“The efficiency of Islamic banks versus conventional banks: an empirical study of an emerging economy”

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THE EFFICIENCY OF ISLAMIC BANKS VERSUS CONVENTIONAL BANKS: AN EMPIRICAL STUDY OF AN EMERGING ECONOMY

Abstract

The purpose of this study is to investigate the efficiency of two different banking systems operating in Egypt (Islamic versus conventional banks). A sample of 35 banks has been used to examine the technical efficiency before and after the financial crisis using data envelopment analysis model. Evaluating the technical efficiency of Egyptian banks will enable policymakers to support which banking system is more efficient to facilitate the financial inclusion and enhance the economic development.

Before the financial crisis, conventional banks outperformed conventional banks with Islamic windows and Islamic banks, scale technical efficiency outperformed pure technical efficiency when analyzing conventional banks and conventional banks with Islamic windows. In terms of Islamic banks, pure efficiency outperformed scale efficiency. After the financial crisis, technical efficiency of all banks decreased. However, pure technical efficiency of Islamic banks has improved as a result of the quality of management and outperformed both conventional banks and conventional banks with Islamic windows. These results imply that Islamic banks have not been affected by the financial crisis. Therefore, the increased adoption and support of the Islamic banks in Egypt is addressed to develop the economy and push forward entrepreneurship projects, support the financial inclusion and the informal economy integration.

Keywords Data envelopment analysis, Egyptian banks, Islamic banks, technical efficiency

JEL Classification G01, G20, G21

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INTRODUCTION

The financial crisis opened the door for raising many questions regarding the current global financial system led by conventional banks to adopt the concept of interest rate in all financial transactions. Also, if the business model of conventional banks has contributed as a major factor to the global financial crisis. Accordingly, many researchers begun to shed light on various aspects of Islamic finance as an alternative to traditional finance offered by conventional banks. Two important factors support the business model of the conventional banks: the use of interest rate as a market indicator, or in the form of return when investing funds. And all financial transactions of conventional banks contain a degree of risk and uncertainty. Interest rate can be viewed as a mechanism of pricing in which funds can be allocated. Conventional banks introduce several financial products to suit the finance requirements of individuals and businesses. Products offered by conventional banks include a degree of uncertainty, so an interest rate is calculated as the cost of borrowing or remuneration. The rise in interest rate is a compensation to the high degree of uncertainty and a low interest rate be a low risk or uncertainty. Islamic finance refers to those activities that comply with Islamic law (Shari'ah). Shari'ah prohibits usury or interest paid to all loans. Usury is prohibited and

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charging and receiving the interest rate on all financial transactions are not allowed. Trading in pork or pork products as well as intoxicants and game of chance is prohibited as well. Moreover, all lines of business relating to these prohibited activities are also prohibited. Therefore, conventional banks do not meet the principles of Islamic law and the interest rate is the main catalyst for them. The operating model in Islamic finance is based on the rates of return achieved by Shari'ah-compliant finance and investment activities, which are related to the profits generated by the activities of economic sectors associated with them and are not entirely dependent on interest rates. Terms and conditions contained in contracts related to those services and activities should not include any element of interest or uncertainty. The philosophy of the Islamic finance is stemmed on the principle of the risk sharing rather than risk transfer. Risk is the main driver of profits or losses, and since risk is shared then profits and losses should be shared too. Shared risk leads to shared economy and this definitely will be significant to the stability and welfare of the economy.

1. A SINGLE VERSUS DUAL SYSTEM

There are two types of financial systems for banks, namely single system and dual banking system. In a single system, all financial transactions must be Shari'ah compliant. However, the dual banking system allows for the existence of both the conventional and the Islamic banking, with laws and regulations governing their work simultaneously. Iran, Sudan and Pakistan were among the first countries to adopt a single banking system. This means they offer exclusively Shari'ah complaint financial products and services. This resulted in establishing a single Islamic financial institution. On the other hand, other countries, including Bahrain, Malaysia, United Arab Emirates, Kuwait and Egypt, follow a dual banking system. In Egypt, windows or counters have been established as part of conventional banks to offer financial products and services according to Shari'ah compliant.

Figure 1 illustrates in greater detail the evolution of deposits, loans and assets values to Islamic banks during the study period.

2. LITERATURE REVIEW

According to Berger and Humphrey (1997), there are 130 studies on efficiency measures for banks. These studies have been applied to American banks and a number of other developed countries. Yet, there are still very few studies to meas-

Table 1. Total assets, deposits and loans for the years 2003 to 2017

Source: Annual Reports of the Central Bank of Egypt.

	Conventional banks			Islamic banks		
Year	Deposits in LE, mln	Assets in LE, mln	Loans in LE, mln	Deposits in LE, mln	Assets in LE, mln	Loans in LE, mln
2003	403.144	577.938	284.722	60,472	44,912	2,847
2004	461.697	633.436	296.199	69,255	46,345	2,962
2005	519.697	705.146	308.195	77,947	50,617	3,082
2006	568.841	761.562	324.041	85,326	52,341	3,240
2007	605,460	882,249	339,236	97,493	55,674	3,427
2008	635,119	1,022,899	268,003	98,080	60,412	3,717
2009	508,810	1,027,390	386,280	101,790	64,603	3,902
2010	583,185	1,150,419	403,675	102,915	70,236	4,078
2011	616,146	1,191,130	439,722	108,732	78,560	4,442
2012	661,135	1,281,218	360,533	116,671	84,942	3,642
2013	762,005	1,373,636	384,001	134,472	90,213	3,879
2014	883,733	1,425,642	414,187	155,953	91,231	4,184
2015	995,813	1,502,324	524,233	188,765	102,231	7,237
2016	1,313,915	1,640,211	609,281	211,904	105,543	9,235
2017	1,432,689	1,723,012	823,456	232,087	151,923	12,723

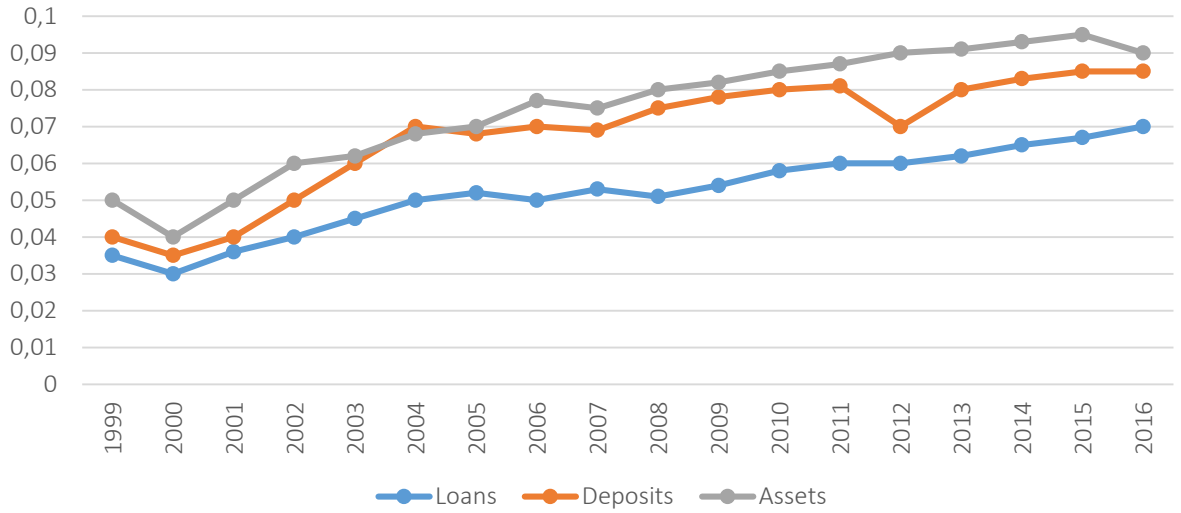

Figure 1. Islamic finance contributions to the banking sector in Egypt

ure efficiency at the level of Islamic banks. Many researchers used financial analysis to compare efficiency between conventional and Islamic banks. Trad and Trabelsi (2017) examined profitability and risk on a sample of 94 Islamic banks operating in 18 countries from 2006 to 2013. They used return on equity and return on assets indicators to measure profitability, credit risk and insolvency risk to measure the risk. Results revealed that capital is the main driver to maximizing stability, profitability and reducing the credit risk. Islamic banks in GCC are more profitable, solvent and less risky than Islamic banks operating in the South East Asian region.

Recently, the focus has been on studying the efficiency of banks through the application of stochastic frontier analysis (SFA) and Non-parametric approaches such as DEA. Srairi (2010) examined profit and cost efficiency using a sample of 71 banks in the GCC. Results indicated that conventional banks outperformed Islamic banks. Yudistira (2004) examined country-specific factors and assured that Islamic banks are less efficient than conventional banks, since Islamic banks are affected only by country-specific factors. Similarly, Abdul-Majid et al. (2010) proved that conventional banks achieved lower return than Islamic banks through the application of output distance function.

Gishkori and Ullah (2013) examined technical efficiency of Islamic and conventional banks operating in Pakistan from 2007 to 2011. Results indicated that technical efficiency varies between the two regimes. In conventional banks, it depends on pure technical inefficiency, while in Islamic banks, it attributes to the bank scale. Ahmed and Abdel Rahman (2012) proved that conventional banks outperformed Islamic banks by using all efficiency measures. This was attributed to the superior of conventional banks in terms of technology and management efficiency. Kamuradin et al. (2014) investigated efficiency of revenue on a sample of 27 Islamic banks and 47 conventional banks operating in the GCC from 2007 to 2011 using data envelopment analysis intermediation technique. Results indicated that conventional banks outperformed Islamic ones. While Yehya et al. (2012) proved that there are no significant differences when applying to banks operating in Malaysia. Abdul-Majid, Saal and Battisti (2009) compared Islamic and conventional banks from an efficiency perspective applying on a sample of banks operating in 10 countries from 1996 to 2002. They applied the technique of output distant by obtaining an efficiency measure. Results concluded that Islamic banking appears to be associated with higher input usage. There are statistically significant differences in inefficiency. Banks in Sudan and Yemen are among those with the highest levels of inefficiency, while banks in Bahrain are among the countries with the lowest levels of inefficiency. Banks exhibit relatively strong returns to scale except for Sudan, although Islamic banks have moderate higher returns to scale than conventional banks, because Islamic banks benefit from the increased scale.

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Abdul-Wahab and Haron (2017) examined technical, pure and scale efficiency for a sample of 15 banks operating in Qatar from 2007 to 2011 using data envelopment analysis and Malmquist productivity index to determine sources of productive efficiencies. Results indicated that Islamic banks outperformed conventional banks in terms of scale efficiency, whereas conventional banks outperformed Islamic banks when it comes to technical and pure technical efficiency.

3. METHODOLOGY

3.1. Sample and data

The study sample has been divided into three groups: Islamic, conventional, and conventional banks with Islamic windows. Bank scope data base and the website of each bank are used to obtain banks' balance sheets and income statements.

3.2. Model specification to measure economic efficiency

There are two main approaches that are mostly used to determine output and input variables. The production approach founded by Benston (1965) and the intermediation approach founded by Sealy and Lindley (1977). Sufian et al. (2013) stated that both approaches apply traditional microeconomics theory of banking, the linear programming method is used to construct a non-parametric piecewise surface (frontier) over the data to compute efficiencies relative to its surfaces. Over the last years, frontiers have been estimated using two common methods; econometric models and mathematical programming, namely DEA and Stochastic frontier. Farrell (1957) defined a simple measure of firm efficiency, which is based on multiple inputs. The economic efficiency of bank consists of two components: technical efficiency, which reflects the ability of a bank to maximal output from a given set of inputs, and allocative efficiency reflecting the ability of a bank to use an input in optimal proportions. Those two measures are combined together to provide a measure of total efficiency.

The technical efficiency (TE) of a bank can be expressed by the ratio

$$TE_1 = 0Q/0P, \quad (1)$$

which is equal to 1–(*QP/0P*).

It will always take a value between one and zero. The allocative efficiency of a bank operating at p is defined as

$$AE_1 = 0R/0Q. \quad (2)$$

In practice, the production function of the fully efficient bank is not known. Therefore, it should be estimated through a number of observations. The total economic efficiency (EE) is defined to be the ratio

$$EE_1 = 0R/0P. \quad (3)$$

The product of technical and allocative efficiency provides the overall economic efficiency of the banks as follows:

$$TE_1 \times AE_1 = \left(0Q/0P\right) \times \left(0R/0Q\right) = \\ = \left(0R/0P\right) = EE_1. \quad (4)$$

The CSR model is widely used based on input orientation concept to allow for comparing between small, medium and large banks. This is in line with the study community represented by banks operating in Egypt.

Assume there are data on *K* inputs and *M* outputs on each of *N* banks or DMU's as they are defined in the DEA literature. For the *i*-th DMU, these could be represented by the vectors x_i and y_i, respectively. The *K* x *N* input matrix, *X*, and the *M* x *N* output matrix, *Y*, represent the data of all N DMU's (Coelli, 1996).

For each bank, one would like to obtain a measure of the ratio of all outputs over all inputs such as $(o'y_i / n'x_i)$, where *o* is an *M* x *1* vector of outputs weights and *n* is a *K* x 1 vector of input weights. In order to select optimal weights, the mathematical programming problem is specified. The technical efficiency of a bank will be calculated by taking the highest value of the weighted outputs into the weighted inputs. In that way, multiple inputs and outputs of decision-making units are reduced to one input and output by optimal weighting.

$$Max_{o,n}\left(o'y_i \,/\, n'x_i\right), \qquad (5)$$

Subject to:

$$(o'y_i \,/\, n'x_i) \le 1, \quad j = 1,\ 2,\ \ldots, n, \quad o, n \ge 0.$$

This involves finding values of *o* and *n* so that the efficiency measure of the *i*-th bank is maximized. This is subject to the constraints that all efficiency measures must be less or equal to one and therefore providing to an infinite number of solutions. To avoid this, one can impose a constant constraint, that is $n'x_i = 1$, which provides the following formula:

$$Max_{\mu,p}\left(\mu'y_i\right), \qquad (6)$$

Subject to:

$$p'x_i = 1, \quad (\mu'y_i\text{-}p'x_i) \le 1, \quad j = 1,\ 2,\ \ldots, N,$$
$$\mu, p \ge 0,$$

where the notation changes from *o*, and *n* to μ and *p* reflect the transformation. This form is known as the multiplier form of the linear programming problem. An equivalent envelopment of the linear programming problem can be derived as follows:

$$Min_{\theta,\lambda}\theta, \qquad (7)$$

Subject to:

$$-y_i + Y\lambda \ge 0, \quad \theta x_i - X\lambda \ge 0, \quad \lambda \ge 0,$$

where θ is a scalar and λ is an *N* x *1* vector of constant. This envelopment form involves fewer constraints than the multiplier ($K + M < N + 1$), and hence it is generally the preferred form to solve. The value of θ is the efficiency score for the *i*-th bank. It will satisfy $\theta \le 1$, with a value of 1 indicating a point on the frontier and therefore a technically efficient bank (Farrell, 1957). It must be solved N times according to the number of banks included in the model.

4. EFFICIENCY MEASURES BEFORE THE FINANCIAL CRISIS

Table 3 shows that the overall efficiency of all banks increased prior to the global financial crisis with an overall average of 0.909. Egyptian banks can reduce the volume of their inputs by 10.1% and achieve the same results if the best manage-

Table 2. Input and output variables

Year	Outputs Total loans	Mean	Min	Max	SD
2003	Total loans	8,134	2,033	52,871	14,315.02
	Income	443.7	80	2,215	645.1
2004	Total loans	8,463	2,116	59,241	15,760
	Income	413.8	86.4	2,478	672.6
2005	Total loans	8,806	2,302	70,448	19,825
	Income	402.3	115.7	2,715	650.0
2006	Total loans	9,259	2,314	76,047	21,231
	Income	541.9	118.9	2,652	711.80
2007	Total loans	9,791	2,447	88,119	23,510
	Income	578.7	149	2,980	750.2
2008	Total loans	10,621	2,655	116,718	24,750
	Income	745.9	133.7	3,340	1.081.1
Year	Inputs Total deposits	Mean	Min	Max	SD
2003	Total deposits	11,518	2,337	69,108	19,750.3
	Assets	16,513	2,814	99,708	28,732.0
2004	Total deposits	13,191	2,578	92,337	22,450.2
	Assets	18,098	3,415	108,588	32,765.1
2005	Total deposits	14,847	2,820	103,929	25,412.45
	Assets	20,147	3,450	120,882	38,564.2
2006	Total deposits	16,252	2,940	117,041	32,456.2
	Assets	21,759	3,615	130,554	42,453.3
2007	Total deposits	18,570	3,068	148,560	41,780.1
	Assets	26,798	3,890	174,187	51,801.2
2008	Total deposits	21,348	3,396	195,141	47,650.1
	Assets	30,952	4,850	216,664	66,789

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Table 3. Measures of efficiency of all banks before the crisis

Year	Measures	Mean	Min	Max	SD
2003	Total efficiency:	0.871	0.589	1.00	0.037
	Pure	0.922	0.621	1.00	0.014
	Scale	0.945	0.654	1.00	0.036
2004	Total efficiency:	0.910	0.524	1.00	0.174
	Pure	0.949	0.578	1.00	0.105
	Scale	0.959	0.624	1.00	0.092
2005	Total efficiency:	0.896	0.424	1.00	0.073
	Pure	0.917	0.498	1.00	0.020
	Scale	0.978	0.533	1.00	0.167
2006	Total efficiency:	0.929	0.624	1.00	0.113
	Pure	0942	0.698	1.00	0.134
	Scale	0.987	0.634	1.00	0.107
2007	Total efficiency:	0.940	0.785	1.00	0.156
	Pure	0.957	0.715	1.00	0.172
	Scale	0.983	0.689	1.00	0.143
2008	Total efficiency:	0.908	0.435	1.00	0.046
	Pure	0.971	0.412	1.00	0.124
	Scale	0.936	0.504	1.00	0.121
All years	Total efficiency:	0.909	0.563	1.00	0.099
	Pure	0.970	0.587	1.00	0.094
	Scale	0.937	0.606	1.00	0.111

ment practices are adopted in banks, which will necessarily vary from one bank to another. Scale efficiency outperformed pure technical efficiency except for year 2008. Results conclude that Egyptian banks were incompetent in using their input resources.

Table 4 shows that the average technical efficiency of conventional commercial banks increased with an overall average of 0.893. This result is consistent with the analysis of overall technical efficiency results of all Egyptian banks on the basis that conventional banks represent 71% of the study sample. Scaled efficiency outperformed pure efficiency except for year 2008. Egyptian banks are inefficient in using their input resources.

Table 5 shows that average technical efficiency of conventional banks with Islamic windows decreased with an overall average of 0.865. This result is in line with the fact that the increase in the establishment of Islamic windows within the

Table 4. Measures of efficiency of conventional commercial banks before the crisis

Year	Measures	Mean	Min	Max	SD
2003	Total efficiency:	0.826	0.785	1.00	0.043
	Pure	0.905	0.781	1.00	0.021
	Scale	0.913	0.713	1.00	0.072
2004	Total efficiency:	0.867	0.878	1.00	0.031
	Pure	0.921	0.819	1.00	0.032
	Scale	0.942	0.789	1.00	0.041
2005	Total efficiency:	0.930	0.854	1.00	0.076
	Pure	0.954	0.930	1.00	0.242
	Scale	0.975	0.876	1.00	0.037
2006	Total efficiency:	0.921	0.825	1.00	0.036
	Pure	0.941	0.890	1.00	0.040
	Scale	0.979	0.852	1.00	0.051
2007	Total efficiency:	0.974	0.863	1.00	0.097
	Pure	0.990	0.872	1.00	0.045
	Scale	0.983	0.787	1.00	0.107
2008	Total efficiency:	0.831	0.785	1.00	0.103
	Pure	0.913	0.761	1.00	0.089
	Scale	0.910	0.763	1.00	0.121
All years	Total efficiency:	0.893	0.797	1.00	0.064
	Pure	0.931	0.842	1.00	0.078
	Scale	0.959	0.796	1.00	0.071

Table 5. Measures of efficiency of conventional banks with Islamic windows before the crisis

Year	Measures	Mean	Min	Max	SD
2003	Total efficiency:	0.800	0.725	1.00	0.067
	Pure	0.889	0.743	1.00	0.015
	Scale	0.900	0.989	1.00	0.054
2004	Total efficiency:	0.794	0.761	1.00	0.197
	Pure	0.880	0.643	1.00	0.132
	Scale	0.903	0.853	1.00	0.321
2005	Total efficiency:	0.794	0.871	1.00	0.342
	Pure	0.871	0.781	1.00	0.114
	Scale	0.912	0.861	1.00	0.071
2006	Total efficiency:	0.793	0.873	1.00	0.087
	Pure	0.860	0.876	1.00	0.202
	Scale	0.923	0.789	1.00	0.155
2007	Total efficiency:	0.757	0.579	1.00	0.185
	Pure	0.802	0.643	1.00	0.194
	Scale	0.945	0.654	1.00	0.071
2008	Total efficiency:	0.709	0.521	1.00	0.305
	Pure	0.803	0.601	1.00	0.061
	Scale	0.883	0.540	1.00	0.196
All years	Total efficiency:	0.865	0.721	1.00	0.197
	Pure	0.890	0.714	1.00	0.119
	Scale	0.971	0.781	1.00	0.144

conventional banking network has led to technical problems that have affected the overall efficiency of operating conventional banks with Islamic windows. The impact of the compatibility between the daily operating systems of conventional banks and the adoption of Islamic windows has affected the overall efficiency of banks. Scale efficiency outperformed pure technical efficiency referring to the misuse of the input resources. Although, conventional banks with Islamic windows operate at a reasonable scale.

Table 6 shows the average overall efficiency of Islamic banks increased with an overall average 0.870. The overall efficiency of Islamic banks has improved compared to the case of conventional banks with Islamic windows but still is not as good compared to conventional banks. The number of Islamic banks operating in Egypt is still small and is increasing over time. Compared to results of conventional banks and conventional banks with Islamic windows, pure efficiency of Islamic banks outperformed scale efficiency. This

Table 6. Measures of efficiency of Islamic banks before the crisis

Year	Measures	Mean	Min	Max	SD
2003	Total efficiency:	0.868	0.521	1.00	0.231
	Pure	0.952	0.531	1.00	0.031
	Scale	0.912	0.540	1.00	0.310
2004	Total efficiency:	0.846	0.531	1.00	0.157
	Pure	0.951	0.520	1.00	0.158
	Scale	0.890	0.541	1.00	0.134
2005	Total efficiency:	0.894	0.489	1.00	0.077
	Pure	0.963	0.457	1.00	0.075
	Scale	0.929	0.431	1.00	0.002
2006	Total efficiency:	0.877	0.621	1.00	0.104
	Pure	0.942	0.501	1.00	0.105
	Scale	0.931	0.489	1.00	0.005
2007	Total efficiency:	0.883	0.560	1.00	0.075
	Pure	0.971	0.613	1.00	0.086
	Scale	0.910	0.789	1.00	0.045
2008	Total efficiency:	0.853	0.761	1.00	0.312
	Pure	0.934	0.640	1.00	0.213
	Scale	0.914	0.610	1.00	0.245
All years	Total efficiency:	0.870	0.580	1.00	0.159
	Pure	0.952	0.543	1.00	0.111
	Scale	0.914	0.567	1.00	0.123

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means that Islamic banks are efficient in both operation management and in using their input resources. One can attribute these results to the fact that Islamic banks operating in Egypt are subsidiaries of Islamic banks operating in the Gulf region for a long time. Accordingly, the Islamic banking departments have the necessary skills and expertise to market and offer their products and services efficiently.

5. FINDINGS SUMMARY

The minimum requirement of 12 decision making units for DEA analysis has been met. Since $n \geq \{m \cdot s, 3(m+s)\}$. Therefore, the number of variables selected in the analysis is reliable. Conventional banks and conventional banks with Islamic windows are inefficient in using their resources compared to Islamic banks. Conventional banks account for 71% of the study sample and have the largest market share in Egypt. The opening of Islamic windows to introduce financial products according to Shari'ah complaint has a negative impact on the efficiency of conventional banks with Islamic windows as a result of reconciliation between the conventional system and Islamic system.

In terms of Islamic banks, results revealed that pure technical efficiency outperformed scale efficiency meaning that Islamic banks are efficient in using their input resources. Both pure and scale technical efficiency improved gradually. The market share of Islamic banks is increasing by the

Table 7. Input and output variables after the crisis

Year	Outputs	Mean	Min	Max	SD
2009	Total loans	9,734	2,433	55,871	16,315
	Income	543.7	100	3,215	715
2010	Total loans	10,463	3,116	63,241	17,860
	Income	583.8	130.7	3,778	815
2011	Total loans	11,806	3,902	77,458	21,625
	Income	612.3	145.7	4,115	911
2012	Total loans	12,959	4,814	81,247	24,731
	Income	745.9	188.9	4,952	1,234
2013	Total loans	14,750	5,847	93,129	26,210
	Income	978.7	215	6,180	1,345
2014	Total loans	18,621	7,655	125,718	28,453
	Income	10,231	311.7	6,940	1,453
2015	Total loans	20,126	9,108	139,813	31,401
	Income	11,321	721.9	9,240	2,345
2016	Total loans	23,751	10,855	144,816	33,477
	Income	13,791	982.7	10,490	3,217
2017	Total loans	25,856	12,557	150,674	35,483
	Income	12,531	1021.7	11,640	4,453
Year	Inputs	Mean	Min	Max	SD
2009	Total deposits	13,218	3,430	70,100	21,850
	Assets	18,113	4,914	101,008	30,232
2010	Total deposits	15,190	4,878	94,237	23,750
	Assets	19,298	6,115	110,508	35,865
2011	Total deposits	16,147	5,820	105,900	28,710
	Assets	22,947	7,350	125,880	41,804
2012	Total deposits	18,452	6,740	117,341	35,550
	Assets	25,859	7,815	135,524	47,653
2013	Total deposits	20,578	8,268	158,500	46,700
	Assets	27,198	10,800	184,187	55,401
2014	Total deposits	24,548	10,306	199,101	51,650
	Assets	32,652	13,950	220,694	70,906
2015	Total deposits	27,645	13,603	215,171	58,691
	Assets	34,256	14,051	228,946	75,205
2016	Total deposits	29,845	15,456	220,187	65,693
	Assets	36,152	16,923	227,163	78,209
2017	Total deposits	30,108	17,256	230,709	78,850
	Assets	40,212	18,509	239,492	84,926

time. Therefore, it is found that the efficiency of the Islamic banks' operation increased during the study period. This is because Islamic banks operating in Egypt are branches of some banks that operate in the Gulf region for a long time.

6. EFFICIENCY MEASURES AFTER THE FINANCIAL CRISIS

Table 8 shows that as a result of the global financial crisis, the relative efficiency of most Egyptian banks has decreased due to the negative impact on the international financial portfolios of these banks with an overall efficiency of 0.730. Scale efficiency still outperformed pure technical efficiency but with a lower rate compared to the same results before the financial crisis. This means that Egyptian banks are still inefficient in using the input resources.

Table 9 shows that efficiency of conventional banks has decreased since it represents almost 71% of the study sample due to the negative impact on the international financial portfolios of these banks due to the crisis with an overall efficiency of 0.771. Scale efficiency outperformed pure technical efficiency but at a lower rate compared to the period from 2003 to 2008 before the financial crisis.

Table 10 indicates that results of the efficiency analysis of conventional banks with Islamic windows have a gradual decrease and then are relatively stable thereafter due to the international financial crisis with an average of 0.795. This can be attributed to the dual effect of the financial crisis and the presence of financial investment of these banks in the international financial markets, the integration of Islamic banking operations within the conventional banking operations and the negative impact of this integration on efficiency. Scale efficiency outperformed pure efficiency except for year 2011, the year of January revolution which had a negative impact on the operations of all Egyptian banks. Scale efficiency outperformed pure efficiency but at a lower rate compared to the same results before financial crisis.

Table 8. Measures of efficiency of all banks after the crisis

Year	Measures	Mean	Min	Max	SD
2009	Total efficiency:	0.716	0.431	1.00	0.103
	Pure	0.884	0.356	1.00	0.093
	Scale	0.810	0.521	1.00	0.110
2010	Total efficiency:	0.601	0.440	1.00	0.105
	Pure	0.785	0.395	1.00	0.110
	Scale	0.765	0.421	1.00	0.109
2011	Total efficiency:	0.720	0.372	1.00	0.102
	Pure	0.834	0.515	1.00	0.054
	Scale	0.863	0.523	1.00	0.072
2012	Total efficiency:	0.790	0.511	1.00	0.032
	Pure	0.892	0.491	1.00	0.021
	Scale	0.886	0.623	1.00	0.124
2013	Total efficiency:	0.765	0.210	1.00	0.201
	Pure	0.870	0.231	1.00	0.210
	Scale	0.879	0.510	1.00	0.141
2014	Total efficiency:	0.790	0.340	1.00	0.131
	Pure	0.883	0.221	1.00	0.171
	Scale	0.895	0.325	1.00	0.105
2015	Total efficiency:	0.780	0.344	1.00	0.121
	Pure	0.882	0.261	1.00	0.151
	Scale	0.884	0.325	1.00	0.143
2016	Total efficiency:	0.798	0.323	1.00	0.121
	Pure	0.870	0.231	1.00	0.131
	Scale	0.917	0.352	1.00	0.125
2017	Total efficiency:	0.793	0.339	1.00	0.141
	Pure	0.810	0.211	1.00	0.191
	Scale	0.979	0.355	1.00	0.115
All years	Total efficiency:	0.730	0.384	1.00	0.132
	Pure	0.858	0.368	1.00	0.109
	Scale	0.850	0.487	1.00	0.110

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Table 9. Measures of efficiency of conventional banks after the crisis

Year	Measures	Mean	Min	Max	SD
2009	Total efficiency:	0.647	0.442	1.00	0.110
	Pure	0.790	0.379	1.00	0.142
	Scale	0.819	0.531	1.00	0.132
2010	Total efficiency:	0.741	0.330	1.00	0.231
	Pure	0.841	0.432	1.00	0.234
	Scale	0.882	0.520	1.00	0.219
2011	Total efficiency:	0.766	0.501	1.00	0.223
	Pure	0.880	0.414	1.00	0.321
	Scale	0.870	0.671	1.00	0.202
2012	Total efficiency:	0.800	0.421	1.00	0.109
	Pure	0.887	0.342	1.00	0.121
	Scale	0.901	0.440	1.00	0.121
2013	Total efficiency:	0.866	0.512	1.00	0.122
	Pure	0.920	0.441	1.00	0.124
	Scale	0.942	0.451	1.00	0.138
2014	Total efficiency:	0.808	0.529	1.00	0.134
	Pure	0.823	0.492	1.00	0.210
	Scale	0.982	0.541	1.00	0.289
2015	Total efficiency:	0.826	0.540	1.00	0.130
	Pure	0.849	0.444	1.00	0.219
	Scale	0.972	0.537	1.00	0.249
2016	Total efficiency:	0.825	0.537	1.00	0.136
	Pure	0.843	0.406	1.00	0.230
	Scale	0.978	0.523	1.00	0.298
2017	Total efficiency:	0.845	0.540	1.00	0.174
	Pure	0.847	0.482	1.00	0.243
	Scale	0.997	0.561	1.00	0.249
All years	Total efficiency:	0.771	0.455	1.00	0.154
	Pure	0.856	0.417	1.00	0.192
	Scale	0.900	0.525	1.00	0.183

Table 10. Measures of efficiency of conventional banks with Islamic windows after the crisis

Year	Measures	Mean	Min	Max	SD
2009	Total efficiency:	0.810	0.621	1.00	0.102
	Pure	0.897	0.530	1.00	0.191
	Scale	0.903	0.528	1.00	0.014
2010	Total efficiency:	0.758	0.341	1.00	0.220
	Pure	0.879	0.452	1.00	0.314
	Scale	0.862	0.411	1.00	0.301
2011	Total efficiency:	0.812	0.344	1.00	0.304
	Pure	0.893	0.389	1.00	0.245
	Scale	0.909	0.492	1.00	0.317
2012	Total efficiency:	0.772	0.412	1.00	0.201
	Pure	0.813	0.520	1.00	0.130
	Scale	0.949	0.254	1.00	0.201
2013	Total efficiency:	0.812	0.280	1.00	0.103
	Pure	0.874	0.354	1.00	0.133
	Scale	0.929	0.231	1.00	0.399
2014	Total efficiency:	0.806	0.400	1.00	0.423
	Pure	0.884	0.429	1.00	0.245
	Scale	0.911	0.524	1.00	0.452
2015	Total efficiency:	0.846	0.441	1.00	0.443
	Pure	0.873	0.459	1.00	0.315
	Scale	0.969	0.564	1.00	0.402
2016	Total efficiency:	0.876	0.474	1.00	0.445
	Pure	0.894	0.430	1.00	0.425
	Scale	0.979	0.519	1.00	0.462
2017	Total efficiency:	0.796	0.395	1.00	0.398
	Pure	0.864	0.419	1.00	0.275
	Scale	0.921	0.504	1.00	0.425
All years	Total efficiency:	0.795	0.399	1.00	0.225
	Pure	0.873	0.445	1.00	0.209
	Scale	0.910	0.406	1.00	0.280

Table 11. Measures of efficiency of Islamic banks after the crisis

Year	Measures	Mean	Min	Max	SD
2009	Total efficiency:	0.782	0.452	1.00	0.301
	Pure	0.894	0.461	1.00	0.241
	Scale	0.875	0.505	1.00	0.200
2010	Total efficiency:	0.930	0.354	1.00	0.321
	Pure	0.985	0.345	1.00	0.231
	Scale	0.945	0.214	1.00	0.241
2011	Total efficiency:	0.917	0.411	1.00	0.234
	Pure	0.973	0.394	1.00	0.251
	Scale	0.943	0.321	1.00	0.261
2012	Total efficiency:	0.941	0.523	1.00	0.332
	Pure	0.982	0.552	1.00	0.345
	Scale	0.959	0.546	1.00	0.242
2013	Total efficiency:	0.902	0.349	1.00	0.231
	Pure	0.990	0.562	1.00	0.331
	Scale	0.912	0.621	1.00	0.345
2014	Total efficiency:	0.861	0.632	1.00	0.245
	Pure	0.945	0.645	1.00	0.341
	Scale	0.911	0.540	1.00	0.245
2015	Total efficiency:	0.881	0.645	1.00	0.246
	Pure	0.907	0.685	1.00	0.321
	Scale	0.971	0.567	1.00	0.275
2016	Total efficiency:	0.847	0.672	1.00	0.291
	Pure	0.915	0.622	1.00	0.311
	Scale	0.925	0.540	1.00	0.205
2017	Total efficiency:	0.842	0.690	1.00	0.235
	Pure	0.911	0.684	1.00	0.301
	Scale	0.925	0.560	1.00	0.233
All years	Total efficiency:	0.886	0.452	1.00	0.267
	Pure	0.961	0.493	1.00	0.298
	Scale	0.922	0.457	1.00	0.245

Table 12. Summary of conclusions

Category of banks	Before crisis	After crisis
All banks	0.909	0.730
Conventional banks	0.893	0.771
Conventional banks with Islamic windows	0.775	0.795
Islamic banks	0.870	0.886

Table 11 indicates that results of Islamic banks improved with a mean efficiency ratio of 0.821 meaning that Islamic banks could use only 0.886 of the inputs to achieve the outputs. The market share of Islamic banks in Egypt is lower than conventional banks. It was at the stage of growth after the January revolution and the Muslim Brotherhood was leading the political scene. After the revolution of June, the growth of Islamic banking activities was limited compared to conventional banks. Egypt is one of the Arab countries attracting the activity of Islamic banks, supported by steady annual growth in population and Islamic culture of Egyptian people. The removal of the Muslim Brotherhood's rule has negatively affected the growth of Islamic banks. These results can be for two reasons. Islamic banks operating in Egypt represent branches of some foreign banks that have been operating in the Gulf region for a long time and have the necessary expertise and technical skills. Secondly, the market share of Islamic banks is increasing.

CONCLUSION

This is a novel research to examine the efficiency of banks operating in Egypt. Before the global financial crisis, the results confirmed the superiority of conventional banks compared to Islamic and conventional banks with Islamic windows. The superiority of conventional banks stems from the level of experi-

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ence for stuff and the increase in the market share. Scale efficiency outperformed pure efficiency. The efficiency of conventional banks has gradually decreased compared to conventional banks with Islamic windows to reach 0.775 and Islamic banks to reach 0.870. Low technical efficiency of conventional banks with Islamic windows is due to the adoption of the Islamic windows in several branches of these banks and the impact of technical issues on the efficiency of these banks.

Technical efficiency of Islamic banks has improved compared to conventional banks to reach 0.870. These results confirm that pure technical efficiency has exceeded the efficiency of scale, which means that Islamic banks are more efficient in management and in using their input resources. After the financial crisis, technical efficiency of all banks decreased to reach 0.730, it is 0.771 for conventional banks, 0.795 for conventional banks with Islamic windows and 0.886 for Islamic banks. This shows the improvement of efficiency of Islamic banks after the crisis due to the efficient management. Islamic banks can play important role in financial inclusion, boosting the economy and integrating the informal economy.

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APPENDIX A

Table A1. The sample

No.	Name of a bank	Type of a bank
1	Commercial International Bank	CCB
2	Union National Bank – Egypt	CCB
3	Société Arabe International De Banque (SAIB)	CCB
4	Suez Canal Bank	CCB
5	Arab African International Bank	CCB
6	Principal Bank for Development and Agricultural Credit	CCB
7	Arab International Bank	CCB
8	Export Development Bank of Egypt	CCB
9	The National Bank of Kuwait Egypt	CCB
10	United Bank	CCB
11	Al Ahli United Bank	CCB
12	Housing and Development Bank	CCB
13	Industrial Development and Workers Bank	CCB
14	Arab Investment Bank	CCB
15	Arab Bank Corporation	CCB
16	Bank Audi	CCB
17	Bloom Bank Egypt	CCB
18	Egyptian and Arab Land Bank	CCB
19	CITI Bank	CCB
20	Piraeus Bank Egypt SAE	CCB
21	Credit Agricola Bank	CCB
22	HSBC Bank	CCB
23	Barclays Bank	CCB
24	African Import and Export Bank	CCB
25	Bank of Alexandria and San Polo	CCB
26	Banque Misr	CCBIW
27	National Bank of Egypt	CCBIW
28	Banque du Caire	CCBIW
29	Egyptian Gulf Bank	CCBIW
30	Misr Iran Development Bank	CCBIW
31	Qatar National Bank Al Ahly	ICB
32	Faisal Islamic Bank of Egypt	ICB
33	Abu Dhabi Islamic Bank	ICB
34	Al Baraka Bank Egypt	ICB
35	National Bank of Kuwait	ICB

Note: CCB – conventional commercial bank, CCBIW – conventional commercial bank with Islamic window, ICB – Islamic commercial bank.

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