly complex. In this paper we use the Schmidt and Lovell (1979) result and we evaluate both technical and allocative efficiency using Cobb Douglas technology.

The cornerstone of efficiency estimation is that the production function represents the production frontier. Deviations of observed output from the frontier are due to inefficiency. Aigner and Chu (1968) considered the estimation of parametric frontier production function using observed data. They assumed that output is determined by:

$$\ln(Y_{it}) = X_{it}\beta - u_{it} \qquad (1)$$

Y_{it} is the vector of observed output and X_{it} is a vector of n production inputs. β is (n×1) vector of unknown parameters to be estimated. The error term u_{it} should be non negative in order to have observed output below the production frontier. This requirement is achieved by assuming that the random error follows a half normal distribution, or Gamma distribution as suggested by Afriat (1972). The ratio of observed output to the frontier gives an estimation of the scale of technical efficiency is given by:

$$TE_{it} = \frac{Y_{it}}{\exp(X_{it}\beta)} = \frac{\exp(\mathrm{X_{it}\beta - u_{it}})}{\exp(\mathrm{X_{it}\beta})} = \exp(-\mathrm{u_{it}}) \qquad (2)$$

Aigner, Lovell and Schmidt (1977) and Meeusen and Van Den Broeck (1977) extended the deterministic frontier model of Aigner and Chu (1968) by adding a random variable ε_{it} capturing the effects of random factors that deviates observed output from the frontier other than inefficient utilization of inputs, as follows:

$$Ln(Y_{it}) = \ln(X_{it})\beta + \varepsilon_{it} - u_{it} \qquad (3)$$

The variable ε_{it} is usually assumed independent and identically distributed normal random variable with zero mean and constant variance. In this model the production is stochastic because observed output is bounded by random variable$(X_{it}\beta + \varepsilon_{it})$. The Likelihood function of the above model can be maximized by standard numerical methods. In the case of cost model the efficiency variable u_{it} is added to equation (1) because observed cost is assumed to be above the cost frontier. The cost function is assumed to be homogeneous of degree one with regard to input prices. To impose input price homogeneity the cost and input prices should normalized by any price vector. In this application we normalized the equation by the price of capital P_{kit} as follows:

$$Ln\left(\frac{C_{it}}{P_{kit}}\right) = \alpha_0 + \gamma_1 \ln(Y_{it}) + \sum_{j=1}^{n} \beta_j \ln\left(\frac{\mathrm{p_{jit}}}{\mathrm{p_{kit}}}\right) + \varepsilon_{it} + u_{it} \qquad (4)$$

In this case the u_{it} provides information on the overall economic, or cost efficiency(EE_{it}). If the cost function is a dual to the production function we can obtain the allocative efficiency from the equation:

$$\mathrm{AE_{it}} = \mathrm{EE_{it}}/\mathrm{TE_{it}} \qquad (5)$$

One major advantage of the stochastic frontier approach is its ability to model inefficiency effects and to carry out hypothesis testing in one unified framework (Kumbhakar, Ghosh and McGukin, 1991 and Reifschneider and Stevenson, 1991). The system approach is superior than the two stage approach of first modeling efficiency by a frontier model and then using regression technique to explain the predicted efficiency scores by a set of explanatory variables. The two stage approach is not accurate because it violates the assumption of u_{it} being identical and independently distributed random variable.

Banking activity is characterized by producing more than one output. Although multi output cost function is easily specified modeling multi output production is only achieved by specifying a distance function. In this case one cannot use the duality theorems in order to decompose economic efficiency into technical and allocative. In order to overcome this constraint we used total banking income as a measure of banking output. In fact preliminary regression analysis of both Cobb-Douglas output and cost function proved to deliver better estimates when total banking income is considered as a measure of output instead of using separately loans and investments as measures of output.

3. Data Highlights

The study focused on six Kuwaiti commercial banks. These banks are: National Bank of Kuwait (NBK), Gulf Bank (GB), Commercial Bank of Kuwait (CBK), Al-Ahli Bank (AB), Bank of Kuwait and Middle East (BKME) and Burgan Bank (BB). These banks are supposed to use the same technology and pursue the same objective. Three other banks, namely Kuwait Finance House, Kuwait Real Estate Bank and Industrial Bank of Kuwait, are not included in the paper since they are regarded as specialized banks. Also, branches of foreign banks operating in Kuwait were not included. The data cover the longest period available from 1994 to 2009 allowing testing whether and how modernization, labor market policies as well as recent financial crises affect Kuwaiti banks efficiency. Data were collected from the financial operations reports published by the Research Unit at the Institute of banking Studies of Kuwait.

In this study, we followed the intermediation approach to define our inputs and outputs[iii]. Consequently, inputs are deposits (consist of deposits obtained from customers), labor (consists of the total number of employees) and fixed assets (defined as all tangible long term assets such as land, buildings, furniture and equipment). Outputs are total banking income (including interest, investment and other incomes) loans (including all types of loans, advances discounts and overdrafts provided by the bank) and investments (including all types of investments on shares, bonds, subsidiaries and affiliates and other short term investments). Inputs' unit prices needed to estimate the parameters of the

cost function are computed as follows. The unit price of deposits is computed as the total interest expenses divided by deposits. The unit price of labor is the total cost of all bank's employees divided by labor enrolled in the bank. The unit price of capital is measured by all other expenses divided by fixed assets.

Table 1 reports summary statistics of inputs, outputs and unit prices. It reports also total assets, ATM number, total cost as well as the percentage of Kuwaiti employees in the banks (Kuwaiti employees over total employees in the bank). Table 1 reveals that the Kuwaiti banking system is highly concentrated. For instance, NBK and GB represent more than 55% of total assets and deposits. According to Central Bank of Kuwait annual report (2010), Kuwaiti banking assets in 2010 were mainly driven by credits facilities to residents and by foreign assets (60% and 17%, respectively). Other local investments account only for 6%. Personal and real estate loans hold the lion's share of total credit disbursed, standing at 33% and 24%, respectively. From the other side of the balance sheet, liabilities are mostly driven by private sector and increasingly by government deposits since the 2008 global credit crunch. They account for 61% and 9% respectively in 2010.

In order to account for the size of Kuwaiti banks as well as labor market regulatory environment, we included two variables, i.e. the number of ATMs and the labor mix between nationals and expatriates. Total ATM number evolved from 25 in 1994 to 119 in 2009 on average, ranging from 53 at BKME to 207 at NBK in 2009. On the other hand, the national labor support low (19/2000) obliged banks to increase the number of Kuwaiti employees. As a result, the percentage of Kuwaiti employees increased from 33% in 1994 to more than 62% in 2009 on average, ranging from 57% at CBK to 68% at GB. Actually, the rationale behind the inclusion of this ratio is the assumed difference between Kuwaiti and non-Kuwaiti employee's working hours and wages, which is expected to highly affect total cost as well as technical, allocative and cost efficiency. Unfortunately data limitations on wages by labor type prevented us from directly testing the labor policy on bank efficiency. However the labor ratio could be taken as a good proxy of the cost incurred by banks due to this labor policy. As an example, the average monthly wage in 1988 ranged from 412 KD for non-Kuwaiti to 777 KD for Kuwaiti employees. Weekly worked hours ranged from 39 for Kuwaiti to 45 for non-Kuwaiti. Also the available data in 2001, on wages of insurance company's employees shows that Kuwaiti had a monthly wage of 1041 KD compared to 394 KD for non-Kuwaiti. Even in public sector, Kuwaiti wages are, on average, 2.7 times non Kuwaiti wages in 2011[iv].

Table 1: Variables descriptive statistics

		Mean	Maximum	Minimum	Std. Dev.
Total Assets (million KD)		2640.03	12907.26	845	2236.58
ATMs number		54.7	207	11	42.13
Kuwaiti employees percentage		0.41	0.68	0.24	0.1
Inputs	**Deposits (million KD)**	2214.43	10869.35	709.61	1907.5
	Labor	798.66	2321.57	391.89	438.9
	Fixed Assets (million KD)	67.81	498.37	11.11	89.93
Total cost (million KD)		128.01	656.62	39.18	107.29
Inputs unit prices	**Deposits unit price**	0.04	0.07	0.02	0.01
	Fixed Assets unit price	0.21	0.66	0.02	0.1
	Labor unit price (KD)	1433.49	3400.63	794.48	547.15
Outputs	**Loans (million KD)**	1311.93	7817.11	123.02	1337.55
	Investments (million KD)	457.73	2213.55	26.02	438.74
	Total banking income(million KD)	176.48	826.33	45.33	146.31

4. Results and Discussion

This section presents the stochastic frontier estimates obtained by using STATA 10 software. Table 2 reports production and cost functions estimates of three different specifications. In Model 1, the production frontier was estimated by regressing total banking income (TBI) on capital, deposits and labor. The relative cost frontier was estimated by regressing Total Cost Relative to the price of capital (TCR) on TBI and the relative prices of deposits and labor. In fact model 1 does not account for environmental variables, i.e. ratio of Kuwait employment and ATMs number. These variables are separately added in models 2 and 3, respectively, since they were found to be highly correlated. Table 3 reports efficiency scores' descriptive statistics from model 1.

The estimation results of the frontier production function in model 1 show that all inputs have positive effects. However, only the coefficients of capital and deposits are statistically significant at 1% level. Labor coefficient is only significant at 10% level. It is noteworthy to note that deposits are by far the most important factor in determining total banking income. Besides, the sum of the output coefficients of the production function (1.04) indicates that Kuwaiti banks are operating, on average, near constant returns to scale. This result is fairly similar to that found by Limam (2001). This means that Kuwaiti banks cannot improve technical efficiency by increasing the scale of production.

Table 2: Estimates of production and cost functions

	Model 1				Model 2				Model 3			
Dependant variable	**TBI**		**TRC**		**TBI**		**TRC**		**TBI**		**TRC**	
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
TBI			0.858*	0.000			0.906*	0.000			0.914*	0.000
Capital	0.086*	0.002			0.123*	0.001			0.157*	0.000		
Deposits	0.829*	0.000			0.608*	0.000			0.547*	0.000		
Labor	0.13***	0.085			0.363*	0.000			0.339*	0.000		
Deposit price			0.642*	0.000			0.583*	0.000			0.572*	0.000
Labor price			0.214*	0.000			0.247*	0.000			0.253*	0.000
constant	-2.23*	0.000	0.910*	0.000	-2.446*	0.000	0.267	0.618	-1.946*	0.000	0.156*	0.000
lnsig2v												
constant	-6.559*	0.000	-37.011	0.739	-3.727*	0.000	-23.308	0.181	-3.833*	0.000	-35.471	0.918
lnsig2u												
constant	-2.709*	0.000	-2.169*	0.000								
K ratio					-21.18**	0.027	-3.76*	0.000				
ATM									-0.231*	0.000	-0.011*	0.000
n of obs.	96		96		96		96		96		96	
Wald chi2	2066.11		7.37e+11		2066.11		3.17e+07		575.34		1.37e+10	
Prob>chi2	0.000		0.000		0.000		0.000		0.000		0.000	
model	Half-normal		Half-normal		Half-normal		Half-normal		Half-normal		Half-normal	

Note: *significant at 1 percent, ** significant at 5 percent and *** significant at 10 percent. Where: TBI is Total banking income; TRC is Total relative cost and K ratio is Kuwaiti to total staff ratio.

By looking at the estimation results of the cost function in model 1, we found that total banking income, as well as relative prices of deposits and labor have the expected positive sign and significant at 1% level. In fact, it is not surprising to find that the effect of deposits' price is three times that of labor's price given the importance of deposits in the production function as discussed above. Estimated technical and cost or overall efficiencies scores derived from functions in model 1 are summarized in Table 3. Calculated allocative efficiency scores, following equation (5), are reported in the same table. The cost efficiency is on average equal to 79%, which means that the average input waste is about 21%. This means that Kuwaiti banks could save 21% of the cost while being producing the same level of output. Limam (2001), Burki and Dashti (2002) and Darrat et al. (2002) have found Kuwaiti banks economically inefficient at 12%, 32% and 24%, respectively, in the 1990s. Also, this inefficiency rate is fairly similar to that found in developed countries. For instance, Berger et al. (1993) found cost inefficiency at 20% for American banks. This result reveals the oligopoly nature of the Kuwaiti banking system. Moreover, the inefficiency rate varies from 74% for BB to 85% for BKME. Larger banks, i.e. NBK and GB are not the most efficient. Therefore, efficiency is not positively linked to banks' size as asserted in the empirical literature. This result concurs with Darrat et al. (2003) and contradicts with Limam (2001), Burki and Dashti (2002).

Nonetheless, this comparison is to be taken with caution since efficiency scores depend on the period of estimation as well as inputs-outputs set taken into consideration in these different studies.

Further information is given by decomposing cost efficiency into allocative and technical. First, it is worth noting that allocative efficiency exerts higher scores than technical efficiency for the six banks. Thus, the dominant source of cost inefficiency is more technical than allocative (13% versus 5%), which means that Kuwaiti banks are doing better job allocatively rather than technically. In other words, Kuwaiti banks use the right inputs-mix given their prices, but do waste resources. With this respect, BKME and CBK outperform all banks allocative and technically, respectively.

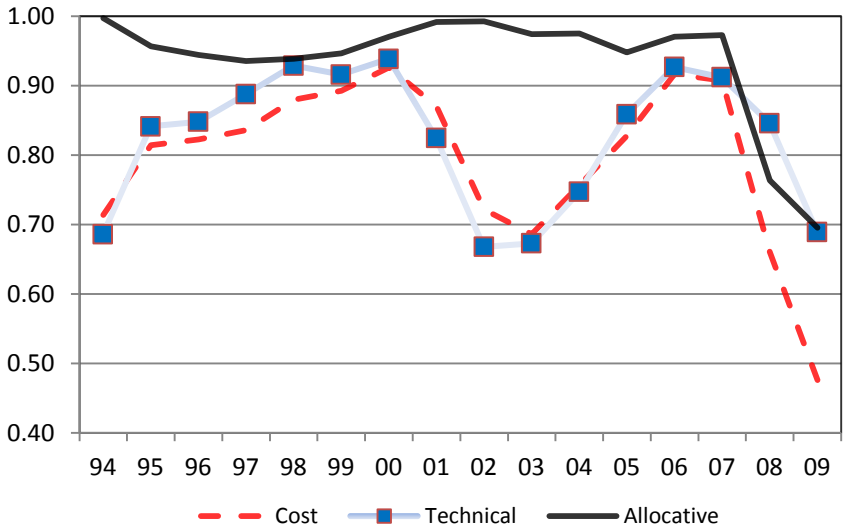
Table 3: Efficiency scores descriptive statistics (from model 1)

	Cost efficiency		**Allocative efficiency**		**Technical efficiency**	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
All banks	**0.79**	**0.15**	**0.95**	**0.11**	**0.83**	**0.12**
ABK	0.78	0.10	0.93	0.07	0.83	0.12
BB	0.74	0.14	0.91	0.10	0.80	0.11
BKME	0.85	0.15	0.99	0.07	0.85	0.14
CBK	0.82	0.17	0.93	0.14	0.88	0.10
GB	0.80	0.20	0.93	0.16	0.86	0.11
NBK	0.77	0.13	0.95	0.06	0.81	0.13

Looking at figure 1, we found that Kuwaiti banks, on average, experienced two efficiency declines in 2000-2002 period and since 2007. Interestingly, allocative efficiency was fairly resilient during the first period, while banks experienced technical efficiency loss leading to a significant cost efficiency loss. Contrarily, since 2007, both allocative and technical efficiencies declined leading to a wider loss in overall efficiency. We believe that this finding reflect a problem of different nature. To further investigate the determinants of the problem, we look at inputs, outputs and inputs unit prices over the investigation period (presented in Appendix figures A, B and C). We found that efficiency decline was likely driven by declining total banking income, which was triggered by lower investment activity. This sounds logical since investments activity would have been affected by the international financial markets' crises of 1997, while loans activity remains local. This contrasts with the last few years, where loans activity shows a significant slowdown, likely due to the economic crises. This is further supported by the slowdown of deposits as shown in Appendix, Figure A. In the mean time, labor maintained an upward trend regardless of the business cycle, contrarily to capital which fits well. Besides, as shown in Appendix, figure C labor price maintained an upward trend, while capital and deposits prices follow, more or less, the business cycle. All in all, banking expenses rose sharply during the period 2000-2003 and since 2007. Kuwaiti banks in reality had no ability to adjust during the crises in the short term. More precisely, Kuwaiti banks had no ability to

adjust technically during 2000-2003, then technically and allocatively in the last three years, which calls Kuwaiti banks to put things in order to return to the same level of efficiency.

Figure 1: Mean of efficiency scores over 1994-2009



Turning to size and labor market policy impact on Kuwait banking efficiency models 2 and 3 indicate that share of Kuwaiti employment as well as ATMs variables' coefficients are negative and significant at 1% level. This means that these two variables negatively affect cost and technical inefficiencies. In other words, this finding implies that banks employing relatively more Kuwaiti employees achieve, contrarily to the accepted perception especially by private sector, higher levels of technical and cost efficiency. This finding can be rationalized by the fact that Kuwaiti banks enjoy in general well skilled Kuwaiti employees generally graduated from the University of Kuwait. In addition, pre-employment as well as internal training ensure a good workmanship, which in turn helps achieving higher efficiency in spite of their higher wages.

Likewise, banks with more ATMs are likely to achieve higher levels of technical and cost efficiency. This can be explained by the fact that banks having more ATMs have better coverage which is crucial for customers who accede easily to their money and save time, which leads banks in turn to collect more deposits and produce more loans and investments.

5. Conclusion

Despite the importance of an efficient banking system in fostering economic growth only few studies investigated the issue of the efficiency of the Kuwaiti banking system. Most of these studies were carried out a decade ago. This paper is a modest contribution toward understanding the trends of efficiency in the Kuwaiti banking system. A stochastic frontier production and cost functions were estimated over the period 1994 to 2009. Banking output and costs were explained by a Cobb-Douglas technology, which enabled us to

decompose overall efficiency into technical and allocative. The estimation results showed that the banking system in Kuwait is facing a serious falling downtrend in their efficiency since 2007. Despite the fall in income probably triggered by a fall on the return on their overseas investments, banks are very slow to adjust their inputs triggering this decline in efficiency. In order to boost income and gain efficiency banks are required either to reallocate their portfolios toward local markets, or adjust the mix of their inputs. Local market size is narrow and limited, but this could be compensated for by the high purchasing power of the population. Banks could expand locally as we found that larger banks are more efficient. Also stringent legislation in the labor market in terms of labor employment does not negatively impact bank efficiency. This is probably that banks were able to recruit more skilled and trained local labor.

Endnotes

[i] See for example Levine, (1997, 2004).
[ii] This method was first suggested by Boles (1966) and Afriat (1972).
[iii] Sealey and Lindley (1977) and Casu and Molyneux (2003) discuss the appropriateness of intermediation and production approaches.
[iv] Alkabas newspaper, 09/10/2011.

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Appendix (Figures A, B, C)

Figure A:Mean of inputs over 1994-2009 (in log)

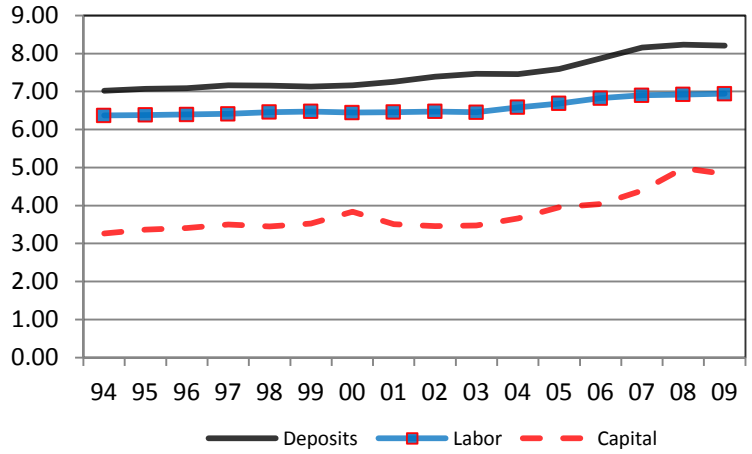

Figure B: Mean of outputs over 1994-2009 (in log)

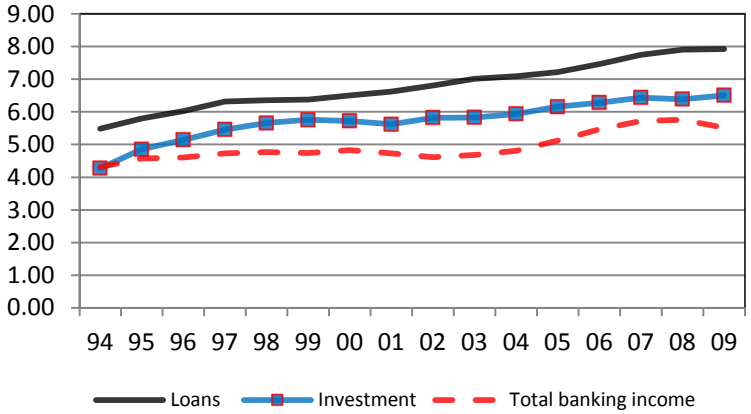

Figure C: Mean of inputs' prices over 1994-2009 (in log)