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TRACKING THE IMPACT OF CHANGE IN OWNERSHIP ON THE EFFICIENCY OF COMMERCIAL BANKS IN MENA COUNTRIES USING A MALMQUIST INDEX-BASED APPROACH

Said Gattoufi, Sameh Sakr
and Mohammed Omran

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Corresponding Author:
Said Gattoufi,College of Commerce and Economics
Sultan Qaboos University, Sultanate of Oman
Email: **gattoufi@squ.edu.om**

Abstract

The aim of this research is to track the impact of ownership including mergers and acquisitions (M&A) in the MENA-region's banking industry on the technical efficiency of its commercial banking units, technical efficiency being the goodness in transforming inputs into outputs. To assess such change, this paper uses Malmquist Productivity Index (MPI) analysis. This index uses the yearly efficiency coefficients provided by Data Envelopment Analysis (DEA) to analyze the evolution of efficiency over time. Moreover, the index is decomposed into two components, one reflecting the intrinsic change in the relative efficiency and one reflecting the shift in the efficient frontier. The conclusions from this study and the results it reports confirm the positive, though limited, impact of change in ownership on the overall efficiency of the commercial banking industry in MENA region, though one needs to be cautious since the sample did not include all banks operating in the region.

ملخص

يهدف هذا البحث إلى تقصي تأثير الملكية بما في ذلك M&A في الصناعة المصرفية في منطقة الشرق الأوسط وشمال أفريقيا على الكفاءة الفنية للوحدات المصرفية التجارية فيها، حيث تعتبر الكفاءة هي مقياس الجودة في تحويل المدخلات إلى مخرجات. ولكي نحسب هذا التغير تستخدم هذه الورقة تحليل مؤثر الإنتاجية لمالمكويث، وهو مؤشر يستخدم معاملات الكفاءة السنوية التي طرحها التحليل التطويقي للبيانات لتحليل تطور الكفاءة على مر الزمن. أضف إلى ذلك أن المؤثر يتحلل إلى تكوين أحدهما يعكس التغير في حد ذاته في الكفاءة النسبية ـ والآخر يعكس التحول في الجبهة ذات الكفاءة. ومن النتائج التي خلصت إليها هذه الدراسة أن النتائج التي تسوقها تؤكد التأثير الإيجابي رغم محدوديته، لتغير الملكية، على الكفاءة العامة للصناعة المصرفية التجارية في منطقة الشرق الأوسط وشمال أفريقيا ومع الرغم من ضرورة توخي الحذر لأن العينة لم تتضمن كافة المصارف العاملة في المنطقة.

1. Introduction

During the last two decades the banking sector around the globe went into deep mutations characterized by an accelerating process of concentration through mergers and acquisitions (M&A), and in many cases, collapses of giant financial institutions at local, regional and international levels confirm this deep mutation.

However, there is an ongoing debate regarding whether getting bigger in the banking sector is always better, in terms of performance in general and in terms of economic efficiency in particular, although the gain in scale and scope are often presented as the main driver for M&A. See for example (Altunbas & Marqués, 2008), (Avkiran, 1999), (Campa & Hernando, 2006), (Cornett & Tehranian, 1992), (De Jonghe & Vennet), (Fixler & Zieschang, 1993), (Haynes & Thompson, 1999), (Mumcu, -nal Zenginobuz, & Simon Neaime, 2005). (Rose, 1987), (Scholtens & Wit, 2004), and (Sherman & Rupert, 2006) among others. Research had also discovered several other reasons for M&A:

Hence, one can question whether the spectacular ongoing change in ownership including the M&A waves in the MENA region are a wise shift for the banking industry or are they an arguable drift triggered by contamination, hubris[1], getting bigger to abuse the Too Big to Fail [TBTF] implicit guarantee afforded by the government to big banks. The efficiency issue of the banking industry in the MENA region as a whole remains an understudied subject with a limited number of published reports (see Saif and Yassin, 2005). However, there is an increasing number of papers addressing the issue for the GCC countries (Ramanathan, 2007) and (Mustafa, 2007a&b) and for individual MENA countries (Omran, 2004; Gattoufi et al., 2003; Gattoufi and Al-Hatmi, 2008; and Avkiran, 2006 among others). However, none of the studies focus on the impact of M&A on the efficiency of banking units besides Mumcu (2005).

Generally speaking M&A do not happen out of the blue. A small change in ownership usually precedes a merger or an acquisition. Toehold acquisitions are in the best interest of a raider even if such acquisitions drive up the pretender target price (Goldman & Qian, 2005)

The MENA region has a great geo-political importance including various countries with different economic structures and resources having critical importance for the international economy. The commercial banking system of those countries committed to sustainable development and engaged in major economic reforms as a requirement for the adhesion to the World Trade Organization, is a determining parameter for the performance of their national financial systems and their national economies in general. Hence, the performance of the banking system is considered as a national strategic issue.

The economic performance of the MENA region from the 1970s to the present has mirrored, for the most part, the changes in oil prices. The rise in oil prices during the 1970s and their decline during the 1980s and 1990s and their rise again during the first decade of the twentieth century have taken the economic performance and developmental efforts of the MENA countries on a roller coaster ride. The oil fortunes have reflected on different sectors of the economy. The banking sector for example has enjoyed an average annual increase of 15% in deposits between 2002 and 2005. For the oil-rich countries, this rise in deposits amounted to more than $30 billion in new deposits every year. The

[1] Managers infected by hubris are those who overestimate their ability to run the banks they purchase and thus they over pay for these banks [Berkovitch and Nrayanan (1993)]. Hubris in the banking industry is documented in Gupta, Lecompete, & Misra (1997).

recent rise in oil prices to record highs, with no expectations of a nearby decline, has impelled the MENA countries to consider ways to promote rapid and lasting economic growth.

Levine (2003) has found that countries with better developed financial systems tend to outgrow countries with less developed financial systems. Most MENA countries have embarked on privatization and financial liberalization programs while increasing the size of the stock market by selling part of the government's equity holdings. Such measures are simply not enough. According to Gentzoglanis (2007), the stock market's liquidity is more important than its size in fostering lasting economic growth. Well functioning financial systems as well as a legal and regulatory reform are necessary to foster the emergence of long lasting growth.

Financial sector reform is very high on the agenda of MENA countries, as reported in Creane, Goyal, Mobarak and Sab (2007). Such reforms are expected to increase the availability and quality of information, lower and monitor transaction costs, which eventually causes the cost of capital to decline and in the process improves the economy's allocation efficiency. The authors examined several aspects of the financial system and found that there is a great disparity between the different countries of the MENA region. As a group however, MENA countries perform well on the measures of financial openness as well as regulation and supervision.

The MENA region affects, and is affected by the ongoing liberalization of the international financial system, and the structure and competitiveness of its financial sector is in continuous change (Turk-Ariss, 2008). Ownership changes including M&A in banking sector are making the daily news in the region. Moreover, the euphoria of getting bigger is not only still ongoing but it is even accelerating in-borders and cross-borders within the region, particularly in GCC countries.

The aim of this research is to track the impact of change in ownership including M&A in the MENA region's banking industry on the technical efficiency of its commercial banking units, technical efficiency being the goodness in transforming inputs into outputs. To assess such change, the paper uses MPI analysis. This index uses the yearly efficiency coefficients provided by Data Envelopment Analysis (DEA) to analyze the evolution of efficiency over time. Moreover, the index is decomposed into two components, one reflecting the intrinsic change in the relative efficiency and one reflecting the shift in the efficient frontier.

2. The Data Envelopment Analysis (DEA) Approach, the Malmquist Productivity Index and the Banking Technical Efficiency

The concept of efficiency is a central concept in the economic theory and full efficiency is defined as the attainment of Pareto optimality (Koopmans, 1951). The efficiency reflects the degree of goodness with which the economic units are performing their objectives. This raises issues of measuring efficiency and whether, indeed, an absolute measure of efficiency does exist. These issues were discussed and there is an agreement in the existing literature (Charnes & Cooper, 1985) that the modern measurement of economic efficiency was introduced by Farrell (1957) who drew upon the work of Debreu (1951) and Koopmans (1951) to define a simple measure of firm efficiency. He proposed that the economic efficiency of a firm is a combination of its technical efficiency, which reflects its ability to obtain the maximal outputs from a given quantity

of inputs, and its allocative efficiency, which reflects its ability to use inputs in optimal proportion given their respective prices.

In order to determine efficiency measures for the firms, Farrell (1957) proposes to first identify an assumed existing efficient frontier using the production function. Deviations from the efficient frontier have a natural interpretation as a measure of the inefficiency with which economic units, or firms, pursue their technical or behavioral objectives.

Farrell (1957) suggested the use of either **(i)** a non-parametric piecewise linear convex form or **(ii)** a parametric function to determine the efficient frontier. DEA belongs to the first class of methods (Gattoufi et al, 2004) while altered forms of Cobb-Douglas function constitute the second class.

Without lingering on details, it is important to mention that Charnes, Cooper and Rhodes (1978) originally developed the standard Data Envelopment Analysis as a methodology to measure the relative efficiency of a homogeneous set of firms, called Decision Making Units (DMU), competing in the same market. By solving a set of Linear Programming models obtained by transforming a set of fractional Linear Programming models known as the ratio form of the DEA, an efficiency coefficient for each DMU is determined. The set of the best performers among them defines the efficient frontier. Deviation from the efficient frontier is interpreted as a measure of the inefficiency for the remaining DMUs. As a benchmark, a virtual efficient target for each inefficient DMU is identified by projection on the efficient frontier. Conventionally, an efficient DMU is given ***1*** as measure of efficiency and all efficiency coefficients have a non-zero value.

The MPI is a comparative statics type analysis using a panel of efficiency coefficients obtained using the DEA approach over several time periods. It is defined as the product of two components named by Cooper et al. (2007) as the catch-up and the frontier-shift terms. The catch-up (or recovery) term relates to the degree to which a banking unit improves or worsens its efficiency between two time periods. On the other hand the frontier-shift (or innovation) term reflects the change in the efficient frontiers between the same two time periods.

In the increasingly large DEA literature (Gattoufi et al. 2004a&b), one can identify an impressive number of studies devoted to the analysis of banking efficiency, single country wide as well as cross-country. Assessing the efficiency levels of banks requires defining the inputs and outputs to consider in the analysis. The survey of the literature shows little agreement over what a bank produces and what it means to be efficient. Appendix 1 reports a number of studies analyzing the efficiency of banking units, in different countries and from different point of views. It also provides information about the inputs and outputs those studies consider in their analysis. The set of variables the banking efficiency studies consider varies depending on the context and objectives defined for those studies and is largely influenced by the approach those studies adopt. Two principal approaches are at stake, the production and the intermediation approaches. Humphrey (1985) provides an extended discussion of the issues involved in this debate. Further discussions are Berger and Humphrey (1997), Athanassopoulos (1997), Miller and Noulas (1996), Ferrier and Lovel (1990), Berger et al. (1987).

The production approach assumes that banks are using physical resources such as labor, capital and plant to generate transactions like taking deposits and lending funds. Under

this approach, labor, capital, and fixed assets are treated as inputs, and deposits and loans are treated as outputs, which is usually measured in number of accounts rather than dollars. Elyasiani and Mehdian, (1990), and Berger and Humphrey (1991) are among those who have used the production approach. The alternative intermediation approach assumes that banks are intermediating funds between savers and investors, in which deposits are regarded as inputs and loans are treated as outputs. Athanassopoulos (1995), Barr et al. (1994), Charnes et al. (1990), Mester (1987), and Avkiran (2005) are among those who adopted the intermediation approach.

The DEA approach proposed for this study provides a non-stochastic measure of the banking units' relative efficiency compared to its competitors, assumed to be comparable and competing in the same market. We assume that the commercial banking system in the MENA region satisfies these assumptions. Moreover, by tracking the change of efficiency over time due to ownership changes (including M&A) using the MPI, one can detect any possible effect of M&A on the efficiency of banking units as a result of that event in particular.

3. Methodology and Data Description

The MPI is a comparative-statics-type analysis using a panel of efficiency coefficients obtained by using the DEA approach over several time periods. It is defined as the product of the two components named by Cooper et al. (2007) the catch-up and the frontier-shift. The catch-up (or recovery) term relates to the degree to which a banking unit improves or worsens its efficiency between two time periods. The frontier-shift (or innovation) term reflects on the other hand the change in the efficient frontiers between the same two time periods.

Hence, the research design calls for the assessment of the relative Technical Efficiency (TE) of each unit considered in the sample, and the identification of the main sources of inefficiency. The TE can be further decomposed into two efficiency indices to determine the sources of overall technical inefficiency. The first one is Pure Technical Efficiency (PTE), which determines the bank's efficiency relative to a frontier that exhibits constant as well as variable returns to scale. The other index, Scale Efficiency (SE), measures whether or not the bank operates at constant returns to scale (optimal scale) or at increasing or decreasing returns to scale (sub-optimal scale). Decomposing technical efficiency scores into pure technical efficiency and scale efficiency designates respectively what can be apprehended in the short-term and in the long-term.

The TE scores are obtained by running the original DEA model under the Constant Return to Scale (CRS) assumption, known as the CCR model by reference to Charnes, Cooper and Rhodes (1978). The PTE scores are obtained by running the DEA model under the assumption of Variable Return to Scale, known as BCC model by reference to Banker, Charnes and Cooper (1984). Any significant difference between the TE and PTE scores indicates the existence of scale inefficiency, a deviation from operating at the appropriate scale. It is then possible to decompose the TE into PTE and SE. The SE scores can be computed by means of the ratio of the overall technical efficiency to that of pure technical efficiency, as explained in Coelli et al. (1998) and Avkiran (2004). They report and discuss in their works that formally, the technical efficiency can be written as:

$$TE = PTE \times SE$$

As for the theoretical background, the intermediation approach described in details in (Berger & Humphrey, 1997); (Yildirim, 2002); (Avkiran, 2004); and (Kao & Liu, 2004) is adopted for this study. The banking sector in MENA is in fact still traditional in its form, considered by the authorities as the main channel for funds needed for ongoing development efforts. Hence the intermediation approach, claiming that commercial banks are mainly collecting funds and providing loans, is convenient for the study.

Two inputs are considered for the analysis, namely: interest expenses (X1), and operating expenses (X2). Interest expenses include expenses for deposits and other borrowed funds while operating expenses represent the costs of converting deposits into loans, including service charges, commissions, expenses of general management affairs, salaries, and other expenses. These inputs represent the costs of labor, administration, equipment and funds purchased for bank operations, for loans and for investment. The two outputs considered for the analysis are interest incomes (Y1), and operating incomes (Y2). Interest income includes interest on loans, and income from government securities. Non-interest income includes service charges on loans and transactions, commissions, and other operating income. These outputs represent bank revenues and the major profit generated by the banking service. Interest expenses can be seen as a proxy for deposits, and interest incomes as a proxy for loans. This makes the model in line with the intermediation approach traditionally using deposits, interest expenses and non-interest expenses as inputs and loans, interest incomes and non-interest incomes as outputs (see for example Yue, 1992; Yildirim, 2002; Avkiran 2004; Kao and Liu 2004).

A second model will be considered that includes an additional input, namely Loan Loss Provisions (X3), which can be considered as a proxy for "Non-Performing Loans". This model assesses the severity of the effect of these types of loans mainly on the efficiency of public sector banking units.

The MPI is then used to analyze the evolution of the efficiency over the four-year period considered, namely 2003-2006. This will provide insight about pre and post ownership changes including mergers/acquisitions for the banking units that went through such process.

The MPI is defined as the product of a catch-up and frontier-shift terms. It evaluates the productivity change of a banking unit between two time periods. The catch-up (or recovery) term relates to the degree which a DMU improves or worsens its efficiency, while the frontier-shift (or innovation) term reflects the change in the efficient frontiers between the two time periods.

The catch-up effect from period 1 to 2 is measured by the following formula:

$$Catch-up = \frac{\text{Efficiency of banking unit in period 2 with respect to period 2 frontier}}{\text{Efficiency of banking unit in period 1 with respect to period 1 frontier}}$$

The catch-up of each DMU is defined in the above formula by appropriate DEA models. (catch-up) > 1 indicates progress in relative efficiency from period 1 to 2, while (catch-up) = 1 and (catch-up) < 1 respectively indicate no change and regress in efficiency.

In addition to the catch-up term, one must take account of the frontier-shift (innovation) effect in order to fully evaluate the productivity change since the catch-up effect is

determined by the efficiencies being measured by the distances from the respective frontiers. This means that there are two terms in the frontier-shift term itself, explicitly:

$$Term_1 = \frac{\text{Efficiency of banking unit in period 1 with respect to period 1 frontier}}{\text{Efficiency of banking unit in period 1 with respect to period 2 frontier}}$$

$$Term_2 = \frac{\text{Efficiency of banking unit in period 2 with respect to period 1 frontier}}{\text{Efficiency of banking unit in period 2 with respect to period 2 frontier}}$$

The frontier-shift effect is defined as the geometric mean of these two terms, explicitly:

$$Frontier - shift = \sqrt{Term_1 x Term_2}$$

A (frontier-shift) > 1 indicates progress in the frontier technology around the corresponding DMU from period 1 to 2, while (frontier-shift) = 1 and (frontier-shift) < 1 respectively indicate the status quo and regression in the frontier technology.

The MPI is computed as the product of (catch-up) and (frontier-shift):

MI = (Catch-up) X (Frontier-shift).

where the first term represents the relative change in performance and the second represents the relative change in the frontier used to evaluate these performances.

The primary source of data for this study is the BankScope database. The initial sample contains 350 banks for which data was collected for the period 1990-2007. Unfortunately, the anomalies from which the data suffers constrained the researchers to restrict the sample to a total of 136 banks operating in 16 different MENA countries.

The period covered by the sample is 2003-2006. Among these banks, 10 went through a merger and/or acquisition during 2005 and 25 during 2006. Table 1 reports the number of banks per country where ownership has changed. The list of banks included in the sample is provided in Appendix 1. Though the sample did not consider all banks, the authors believe that it provides interesting cross-border benchmarks for local banks and hence this can help in improving their regional competitiveness in a continuously mutating financial sector, boosted by the regional economic boom and the need for sustainable development in which banks play a key role.

4. Empirical Results

Two types of models were solved using the DEA-Solver Software. The first type is the one dealing with panel data, namely the output oriented radial Malmquist model. The model was solved once under the Constant Return to Scale assumption, and once under the Variable Return to Scale assumption using the two inputs and the two outputs considered. Similarly, the model was solved including the additional input. The second class of models solved consists of output the oriented DEA model under the Constant Return to Scale assumption, known as CCR model, and the output oriented DEA model under the Variable Return to Scale assumption, known as the BCC model. For each year, the CCR and the BCC were solved once using two inputs and two outputs and once three inputs and two outputs. The choice of output oriented models is due to the existence of negative values for the additional input considered.

4.1 Malmquist Productivity Index Analysis

The MPI results are based on the output maximization model, which is also known as output-oriented approach. This model instructs the DEA model to reduce the outputs without reducing the inputs levels, which means, the focus is on raising productivity without increasing the resource base. Two sets of models are used, one with four variables and the second with five variables. The model with five variables includes the additional variable (Loan Loss Provisions) to capture its effect on the efficiency. Each of them is run under Constant Return to Scale (CRS) and Variable Return to Scale (VRS) assumptions. While the CRS is used to determine the overall technical efficiency, the VRS is used to capture the pure technical efficiency and hence scale efficiency can be determined. By comparing the results one can determine the impact of change in ownership including M&A on banking units' efficiency. Moreover, the results can suggest whether the improvement is in scale efficiency or in pure technical efficiency or in both. Table 2 provides a summary of the MPI analysis.

Notice that the four models consistently indicate a net improvement in the efficiency of banks considered in the sample. The results obtained from the first model, four variables under CRS assumption, indicate an overall average improvement of 7% in technical efficiency during the whole period, with an increase of 4% during the last year of the period. However, the results reveal that there is no exceptional increase in the overall banking efficiency during the last two years during which the changes in ownership, including M&A events, are reported.

The decomposition of the MPI indicates an increase of 8% in the catch-up and frontier-shift terms. Surprisingly, the increase in the last period is as high as 30% for both terms. The results of the model under the VRS indicate a similar level of increase, confirming that the improvement was mainly in pure technical efficiency. Another unexpected conclusion suggested by the results is the level of efficiency revealed by the second model, including the additional variable used as proxy for non-performing loans. That is, the recognition of such a variable improves the efficiency scores, and hence confirms the importance of transparency in banking accounting. These conclusions are confirmed by the results of individual banks, reported in Appendix 3, which went through ownership changes including M&A during the last two years of the period considered in the study. Unless there is a lagging effect in the future, these results confirm those reported in the literature about the limited effect of M&A on banking performance.

In conclusion, these results confirm the positive, though limited, impact of M&A on the overall efficiency of the commercial banking industry in MENA region, though one needs to be cautious since the sample did not include all banks operating in the region.

4.2 Overall Efficiency Analysis

Table 3 provides a summary of the average scores for the whole period considered in the analysis. It is interesting to notice the continuous improvement of average efficiency score and the high level in the average scale efficiency scores. This indicates that the technical efficiency of the whole commercial banking sector in the MENA region is improving. This can be, as discussed earlier, an indicator of a positive impact of ongoing local and regional concentration in the banking sector, among other factors.

Appendix 3 provides the overall ranking of the banks based on their efficiency scores. The results show an improvement in the ranking of most banks that had gone through M&A during 2005 and 2006, and this was confirmed by the results of the other models (not included in details in this document). Hence, with some exception, the positive impact of change in ownership including M&A on banking performance is confirmed.

Finally, the decomposition of the efficiency scores for the year 2006 shows, with very few exceptions, the substantial gain realized by those banks that have undergone M&A in terms of scale efficiency, confirming the positive substantial impact of M&A.

5. Policy Implications and Conclusions

A central component of any national financial system is its banking system. It constitutes the main channel for in-border and cross-border circulation of funds, and is the major pillar in the development efforts, particularly in developing countries. The level of performance of any national banking system, seen mainly through its productivity level, indicates the healthiness and the competitiveness of the national financial system.

Both the dynamics and vitality of the financial industry increase the vulnerability of financial systems, and crises are not rare events any more. Also, the liberalization of the international economy facilitates the cross-border contamination of financial crises. The Mexican crisis and its impact on the American financial system, the Asian, Russian and the Japanese banking crises and lately the British and the Sub-prime financial crises**,** and their respective regional and international impacts on financial systems exemplify the vulnerability of the current financial system worldwide. This vulnerability is even aggravated by the ongoing M&A since they may create low-performing uncontrollable giants in the banking industry that may increase the public burden in the region in case of failure. The "too big to fail" principle is not valid anymore, as exemplified by several cases.

Hence, insights about the performance of banking units with regional benchmarks are of great importance for public authorities and regulating institutions. While financial reports provide information about the short-run performance, this study aims to provide information about the long-run performance of the banking units in the MENA region. To the best of the authors' knowledge, this issue is not addressed in the existing published literature.

In conclusion, the results of this study confirm the positive — though limited — impact of change in ownership including M&A on the overall efficiency of the commercial banking industry in MENA region, though one needs to be cautious since the sample did not include all banks operating in the region.

The results confirm the positive impact of M&A on banking units that have gone through with either in particular and on the banking sector in the MENA region in general. However, by looking into the decomposition of the MPI and the technical efficiency scores, one can conclude that the impact of change in ownership were more concentrated in the scale efficiency rather than in the pure technical efficiency particularly for the year 2006. However, one needs to be aware of the limitations of these conclusions since there might be a lagging effect — positive or negative — during the coming years.

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Appendix 1: List of Banks Included in the Sample

Bank	Country
Abu Dhabi Commercial	UAE
Ahli Bank QSC	Qatar
Ahli United Bank BSC	Bahrain
Al Ahli Bank of Kuwait	Kuwait
Al Khalij Commercial Bank	Qatar
Al Watany Bank of Egypt	Egypt
Amen Bank	Tunisia
Arab African International Bank	Egypt
Arab Bank Group	Jordan
Arab Bank Plc	Jordan
Arab Banking Corporation - Algeria	Algeria
Arab Banking Corporation - Tunisie	Tunisia
Arab Banking Corporation (Jordan)	Jordan
Arab Banking Corporation BSC	Bahrain
Arab International Bank	Egypt
Arab National Bank	Saudi Arabia
Arab Tunisian Bank	Tunisia
B.L.C. Bank S.A.L	Lebanon
Bahraini Saudi Bank (The) BSC	Bahrain
Bank Al-Jazira	Saudi Arabia
Bank Audi SAL - Audi Saradar Group	Lebanon
Bank Dhofar SAOG	Oman
Bank Muscat SAOG	Oman
Bank of Alexandria	Egypt
Bank of Beirut S.A.L.	Lebanon
Bank of Commerce & Development	Libya
Bank of Jordan Plc	Jordan
Bank of Kuwait & The Arab World SAL	Kuwait
Bank of Kuwait & The Middle East (The)	Kuwait
Bank Refah	Iran
Bank Saudi Faransi	Saudi Arabia
Bankmed, sal	Lebanon
Banque Al Baraka d'Algerie-Albaraka of Algeria	Algeria
Banque BEMO	Lebanon
Banque Centrale Populaire	Morocco
Banque de l'Habitat	Tunisia
Banque de l'Industrie et du Travail SAL	Lebanon
Banque de Tunisie	Tunisia
Banque du Caire SAE	Egypt
Banque Franco-Tunisienne	Tunisia
Banque Internationale Arabe de Tunisie - BIAT	Tunisia
Banque Libano-Francaise	Lebanon
Banque Marocaine du Commerce Extérieur - BMCE (Agregee)	Morocco
Banque Marocaine pour le Commerce et l'Industrie BMCI	Morocco
Banque Misr Liban	Egypt
Banque Misr SAE	Egypt

Banque Nationale Agricole	Tunisia
Banque Nationale d'Algérie	Algeria
Banque Pharaon & Chiha SAL	Lebanon
Barclays Bank	Egypt
BBAC Sal	Lebanon
BBK BSC	Bahrain
BMCE Bank	Morocco
BNP Paribas	Egypt
Burgan Bank SAK	Kuwai
Byblos Bank S.A.L.	Lebanon
Cairo Amman Bank	Egypt
Capital Bank of Jordan	Jordan
Commercial Bank International	UAE
Commercial Bank of Dubai	UAE
Commercial Bank of Kuwait SAK (The)	Kuwait
Commercial Bank of Qatar	Qatar
Commercial International Bank	Egypt
Credit Agricole Du Maroc	Morocco
Credit Agricole Egypt	Egypt
Credit du Maroc	Morocco
Credit Libanais S.A.L.	Lebanon
Credit Populair D'Algeria	Algeria
Credit Populair Du Maroc	Morocco
CreditBank SAL	Lebanon
Doha Bank	Qatar
Egyptian Gulf Bank	Egypt
Emirates Bank International	UAE
EN Bank-Eghtesad Novain Ban	Iran
First Gulf Bank	UAE
First National Bank SAL	Lebanon
Fransabank SAL	Lebanon
Gulf Bank KSC (The)	Kuwait
Housing Bank for Trade and Finance	Jordan
HSBC Bank Egypt S A E	Egypt
International Bank of Qatar Q.S.C.	Qatar
Jammal Trust Bank SAL	Lebanon
Jordan Ahli Bank Plc	Jordan
Jordan Commercial Bank	Jordan
Jordan Kuwait Bank	Jordan
Karafarin Bank	Iran
Lebanese Canadian Bank Sal	Lebanon
Lebanese Swiss Bank SAL (The)	Lebanon
Lebanon & Gulf Bank S.A.L.	Lebanon
Mashreqbank	UAE
MEAB SAL	Lebanon
National Bank for Development	Egypt
National Bank of Abu Dhabi	UAE
National Bank of Bahrain	Bahrain
National Bank of Egypt	Egypt
National Bank of Fujairah	UAE

National Bank of Kuwait S.A.K.	Kuwait
National Bank of Oman (SAOG)	Oman
National Bank of Umm Al-Qaiwain	UAE
National Bank of Yemen	Yemen
National Commercial Bank (The)	Saudi Arabia
Near East Commercial Bank SAL	Lebanon
North Africa Commercial Bank SAL	Lebanon
North Africa International Bank - NAIB	Tunisia
Société Générale de Banque au Liban - SGBL	Lebanon
Oman Arab Bank SAOG	Oman
Oman International Bank	Oman
Parsian Bank	Iran
Piraeus Bank Egypt SAE	Egypt
Qatar Development Bank Q.S.C.C.	Qatar
Qatar National Bank	Qatar
RAKBANK-National Bank of Ras Al-Khaimah (P.S.C.) (The)	UAE
Riyad Bank	Saudi Arabia
Sahara Bank	Libya
Saman Bank	Iran
Samba Financial Group	Saudi Arabia
Saudi British Bank (The)	Saudi Arabia
Saudi Hollandi Bank	Saudi Arabia
Société Arabe Internationale de Banque	Egypt
Société générale de Banque-Jordanie	Jordan
Société Générale Marocaine de Banques	Morocco
Société Nouvelle de la Banque de Syrie et du Liban	Lebanon
Société Tunisienne de Banque	Tunisia
Suez Canal Bank	Egypt
Syrian Lebanese Commercial Bank SAL	Syria
TAIB Bank B.S.C.	Bahrain
Unicredit Banca di Roma SpA	Lebanon
Union Internationale de Banques	Tunisia
Union National Bank	UAE
Union National Bank - Egypt SAE	Egypt
United Arab Bank PJSC	UAE
Yemen Commercial Bank	Yemen
Yemen Gulf Bank	Yemen
Yemen Kuwait Bank for Trade and Investment	Yemen
Attijari Bank	Tunisia
Attijariwafa Bank	Morocco

Appendix 2: Malmquist Index Decomposition for the Output-Oriented Model with 2 Inputs and 2 Outputs under Constant Return to Scale Assumption

(banks that went through mergers and/or acquisitions are highlighted in yellow)

Catch-up	2003=>2004	2004=>2005	2005=>2006	Average
B001	1.37	0.87	1.07	1.10
B002	1.05	0.89	1.23	1.06
B004	0.88	1.09	1.33	1.10
B005	1.10	0.92	1.11	1.04
B006	1.27	0.96	1.41	1.21
B007	0.90	0.97	1.48	1.11
B008	1.03	0.77	1.82	1.21
B009	1.16	1.04	0.79	1.00
B010	1.03	0.94	1.37	1.11
B011	1.04	0.87	1.53	1.15
B012	1.27	1.84	1.00	1.37
B013	0.82	0.33	3.96	1.70
B014	0.99	0.99	1.34	1.11
B015	1.31	1.02	1.23	1.18
B016	0.84	0.98	1.20	1.01
B017	1.08	0.83	1.42	1.11
B018	1.13	0.82	1.37	1.11
B021	1.43	0.68	1.31	1.14
B022	1.04	0.74	1.46	1.08
B023	1.12	1.22	1.61	1.31
B025	1.02	0.93	1.20	1.05
B026	1.01	0.81	1.55	1.12
B027	1.05	0.74	1.49	1.09
B028	0.98	0.69	1.10	0.92
B029	0.98	0.91	1.20	1.03
B030	0.85	0.81	0.89	0.85
B032	1.18	0.78	1.55	1.17

Frontier	2003=>2004	2004=>2005	2005=>2006	Average
B001	1.04	1.09	0.89	1.01
B002	1.08	1.14	0.85	1.03
B004	1.03	1.19	0.88	1.03
B005	0.97	1.18	0.85	1.00
B006	1.02	1.23	0.83	1.03
B007	0.94	1.22	0.83	1.00
B008	0.97	1.26	0.76	1.00
B009	0.99	1.15	0.83	0.99
B010	1.03	1.17	0.82	1.01
B011	1.01	1.26	0.79	1.02
B012	1.03	1.34	0.57	0.98
B013	0.97	1.18	0.68	0.94
B014	1.05	1.33	0.80	1.06
B015	0.94	1.15	0.91	1.00
B016	1.08	1.25	0.85	1.06
B017	1.01	1.28	0.80	1.03
B018	1.01	1.29	0.78	1.03
B021	0.92	1.15	0.85	0.97
B022	1.03	1.32	0.77	1.04
B023	0.97	1.54	0.96	1.15
B025	0.91	1.17	0.85	0.98
B026	1.01	1.33	0.77	1.03
B027	1.03	1.30	0.77	1.03
B028	0.91	1.13	0.89	0.98
B029	0.90	1.14	0.89	0.98
B030	1.29	1.10	0.74	1.04
B032	0.98	1.39	0.72	1.03

Malmquist	2003=>2004	2004=>2005	2005=>2006	Average
B001	1.43	0.95	0.95	1.11
B002	1.14	1.01	1.05	1.07
B004	0.90	1.29	1.18	1.13
B005	1.06	1.08	0.95	1.03
B006	1.29	1.19	1.16	1.21
B007	0.84	1.18	1.22	1.08
B008	1.00	0.97	1.38	1.12
B009	1.15	1.19	0.65	1.00
B010	1.06	1.10	1.12	1.10
B011	1.05	1.09	1.21	1.12
B012	1.31	2.46	0.57	1.45
B013	0.80	0.39	2.69	1.29
B014	1.04	1.32	1.07	1.14
B015	1.23	1.18	1.11	1.17
B016	0.90	1.23	1.02	1.05
B017	1.09	1.06	1.14	1.09
B018	1.14	1.06	1.07	1.09
B021	1.31	0.78	1.11	1.07
B022	1.07	0.99	1.13	1.06
B023	1.08	1.88	1.54	1.50
B025	0.94	1.09	1.02	1.02
B026	1.02	1.08	1.19	1.09
B027	1.08	0.96	1.14	1.06
B028	0.89	0.78	0.98	0.88
B029	0.88	1.03	1.06	0.99
B030	1.10	0.89	0.66	0.88
B032	1.16	1.08	1.12	1.12

B033	1.07	0.80	1.14	1.00	B033	0.92	1.16	0.83	0.97	B033	0.99	0.93	0.95	0.95
B034	1.07	0.98	1.30	1.12	B034	0.99	1.18	0.87	1.01	B034	1.06	1.15	1.13	1.11
B036	1.64	1.00	0.95	1.20	B036	1.75	0.34	0.57	0.89	B036	2.88	0.34	0.54	1.25
B037	1.02	0.86	1.24	1.04	B037	1.05	1.14	0.89	1.03	B037	1.08	0.98	1.11	1.06
B038	1.02	0.85	1.11	0.99	B038	0.92	1.11	0.90	0.98	B038	0.94	0.94	1.00	0.96
B039	0.99	0.83	1.30	1.04	B039	1.02	1.34	0.75	1.04	B039	1.01	1.10	0.98	1.03
B040	1.02	0.85	1.30	1.06	B040	0.94	1.21	0.83	0.99	B040	0.95	1.03	1.07	1.02
B041	0.94	1.33	0.85	1.04	B041	0.92	1.14	0.93	0.99	B041	0.86	1.51	0.79	1.05
B042	0.96	0.72	1.48	1.05	B042	1.00	1.33	0.76	1.03	B042	0.95	0.96	1.12	1.01
B043	1.15	0.82	1.29	1.09	B043	0.93	1.19	0.85	0.99	B043	1.07	0.97	1.09	1.05
B044	1.00	0.79	1.23	1.01	B044	1.01	1.30	0.75	1.02	B044	1.01	1.03	0.93	0.99
B045	0.83	0.73	1.82	1.13	B045	0.94	1.24	0.82	1.00	B045	0.78	0.90	1.49	1.06
B047	0.89	0.84	1.45	1.06	B047	1.02	1.32	0.77	1.04	B047	0.92	1.11	1.12	1.05
B048	0.92	0.78	1.24	0.98	B048	1.02	1.32	0.79	1.05	B048	0.94	1.03	0.98	0.98
B049	1.07	0.87	1.22	1.05	B049	0.92	1.16	0.86	0.98	B049	0.98	1.02	1.05	1.02
B050	1.16	0.75	1.40	1.10	B050	0.94	1.39	0.72	1.02	B050	1.10	1.04	1.00	1.05
B051	1.01	0.78	1.28	1.02	B051	1.03	1.29	0.78	1.03	B051	1.03	1.01	1.00	1.01
B052	1.12	0.87	1.08	1.02	B052	0.91	1.11	0.88	0.97	B052	1.02	0.97	0.95	0.98
B053	1.10	0.66	1.42	1.06	B053	0.92	1.19	0.85	0.99	B053	1.01	0.79	1.21	1.00
B054	1.07	0.69	1.40	1.05	B054	1.01	1.37	0.75	1.04	B054	1.09	0.94	1.05	1.02
B055	1.49	1.10	1.00	1.20	B055	1.02	1.37	0.77	1.05	B055	1.51	1.51	0.77	1.26
B056	0.90	0.84	1.36	1.03	B056	0.99	1.26	0.79	1.01	B056	0.89	1.05	1.07	1.01
B057	1.51	1.13	0.88	1.18	B057	1.05	1.09	0.91	1.02	B057	1.57	1.23	0.81	1.21
B058	1.19	0.92	1.17	1.09	B058	0.91	1.11	0.93	0.99	B058	1.09	1.02	1.09	1.07
B059	0.95	0.98	1.27	1.07	B059	1.05	1.24	0.83	1.04	B059	1.00	1.21	1.05	1.09
B062	1.08	0.74	1.51	1.11	B062	0.96	1.37	0.70	1.01	B062	1.04	1.02	1.06	1.04
B063	2.09	0.89	1.34	1.44	B063	0.97	1.21	0.83	1.00	B063	2.03	1.08	1.11	1.41
B065	1.49	0.96	1.21	1.22	B065	0.96	1.18	0.87	1.00	B065	1.43	1.13	1.05	1.20
B066	1.09	0.89	1.17	1.05	B066	0.92	1.11	0.91	0.98	B066	1.00	0.99	1.06	1.02
B067	1.31	0.89	1.12	1.11	B067	0.94	1.44	0.72	1.04	B067	1.23	1.29	0.81	1.11
B068	1.04	1.03	1.25	1.11	B068	1.18	1.16	0.86	1.06	B068	1.24	1.18	1.07	1.16
B069	0.78	0.93	1.09	0.93	B069	1.01	1.43	0.76	1.07	B069	0.79	1.33	0.83	0.98
B070	1.00	0.74	1.24	0.99	B070	0.91	1.33	0.78	1.01	B070	0.91	0.98	0.98	0.96

B071	1.09	0.90	1.27	1.09	B071	1.17	1.15	0.83	1.05	B071	1.27	1.03	1.06	1.12
B072	1.03	0.91	1.06	1.00	B072	1.08	1.13	0.83	1.01	B072	1.10	1.03	0.88	1.01
B074	1.14	0.73	1.32	1.06	B074	0.96	1.24	0.79	1.00	B074	1.09	0.91	1.05	1.01
B075	1.00	0.74	1.16	0.96	B075	1.01	1.34	0.79	1.05	B075	1.01	0.99	0.92	0.97
B076	1.07	0.95	1.28	1.10	B076	0.91	1.19	0.82	0.97	B076	0.98	1.14	1.05	1.05
B077	1.00	0.80	1.51	1.10	B077	0.98	1.30	0.70	0.99	B077	0.98	1.05	1.05	1.03
B078	1.10	0.86	1.26	1.07	B078	0.91	1.17	0.85	0.98	B078	1.00	1.01	1.07	1.03
B079	0.53	0.87	2.27	1.23	B079	0.97	1.30	0.76	1.01	B079	0.51	1.14	1.72	1.12
B080	1.26	0.76	1.28	1.10	B080	1.03	1.31	0.77	1.04	B080	1.29	0.99	0.99	1.09
B081	1.05	0.72	1.42	1.06	B081	0.92	1.19	0.84	0.98	B081	0.97	0.86	1.19	1.00
B082	1.50	1.05	0.98	1.18	B082	1.01	1.20	0.87	1.03	B082	1.51	1.25	0.86	1.21
B083	1.82	0.77	1.44	1.35	B083	1.03	1.19	0.80	1.01	B083	1.88	0.92	1.15	1.32
B084	0.93	0.98	1.03	0.98	B084	1.09	1.14	0.86	1.03	B084	1.00	1.11	0.88	1.00
B085	0.96	1.04	1.00	1.00	B085	0.90	1.21	0.91	1.01	B085	0.86	1.26	0.91	1.01
B088	1.00	1.55	0.99	1.18	B088	0.98	1.17	0.96	1.04	B088	0.98	1.81	0.95	1.25
B089	1.19	0.80	1.19	1.06	B089	0.90	1.11	0.92	0.98	B089	1.07	0.89	1.09	1.02
B090	1.13	0.71	1.26	1.03	B090	0.91	1.13	0.89	0.98	B090	1.03	0.80	1.12	0.98
B092	1.14	0.71	1.36	1.07	B092	1.10	1.10	0.86	1.02	B092	1.26	0.78	1.17	1.07
B094	1.17	0.89	1.54	1.20	B094	0.97	1.32	0.76	1.02	B094	1.14	1.17	1.17	1.16
B095	1.12	0.99	1.50	1.20	B095	0.98	1.20	0.87	1.02	B095	1.10	1.18	1.31	1.20
B098	1.09	0.94	1.13	1.06	B098	0.97	1.28	0.80	1.02	B098	1.06	1.21	0.91	1.06
B101	1.04	0.78	1.36	1.06	B101	0.99	1.24	0.80	1.01	B101	1.03	0.96	1.08	1.03
B103	1.02	0.95	1.46	1.14	B103	1.02	1.33	0.75	1.03	B103	1.04	1.26	1.09	1.13
B104	1.07	0.94	1.58	1.20	B104	0.98	1.57	0.73	1.09	B104	1.04	1.48	1.16	1.23
B105	1.09	0.84	1.46	1.13	B105	1.11	1.14	0.83	1.03	B105	1.20	0.96	1.21	1.13
B106	1.00	0.92	1.03	0.98	B106	0.90	1.13	0.95	0.99	B106	0.90	1.04	0.98	0.97
B107	1.46	0.93	1.07	1.15	B107	0.90	1.12	0.94	0.99	B107	1.32	1.04	1.01	1.12
B108	0.90	1.04	1.10	1.01	B108	0.91	1.12	0.92	0.98	B108	0.82	1.17	1.01	1.00
B109	1.14	0.93	1.27	1.11	B109	0.92	1.12	0.91	0.98	B109	1.05	1.05	1.15	1.08
B110	0.86	1.05	1.11	1.01	B110	1.09	1.20	0.84	1.04	B110	0.94	1.26	0.93	1.04
B111	1.07	0.88	1.14	1.03	B111	0.90	1.11	0.92	0.98	B111	0.96	0.98	1.05	1.00
B112	1.42	0.84	0.86	1.04	B112	0.91	1.11	0.87	0.96	B112	1.29	0.93	0.75	0.99
B113	0.92	1.23	1.03	1.06	B113	1.11	1.07	0.95	1.04	B113	1.02	1.32	0.98	1.11

B114	1.12	0.83	1.29	1.08	B114	1.02	1.26	0.83	1.04	B114	1.14	1.05	1.07	1.09
B115	1.00	0.81	1.21	1.01	B115	0.92	1.16	0.87	0.98	B115	0.92	0.94	1.05	0.97
B116	1.03	0.83	1.35	1.07	B116	1.04	1.22	0.85	1.04	B116	1.07	1.01	1.15	1.07
B117	0.90	0.91	1.14	0.98	B117	1.13	1.15	0.82	1.03	B117	1.02	1.05	0.93	1.00
B118	1.34	1.06	1.52	1.30	B118	1.07	1.27	0.77	1.04	B118	1.43	1.34	1.16	1.31
B119	1.16	0.90	1.06	1.04	B119	0.99	1.42	0.77	1.06	B119	1.15	1.29	0.82	1.08
B120	1.08	1.02	0.98	1.03	B120	0.92	1.14	0.86	0.97	B120	0.99	1.17	0.85	1.00
B121	1.02	0.83	1.20	1.02	B121	0.98	1.27	0.78	1.01	B121	1.00	1.05	0.94	1.00
B123	0.86	0.80	1.00	0.89	B123	0.94	1.21	0.80	0.98	B123	0.81	0.97	0.80	0.86
B124	1.02	0.91	1.31	1.08	B124	1.01	1.24	0.85	1.03	B124	1.03	1.14	1.11	1.09
B125	0.79	0.76	1.65	1.07	B125	0.98	1.50	0.65	1.04	B125	0.77	1.14	1.07	0.99
B126	0.97	0.83	1.30	1.03	B126	0.97	1.25	0.78	1.00	B126	0.94	1.04	1.01	1.00
B127	1.17	0.79	1.31	1.09	B127	0.93	1.40	0.72	1.02	B127	1.09	1.11	0.95	1.05
B128	1.15	1.07	1.45	1.22	B128	0.99	1.32	0.76	1.02	B128	1.13	1.41	1.11	1.22
B129	0.66	1.40	1.15	1.07	B129	0.95	1.12	0.98	1.02	B129	0.63	1.57	1.13	1.11
B130	1.01	0.73	1.16	0.97	B130	0.91	1.20	0.79	0.97	B130	0.92	0.88	0.91	0.90
B131	1.00	0.42	1.89	1.10	B131	1.20	0.80	0.59	0.86	B131	1.20	0.33	1.11	0.88
B132	1.12	0.86	1.23	1.07	B132	1.01	1.11	0.91	1.01	B132	1.13	0.95	1.12	1.07
B133	1.02	0.68	1.32	1.01	B133	0.93	1.37	0.73	1.01	B133	0.95	0.94	0.97	0.95
B134	1.21	0.74	1.24	1.07	B134	0.96	1.29	0.78	1.01	B134	1.17	0.96	0.97	1.03
B135	2.01	0.58	1.95	1.51	B135	1.03	1.45	0.65	1.04	B135	2.07	0.84	1.26	1.39
B136	1.16	0.84	0.99	1.00	B136	0.92	1.11	0.93	0.99	B136	1.06	0.93	0.92	0.97
B137	1.38	0.83	1.32	1.18	B137	0.99	1.22	0.81	1.00	B137	1.36	1.01	1.06	1.15
B138	1.06	0.73	1.29	1.03	B138	1.02	1.24	0.79	1.01	B138	1.08	0.91	1.02	1.00
B139	0.94	0.90	1.05	0.96	B139	1.03	1.21	0.81	1.02	B139	0.97	1.09	0.85	0.97
B140	1.12	0.91	1.63	1.22	B140	1.01	1.22	0.84	1.03	B140	1.13	1.11	1.38	1.21
B142	1.35	0.76	1.51	1.21	B142	0.98	1.39	0.73	1.03	B142	1.32	1.06	1.10	1.16
B143	0.94	0.79	1.55	1.09	B143	1.03	1.33	0.67	1.01	B143	0.97	1.05	1.03	1.02
B144	0.84	1.01	1.22	1.02	B144	0.91	1.13	0.93	0.99	B144	0.77	1.15	1.13	1.01
B145	0.97	0.80	1.27	1.01	B145	0.97	1.28	0.76	1.00	B145	0.95	1.02	0.96	0.98
B146	1.27	0.29	2.54	1.37	B146	0.91	1.22	0.82	0.98	B146	1.15	0.35	2.09	1.20
B147	1.06	0.74	0.91	0.90	B147	1.25	1.11	0.76	1.04	B147	1.33	0.82	0.70	0.95
B148	1.36	0.86	1.22	1.15	B148	1.11	1.62	0.63	1.12	B148	1.51	1.39	0.77	1.22

B151	1.41	0.73	1.37	1.17	B151	1.01	1.31	0.77	1.03	B151	1.43	0.96	1.06	1.15
B152	0.92	0.79	1.23	0.98	B152	1.02	1.33	0.80	1.05	B152	0.93	1.05	0.98	0.99
B153	0.88	1.04	1.21	1.04	B153	1.03	1.14	0.89	1.02	B153	0.90	1.18	1.08	1.05
B154	1.23	0.70	0.88	0.94	B154	0.92	1.14	0.82	0.96	B154	1.13	0.79	0.72	0.88
B155	1.07	0.88	1.21	1.05	B155	0.92	1.27	0.79	1.00	B155	0.99	1.12	0.96	1.02
B156	1.02	0.82	1.47	1.10	B156	1.01	1.30	0.77	1.03	B156	1.03	1.07	1.12	1.08
B157	1.05	0.74	1.25	1.01	B157	1.02	1.32	0.78	1.04	B157	1.08	0.98	0.97	1.01
B158	1.40	0.70	1.22	1.10	B158	0.93	1.14	0.84	0.97	B158	1.31	0.79	1.02	1.04
B159	0.94	0.70	0.75	0.80	B159	1.01	1.35	0.72	1.03	B159	0.96	0.94	0.53	0.81
B160	0.99	0.86	1.35	1.07	B160	1.02	1.34	0.76	1.04	B160	1.01	1.16	1.02	1.06
Average	1.10	0.87	1.30	1.09	Average	1.00	1.23	0.81	1.01	Average	1.10	1.07	1.05	1.07
Max	2.09	1.84	3.96	1.70	Max	1.75	1.62	0.98	1.15	Max	2.88	2.46	2.69	1.50
Min	0.53	0.29	0.75	0.80	Min	0.90	0.34	0.57	0.86	Min	0.51	0.33	0.53	0.81
SD	0.22	0.18	0.34	0.12	SD	0.10	0.14	0.08	0.04	SD	0.27	0.25	0.24	0.11

Appendix 3: Comparative Results of Efficiency Scores and Ranking Obtained by Running the Output-Oriented Model with 2 Inputs and 2 Outputs under Constant Return to Scale Assumption

(banks that went through mergers and/or acquisitions are highlighted in yellow)

Bank	2003		2004		2005		2006	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score
B001	38	0.6683	12	0.9161	17	0.8002	33	0.8550
B002	30	0.7268	36	0.7659	33	0.6802	36	0.8383
B004	68	0.5858	103	0.5147	68	0.5613	53	0.7488
B005	35	0.6906	37	0.7605	31	0.6984	48	0.7744
B006	85	0.5333	56	0.6750	39	0.6494	22	0.9127
B007	107	0.4782	129	0.4281	106	0.4133	94	0.6113
B008	103	0.4907	107	0.5044	114	0.3892	67	0.7075
B009	97	0.5170	74	0.6019	45	0.6262	118	0.4940
B010	88	0.5293	97	0.5432	79	0.5110	69	0.6979
B011	95	0.5201	98	0.5412	86	0.4683	63	0.7185
B012	124	0.4273	96	0.5446	1	1.0000	1	1.0000
B013	115	0.4542	133	0.3722	136	0.1228	121	0.4870
B014	77	0.5590	93	0.5542	72	0.5498	58	0.7365
B015	117	0.4531	83	0.5922	54	0.6035	57	0.7396
B016	82	0.5425	122	0.4548	96	0.4467	112	0.5380
B017	40	0.6648	45	0.7155	59	0.5944	34	0.8443
B018	113	0.4563	104	0.5142	103	0.4199	102	0.5759
B021	90	0.5276	39	0.7545	80	0.5104	77	0.6696
B022	45	0.6506	55	0.6750	81	0.5029	59	0.7348
B023	112	0.4571	105	0.5106	50	0.6215	1	1.0000
B025	71	0.5793	82	0.5932	71	0.5531	78	0.6660
B026	33	0.6964	49	0.7002	65	0.5693	27	0.8828
B027	74	0.5695	79	0.5957	98	0.4428	81	0.6601
B028	61	0.6075	78	0.5961	107	0.4116	125	0.4509
B029	32	0.6982	54	0.6847	49	0.6217	55	0.7437
B030	9	0.8995	35	0.7683	48	0.6218	108	0.5556
B032	99	0.5055	77	0.5984	88	0.4645	62	0.7206

B033	37	0.6697	44	0.7193	63	0.5733	84	0.6522
B034	63	0.6058	61	0.6485	42	0.6366	40	0.8277
B036	60	0.6081	1	1.0000	1	1.0000	18	0.9460
B037	10	0.8948	11	0.9168	18	0.7924	9	0.9850
B038	46	0.6486	57	0.6632	67	0.5621	92	0.6258
B039	42	0.6622	59	0.6540	73	0.5408	68	0.7032
B040	96	0.5184	99	0.5275	93	0.4499	100	0.5837
B041	69	0.5855	95	0.5509	27	0.7312	93	0.6239
B042	93	0.5258	108	0.5037	120	0.3642	111	0.5392
B043	83	0.5352	69	0.6152	82	0.5023	85	0.6497
B044	55	0.6170	68	0.6173	84	0.4897	97	0.6036
B045	98	0.5169	128	0.4308	130	0.3126	106	0.5688
B047	126	0.4138	134	0.3699	131	0.3101	126	0.4496
B048	104	0.4878	125	0.4479	123	0.3494	129	0.4323
B049	58	0.6115	60	0.6531	64	0.5708	70	0.6969
B050	130	0.3987	120	0.4634	125	0.3477	120	0.4873
B051	50	0.6274	64	0.6306	83	0.4949	90	0.6335
B052	57	0.6153	53	0.6886	56	0.6012	86	0.6496
B053	108	0.4782	100	0.5272	122	0.3498	116	0.4983
B054	111	0.4580	110	0.4900	127	0.3383	124	0.4735
B055	59	0.6085	13	0.9068	1	1.0000	1	1.0000
B056	54	0.6185	92	0.5565	87	0.4656	91	0.6327
B057	80	0.5528	24	0.8323	6	0.9446	37	0.8359
B058	49	0.6298	40	0.7511	32	0.6890	43	0.8046
B059	53	0.6205	85	0.5907	62	0.5775	60	0.7341
B062	122	0.4307	119	0.4653	126	0.3455	114	0.5220
B063	136	0.2388	109	0.4992	97	0.4460	98	0.5982
B065	100	0.4990	41	0.7425	29	0.7091	32	0.8612
B066	44	0.6554	46	0.7138	43	0.6338	56	0.7421
B067	114	0.4559	80	0.5956	75	0.5308	99	0.5939
B068	39	0.6656	50	0.6946	28	0.7123	24	0.8939
B069	84	0.5352	130	0.4159	115	0.3888	130	0.4243
B070	1	1.0000	1	1.0000	25	0.7384	21	0.9184

B071	20	0.7898	21	0.8576	20	0.7682	10	0.9794
B072	19	0.7929	26	0.8128	22	0.7412	47	0.7827
B074	79	0.5563	63	0.6333	89	0.4644	95	0.6111
B075	91	0.5270	101	0.5252	116	0.3871	127	0.4481
B076	86	0.5307	88	0.5673	74	0.5399	72	0.6920
B077	76	0.5594	90	0.5593	94	0.4486	75	0.6757
B078	78	0.5582	71	0.6118	76	0.5259	80	0.6615
B079	8	0.9134	112	0.4842	102	0.4235	12	0.9635
B080	51	0.6261	31	0.7879	58	0.5977	50	0.7650
B081	67	0.5946	65	0.6263	91	0.4527	88	0.6418
B082	73	0.5735	20	0.8596	10	0.8997	26	0.8837
B083	134	0.3246	84	0.5921	90	0.4568	82	0.6585
B084	24	0.7444	51	0.6891	36	0.6720	73	0.6891
B085	1	1.0000	9	0.9597	1	1.0000	1	1.0000
B088	62	0.6074	73	0.6076	7	0.9400	20	0.9291
B089	47	0.6474	34	0.7696	52	0.6163	61	0.7339
B090	22	0.7552	22	0.8569	53	0.6059	51	0.7617
B092	12	0.8731	8	0.9964	30	0.7054	14	0.9609
B094	81	0.5472	62	0.6420	66	0.5682	29	0.8765
B095	87	0.5299	81	0.5939	60	0.5861	28	0.8776
B098	18	0.8164	15	0.8911	13	0.8399	16	0.9532
B101	105	0.4848	106	0.5057	111	0.3950	113	0.5371
B103	129	0.4041	131	0.4110	112	0.3908	105	0.5720
B104	128	0.4061	127	0.4327	108	0.4081	87	0.6452
B105	31	0.7170	33	0.7790	37	0.6578	13	0.9634
B106	1	1.0000	1	1.0000	8	0.9195	17	0.9502
B107	65	0.5985	19	0.8733	15	0.8125	31	0.8668
B108	21	0.7880	47	0.7107	23	0.7404	42	0.8152
B109	89	0.5277	75	0.6011	69	0.5607	66	0.7106
B110	43	0.6611	87	0.5674	57	0.5981	79	0.6619
B111	41	0.6632	48	0.7079	46	0.6255	64	0.7161
B112	121	0.4325	70	0.6139	77	0.5142	128	0.4433
B113	14	0.8623	30	0.7930	5	0.9749	1	1.0000

B114	29	0.7271	25	0.8137	35	0.6744	30	0.8676
B115	70	0.5838	86	0.5847	85	0.4741	103	0.5741
B116	27	0.7360	38	0.7559	47	0.6247	35	0.8420
B117	5	0.9494	23	0.8544	19	0.7803	25	0.8889
B118	135	0.2518	136	0.3362	121	0.3560	110	0.5401
B119	15	0.8612	1	1.0000	9	0.9046	15	0.9556
B120	26	0.7387	29	0.7955	14	0.8130	44	0.7992
B121	11	0.8831	14	0.8997	21	0.7443	23	0.8965
B123	75	0.5659	111	0.4882	113	0.3904	132	0.3898
B124	109	0.4749	114	0.4829	99	0.4413	101	0.5764
B125	102	0.4932	132	0.3905	133	0.2975	119	0.4905
B126	101	0.4970	113	0.4833	110	0.4007	115	0.5194
B127	52	0.6234	43	0.7316	61	0.5816	52	0.7610
B128	94	0.5248	76	0.6010	41	0.6444	19	0.9371
B129	6	0.9437	67	0.6214	11	0.8685	1	1.0000
B130	119	0.4486	123	0.4518	129	0.3292	133	0.3819
B131	1	1.0000	1	1.0000	104	0.4164	46	0.7852
B132	16	0.8424	10	0.9466	16	0.8114	1	1.0000
B133	66	0.5950	72	0.6085	105	0.4155	109	0.5470
B134	36	0.6701	27	0.8105	55	0.6026	54	0.7488
B135	120	0.4403	17	0.8861	78	0.5124	1	1.0000
B136	13	0.8629	1	1.0000	12	0.8407	39	0.8298
B137	48	0.6461	16	0.8905	24	0.7388	11	0.9735
B138	17	0.8294	18	0.8826	40	0.6467	38	0.8333
B139	28	0.7322	52	0.6886	51	0.6198	83	0.6533
B140	123	0.4285	115	0.4801	100	0.4361	65	0.7126
B142	127	0.4124	91	0.5578	101	0.4235	89	0.6390
B143	64	0.6044	89	0.5669	95	0.4478	71	0.6923
B144	25	0.7404	66	0.6222	44	0.6297	49	0.7665
B145	106	0.4844	117	0.4714	119	0.3774	122	0.4791
B146	56	0.6164	32	0.7801	135	0.2255	104	0.5737
B147	7	0.9401	1	1.0000	26	0.7353	76	0.6724
B148	132	0.3467	118	0.4699	109	0.4044	117	0.4945

B151	133	0.3381	116	0.4772	124	0.3479	123	0.4779
B152	131	0.3983	135	0.3646	134	0.2888	134	0.3560
B153	23	0.7468	58	0.6557	34	0.6801	41	0.8253
B154	118	0.4493	94	0.5516	117	0.3839	135	0.3383
B155	34	0.6944	42	0.7411	38	0.6506	45	0.7883
B156	116	0.4533	121	0.4630	118	0.3814	107	0.5603
B157	125	0.4268	124	0.4488	128	0.3322	131	0.4151
B158	72	0.5742	28	0.8035	70	0.5591	74	0.6794
B159	110	0.4587	126	0.4328	132	0.3019	136	0.2251
B160	92	0.5258	102	0.5216	92	0.4500	96	0.6060

Appendix4: Decomposition of the Banking Technical Efficiency Scores of the Year 2006 Scores Obtained by Running the Output-Oriented Model with 2 Inputs and 2 Outputs under Constant Return to Scale Assumption into Pure Technical and Scale Efficiency Scores

(banks that went through mergers and/or acquisitions are highlighted in yellow)

Bank	Technical Efficiency (TE)	Pure Technical Efficiency (PTE)	Scale Efficiency
B001	0.8550	0.8930	0.9574
B002	0.8383	0.8546	0.9809
B004	0.7488	0.7771	0.9636
B005	0.7744	0.7748	0.9995
B006	0.9127	0.9396	0.9713
B007	0.6113	0.6175	0.9899
B008	0.7075	1.0000	0.7075
B009	0.4940	0.4993	0.9895
B010	0.6979	0.9052	0.7710
B011	0.7185	0.8169	0.8795
B012	1.0000	1.0000	1.0000
B013	0.4870	0.6792	0.7170
B014	0.7365	0.7807	0.9434
B015	0.7396	0.7917	0.9342
B016	0.5380	0.5453	0.9865
B017	0.8443	0.9102	0.9277
B018	0.5759	0.5862	0.9825
B021	0.6696	0.6789	0.9864
B022	0.7348	0.8259	0.8897
B023	1.0000	1.0000	1.0000
B025	0.6660	0.7112	0.9365
B026	0.8828	0.9034	0.9771
B027	0.6601	0.6963	0.9481
B028	0.4509	0.5411	0.8332
B029	0.7437	0.7481	0.9941
B030	0.5556	0.5788	0.9599
B032	0.7206	0.7310	0.9857
B033	0.6522	0.7051	0.9250
B034	0.8277	0.8309	0.9961

B036	0.9460	1.0000	0.9460
B037	0.9850	1.0000	0.9850
B038	0.6258	0.6269	0.9982
B039	0.7032	0.7397	0.9508
B040	0.5837	0.6171	0.9457
B041	0.6239	0.6258	0.9970
B042	0.5392	0.5424	0.9941
B043	0.6497	0.7370	0.8816
B044	0.6036	0.6125	0.9853
B045	0.5688	0.5884	0.9667
B047	0.4496	0.5173	0.8690
B048	0.4323	0.4504	0.9600
B049	0.6969	0.6997	0.9959
B050	0.4873	0.6578	0.7408
B051	0.6335	0.6347	0.9982
B052	0.6496	0.7114	0.9132
B053	0.4983	0.6385	0.7805
B054	0.4735	0.4737	0.9995
B055	1.0000	1.0000	1.0000
B056	0.6327	0.8196	0.7720
B057	0.8359	0.8601	0.9718
B058	0.8046	0.8172	0.9845
B059	0.7341	0.7376	0.9952
B062	0.5220	0.7410	0.7044
B063	0.5982	0.6143	0.9738
B065	0.8612	0.8636	0.9972
B066	0.7421	0.7431	0.9986
B067	0.5939	0.6012	0.9878
B068	0.8939	0.9389	0.9521
B069	0.4243	0.4271	0.9934
B070	0.9184	0.9232	0.9948
B071	0.9794	0.9797	0.9996
B072	0.7827	0.7836	0.9989
B074	0.6111	0.6281	0.9729
B075	0.4481	0.5171	0.8665
B076	0.6920	0.6996	0.9891
B077	0.6757	0.8098	0.8344

B078	0.6615	0.6673	0.9913
B079	0.9635	0.9676	0.9958
B080	0.7650	1.0000	0.7650
B081	0.6418	0.6791	0.9452
B082	0.8837	0.8878	0.9954
B083	0.6585	0.6901	0.9543
B084	0.6891	0.7516	0.9168
B085	1.0000	1.0000	1.0000
B088	0.9291	0.9299	0.9992
B089	0.7339	0.7614	0.9639
B090	0.7617	0.7647	0.9961
B092	0.9609	0.9613	0.9996
B094	0.8765	0.8786	0.9975
B095	0.8776	0.8879	0.9885
B098	0.9532	0.9897	0.9632
B101	0.5371	0.5959	0.9013
B103	0.5720	0.5771	0.9912
B104	0.6452	0.6843	0.9428
B105	0.9634	0.9832	0.9799
B106	0.9502	0.9654	0.9843
B107	0.8668	0.8748	0.9908
B108	0.8152	0.9477	0.8602
B109	0.7106	0.7564	0.9395
B110	0.6619	0.6742	0.9818
B111	0.7161	0.8301	0.8626
B112	0.4433	0.4493	0.9866
B113	1.0000	1.0000	1.0000
B114	0.8676	0.8767	0.9896
B115	0.5741	0.9734	0.5898
B116	0.8420	0.8611	0.9778
B117	0.8889	0.9707	0.9158
B118	0.5401	0.5424	0.9958
B119	0.9556	0.9994	0.9561
B120	0.7992	0.8653	0.9237
B121	0.8965	1.0000	0.8965
B123	0.3898	0.4695	0.8301
B124	0.5764	0.6187	0.9317

B125	0.4905	0.5119	0.9581
B126	0.5194	0.5226	0.9938
B127	0.7610	0.7807	0.9748
B128	0.9371	0.9546	0.9817
B129	1.0000	1.0000	1.0000
B130	0.3819	0.3906	0.9778
B131	0.7852	1.0000	0.7852
B132	1.0000	1.0000	1.0000
B133	0.5470	0.5481	0.9980
B134	0.7488	0.8195	0.9138
B135	1.0000	1.0000	1.0000
B136	0.8298	0.8463	0.9805
B137	0.9735	1.0000	0.9735
B138	0.8333	0.8780	0.9491
B139	0.6533	0.7076	0.9233
B140	0.7126	0.7484	0.9521
B142	0.6390	0.7561	0.8452
B143	0.6923	0.9479	0.7304
B144	0.7665	0.8534	0.8982
B145	0.4791	0.4793	0.9998
B146	0.5737	0.5805	0.9883
B147	0.6724	0.7588	0.8862
B148	0.4945	0.5071	0.9752
B151	0.4779	0.4868	0.9816
B152	0.3560	0.3605	0.9875
B153	0.8253	0.8259	0.9992
B154	0.3383	0.3589	0.9425
B155	0.7883	0.8097	0.9735
B156	0.5603	0.6211	0.9021
B157	0.4151	0.5477	0.7578
B158	0.6794	0.7922	0.8576
B159	0.2251	0.2844	0.7916
B160	0.6060	0.7257	0.8351

Table 1: Number of Commercial Banks Included in the Sample per Country

Country	Number of Banks
Lebanon	24
Egypt	20
Tunisia	12
UAE	12
Jordan	10
Morocco	9
Saudi Arabia	8
Kuwait	7
Qatar	7
Bahrain	6
Iran	5
Oman	5
Algeria	4
Yemen	4
Libya	2
Syria	1

Table 2: Malmquist Productivity Index Comparative Results

Malmquist Index decomposition for the output-oriented model with 2 inputs and 2 outputs under Constant Return to Scale assumption

Catch-up	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0969	0.8711	1.3017	1.0899
Max	2.0908	1.8363	3.9643	1.7046
Min	0.5301	0.2891	0.7457	0.7956
SD	0.2195	0.1833	0.3432	0.1168
Frontier	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.00	1.23	0.81	1.01
Max	1.75	1.62	0.98	1.15
Min	0.90	0.34	0.57	0.86
SD	0.10	0.14	0.08	0.04
Malmquist	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0954	1.0676	1.0491	1.0707
Max	2.8850	2.4551	2.6924	1.4970
Min	0.5134	0.3312	0.5350	0.8120
SD	0.2699	0.2483	0.2391	0.1116

Malmquist Index decomposition for the output-oriented model with 2 inputs and 2 outputs under Variable Return to Scale assumption

Catch-up	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0544	0.9624	1.1869	1.0679
Max	2.0325	2.0169	5.3390	2.1563
Min	0.5142	0.2766	0.5239	0.8416
SD	0.2252	0.2398	0.4415	0.1414
Frontier	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0517	1.1258	0.9063	1.0279
Max	3.7195	1.5259	1.6564	1.6310
Min	0.6982	0.3456	0.5110	0.8736
SD	0.2469	0.1597	0.1447	0.0797
Malmquist	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.1136	1.0671	1.0541	1.0783
Max	5.4623	2.0029	3.8755	2.2119
Min	0.5154	0.3410	0.5110	0.8244
SD	0.4393	0.2412	0.3180	0.1593

Malmquist Index decomposition for the output-oriented model with 3 inputs and 2 outputs under Constant Return to Scale assumption

Catch-up	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.1155	0.9914	1.1408	1.0826
Max	2.1281	2.1280	4.2984	1.7814
Min	0.5301	0.2810	0.4945	0.7964
SD	0.2720	0.2471	0.3733	0.1277
Frontier	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0008	1.0766	0.9440	1.0071
Max	1.8155	1.4876	1.4769	1.2081
Min	0.6596	0.3414	0.5731	0.7856
SD	0.1065	0.1423	0.1144	0.0491
Malmquist	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.1146	1.0630	1.0658	1.0811
Max	2.7879	2.4551	3.3017	1.5997
Min	0.5134	0.3404	0.5092	0.7658
SD	0.2958	0.2922	0.3034	0.1317

Malmquist Index decomposition for the output-oriented model with 3 inputs and 2 outputs under Variable Return to Scale assumption

Catch-up	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0688	1.0237	1.0958	1.0628
Max	2.4244	2.0839	5.5181	2.1560
Min	0.5142	0.2766	0.4695	0.8349
SD	0.2799	0.2645	0.4512	0.1475
Frontier	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.0667	1.0674	0.9966	1.0436
Max	3.7566	1.5329	1.7741	1.6433
Min	0.6631	0.3456	0.5110	0.7951
SD	0.2761	0.1616	0.1583	0.0924
Malmquist	2003=>2004	2004=>2005	2005=>2006	Average
Average	1.1420	1.0810	1.0786	1.1005
Max	5.2170	1.8856	5.0911	2.1301
Min	0.5154	0.2850	0.5110	0.7680
SD	0.4668	0.2794	0.4189	0.1815

Table 3: Summary of Average Efficiency Scores for the Period 2003-2004

Year	TE (CRS)	PTE(VRS)	SE (TE/PTE)
2003	0.6063	0.6861	0.8910
(SD)	0.1606	0.1803	0.0997
2004	0.6521	0.7084	0.9266
(SD)	0.1687	0.1850	0.0835
2005	0.5675	0.6735	0.8555
(SD)	0.1828	0.2047	0.1409
2006	0.7064	0.7532	0.9385
(SD)	0.1766	0.1772	0.0796
Overall Average	0.6331	0.7053	0.9029
SD	0.0599	0.0351	0.0375
M&A	0.6519	0.7025	0.9297