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Measuring the efficiency of Lebanese banks after the 2007 financial crisis and the turmoil of the 2011 Arab Spring

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Abstract

This paper measures and compares the efficiency and productivity of the Lebanese banking sector after the 2007 financial crisis and the 2011 Arab Spring by means of a Data Envelopment Analysis for the years 2008, 2011 and 2013. Number of employees, total interest expense and number of branches were used as input factors versus total interest income and total non-interest income as output factors. According to the CCR and BCC models, most banks recorded better efficiency results in 2013 than in either 2011 or 2008. The Wilcoxon matched-pairs signed-rank test confirmed that the efficiency of Lebanese banks was not affected in the aftermath of the financial crisis and even improved after the turmoil of the Arab Spring. Scale efficiency was calculated and all possible sources of inefficiency corresponding to each bank were examined. The Malmquist Total Factor Productivity (TFP) index revealed an overall improvement in productivity of 6.3% due to the progress in technology and managerial efficiency. Quantified improvements were suggested for inefficient banks: total non-interest income appears to be an under-produced output for 10 banks and a serious effort is thus required to diversify the sources of income; and total interest expenses should be reduced through cutting interest rates or reducing deposit amounts. Despite the overall efficiency of the Lebanese banks, they remain at risk due to their vulnerability to various macro, socio and political factors.

Keywords:

Data envelopment analysis; Lebanese banks; CCR; BCC; A&P; Scale efficiency; Malmquist total factor productivity index; Wilcoxon matched-pairs rank test.

JEL classification:

C12, C22; C32, C67, C89.

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La eficiencia de la banca libanesa **tras la crisis financiera de 2007 y la Primavera Árabe de 2011**

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Resumen

Este artículo mide y compara la eficiencia y productividad del sector bancario libanés, tras la crisis financiera de 2007 y la primavera árabe de 2011, mediante la implementación de un Análisis Envolvente de Datos para los años 2008, 2011 y 2013. Los inputs considerados son el número de empleados, el gasto total por intereses y el número de sucursales; los ouputs son los ingresos por intereses y los ingresos distintos de los intereses. De acuerdo con los modelos de rendimientos a escala variables (modelo BCC) y constantes (modelo CCR), en 2013 la mayoría de los bancos registraron mejores resultados, en lo que a eficiencia se refiere, que en 2011 y 2008. El test de los rangos con signos de Wilcoxon confirmó que la eficiencia de los bancos libaneses no se vio afectada por las secuelas de la crisis financiera, e incluso mejoró tras los disturbios de la primavera árabe. Se ha calculado la eficiencia de escala y se han investigado todas las posibles fuentes de ineficiencia para cada banco. El índice de Malmquist de la productividad total de los factores reveló un aumento del 6.3% en la productividad como consecuencia del avance en tecnología y eficiencia de gestión. Se sugieren una serie de mejoras, cuantificadas, para los bancos ineficientes: los ingresos distintos de los intereses parecen insuficientes en el caso de 10 entidades bancarias, por lo que requieren un serio esfuerzo en lo que se refiere a la diversificación de sus ingresos; y los gastos por intereses deberían reducirse vía recortes en los tipos de interés o reducción de las cantidades depositadas. La eficiencia global de los bancos libaneses no elimina su riesgo, y ello debido a su vulnerabilidad ante una serie de factores de corte macroeconómico, social y político.

Palabras clave:

Análisis envolvente de datos, sector bancario libanés, CCR, BCC, A&P, eficiencia de escala, índice de Malmquist de la productividad total de los factores, test de los rangos con signos de Wilcoxon.

1. Introduction

The 2007 financial crisis was the most significant crisis faced by the banking industry since the great depression of the 1930s in the U.S. The 2007 crisis spread rapidly from the U.S. to other countries and from financial markets to the real economy. It destroyed faith in the financial system, in free enterprise, as well as in economic theories (De Bondt, 2010). It revealed a number of inefficiencies in the banking sector, most significantly inefficiencies in the implementation of risk management practices, in diversifying sources of income and in containing costs. In the aftermath of the crisis, it has become crucial for banks to measure and address these inefficiencies in order to overcome their short- and long-term challenges. Banks are now forced to adjust to the new financial environment as regulators are re-writing the rulebook and increasing capital requirements. Repairing their balance sheets involves write-downs of bad assets, resulting in losses to stakeholders and heavy recapitalization. Therefore, their profitability is seriously threatened by a rise in funding costs.

These challenges require banks to seek ways to boost their profitability and offset their increasing financing costs. Possibilities include adopting more aggressive cost management strategies and efficient operating models. Cost-cutting, which is a natural post-crisis strategy, has the potential to lead to a sustained recovery and a more agile business model that is more responsive to the turbulent risk environment, thus decreasing the possibility of bank failure.

The Lebanese banks remained to a large extent shielded from the effects of the financial crisis (Naimy and Karayan, 2016), however they are subject to the resulting regulations and stringent capital requirements. They consequently face similar profitability challenges to banks in the rest of the world, and thus need to adopt more efficient operating models.

On the other hand, it would not have been surprising had the Lebanese economy already undergone a crisis since over the years it has faced numerous episodes of financial and economic pressures, and also has one of the highest government debt-to-GDP ratios in the world, mostly financed by the Lebanese banks (Gardner and Schimmelpfennig, 2008). In fact, the banking sector remains the backbone of the Lebanese economy. It is absolutely critical to ensure the efficient and profitable operation of Lebanese banks. Failure to do so could undermine the economy's ability to withstand future disruptions and push the country into a debt crisis or even bankruptcy.

In practical terms, 73 banks (including foreign banks) actively operate a total of 985 branches in Lebanon (Association of Banks in Lebanon, 2014). This large number of banks serving an almost saturated market creates intense rivalry in the industry, which thus increases the need to operate at optimal efficiency levels and to reduce costs. Further analysis of profitability and efficiency ratios (return on average equity, return on average assets and cost-to-income) shows that Lebanese banks are underperforming compared to other emerging markets (Bankdata, 2014). They therefore need to start making serious efforts to improve their efficiency, which could help them boost their profitability despite all the regional tensions. In addition, and based on suggestions made by the World Bank and the U.S. Treasury Department aimed at accelerating the consolidation activity of banks, the Central Bank of Lebanon is planning to reduce the number of working banks to 25 within a five-year period. Consequently, efficiency scores will help to evaluate the success of these consolidations by measuring the efficiency of banks before and after the merger and acquisition operations.

In line with this perspective, this paper seeks to implement the Data Envelopment Analysis (DEA) Model to compute the technical efficiencies of Lebanese commercial banks. DEA is a non-stochastic, non-parametric, linear programming (LP) based method; it measures the relative efficiency of similar decision making units (DMUs) with common inputs and outputs. DEA is superior to alternative measures of efficiency because it can incorporate multiple inputs and outputs without prior assumptions about the production function or the weights of the factors of production. It is a generic method that has been used in analyzing DMUs in different industries such as hospitals, universities, cities, banks, courts and business firms.

Despite the fact that DEA has been widely used to measure banks' efficiency in several countries, studies remain very limited and it has been many years since such analysis last addressed the Lebanese context. To this end, this paper applies DEA to measure the efficiency and productivity of 24 Lebanese commercial banks in 2008, 2011 and 2013. Since 2013 is the most recent year under study, the results from that year are explored in depth in order to reveal the specific sources of inefficiency and suggest strategies for improvement. The years 2008 and 2011 represent, respectively, the year of the outbreak of the global financial crisis, and the year of the eruption of the Arab Spring; efficiency scores for those two years are calculated and compared to scores for 2013. The banks are then ranked according to the 2013 efficiency results and the scores are compared to some key bank performance ratios. The Malmquist TFP index is used to calculate and decompose the productivity of the banks under study.

The rest of the paper is structured as follows. Section 2 provides a review of the efficiency measurement literature, specifically focusing on DEA. Section 3 reviews the methodology and presents the sample and data collection. Section 4 details the main findings of the research while investigating significant changes in efficiency scores under the BCC and the CCR Models, and ranking the efficient banks using the A&P Model. Section 5 concludes, discusses the empirical findings and suggests improvements.

2. Literature review

There is an increased need for performance evaluation and efficiency measurement in the banking sector as a result of recent global developments. In the past three decades, five frontier methodologies have been used to measure the efficiency of banks. We distinguish between parametric models—comprising the stochastic frontier approach (SFA), the thick frontier approach (TFA) and the distribution-free approach (DFA)—and non-parametric models, principally the DEA method and the free disposal hull (FDH), which is a special case of DEA. Parametric methods require assumptions regarding the shape of the production curve and include two error components: an error term that reflects inefficiency and a random error. Non-parametric methods require few assumptions when specifying the optimal frontier and do not account for random errors. There is still no consensus as to the superiority of one type of method over another. Other performance evaluation methods include multivariate statistical analysis (path analysis, factor analysis, principal component analysis, multiple regression analysis, MANOVA, MANCOVA, structural equation modeling, canonical correlations, and discriminant analysis), analytic hierarchy process, grey relational analysis and balanced scorecard.

From 1997 through 2010, 225 applications of DEA were identified in the banking industry (Cooper *et al.*, 2011). The banking sector is probably the most intensively studied sector in the DEA literature and this methodology has been used in numerous applications. Below is a review of a selected number of significant DEA studies conducted on commercial banks both nationally and internationally.

An in-depth study conducted by Siems and Barr (1998) evaluates the productive efficiency of U.S. commercial banks in three chosen years, 1991, 1994 and 1997. The authors implement a constrained-multiplier, input-oriented DEA model. The chosen inputs include salary expense, premises and fixed assets, other non-interest expense, interest expense and purchased funds while selected outputs are earning assets, interest income and non-interest income. The study reveals that, over time, non-interest income became a significantly more important variable in determining efficiency as banks focused on generating more fee income and offering a greater selection of products. It also finds for the three years under study that the most efficient banks earn a significantly higher return on average assets, hold higher equity capital and manage relatively smaller loan portfolios with fewer troubled assets. Finally, the authors show that banks that are awarded higher CAMEL (Capital Adequacy, Asset Quality, Management Quality, Earnings Ability, Liquidity) ratings by banking regulators, are significantly more efficient.

Another interesting analysis performed by Ataullah and Le (2006) examines, with respect to banks in India, the relationship between three elements of economic reform—namely fiscal reform, financial reform, investment liberalization—and technical efficiency (TE) by measuring the output-oriented BCC efficiency scores of banks operating in India for the period 1992-1998. Two DEA models are implemented: model A (the loan-based model) and model B (the income-based model). Both models use operating and interest expenses as inputs but they differ in their outputs selection. Model A uses loans & advances and investments as outputs, while model B employs interest and non-interest income. A "grand-frontier" is constructed to envelop all banks in the sample for all years in the 1992-1998 period instead of calculating a different frontier for each separate year. Results show a significant increase in efficiency. The authors also analyze the efficiency scores of both models separately using the Ordinary Least Squares (OLS) and the Generalized Method of Moments Estimation[1] (GMM) against macroeconomic variables affected by the economic reforms. Results of the OLS and GMM estimates reveal a negative relationship between bank efficiency, fiscal deficits and presence of foreign banks. A positive relationship is found between the level of competition and bank efficiency.

A comprehensive study of Greek banks is conducted by Chortareas *et al.* (2009), who investigate the Greek banking system's efficiency within the context of the new environment imposed by participation in the Economic and Monetary Union (EMU). Cost and profit efficiencies as well as productivity change are calculated using the DEA and Malmquist TFP index for 85 commercial banks for the period 1998-2003, a period which includes Greece's entry into the Eurozone in 2001. Total cost is used as the input factor, with total customer loans and other earning assets as the output factors. Average cost efficiency ranges between 82.6% and 91.1%. As to profit efficiency, it averages 75% for the whole study period, increasing by 93% from 1998 to 2003. The Malmquist TFP index reveals that the Greek banking sector experienced significant productivity growth of 15%, mainly due to technological change.

Chiu *et al.* (2010) use DEA to measure the BCC and Super-Efficiency scores of 34 domestic banks in Taiwan from 2001 to 2003. Two DEA models are implemented, both employing total deposits, number of employees and fixed assets as inputs, with total loans, total investment and non-interest income as outputs. However, one of the models includes credit ratings as an output. Results show that there is a positive relationship between efficiency scores and credit ratings, while the Malmquist TFP index revealed an average improvement in all the efficiencies during the years 2001-2003.

Another study by Sufian *et al.* (2012) addresses the Mergers and Acquisitions (M&A) that were forced by the Malaysian Central Bank and examines their effect on Malaysian banks' revenue efficiency. The sample comprises 34 commercial banks and the analysis covers both pre-merger (1995-1996) and post-merger (2002-2009) periods. DEA model inputs consist of deposits, labor and physical capital, and the

[1] *Exhaustive studies by Racicot and Theoret (2014, 2016) suggest a new GMM approach that deals with the endogeneity of macroeconomic uncertainty measures.*

corresponding input prices are price of loanable funds, price of labor and price of physical capital. Outputs include loans, investments and off-balance sheet items while output prices comprise, respectively, price of loans, price of investment and price of off-balance sheet items. The results show that all efficiency concepts improved during the post-merger period. To test the robustness of the results, parametric tests (T-Test) and non-parametric tests (Mann-Whitney and Kruskal-Wallis) are conducted. All three tests confirm that cost and profit efficiencies of the banks improved during the post-merger compared to the pre-merger period.

A significant study is carried out by Osman *et al.* (2008) on all Lebanese banks over an eight-year period. The authors start with 60 banks in 1997 and end with 45 in 2004, due to bank failures and M&A. DEA input oriented models are used to measure banks' technical efficiencies and study the impact of mergers and failures. Chosen inputs are interest expenses, general expenses, total deposits, number of employees and number of branches, while selected outputs are interest income and non-interest income. Results reveal that on average, 9 out of 60 banks are fully technically efficient. TE scores show decreasing trends for some banks, leading to the closure of low-efficiency banks or their merger with high-efficiency banks. The study concludes by presenting a DEA-based model for the Banking Control Commission of the Lebanese Central Bank to provide early warning signals of banks at risk. The model determines the lower and upper bound of a warning interval of TE scores.

Given the continuous need to monitor bank efficiency and the rapid developments the sector has witnessed since the last study related to the efficiency of Lebanese banks was conducted in 2008, this research seeks to fill this gap by measuring the efficiency and productivity of this vital sector for the years 2008, 2011 and 2013.

3. Methodology and sample

As shown in the previous section, the development and growth in DEA is evidence to its acceptance as a valuable model for measuring efficiency in the banking sector. This section applies the DEA along with its most significant models, namely the CCR, BCC and A&P models. It also employs the Wilcoxon matched-pairs signed-rank test and the Malmquist TFP index.

DEA is a non-parametric LP-based technique that converts multiple input and output measures into a single comprehensive measure of relative efficiency. DEA is a methodology directed to frontiers rather than central tendencies. It uncovers the relationships between the inputs and outputs, and does not keep them hidden as with other modeling instruments such as statistical regression, where a regression plane is fit through the center of the data. In DEA, the organization under study is called a DMU, the definition of which has been intentionally left unrestricted to allow DEA to be used for a wide range of applications. Any entity responsible for converting inputs into outputs and whose performance is to be measured can be considered a DMU. DEA is concerned with measuring relative efficiency, and so a DMU is rated as 100% or fully efficient if, and only if, the performances of other DMUs do not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs (Cooper *et al.*, 2011). This definition of relative efficiency removes the need to assume weights for the factors of production or to specify the relations that are supposed to exist between them.

3.1. Input-output selection

There is no universal recipe for the best selection of inputs and outputs. We therefore select our factors based on the intermediation approach, which assumes that the bank collects deposits using the labor and capital factors to transform them into loans and investments, and on the TE approach, according to which a DMU produces the maximum amount of output using a minimum amount of input. Such approaches are widely used in the banking sector. Within this context, banks produce loans and investments and in order to be technically efficient, they must maximize loans and investments given a certain level of inputs. To this end, and with regard to output factors, we use total interest income and total non-interest income as proxies for loans and investments. Off-balance sheet items were excluded due to discrepancies in data and to their low significance compared to other items (for instance, derivatives are not allowed in the Lebanese banking system). Number of branches, number of employees and total interest expense were used as input factors for capital, labor and deposits respectively, assuming that a bank collects deposits using labor and capital. Table 1 summarizes the chosen inputs and outputs.

Table 1. Input/output factors

Inputs	Symbol	Outputs	Symbol
Number of branches	Br	Total interest income: Interest & similar income (Interest income on loans + Other interest income + Dividend income)	II
Number of employees	Emp	Total non-interest income: Net fees & commission income + Net gain/loss on financial assets and/or investments + Net profits on foreign exchange + Other operating income + Other net non-operating income	NII
Total interest expense: Interest & similar expense (Interest expense on customer deposits + Other interest expenses)	IE		

3.2. The sample

The Association of Banks in Lebanon classifies banks into five categories: Lebanese banks S.A.L., Lebanese banks S.A.L. under Arab control, Lebanese banks S.A.L. under foreign non-Arab control, Arab banks and foreign banks. For purposes of homogeneity and to minimize estimation bias, the sample consisted entirely of Lebanese banks S.A.L. (24 banks) and only commercial banks. Appendix 1 lists the selected banks. In addition, for all the chosen inputs and outputs related to the sample, data was complete and positive. Many banks were eliminated because they recorded negative figures. We selected the highest possible number of DMUs in order to better distinguish between them with respect to efficiency discrimination among them and improve the likelihood of capturing high performance units, while more clearly identifying the relations that exist between the inputs and outputs. The selection of the number of banks satisfied the following constraint in equation (1).

$$n \geq max\ \{m \cdot s, 3(m+s)\} \tag{1}$$

Where:
n is the number of DMUs
m is the number of inputs
s is the number of outputs

$n = 24, m = 3$ and $s = 2$. Therefore $24 > max(6, 15)$.

The isotonicity principle was also met. Increasing the value of any input while keeping all other factors constant should not lead to a decrease in any output but rather should result in an increase in the value of at least one output. This isotonicity property was tested using correlation analysis on the input and output variables. Table 2 depicts the correlation coefficients which are greater than 0.8. This indicates a strong positive correlation between the input and output variables for the three years under study.

Table 2. **Pearson correlation coefficient between inputs and outputs for 2008, 2011 and 2013**

2008	Total interest income	Total non-interest income
Number of branches	0.9482	0.9062
Number of employees	0.9761	0.9547
Total interest expense	0.9976	0.9394

2011	Total interest income	Total non-interest income
Number of branches	0.9471	0.8331
Number of employees	0.9854	0.8966
Total interest expense	0.9967	0.9278
2013	**Total interest income**	**Total non-interest income**
Number of branches	0.9716	0.8852
Number of employees	0.9904	0.9325
Total interest expense	0.9970	0.9570

Data was collected from Bankdata, a yearly publication containing aggregates of data and performance ratios for the banking sector in Lebanon. Table 3 provides the corresponding descriptive statistics for the years 2008, 2011, and 2013.

Table 3. Descriptive statistics for the selected inputs and outputs for 2008, 2011 and 2013

2008	Mean	Median	Minimum	Maximum	Standard deviation
Number of branches	40	21.5	5	143	39
Number of employees	907	343.5	74	4200	1075
Total interest expense (USD)	171,426,289	81,319,947	5,811,162	724,150,202	210,007,780
Total interest income (USD)	259,923,109	115,329,800	8,445,225	1,147,155,510	329,079,111
Total non-interest income (USD)	37,321,537	8,827,657	2,122,618	238,569,973	54,746,952
2011	**Mean**	**Median**	**Minimum**	**Maximum**	**Standard deviation**
Number of branches	51	28	5	154	47
Number of employees	1198	665	95	4560	1312
Total interest expense (USD)	212,836,568	127,623,357	7,485,485	841,625,343	235,571,452
Total interest income (USD)	327,491,969	173,959,051	11,989,062	1,364,492,319	383,463,177
Total non-interest income (USD)	64,296,973	29,579,712	1,624,303	437,539,789	97,474,522
2013	**Mean**	**Median**	**Minimum**	**Maximum**	**Standard deviation**
Number of branches	55	30	6	189	52
Number of employees	1286.791667	734.5	107	5894	1487
Total interest expense (USD)	261,417,755	150,084,972	8,829,952	1,151,746,245	291,662,549
Total interest income (USD)	397,373,295	216,273,621	17,781,935	1,807,143,715	458,751,931
Total non-interest income (USD)	74,648,147	22,277,234	2,375,974	398,049,998	101,965,283

3.3. Data envelopment analysis

Three DEA models are used to calculate the relative TE scores of the 24 selected banks: the basic CCR model, the BCC model and the A&P model. We also use the input-oriented model for the calculation of the efficiency scores in order to measure the amount by which a bank can reduce inputs while still producing the same amount of outputs. The reason for this is that banks have better control over their inputs whereas outputs can be driven by various factors beyond banks' control, such as competition.

3.3.1. The basic CCR model

The basic CCR refers to the first DEA model developed by Charnes, Cooper and Rhodes (1978). Efficiency is the ratio of the weighted sum of outputs to weighted sum of inputs. Therefore efficiency becomes:

$$Efficiency\ (E) = \left(\frac{II\ u_1 + NII\ u_2}{Emp\ v_1 + Br\ v_2 + IE\ v_3} \right) \qquad (2)$$

Where:

u_1 is the weight given to the total interest income output

u_2 is the weight given to the total non-interest income output

v_1 is the weight given to the number of employees input

v_2 is the weight given to the number of branches input

v_3 is the weight given to the total interest expense

Equation (2) is transformed into LP to overcome the determination of weights. It becomes:

$$Max\ E_{1,1} = IIu_1 + NII\ u_2 \text{ for bank 1 in year 1} \qquad (3)$$

Subject to:

$$Emp\ v_1 + Br\ v_2 + IE\ v_3 = 1$$

$\sum IIu_1 + NII\,u_2 - \sum Emp\ v_1 + Br\ v_2 + IE\ v_3 \leq 0$ for all banks in year 1 (Where Σ denotes the mathematical sum)

$$u_1,\ u_2,\ v_1,\ v_2,\ v_3 \geq \varepsilon \geq 0$$

3.3.2. The BCC model

The CCR model takes into account constant returns to scale (CRS), however, banks do not always operate at optimal scale and are subject to variable returns to scale (VRS). In 1984, Banker, Charnes and Cooper proposed an extension to the CCR model to account for VRS, referred to as the BCC model. A variable u_0 that accounts for VRS is included. The LP formula in the BCC model becomes:

$$Max\ E_{1,1} = IIu_1 + NII\ u_2 - u_0 \text{ for bank 1 in year 1} \qquad (4)$$

Subject to:

$$Emp\ v_1 + Br\ v_2 + IE\ v_3 = 1\,.$$

$\sum IIu_1 + NII\,u_2 - \sum Emp\ v_1 + Br\ v_2 + IE\ v_3 - u_0 \leq 0$ for all banks in year 1 (Where Σ denotes the mathematical sum).

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$u_1, u_2, v_1, v_2, v_3 \geq \varepsilon \geq 0$.
u_0 free in sign.

3.3.3. Scale efficiency

Scale efficiency (SE) is expressed as the ratio of overall technical efficiency (OTE) obtained from the CCR model, to pure technical efficiency (PTE) obtained from the BCC model. Scores will be compared to see how similar they are, with differences attributable to the effects of scale efficiency.

$$SE = \frac{OTE}{PTE} = \frac{CCR}{BCC} \quad (5)$$

3.3.4. Super-efficiency

Both the CCR and BCC models measure the relative efficiency of all banks. They assign a score of 100% to all the efficient banks outperforming their peers. However, in some situations it is important to rank the efficient banks, something that cannot be achieved using the traditional DEA models. Only the A&P model (Andersen and Petersen, 1993) allows differentiation between efficient DMUs.

3.3.5. Malmquist TFP Index

Total factor productivity change (TFPCH) or the Malmquist Index was introduced by S. Malmquist in 1953 and has been further developed in the non-parametric framework by several authors to evaluate the TFPCH of a DMU between two time periods. It is defined in equation (6).

$$TFPCH = TEC \; x \; TC = PEC \; x \; SEC \; x \; TC \quad (6)$$

Where:

TEC is the technical efficiency change. It indicates the degree to which the managerial efficiency of a DMU improves or worsens. It can be decomposed into pure efficiency change (PEC) and scale efficiency change (SEC).

TC is the technological change. It reflects innovation and the change in the efficient frontier between two time periods.

Mathematically, the Malmquist index is stated as follows:

$$M(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)} \; x \left[\frac{D^t(x^{t+1}, y^{t+1})}{D^{t+1}(x^{t+1}, y^{t+1})} \; x \; \frac{D^t(x^t, y^t)}{D^{t+1}(x^t, y^t)} \right]^{1/2} \quad (7)$$

Where the notation $D^{t+1}(x^t, y^t)$ is the distance between the period t observation and the period t+1 technology. The term outside the bracket relates to TEC and the term inside the bracket relates to TC.

4. Findings

DEA results were generated using the Efficiency Measurement System, EMS 1.3 and DEAP 2.1 programs. The three models followed the input orientation and assumed convexity. Radial distance was chosen since it represents the proportional distance of a DMU to the efficiency frontier. Table 4 compares the CCR and BCC scores for the years 2008, 2011 and 2013.

Table 4. **CCR and BCC scores**

Bank	CCR scores			BCC scores		
	2008	2011	2013	2008	2011	2013
B.L.C Bank S.A.L.	0.900	0.913	1.000	0.904	0.926	1.000
Bank Audi S.A.L.	1.000	1.000	1.000	1.000	1.000	1.000
Bank of Beirut S.A.L.	1.000	0.929	1.000	1.000	0.931	1.000
BankMed S.A.L.	1.000	0.968	1.000	1.000	0.979	1.000
Banque Bemo S.A.L.	1.000	0.762	0.861	1.000	0.887	0.964
Banque de L'Industrie et du Travail S.A.L.	0.784	0.805	0.791	0.801	0.818	0.821
Banque Libano-Française S.A.L.	1.000	0.964	0.992	1.000	0.964	0.994
Banque Pharaon et Chiha S.A.L.	1.000	1.000	1.000	1.000	1.000	1.000
BBAC S.A.L.	0.842	0.907	0.899	0.851	0.917	0.901
BLOM Bank S.A.L.	1.000	1.000	1.000	1.000	1.000	1.000
BSL Bank S.A.L.	0.815	0.776	0.802	0.827	0.780	0.803
Byblos Bank S.A.L.	0.948	0.960	0.939	0.949	0.975	1.000
Credit Libanais S.A.L.	0.890	0.867	0.888	0.891	0.872	0.889
CreditBank S.A.L.	0.829	0.865	0.854	0.838	0.920	0.881
Fenicia Bank S.A.L.	0.920	0.921	0.908	0.939	0.977	0.930
First National Bank S.A.L.	0.832	0.877	0.908	0.859	0.936	0.932
Fransabank S.A.L	0.951	0.913	0.968	0.951	0.922	0.975
IBL Bank S.A.L.	1.000	1.000	1.000	1.000	1.000	1.000
Jammal Trust Bank S.A.L.	0.861	0.977	0.922	0.870	1.000	1.000
Lebanese Swiss Bank S.A.L.	0.884	0.833	0.837	0.917	0.889	0.863
LGB Bank S.A.L.	0.801	0.808	0.947	0.860	0.951	0.985
MEAB S.A.L.	0.823	0.807	0.960	1.000	0.974	1.000
Near East Commercial Bank S.A.L.	0.970	0.975	1.000	1.000	1.000	1.000
Société Générale de Banque au Liban S.A.L.	1.000	0.894	1.000	1.000	0.952	1.000
Minimum	**0.784**	**0.762**	**0.791**	**0.801**	**0.780**	**0.803**
Efficient banks	**9**	**4**	**9**	**11**	**6**	**12**
Average	**0.919**	**0.905**	**0.937**	**0.936**	**0.940**	**0.956**
Median	**0.934**	**0.913**	**0.954**	**0.950**	**0.951**	**0.997**
Standard deviation	**0.079**	**0.076**	**0.069**	**0.070**	**0.059**	**0.063**
Coefficient of variation	**0.086**	**0.084**	**0.073**	**0.075**	**0.063**	**0.066**

Under both constant and variable returns to scale, Table 4 shows Lebanese banks to be highly efficient, a result which might be due to the intense competition within the

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sector and to the strong supervision imposed by the Central Bank of Lebanon. However, a difference between the CCR and BCC scores was noted for some banks, which indicates the presence of scale efficiency. Most importantly, Bank Audi, Banque Pharaon et Chiha, BLOM bank and IBL appear to be leaders in their field as they remained fully efficient throughout the years under study.

4.1. CCR vs BCC

According to the CCR model, most banks recorded better efficiency results in 2013 than in either 2011 or 2008. An average of 0.937, the highest value of the three years, indicated superior and improved efficiency levels. BCC scores also reveal that banks registered better efficiency results in 2013 (an average score of 0.956) than in either 2011 or 2008, and half of the 24 banks under study were fully efficient. Average BCC scores are greater than those of CCR, which means that when bank size is considered efficiency scores increase and therefore problems of scale efficiency arise.

Despite the 2007 crisis during which banks around the world incurred severe losses, CCR results for the Lebanese banks slightly decreased from 0.919 in 2008 to 0.905 in 2011 and the number of fully efficient banks decreased from 9 to 4. Conversely, the BCC average efficiency increased from 0.936 in 2008 to 0.940 in 2011. Even after the Arab Spring erupted in 2011, the Lebanese banking sector showed strong resilience and, as indicated above, 2013 was the most efficient year. The Wilcoxon matched-pairs signed-rank test confirmed that the efficiency of Lebanese banks did not change significantly in the aftermath of the financial crisis and in fact improved after the Arab Spring turmoil. Table 5 reports the corresponding p-values.

Table 5. Wilcoxon Matched-Pairs signed-rank test *P*-values

	CCR		BCC	
	2008-2011	2011-2013	2008-2011	2011-2013
P-value	0.380	0.008	0.825	0.041

4.2. Scale efficiency

Scale efficiency is determined in order to investigate the possible sources of inefficiency affecting each bank. Table 6 depicts the SE results for 2013 together with the returns to scale description. The SE average exceeds the PTE average, which means that the decrease in the overall TE is mainly attributable to managerial efficiency in terms of the use of inputs to maximize outputs. Therefore, PTE can be improved through better monitoring of borrowers, creative marketing plans to attract depositors, better cost-control strategies and more efficient risk management techniques. Byblos Bank, Jammal

Trust Bank and MEAB have a PTE of 1 but their SE scores are all below 1. This indicates that although these banks display managerial efficiency, they are not operating at their optimal scale size.

Table 6. **Scale efficiency scores in 2013 and returns to scale description**

Bank	OTE (CCR)	PTE (BCC)	SE=OTE/ PTE	Returns to scale*
B.L.C Bank S.A.L.	1.000	1.000	1.000	CRS
Bank Audi S.A.L.	1.000	1.000	1.000	CRS
Bank of Beirut S.A.L.	1.000	1.000	1.000	CRS
BankMed S.A.L.	1.000	1.000	1.000	CRS
Banque Bemo S.A.L.	0.861	0.964	0.894	IRS
Banque de L'Industrie et du Travail S.A.L.	0.791	0.821	0.963	DRS
Banque Libano-Française S.A.L.	0.992	0.994	0.999	IRS
Banque Pharaon et Chiha S.A.L.	1.000	1.000	1.000	CRS
BBAC S.A.L.	0.899	0.901	0.998	IRS
BLOM Bank S.A.L.	1.000	1.000	1.000	CRS
BSL Bank S.A.L.	0.802	0.803	0.999	DRS
Byblos Bank S.A.L.	0.939	1.000	0.939	DRS
Credit Libanais S.A.L.	0.888	0.889	0.999	IRS
CreditBank S.A.L.	0.854	0.881	0.970	DRS
Fenicia Bank S.A.L.	0.908	0.930	0.977	IRS
First National Bank S.A.L.	0.908	0.932	0.975	IRS
Fransabank S.A.L	0.968	0.975	0.992	DRS
IBL Bank S.A.L.	1.000	1.000	1.000	CRS
Jammal Trust Bank S.A.L.	0.922	1.000	0.922	DRS
Lebanese Swiss Bank S.A.L.	0.837	0.863	0.970	IRS
LGB Bank S.A.L.	0.947	0.985	0.961	IRS
MEAB S.A.L.	0.960	1.000	0.960	IRS
Near East Commercial Bank S.A.L.	1.000	1.000	1.000	CRS
Société Générale de Banque au Liban S.A.L.	1.000	1.000	1.000	CRS
Efficient banks	**9**	**12**	**9**	
Average	**0.937**	**0.956**	**0.980**	
Median	**0.954**	**0.997**	**0.998**	

**If SE=1, the bank is operating at CRS. If SE≠1, the nature of the returns to scale can be determined by running an additional DEA model with non-increasing returns to scale (NIRS) imposed. If NIRS TE score = VRS TE score, this indicates DRS; if not, it indicates IRS.*

Choosing the optimal scale of production is a sign of scale efficiency where banks operate at CRS, meaning that an increase in inputs is accompanied by a proportionate rise in outputs. Conversely, scale inefficiency occurs when banks operate at VRS. There are two possible scenarios in such a case: a modus operandi with increasing returns to scale (IRS), where an increase in inputs leads to a more than proportionate rise in outputs; or decreasing returns to scale (DRS) where an increase in inputs is accompanied by a less than proportionate rise in outputs. Out of the 24 banks, 9 were operating at CRS, 9 at IRS and 6 were at DRS. Byblos and Jammal Trust Bank are operating at DRS, above their optimal scale size (PTE=1). An appropriate strategy in this case would be to reduce the scale of operations by means of branch closures and staff redundancy, for example. As for banks showing managerial inefficiency and also operating at DRS (PTE<1), they include Banque de L'Industrie et du Travail, BSL Bank, Creditbank and Fransabank. These banks are advised to implement strategies aimed at increasing their overall managerial and scale efficiencies. On the other hand, MEAB is operating at IRS, below its optimal scale size (PTE=1), hence a good strategy would be to increase its scale of operations through opening new branches, bank mergers and business collaborations. The remaining banks demonstrate managerial and scale inefficiency and are operating at IRS.

4.3. A&P model

The radial super-efficiency approach results used to rank the banks are detailed in Table 7 together with the A&P scores. Table 7 also compares these rankings to those of some selected, widely-used key performance ratios, revealing significant discrepancies. This indicates that key ratios are no longer an adequate way of assessing banks' efficiency and performance and the use of DEA thus becomes indispensable since it is the only model designed to convert multiple input and output measures into one single measure of efficiency.

Table 7. **A&P rankings vs ratio rankings in 2013**

Bank	A&P scores	A&P	Total assets	Loan loss reserves	Loans to deposits	Capital adequacy ratio	ROAA	Cost/ income
IBL Bank S.A.L.	**2.082**	1	12	10	2	24	3	1
BankMed S.A.L.	**1.451**	2	5	15	17	12	9	17
Pharaon et Chiha S.A.L.	**1.160**	3	24	17	15	6	1	13
NECB S.A.L.	**1.154**	4	23	11	4	1	23	23
Bank Audi S.A.L.	**1.052**	5	1	23	21	19	12	14
BLOM Bank S.A.L.	**1.037**	6	2	18	5	3	2	2
SGBL S.A.L.	**1.020**	7	7	14	8	18	5	5
B.L.C Bank S.A.L.	**1.007**	8	10	19	18	10	17	21
Bank of Beirut S.A.L.	**1.005**	9	6	9	13	13	4	8
BLF S.A.L.	0.992	10	8	6	16	17	10	7
Fransabank S.A.L	0.968	11	4	16	14	8	8	10
MEAB S.A.L.	0.960	12	16	12	24	23	11	3
LGB Bank S.A.L.	0.947	13	14	22	19	16	13	4
Byblos Bank S.A.L.	0.939	14	3	13	9	5	14	6

JTB S.A.L.	0.922	15	21	7	20	20	20	22
FNB S.A.L.	0.908	16	13	8	7	22	19	16
Fenicia Bank S.A.L.	0.908	17	19	21	10	11	6	9
BBAC S.A.L.	0.899	18	11	1	6	15	15	12
Credit Libanais S.A.L.	0.888	19	9	20	12	4	16	15
Banque Bemo S.A.L.	0.861	20	18	3	22	9	22	20
CreditBank S.A.L.	0.854	21	15	24	23	21	18	18
LSB S.A.L.	0.837	22	17	4	3	2	7	11
BSL Bank S.A.L.	0.802	23	20	2	1	14	21	19
BIT S.A.L.	0.791	24	22	5	11	7	24	24

4.4. Malmquist TFP ndex

The Malmquist TFP index is calculated to evaluate the productivity change of banks from 2008 to 2011, from 2011 to 2013 and from 2008 to 2013. Table 8 shows the structure of the geometric means for the TFPCH of all the banks under study.

Table 8. **Malmquist Index summary of geometric means**

Years	TEC	TC	PEC	SEC	TFPCH
2008-2011	0.985	1.093	1.006	0.980	1.077
2011-2013	1.036	1.012	1.016	1.019	1.048
Mean of study period	1.010	1.052	1.011	0.999	1.063

Between 2008 and 2011, productivity improved by 7.7%. This improvement was due to a TC of 9.3%, which managed to offset the negative TEC of –1.5%. This was attributable to the SEC of 2%. Similarly, the positive productivity change witnessed from 2011 to 2013 reached 4.8%. Overall, the productivity of banks improved by 6.3%, which was the result of improvements in both the TC and TEC. An advance in the production boundary over time due to technological progress was noted, together with a slight movement of banks towards the frontiers generated by another improvement in managerial efficiency.

Appendix 2 lists the Malmquist TFP index for all the banks under study. Interestingly, IBL bank recorded the highest productivity change of 27.7%, which made it the leader in terms of efficiency and productivity. On the other hand, BLOM, which was revealed as fully efficient, recorded a decrease in productivity. Closer analysis of the 6.7% decrease in TC shows that this bank needs to invest in technology. The remaining banks with an index below 1 face managerial efficiency problems despite their investments in technology.

5. Discussion and conclusion

The ultimate objective of DEA, in addition to measuring the relative efficiencies of DMUs and specifying the sources of inefficiency, is to identify potential improvements. We opted to implement the input orientation approach, which orders DEA to reduce the inputs as much as possible without decreasing outputs, provided that those inputs can be controlled by the banks and keeping in mind that the aim of the DEA in this case is to save costs. However, it is possible to find slacks in inputs and outputs. In other words, potential improvements in DEA might include an increase in one or more of the outputs while decreasing the inputs. Such output slacks represent outputs that are under-produced. Similarly, using the output oriented approach, the results may suggest increasing outputs and decreasing one or more inputs. These input slacks represent over-utilized inputs. Table 9 illustrates the improvements suggested by DEA for the year 2013 under the BCC approach. The target or projected values for the efficient banks are not included, they remain de facto the same; therefore target values are only suggested for the 12 inefficient banks. Targets for the number of branches and employees were kept in decimals as this might represent hiring part time employees or setting up ATMs instead of branches.

With regard to output-related improvements, total interest income presents no slacks whatsoever meaning that it is an adequately-produced output for all inefficient banks. Conversely, the total non-interest income output seems to be severely under produced by 10 banks, hence requiring serious effort to diversify the sources of income. On the inputs side, an overall decrease in all the selected inputs is needed to reach optimal efficiency levels. Total interest expenses should be reduced through cutting interest rates or decreasing deposit amounts.

Table 9. Suggested improvements for inefficient banks in 2013

1. Banque Bemo	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	60,972,380.10	0	0	60,972,380.10
Total non-interest income	9,272,936.65	0	3,604,737.49	12,877,674.14
Total interest expense	41,883,454.73	-1,525,012.51	0	40,358,442.22
Number of branches	10	-0.36	0	9.64
Number of employees	262	-9.54	-50.04	202.42
2. Banque de L'Industrie et du Travail	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	37,562,031.18	0	0	37,562,031.18
Total non-interest income	2,375,974.13	0	4,993,960.86	7,369,934.98
Total interest expense	25,049,066	-4,494,424.96	0	20,554,641.04
Number of branches	13	-2.33	0	10.67
Number of employees	242	-43.42	-0.96	197.62

3. Banque Libano-Française	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	496,750,790	0	0	496,750,790
Total non-interest income	82,350,013.27	0	0	82,350,013.27
Total interest expense	332,762,936.70	-2,159,155.11	0	330,603,781.59
Number of branches	62	-0.40	0	61.60
Number of employees	1308	-8.49	0	1299.51
4. BBAC	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	247,343,833.50	0	0	247,343,833.5
Total non-interest income	37,833,975.46	0	0	37,833,975.46
Total interest expense	169,388,319.70	-16,795,544.69		152,592,775
Number of branches	41	-4.07	-0.828	36.11
Number of employees	870	-86.26	0	783.74
5. BSL Bank	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	49,820,563.18	0	0	49,820,563.18
Total non-interest income	6,651,896.52	0	1,543,339.24	8,195,235.75
Total interest expense	35,147,217.25	-6,923,374.64	0	28,223,842.62
Number of branches	18	-3.55	-4.16	10.30
Number of employees	261	-51.41	0	209.59
6. Credit Libanais	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	441,587,634.50	0	0	441,587,634.50
Total non-interest income	57,605,767.16	0	9,374,938.65	66,980,705.81
Total interest expense	304,743,651.70	-33,870,798.20	0	270,872,853.50
Number of branches	70	-7.78	0	62.22
Number of employees	1591	-176.83	0	1414.17
7. CreditBank	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	161,022,250.10	0	0	161,022,250.10
Total non-interest income	23,354,595.69	0	8,107,592.76	31,462,188.45
Total interest expense	108,099,411.60	-12,898,136.14	0	95,201,275.46
Number of branches	33	-3.94	0	29.06
Number of employees	869	-103.69	-110.06	655.25
8. Fenicia Bank	**Original value in USD**	**Radial movement**	**Slack movement in USD**	**Projected value in USD**
Total interest income	69,115,507.13	0	0	69,115,507.13
Total non-interest income	9,285,219.24	0	1,309,639.04	10,594,858.28
Total interest expense	46,375,501.16	-3,265,303.90	0	43,110,197.26
Number of branches	17	-1.20	-3.68	12.12
Number of employees	247	-17.39	0	229.61

9. First National Bank	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	185,203,407.60	0	0	185,203,407.60
Total non-interest income	12,921,632.50	0	24,830,394.92	37,752,027.42
Total interest expense	130,781,624.50	-8,899,919.66	0	121,881,704.84
Number of branches	24	-1.63	0	22.37
Number of employees	600	-40.83	0	559.17

10. Fransabank	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	912,772,963.80	0	0	912,772,963.80
Total non-interest income	97,582,727.03	0	79,291,397.07	176,874,124.10
Total interest expense	565,138,863	-14,017,164.41	0	551,121,698.59
Number of branches	154	-3.82	-37.26	112.92

11. Lebanese Swiss Bank	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	79,047,184.74	0	0	79,047,184.74
Total non-interest income	9,378,738.31	0	2,383,527.07	11,762,265.38
Total interest expense	58,962,687.89	-8,086,416.11	0	50,876,271.78
Number of branches	18	-2.47	-2.71	12.82

12. LGB Bank	Original value in USD	Radial movement	Slack movement in USD	Projected value in USD
Total interest income	140,799,999.30	0	0	140,799,999.30
Total non-interest income	20,644,455.06	0	9,739,573.82	30,384,028.88
Total interest expense	98,500,683.25	-1,455,575.58	0	97,045,107.67
Number of branches	17	-0.25	0	16.75
Number of employees	409	-6.04	-2.80	400.16

In this study, we attempted to overcome the weaknesses of the DEA model by selecting the DMUs very carefully in order to ensure total homogeneity. We also minimized the use of statistical tests given the non-parametric hypothesis behind this model. By the same token, the selection of our inputs and outputs was dictated by the available data, in other words a different set of inputs and outputs could have yielded different results. In addition, the allocation of weights to input and output factors was calculated automatically, which reduced the accuracy of our results if weights had been set in advance in accordance with each bank's strategy. We employed a careful filtering process to eliminate discrepancies among the sources of data, however, we were not able to control small errors related to the efficiency frontier determination and therefore to efficiency scores. On the other hand, all results and suggested improvements are based on the relative efficiency characteristics of the DEA, not on the absolute efficiency of the bank, and since they are based on series of LP methods they do not yield a simple interpretation.

Despite the encouraging results of this paper which indicate that almost all the banks are operating efficiently and profitably, as confirmed by the BCC, CCR, and A&P models and by the Malmquist TFP index, there is a worrying economic situation that continues to jeopardize the whole banking system: large public debt exceeding 160% of the national GDP and mostly financed by this sector, a sector that strongly depends on deposits to finance such debt. The continuous growth of public debt creates the accumulation of deposits where deposits and public debt are following exactly the same increasing tempo without limits (Naimy, 2011). Results in this study suggest that inefficient banks should reduce their deposit amounts; therefore, the growth in public debt matched by the growth in deposits seriously harms banks' performance. The continuous and continuing existence of such vulnerability factors since 1990, in addition to the current political tensions and pressures, are enough to threaten the soundness of the whole banking sector and cause it to collapse. Therefore, though indispensable, monitoring efficiency and profitability is not enough.

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Appendix I. List of the selected banks

1. B.L.C Bank S.A.L.	13. Credit Libanais S.A.L.
2. Bank Audi S.A.L.	14. CreditBank S.A.L.
3. Bank of Beirut (BOB) S.A.L.	15. Fenicia Bank S.A.L.
4. BankMed S.A.L.	16. First National Bank (FNB) S.A.L.
5. Banque Bemo S.A.L.	17. Fransabank S.A.L.
6. Banque de L'Industrie et du Travail (BIT) S.A.L.	18. IBL Bank S.A.L.
7. Banque Libano-Française (BLF) S.A.L.	19. Jammal Trust Bank (JTB) S.A.L.
8. Banque Pharaon et Chiha S.A.L.	20. Lebanese Swiss Bank (LSB) S.A.L.
9. BBAC S.A.L.	21. LGB Bank S.A.L.
10. BLOM Bank S.A.L.	22. MEAB S.A.L.
11. BSL Bank S.A.L.	23. Near East Commercial Bank (NECB) S.A.L.
12. Byblos Bank S.A.L.	24. Société Générale de Banque au Liban (SGBL) S.A.L.

Appendix 2. Malmquist Index distribution per bank

Bank	TEC	TC	PEC	SEC	TFPCH
B.L.C Bank S.A.L.	1.054	1.021	1.052	1.002	1.076
Bank Audi S.A.L.	1.000	1.146	1.000	1.000	1.146
Bank of Beirut S.A.L.	1.000	1.034	1.000	1.000	1.034
BankMed S.A.L.	1.000	1.069	1.000	1.000	1.069
Banque Bemo S.A.L.	0.928	1.077	0.982	0.945	0.999
Banque de L'Industrie et du Travail S.A.L.	1.004	1.037	1.012	0.992	1.041
Banque Libano-Française S.A.L.	0.996	0.979	0.997	0.999	0.975
Banque Pharaon et Chiha S.A.L.	1.000	1.053	1.000	1.000	1.053
BBAC S.A.L.	1.033	1.005	1.029	1.004	1.039
BLOM Bank S.A.L.	1.000	0.993	1.000	1.000	0.993
BSL Bank S.A.L.	0.992	1.028	0.985	1.007	1.019
Byblos Bank S.A.L.	0.995	1.050	1.026	0.969	1.044
Credit Libanais S.A.L.	0.999	1.018	0.999	1.000	1.017
CreditBank S.A.L.	1.015	1.037	1.025	0.990	1.053
Fenicia Bank S.A.L.	0.993	1.019	0.995	0.998	1.012
First National Bank S.A.L.	1.045	0.997	1.042	1.003	1.042
Fransabank S.A.L	1.009	1.012	1.013	0.996	1.021
IBL Bank S.A.L.	1.000	1.277	1.000	1.000	**1.277**
Jammal Trust Bank S.A.L.	1.035	1.047	1.072	0.965	1.084
Lebanese Swiss Bank S.A.L.	0.973	1.025	0.970	1.003	0.997
LGB Bank S.A.L.	1.087	1.117	1.070	1.016	**1.214**
MEAB S.A.L.	1.080	1.052	1.000	1.080	1.136
Near East Commercial Bank S.A.L.	1.015	1.154	1.000	1.015	1.171
Société Générale Société Générale de Banque au Liban S.A.L.	1.000	1.043	1.000	1.000	1.043