



**EFFICIENCY MEASURES FOR BANKING GROUPS
IN EGYPT**

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Abstract

This paper investigates the performance of the banking sector in Egypt during a period characterized by privatization and a liberal economic regime. It reviews the developments in market structure and regulatory framework towards a more competitive system and measures efficiency for the various bank groups as classified by type of business activity and ownership using econometric analysis. The concepts of cost and profit efficiency are used in the analysis to account for both the expenditures side and the revenues side. The empirical investigation uses panel data over the period 1992-2006 and shows that the performance results for the public and private sector banks are mixed after controlling for asset quality.

ملخص

تبحث هذه الدراسة في أداء القطاع المصرفي في مصر خلال فترة اتسمت بتطبيق برنامج الخصخصة والاتجاه نحو تطبيق آليات الاقتصاد الحر. وتتناول الورقة التطورات التي شهدتها هيكل السوق والإطار التنظيمي نحو تحقيق نظام أكثر تنافسية، كما تقيس كفاءة مجموعات مصرفية مختلفة تم تصنيفها وفقا لطبيعة النشاط والملكية، وذلك باستخدام التحليل الكمي. واستخدمت الدراسة في التحليل مفهومي كفاءة التكلفة والربحية لدراسة جانبي النفقات والإيرادات. ويستخدم البحث التطبيقي بيانات مقطعية عبر الزمن للفترة ١٩٩٢-٢٠٠٦، ويخلص إلى وجود تباين في نتائج أداء بنوك القطاعين العام والخاص بعد تثبيت المتغير المتعلق بجودة الأصول.

1. INTRODUCTION

Egypt undertook banking sector reforms in the 1990s towards a more liberal system. The new policy environment aimed at improving market competition and efficiency of banks while ensuring financial stability. The authorities liberalized financial prices to improve efficiency and implemented a bank privatization program to reduce market concentration and enhance competition. At the same time, the central bank strengthened its supervisory role with emphasis on prudential regulation and detailed audits based on uniform and internationally-accepted accounting standards.

Also, banks have reassessed their financial services for a more active participation in business life. In addition to corporate finance, banks have widened their retail base with a view to meeting their clients' demand for personal loans, mortgages, insurance products, individual retirement plans and credit cards. This entails a move towards despecialization as the portfolio behavior of banks becomes similar to that of universal ones. These developments have been reflected in the banking law no. 88/2003, which effectively abolished the distinction between commercial, business and investment, and specialized banks of the earlier banking law no. 120/1975. However, banking sector data are still published for such classification of banks as specified in the issued business licenses and as will be used here.

The adjustment process to the new market conditions has normally varied among the banks depending on the initial quality of their portfolios at the time of reform. Specifically, some private sector banks with initially good capital-asset ratio and financial viability have adapted faster to the new policy environment. For some other private sector banks, the share of the public sector in their capital has been divested through the stock market to expose these banks to greater market competition. In the meantime, private sector banks with weak capital structure have gone through mergers and acquisitions to strengthen their financial position. Still other private sector banks have been sold to strategic investors to promote their performance. A listing of the privatized joint-venture banks and of the mergers and acquisitions activity may be found in AmCham (2005) and Central Bank of Egypt (CBE 2007).

Regarding public sector banks, they had to deal with problem loans of significant size related to borrowings by state-owned enterprises of low creditworthiness. But their financial

health has been gradually improving with debt repayment from privatization proceeds and enterprise restructuring. Also, two public sector commercial banks, namely, Bank of Alexandria and Banque du Caire, were offered for sale to increase competition in the banking sector. Privatization of the Bank of Alexandria was concluded in late 2006 while the privatization of Banque du Caire was scheduled for 2008 but the enterprise valuation procedures are still in progress.

With these developments in the banking market, this paper aims to investigate empirically the relative performance of the various bank groups in Egypt over the period 1992-2006. In particular, it measures bank efficiency and studies which bank group outperforms the others under the new policy environment. This will be carried out by examining efficiency on both the expenditures side and the revenues side by estimating cost and profit functions using panel data for all banks classified by their type of business activity and ownership. In the process, the measurement of cost efficiency and profit efficiency will also indicate the relative performance of the public and private sector banks after controlling for asset quality.

Earlier empirical studies on bank efficiency in transitional and emerging economies include Hasan and Marton (2003) and An, Bae, and Ratti (2007), respectively, which document that private ownership is associated with higher efficiency scores. Other studies in the literature focused mainly on analyzing the performance of private sector banks in industrial economies. These include Berger, Hancock, and Humphrey (1993), Mester (1996), Berger and Mester (1997, 1999), and Akhavein, Berger, and Humphrey (1997) on the US market, Welzel and Lang (1996) on the German market, Altunbas et al. (2000) on the Japanese market, and Fitzpatrick and McQuinn (2008) on European and other markets. Also, Bikker and Haaf (2002) examined the impact of market structure on bank performance in a sample of industrialized countries and found evidence in support of the conventional view that concentration impairs competitiveness.

The present work uses panel estimation for measuring bank efficiency and employs a translog functional form. The panel data methods used in measuring firm efficiency are discussed, for example, in Schmidt and Sickles (1984), Cornwell, Schmidt, and Sickles (1990), Kalirajan and Obwona (1994), Kalirajan and Shand (1999), Ali, Parikh, and Shah

(1996), Kumbhakar (1996), and Greene (1997). The translog function for studying economic efficiency is discussed in Berndt and Christensen (1973).

The rest of the paper is organized as follows. Section 2 gives an overview of the Egyptian banking system. Section 3 discusses the concepts of cost and profit efficiency of banks. Section 4 presents the econometric model and empirical results. Section 5 concludes.

2. THE EGYPTIAN BANKING SYSTEM: AN OVERVIEW

2.1. Market Structure

The Egyptian banking sector expanded markedly in the mid-1970s spurred by the country's so-called open door policy. This policy aimed at active participation by private domestic and foreign capital in financing economic growth and development. To serve the new policy, a banking law was enacted in 1975 (law no. 120/1975) defining the nature and mode of operations for all banks. It identified three types of banks:

- (a) Commercial banks, which usually accept deposits and provide finance for a wide variety of transactions.
- (b) Business and investment banks, which carry out medium- and long-term operations such as the promotion of new businesses and financing of fixed asset investments. They may also accept deposits and finance foreign trade operations.
- (c) Specialized banks, which carry out operations serving a specific type of economic activity. They may accept demand deposits.

In addition, there are banks which are established under special laws and not registered with the CBE, namely, the Arab International Bank and Nasser Social Bank.

Banks operating in Egypt can also be classified as public sector or private sector according to ownership. All specialized banks are state-owned and are assigned the task of providing long-term finance for industrial, real estate and agricultural development. They mainly cater to the needs of the private sector and depend on long-term borrowing from financial institutions in their fund-raising activity with acceptance of demand deposits being not necessarily important for carrying out their tasks. There are also public sector commercial banks whose volume of business constitutes a significant share in total bank transactions.

The private sector banks include joint-venture and foreign banks operating through branches or subsidiaries. In many cases, the private sector banks are joint-ventures between public sector banks and foreign banks. In this connection, it is noteworthy that foreign shareholders were not allowed to take majority stakes in joint-venture banks before this ownership restriction was removed in 1996. Joint-venture banks are either registered as commercial or business and investment banks depending on whether they are established under the joint-stock companies law no. 159/1981 or the investment law no. 43/1974 and its amendments, respectively. In practice, the choice of the joint-venture banks to be registered as business and investment has less to do with their principal orientation according to the banking law no. 120/1975 than with the market incentives of the investment law under which they are established. Foreign banks are all registered as business and investment banks as their envisaged role is principally to raise long-term funds on the international financial markets and to promote investment. Also, they are all established under the investment law.

The public sector commercial banks have a significant market share in retail and corporate banking services through large branch networks and close relationship with state-owned companies. The private sector banks play a less dominant role in the market for loanable funds and focus on trade-related financial services to businesses. They have shown a preference to finance working capital and trade activities whose transactions normally require short-term credit and result in quicker and more secure returns (see El-Shazly 2001). They have also been active in personal banking more recently. In practice, the portfolio behavior of the private commercial banks and of the business and investment banks have been quite similar, which eventually led to treating all private sector banks as commercial ones in the newer banking law of 2003 (law no. 88/2003). This law was enacted to further improve the working of financial markets in a private-sector-led economy.

The public sector commercial banks are the largest operating banks in Egypt in terms of balance-sheet size, accounting for nearly 38 percent of total bank assets in 2006. However, in terms of market concentration, this percentage compares favorably to the 1992 figure of about 57 percent as a result of the privatization and bank restructuring efforts through mergers and acquisitions since the early 1990s with the aim of reducing concentration and enhancing competition in the banking industry. Each of the public sector commercial banks has divested its shares in the joint-venture banks with a maximum ownership of 20 percent. Also, one public sector commercial bank, namely, Bank of Alexandria, was privatized in 2006 and

another one (Banque du Caire) was to be privatized in 2008 but postponed for a later date after financial restructuring to ensure higher sale proceeds. Meanwhile, the private sector banks have further diversified their financial products to improve their competitiveness.

At end-June 2006, the banking system in Egypt consisted of 43 operating banks under the supervision of CBE, of which 4 were public sector commercial banks, 29 were private sector banks, and 7 were foreign banks. There were also 3 specialized banks, one for each of industrial, real estate and agricultural development. The public sector commercial banks had 975 branches nationwide compared to 674 branches for the private sector banks and 48 branches for foreign banks, mainly in the cities. For the public sector specialized banks, the industrial bank had 13 branches, the real estate bank had 28 branches, and the agricultural bank had 1206 branches, mainly in rural areas. Although there are no restrictions on branching in locations that are deprived of adequate banking services such as the new communities and the provinces, private banks still prefer to operate in the cities where business activity is normally higher. Thus, branches of the public sector banks considerably outnumber those of the private sector ones.

These figures compare with 4 public sector commercial banks, 51 private sector banks, and 22 foreign banks at end-June 1992. There were also 4 specialized banks, consisting of one industrial development bank, two real estate banks and one agricultural bank. The number of branches was 772 for the public sector commercial banks, 328 for the private sector banks (254 for commercial ones and 74 for business and investment ones), and 45 for foreign banks. Concerning the public sector specialized banks, the number of branches was 8 for the industrial bank, 15 for the real estate banks, and 936 for the agricultural bank.

Table 1 shows the change in the structure of the Egyptian banking system over the period 1992-2006. The reduction in the number of private sector and foreign banks reflects banking sector reform through mergers and acquisitions to establish a market structure characterized by a smaller number of banks but of stronger financial position for a healthier competition. The CBE has not issued new licenses since the mid-1990s under the restructuring effort such that market entry has been through acquisition of existing banks. In the meantime, the increase in the number of branches indicates a wider provision of the banking services in the economy. This has contributed to a greater share of the financial

sector in gross domestic product, where the income generated in banking and finance increased from 3.5 percent in 1992 to 5 percent in 2006.

Table 1. Structure of the Egyptian Banking System (1992, 2006)

End of June:	1992		2006	
	Units	Branches	Units	Branches
Total	81	2104	43	2944
Public sector banks	8	1731	7	2222
Commercial	4	772	4	975
Specialized	4	959	3	1247
Private sector banks	73	373	36	722
Commercial	40	254	29	674
Foreign	22	45	7	48
Business and investment	11	74		

Source: Central Bank of Egypt.

Notes:

1. One public sector commercial bank, namely, Bank of Alexandria, was privatized later in 2006.
2. Joint-venture private-sector banks are all classified as commercial banks in central bank reports after enactment of the banking law no. 88/2003 even though some are still registered as business and investment banks.

2.2. Regulatory Framework

Concerning the regulatory framework, the banking sector reforms in the 1990s included significant changes towards a more efficient functioning of banks under a market-based system. Regulations that discriminate against private banks and inhibit a level playing field for all participants were removed. For example, state-owned companies were allowed to deal with all banks without prior permission from a public sector bank. Branches of foreign-owned banks were allowed to operate in local currency and full entry of foreign banks through the establishment of local subsidiaries was authorized. Foreign partners were allowed majority equity holdings in joint venture banks. Bank fees and charges, creditor and debtor rates, and transactions on the foreign exchange market were liberalized. Administrative credit allocation was phased out and T-bill auctions were used to manage liquidity and indirectly provide a reference interest rate to the financial markets.

The CBE also took various measures in 1991 to strengthen the solvency of banks covering reserve and liquidity requirements, capital adequacy ratio, foreign-exchange exposure, investment concentration abroad, credit concentration, and loan classification and provisioning (see CBE 1992; IMF 1998). First, to reduce the implicit tax on banking activity,

the non-interest-bearing reserve balances held by banks at the CBE were reduced (from 25 percent) to 15 percent of total Egyptian pound deposits. For foreign currency deposits, the reserve balances earn interest equivalent to LIBOR and were reduced from 15 percent to 10 percent as from end-December 1993.

In 2001, the CBE further decided to exclude long-term deposits of maturity 3 years and more from the reserve ratio for Egyptian pound deposits. The CBE also reduced the reserve ratio from 15 percent to 14 percent and allowed banks to include their holdings of T-bills in the reserve ratio. However, the inclusion of T-bills in the reserve ratio was subject to the restriction that their value should not exceed 10 percent of the reserve balances (numerator of the reserve ratio) and that the remaining period to the maturity date of the T-bills should not exceed 15 days. In addition, the individual banks' holdings of T-bills that might be included in the reserve ratio subject to these restrictions would be excluded from the numerator of the liquidity ratio (liquid assets).

Meanwhile, the liquidity ratio was reduced and its scope was widened. It became 20 percent (down from 30 percent) and 25 percent for local- and foreign-currency balances, respectively. The liquidity ratio was also extended to business and investment banks in addition to commercial banks.

Second, the banks' minimum capital requirements vis-à-vis their risk-weighted assets were set at 8 percent along the lines of Basel Committee on Banking Supervision. As mentioned below, this capital adequacy ratio was later raised to 10 percent as a conservative approach to financial risk management, where all banks had to satisfy that ratio by 2005. Capital was defined to consist of two components:

- (a) Primary capital, which includes paid-up capital and reserves.
- (b) Other capital, which includes provisions for general banking risks and subordinated long-term loans of at least five-year maturity (these loans would be amortized over the last five years of their maturity period at the rate of 20 percent per annum).

As a general rule, one-half of the capital adequacy ratio would be met from primary capital. In addition, the provisions for general banking risks would account for no more than 1.25 percent of the risk weighted assets, and the subordinated loans should not exceed 50 percent of primary capital.

The CBE decision for the 8 percent capital adequacy ratio was taken in January 1991. Banks whose capital did not comply with the new regulations at the time were allowed gradual compliance:

- (a) For banks with capital adequacy ratio between 7 percent and 8 percent at end-December 1990, they were required to comply with the new regulations by end-December 1992.
- (b) For banks with capital adequacy ratio below 7 percent at end-December 1990, they were required to comply with the new regulations by end-December 1993.

Also, the public sector banks were recapitalized through government bonds to comply with the capital adequacy ratio. At present, banks comply with the more conservative 10 percent ratio as set by the CBE.

Third, limits were set on the banks' foreign-exchange exposure for prudent risk management. The ratio of foreign currency liabilities to foreign currency assets became subject to a maximum limit of 105 percent, and the open position for a single currency and for all currencies combined became subject to limits of 10 percent and 20 percent, respectively, of bank capital. With open position in several currencies, the 20 percent limit represents a cap on the single currency exposure limit.

Fourth, investment abroad by banks became subject to a limit of 40 percent of the bank capital. Also, the bank's deposits held with single foreign correspondents should not exceed 10 percent of total investments abroad (or \$3 million, whichever is higher). These measures are meant to limit investment concentration abroad for risk management purposes.

Fifth, single customer exposure (credit facilities, bonds and share holdings) was limited to 30 percent of bank capital according to the Basel definition. At the same time, credit to a single customer should not exceed 25 percent of a bank's paid-up capital and reserves. This applies to all bank borrowers including the public sector ones. When first applied in 1991, some banks that exceeded this limit with a wide margin were allowed gradual compliance. In addition, to discourage lending to insiders, banks were prohibited from granting any credit facilities to members of their board of directors or to their auditors. There is also surveillance by the CBE on geographical and sectoral concentration of bank lending so as to diversify portfolio risk. For equity holdings, bank participation in the share capital of joint-stock

companies was limited to 40 percent of the company's capital, provided that the nominal value of the shares owned by the bank shall not exceed its paid-up capital and reserves.

Sixth, stricter loan classification and provisioning criteria were issued to ensure that individual banks act prudently. Non-performing loans were classified as substandard, doubtful or bad according to the delay in debt repayment. All types of banks were mandated to take provisions on non-performing loans as follows:

- (a) If interest or principal repayment is delayed for over three months (substandard debt), a 20 percent provision has to be taken.
- (b) If unfulfillment of debt-servicing obligations extends to over six months (doubtful debt), the provision increases to 50 percent.
- (c) If the delay in servicing bank debt exceeds a year (bad debt), a 100 percent provision is called for.

The CBE examiners may also request the classification of certain borrowers as high-risk, and consequently mandate increased provisions on the part of banks. This is intended to cover risks that are known to exist but which have not been identified at the balance sheet date. In case of provision inadequacy, the CBE is empowered to prohibit the bank from distributing dividends to its shareholders in order to strengthen the bank's financial position. In addition, interest accrual on non-performing loans should be suspended and appear as a footnote to the financial statements; it should not be added to customer debit balances. It is noteworthy that non-performing loans may not be classified as such if borrowers put up highly liquid collateral (near monies) such as bank deposits and Treasury securities that fully guarantee the debt repayment.

In recent years, the CBE took further measures to upgrade the risk management practices in banks to comply with the Basel II Capital Accord for global financial stability (see e.g., AmCham 2005). This covers liquidity, market, credit and operational risks. For liquidity risk management, the CBE requests banks to prepare on a regular basis a maturity structure of their assets and liabilities for one month ahead and to submit a contingency plan under stress testing scenarios for review and approval. For market risk management, the CBE requests banks to present their trading positions for review in the weekly meetings of an asset and liability committee. For credit risk management, the CBE requests banks to classify their borrowers using a credit rating system for the calculation of minimum capital requirements. In

this regard, private sector banks established a credit bureau in 2006 to provide detailed information on borrowers' creditworthiness for rating purposes. For operational risk management, the CBE requests banks to undergo internal and external audits on a regular basis.

On the market transparency front, public disclosure of financial information has improved to allow effective monitoring of bank behavior by stakeholders and establish market discipline. Banks have adopted international accounting standards in preparing their financial statements. They also publish their financial statements on a quarterly basis with sufficient details in widely circulated newspapers for frequent updates on portfolio management.

To ensure that banks are well-capitalized for solvency purposes, the banking law no. 88/2003 sets the minimum issued and paid-up capital for domestic banks at EGP 500 million. For foreign banks, however, the minimum authorized capital is set at \$50 million or the equivalent in other major currencies.¹ The CBE regards these capital requirements as appropriate for fostering competition among financially-viable banks. In addition, all banks should fulfill a 10 percent risk-weighted capital adequacy ratio, which is higher by 2 percentage points than the minimum requirement of the Basel Committee on Banking Supervision for risk management purposes. The small operating banks were able to meet these capital requirements through mergers and acquisitions.

2.3. Determinants of Efficiency

For policy purposes, it is worth measuring and comparing the efficiency of the various bank groups under these developments in market structure and regulatory framework to shed light on performance of the banking sector during a period characterized by privatization and a liberal economic regime. Table 2 displays summary statistics for the variables used in studying bank efficiency over the period 1992-2006. These variables are used in the estimation of cost and profit functions of banks in Section 4 and include input prices, outputs, environment or market conditions, cost and profit. The data is disaggregated over six bank groups, of which three are public sector banks and three are private sector ones. It should be emphasized, however, that the public sector specialized banks have a much smaller deposit base than the commercial and the business and investment banks given the nature of their operations and their fund-raising activity.

¹ The Egyptian pound-US dollar exchange rate was roughly USD = EGP 6.0 when the law was issued in 2003.

For input prices, the mean and standard deviation of implicit interest rates on time deposits in public sector specialized banks are higher than those for the public sector commercial banks and the private sector banks. The higher levels and greater variation of interest cost in the specialized banks are related to their fund-raising activity that depends mainly on long-term borrowing from financial institutions with a relatively small deposit base. Concerning the real wage rate, it is significantly higher with greater variation in foreign banks that attract high caliber and offer attractive salaries for delivering their financial services. The wage rate is also higher with greater variation in the other business and investment as well as commercial private sector banks than in the public sector ones, which can be explained by overstaffing and the budgetary constraints in governmental institutions.

For outputs, loans and securities investment are divided by equity to adjust for scale bias. The ratio of loans to equity is higher with greater variation in the public sector banks given their more diversified lending activities, where corporate borrowers include both large state-owned enterprises and smaller private businesses. The ratio of securities investment to equity is higher in the commercial public sector banks and the private sector bank groups as their holding of T-bills and bonds as well as their participation in the equity capital of private sector companies are normally greater than in the specialized banks, which focus mainly on lending activity.

The ratio of fixed assets to equity accounting for the contribution of physical capital to the financial intermediation process has higher mean and standard deviation in the private sector banks, which may be explained by their greater investments in information technology despite the larger branch network of the public sector banks. The environment variable that reflects market conditions is measured as the ratio of annual provisions to net interest income. This ratio is negative and high with greater variation in the public sector commercial banks, indicating their lower asset quality associated with lending to loss-making state-owned enterprises. Clearly, political influence on the lending decisions of banks owned by the government has a negative impact on performance and financial viability.

Similar to the output variables, bank costs and profit are divided by equity to adjust for scale bias. The ratio of total cost to equity is higher in the public sector commercial and specialized banks, indicating weaker control over interest and non-interest expenses than in the private sector banks. At the same time, the return on equity is lower in the public sector

commercial and specialized banks, indicating lower revenues from income producing assets than in the private sector banks. These observations can be explained by the negative impact of political influence on lending and employment policies in the public sector banks.

Table 2. Summary Statistics on Bank Group Data (1992 - 2006)

	Pub. comm.		R. estate & ind. spec.		Agr. spec.		Pri. comm.		Foreign		Pri. bus. & inv.	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
w_1	0.089	0.022	0.357	0.208	0.134	0.078	0.076	0.019	0.086	0.030	0.132	0.059
w_2	10.163	0.858	11.294	0.860	6.901	2.652	15.988	2.367	48.374	8.521	18.453	3.177
y_1/z_2	11.761	2.090	14.777	5.036	7.114	4.090	6.875	2.063	7.275	2.131	5.809	0.635
y_2/z_2	12.968	2.899	2.545	0.770	3.962	4.107	11.083	5.969	12.105	4.500	6.291	1.084
z_1/z_2	0.104	0.040	0.102	0.057	0.160	0.089	0.160	0.091	0.197	0.146	0.198	0.144
m	-1.459	4.304	0.784	0.123	0.321	0.092	0.801	0.995	0.483	0.254	0.652	1.191
TC/z_2	2.063	0.452	1.990	0.804	0.955	0.664	1.235	0.372	1.240	0.469	1.011	0.152
ROE	0.076	0.026	0.031	0.015	0.037	0.055	0.228	0.086	0.113	0.038	0.141	0.039

Source: CAPMAS, Financial Statistics and Indicators for Banks and Insurance Companies, various issues.

Notes:

1. The table shows the mean and standard deviation of financial data for six groups of banks over the 1992-2006 period: public sector commercial banks, real estate and industrial specialized banks, agriculture specialized banks, private sector commercial banks, foreign banks, and private sector business and investment banks.

2. The notation w_1 denotes implicit interest rate on deposits, w_2 denotes real wage rate in thousand Egyptian pounds (1992 = 1), y_1/z_2 denotes the loans/equity ratio, y_2/z_2 denotes securities/equity ratio, z_1/z_2 denotes the ratio of fixed assets to equity, m denotes the ratio of annual provisions to net interest income, TC/z_2 denotes the ratio of total costs to equity, and ROE denotes the return on equity (i.e., net income/equity ratio).

3. THE CONCEPTS OF COST AND PROFIT EFFICIENCY

The concepts of cost and profit efficiency as discussed in Berger and Mester (1997) will be used in measuring the efficiency of banks. Cost efficiency gives a measure of how close a bank or a bank group's cost is to what a best-practice bank group's cost would be for producing the same output under the same conditions. It is derived from a cost function in which variable costs depend on the prices of variable inputs, the quantities of variable outputs, the quantities of any fixed netputs (inputs or outputs), environmental or market variables, random error and efficiency. Such a cost function may be written as

$$C = C(w, y, z, m, u_c, \varepsilon_c) \quad (1)$$

where C measures variable costs, w is a vector of prices of variable inputs, y is the vector of quantities of variable outputs, z indicates the quantities of any fixed netputs, which account

for the effects of these netputs on variable costs owing to substitutability or complementarity with variable inputs, m is a set of environmental variables that may affect performance, u_c is an inefficiency factor that may raise cost above the best-practice level, and ε_c is a random error. The inefficiency factor u_c incorporates both allocative inefficiencies from failing to react optimally to relative prices of inputs, w , and technical efficiencies from employing too much of the inputs to produce y . For analytical simplicity, the inefficiency and random terms, u_c and ε_c , are assumed to be multiplicatively separable from the rest of the cost function, and both sides of the cost function (1) are represented in natural logarithms:

$$\ln C = f(w, y, z, m) + \ln u_c + \ln \varepsilon_c \quad (2)$$

where f denotes some functional form. The term $\ln u_c + \ln \varepsilon_c$ is treated as a composite error term where $\ln \varepsilon_c$ is assumed to be two-sided normally distributed and $\ln u_c$ is typically assumed to be one-sided half-normally distributed in cross-sectional analysis under the stochastic frontier approach to efficiency measurement proposed by Aigner, Lovell, and Schmidt (1997). The cost efficiency of bank group b is defined as the estimated cost needed to produce bank group b 's output vector if the bank were as efficient as the best-practice bank group in the industry facing the same exogenous variables (w, y, z, m) divided by the estimated actual cost of bank group b , adjusted for random error, as follows:

$$\text{Cost Efficiency} = \frac{\hat{C}^{\min}}{\hat{C}^b} = \frac{\exp[\hat{f}(w^b, y^b, z^b, m^b)] \times \exp[\ln \hat{u}_c^{\min}]}{\exp[\hat{f}(w^b, y^b, z^b, m^b)] \times \exp[\ln \hat{u}_c^b]} = \frac{\hat{u}_c^{\min}}{\hat{u}_c^b} \quad (3)$$

where \hat{u}_c^{\min} is the minimum \hat{u}_c^b across all bank groups in the industry. Specified as such, cost efficiency ranges between 0 and 1, and equals unity for a best-practice bank group within the observed data. Thus, the cost efficiency ratio as given in equation (3) measures the proportion of resources that are used efficiently.

For profit efficiency, there are two concepts used in the literature, namely, standard profit efficiency and alternative profit efficiency. Standard profit efficiency measures how close a bank group is to producing the maximum profit given a particular level of input prices and output prices as well as other factors. Thus, in contrast to the cost function, the standard profit function specifies variable profits in place of variable costs and takes variable output prices as given rather than holding all output quantities fixed at their observed values. That is,

the profit dependent variable allows for consideration of net revenues that can be earned by varying outputs as well as inputs. Output prices are taken as exogenous, allowing for inefficiencies in the choice of outputs when responding to these prices or to any other arguments of the profit function.

The standard profit function in logarithmic form is

$$\ln(\pi + \theta) = f(w, p, z, m) + \ln u_{\pi} + \ln \varepsilon_{\pi} \quad (4)$$

where π is the variable profits of the bank group, which includes interest and fee income earned on the variable outputs minus variable costs, C , used in the cost function, θ is a constant added to every bank group's profit so that the natural log is taken of a positive number, p is the vector of prices of the variable outputs, $\ln \varepsilon_{\pi}$ represents a random error, and $\ln u_{\pi}$ represents inefficiency that reduces profits.

The standard profit efficiency is defined as the ratio of predicted actual profits to the predicted maximum profits that could be earned if the bank group was as efficient as the best-practice bank group in the industry, net of random error, as follows:

$$\text{Standard Profit Efficiency} = \frac{\hat{\pi}^b}{\hat{\pi}^{\max}} = \frac{\{\exp[\hat{f}(w^b, p^b, z^b, m^b)] \times \exp[\ln \hat{u}_{\pi}^b]\} - \theta}{\{\exp[\hat{f}(w^b, p^b, z^b, m^b)] \times \exp[\ln \hat{u}_{\pi}^{\max}]\} - \theta} \quad (5)$$

where \hat{u}_{π}^{\max} is the maximum value of \hat{u}_{π}^b in the industry. The standard profit efficiency ratio as given in equation (5) measures the proportion of maximum profits that is earned by bank group b . The standard profit efficiency ratio equals one for a best-practice bank group that maximizes profits given the observed data. Unlike cost efficiency, standard profit efficiency can be negative since bank groups can throw away more than 100 percent of their potential profits.

The concept of alternative profit efficiency, on the other hand, measures how close a bank group comes to earning maximum profits given its output levels rather than its output prices. The alternative profit function employs the same dependent variable as the standard profit function and the same exogenous variables as the cost function. Thus, instead of considering deviations from optimal output as inefficiency, as in the standard profit function, variable output is given as in the cost function while output prices are free to vary and affect profits.

The alternative profit function in logarithmic form is

$$\ln(\pi + \theta) = f(w, y, z, m) + \ln u_{a\pi} + \ln \varepsilon_{a\pi} \quad (6)$$

which is similar to the standard profit function but with y replacing p in the function f , yielding different values for the inefficiency and random error terms, $\ln u_{a\pi}$ and $\ln \varepsilon_{a\pi}$, respectively. Also, similar to standard profit efficiency, alternative profit efficiency is the ratio of predicted actual profits to the predicted maximum profits for a best-practice bank group:

$$\text{Alt. Profit Efficiency} = \frac{a\hat{\pi}^b}{a\hat{\pi}^{\max}} = \frac{\{\exp[\hat{f}(w^b, y^b, z^b, m^b)] \times \exp[\ln \hat{u}_{a\pi}^b]\} - \theta}{\{\exp[\hat{f}(w^b, y^b, z^b, m^b)] \times \exp[\ln \hat{u}_{a\pi}^{\max}]\} - \theta} \quad (7)$$

In this equation, efficiency values are allowed to vary with output prices but errors in choosing output quantities do not affect alternative profit efficiency except through the point of evaluation $\hat{f}(w^b, y^b, z^b, m^b)$ to the extent that the best-practice bank group is not operating at the same vector (w, y, z, m) as bank group b .

As pointed out in Berger and Mester (1997), alternative profit efficiency is more appropriate to use when (a) there are substantial unmeasured differences in the quality of banking services, (b) outputs are not completely variable, (c) output market is not perfectly competitive, or (d) output prices are not accurately measured. The first factor considers the additional revenue that higher quality output can generate. The second factor allows for the possibility that banks cannot achieve every output scale and product mix as when there are significant differences in the assets size of banks. The third factor is relevant in situations in which banks have some market power over the prices they charge, especially when output levels are relatively fixed in the short run. The fourth factor implies that inaccurate measurement of output prices does not provide accurate guides to opportunities to earn revenues and profits in the standard profit function so that considering other variables such as the output quantities y may yield a better fit.

In general, alternative profit efficiency is the more appropriate concept to use in practice. Also, the profit efficiency is apparently superior to the cost efficiency for evaluating the overall performance of bank groups. Profit efficiency accounts for errors on the output side and the input side. It is based on the more accepted economic goal of profit maximization, which requires the same amount of managerial attention be paid to raising a marginal monetary unit of revenue as to reducing a marginal monetary unit of costs.

4. THE ECONOMETRIC MODEL

4.1. *The Data*

The dependent variable of the cost function is total costs, including interest and non-interest operating expenses, while that of the profit function is net income, measured as the difference between total revenues from financial assets and total costs. The explanatory variables for both the cost and the alternative (as opposed to the standard) profit functions include variable input prices, variable output quantities, fixed netputs (inputs or outputs) quantities, and environmental variables measuring the economic conditions faced by banks that may affect performance. The standard profit function has variable output prices (which include the price of loans and of securities) as exogenous variables instead of the variable output quantities. However, it will not be considered in this study since output prices will be inaccurately measured in the presence of defaults on loans.

The variable input prices include the price of deposits (w_1), i.e., interest rate, and the price of labor (w_2) measured in constant pounds per employee. The interest rate in this study is an implicit rate, which is measured as the ratio of interest expenses to time deposits, since share-weighted explicit interest rates paid by each bank group on deposits are not available. The variable output quantities include loans (y_1) and securities (y_2), representing all non-loan financial assets as measured by the difference between total assets and loans plus physical capital. The fixed netput quantities include fixed assets (z_1) and financial equity capital (z_2).

A bank's insolvency risk depends on its financial capital available to absorb portfolio losses. Insolvency risks affect bank costs and profits through the intensity of risk management activities the bank undertakes. For this reason, the financial capital of banks should be considered when studying efficiency. Also, financial capital accounts for differences in the banks' risk preferences. If some bank groups (e.g., private sector banks) are more risk averse than others (e.g., public sector banks), they may hold a higher level of financial capital than the level that maximizes profits or minimizes costs under the assumption of risk neutrality. If financial capital is ignored, the efficiency of these banks would be mismeasured even though

they are behaving optimally given their risk preferences. Even apart from risk, a bank's capital level directly affects costs by providing an alternative to deposits as a funding source for loans. Interest paid on debt counts as a cost whereas dividends paid do not. So, to the extent that large banks use a higher proportion of debt financing to finance their portfolios than small banks, measured costs will be higher for these banks. Thus, a failure to control for equity capital can yield a scale bias.

Finally, the ratio of annual provisions to net interest income (m) is used as an environmental variable that signals asset quality for bank groups given market conditions as well as regulatory requirements so that a negative value or a high ratio is expected to have a negative impact on performance. The environmental variable is exogenous insofar as it is not an outcome of managerial inefficiencies or bad management of bank portfolios. This condition is satisfied when working with bank groups rather than individual banks. Since the measurement of relative inefficiencies presupposes that the bank groups produce the same output quality, such an exogenous variable controls for the heterogeneity in output quality. It is noteworthy, however, that the interest income and loan loss provisions associated with a particular loan tend to materialize in different time periods when considering implicit interest rates as in the present analysis.

4.2. Model Specification

The econometric analysis uses a panel data approach to modeling bank efficiency, whether on the expenditures side by studying cost efficiency or on both the expenditures and the revenues sides by studying alternative profit efficiency. In terms of equations (2) and (6) of Section 3, the residual in panel estimation is composed of both inefficiency, $\ln u$, and random error, $\ln \varepsilon$, without making explicit assumptions about their distributions. For each cross-sectional unit, the random error, $\ln \varepsilon$, is assumed to average out over time while inefficiency, $\ln u$, is assumed to persist over time and is used to compute average efficiency. This represents a distribution-free approach to efficiency measurement where it is assumed that there is an average efficiency for each cross-sectional unit over time. Under this approach, the analysis is similar to estimating an efficient frontier and measuring the average differences between observed banks and banks on the frontier. The efficiency concept may be defined relative to the best practice observed in the banking industry rather than to any true minimum costs or

maximum profits assuming risk neutrality of banks since the underlying technology is unknown.

The empirical model adopts a flexible translog specification that allows unrestricted factor substitution for the cost and alternative profit functions. This modeling approach is appropriate as it does not impose unrealistic restrictions on the form of the cost or profit function in banking. The data is obtained from the annual balance sheets of six groups of banks over the period 1992-2006, as published by the official statistics agency (CAPMAS). The bank groups are: (1) public sector commercial banks, (2) public sector industrial and real estate specialized banks, (3) public sector agricultural specialized banks, (4) private sector commercial banks, (5) foreign banks, and (6) private sector business and investment banks.

The panel model used here is of the fixed-effects specification that is similar to a deterministic frontier approach to efficiency measurement discussed in Greene (1980). This specification allows considering the impact of ownership type (public or private) on bank cost and profit efficiency after controlling for asset or credit quality. It also includes a time trend to account for technological change in banking.

The specification for the cost function is

$$\begin{aligned}
\ln(C_{it} / w_{i2} z_{it2}) = & \alpha_0 + \beta_1 \ln(w_{i1} / w_{i2}) + 1/2 \beta_{11} [\ln(w_{i1} / w_{i2})]^2 \\
& + \sum_{k=1}^2 \gamma_k \ln(y_{ik} / z_{it2}) + 1/2 \sum_{k=1}^2 \sum_{l=1}^2 \gamma_{kl} \ln(y_{ik} / z_{it2}) \ln(y_{il} / z_{it2}) \\
& + \delta_1 \ln(z_{it1} / z_{it2}) + 1/2 \delta_{11} [\ln(z_{it1} / z_{it2})]^2 \\
& + \sum_{k=1}^2 \eta_{1k} \ln(w_{i1} / w_{i2}) \ln(y_{ik} / z_{it2}) \\
& + \zeta_{11} \ln(w_{i1} / w_{i2}) \ln(z_{it1} / z_{it2}) \\
& + \sum_{k=1}^2 \phi_{k1} \ln(y_{ik} / z_{it2}) \ln(z_{it1} / z_{it2}) \\
& + \mu_1 \ln m_{it} + 1/2 \mu_{11} [\ln m_{it}]^2 \\
& + \psi T + \alpha_i + \varepsilon_{it}
\end{aligned} \tag{8}$$

where an adjustment factor is added as appropriate to the values of the variables for every bank group in order to avoid taking the natural logarithm of non-positive number. In equation (8), T is a time trend, α_i is the specific or fixed effect of the i -th bank group measuring inefficiency, t denotes time, and ε is an error term. The standard symmetry restrictions apply to this functional form so that $\gamma_{kl} = \gamma_{lk}$. Also, the dependent variable and input price terms are normalized by the price of labor (w_2) to impose linear homogeneity on the model as cost shares must add up to one (see e.g., Greene 2008). The dependent variable, output quantities,

and fixed netput quantities are specified as ratios to the financial capital input or equity (z_2) to control for heteroskedasticity since the estimation equation of large bank groups would have error terms with considerably larger variances in the absence of normalization.

The alternative profit function uses a similar specification with few changes. First, the dependent variable for the profit function is $\ln[(a\pi_{it} / w_{it2}z_{it2}) + |(a\pi_{it} / w_{it2}z_{it2})^{\min}| + 1]$, where $|(a\pi / w_2z_2)^{\min}|$ indicates the absolute value of the minimum value of $(a\pi / w_2z_2)$ across the bank groups for the same year. This adjustment factor is used when bank profit is of negative value. Thus, the constant $\theta = |(a\pi / w_2z_2)^{\min}| + 1$ is added to every bank group's dependent variable in the profit function so that the natural logarithm is taken of a positive number. So, for the bank group with the lowest value of $(a\pi / w_2z_2)$ that happens to be negative for that year, the dependent variable will be $\ln(1) = 0$. A similar adjustment applies to the explanatory environmental variable of the ratio of provisions to net interest income, whose value can be negative. This variable appears in both the cost and profit functions as discussed earlier. While the linear homogeneity restriction does not have to be imposed on the alternative profit function, it is usually imposed to keep the functional form equivalent as reported in Berger and Mester (1997).

Under the distribution-free approach to efficiency measurement using panel data, the estimated inefficiencies for a cost function can be normalized according to

$$\hat{u}_{i,c} = \alpha_i - \min \alpha_i \quad (9)$$

where α are fixed effects as defined in equation (8). Similarly, the estimated inefficiencies for a profit function can be normalized according to

$$\hat{u}_{i,a\pi} = \max \alpha_i - \alpha_i \quad (10)$$

With such normalization, one of the bank groups will meet the benchmark value of zero for best practice and the remaining bank groups will have positive inefficiency estimates (see Greene 1997).

4.3. Empirical Results

Tables 3 and 4 report the estimation results for the cost and profit functions, respectively. In general, the panel model is well specified for each of the cost and profit functions. The

hypothesis of no inefficiency effects is rejected in both specifications. The time trend in the cost function is significant at the 10 percent level but not at the 5 percent level. It takes on a positive value, however, indicating that control over costs deteriorates over time. On the other hand, the trend term is not statistically significant in the profit function. These results suggest the need for further modernization and technical progress in the banking sector to enhance efficiency.

Figures 1 and 2 show the cost and profit efficiency scores for the various bank groups using the normalization in equations (9) and (10), respectively.² The efficiency performance results of the public and private sector banks are mixed. As can be seen, the private sector commercial banks have higher cost inefficiency and profit efficiency than other bank groups. This suggests that private sector commercial banks bear higher costs than other bank groups to generate greater revenues and profits (see Pasiouras, Tanna, and Zopounidis 2007).

It is noteworthy that the discrepancy in efficiency scores between private and public sector banks is less pronounced on the cost side than on profits. This is partly attributed to the lower wage rate in public sector banks. In this connection, the recent mergers and acquisitions among private sector commercial banks may be helpful in improving their overall performance by allowing for better methods of cost control over materials and supplies through economies of scale.

One should exercise care, however, in interpreting the results for the specialized banks. In particular, these banks depend more on long-term borrowing from financial institutions than on deposit-taking activities in raising funds. The interest rates on these borrowed funds are often lower than the interest rates on deposits with shorter-term maturity. As a result, the cost of funds in the specialized banks tend to be lower than that in the commercial and the business and investment banks with favorable impact on the expenditures side. Also, the agricultural specialized bank takes part in the distribution of pesticides and fertilizers to farmers in addition to the provision of credit and so its cost and revenue structures are different from those of standard financial intermediation. To the extent that the bank takes the

² As can be expected, the empirical results are sensitive to the choice of the starting year of banking sector reforms. For example, choosing 1991-2006 as the estimation period yields different results affected by the policy environment of the pre-reform period. Since reforms started in January 1991 and the banking data are published for fiscal years in Egypt, which run from the beginning of July through the end of June, the estimation period 1992-2006 is more appropriate.

prices of these commodities as given and do not charge farmers service fees, its profitability is negatively affected given the administrative costs.

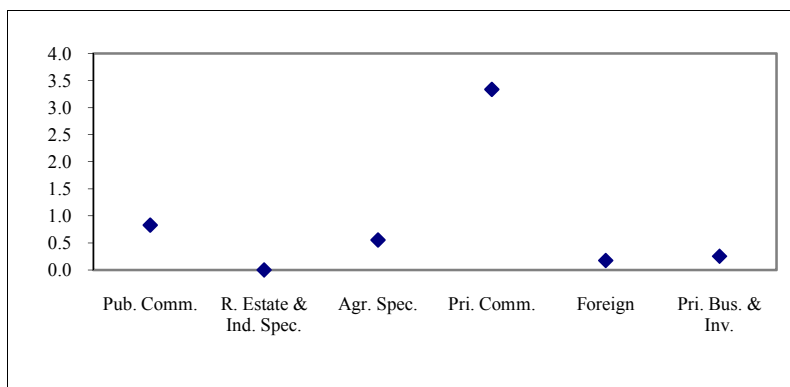
Table 3. Estimates of the Fixed Effects Model for the Cost Efficiency Function

Parameter	Estimate	t-Statistic
α_0	-3.435	-2.851
β_1	0.047	0.127
β_{11}	-0.047	-1.135
γ_1	1.179	2.023
γ_2	0.449	1.339
γ_{11}	-0.054	-0.279
γ_{12}	-0.409	-1.965
γ_{22}	0.342	3.216
δ_1	0.031	0.122
δ_{11}	0.090	2.174
η_{11}	-0.007	-0.074
η_{12}	0.130	2.487
ζ_{11}	-0.074	-2.439
ϕ_{11}	0.038	0.443
ϕ_{21}	-0.113	-1.965
μ_1	-0.244	-1.046
μ_{11}	0.315	2.084
ψ	0.028	1.906
Adj. R ²	0.983	
H ₀ : No inefficiency effects		
$\chi^2(5) = 337.888$		
P-value = 0.000		

Notes:

1. Large-sample critical values for the t -statistic at the 1 percent, 5 percent and 10 percent significance levels are 2.576, 1.960 and 1.645, respectively.
2. The test statistic for joint significance of the fixed effects is chi-squared distributed with degrees of freedom equal to the number of independent constraints under the null hypothesis of no inefficiency effects.

Figure 1. Cost Efficiency in Banks



Note: A higher value indicates a less efficient bank group. The benchmark value of zero signifies best practice.

Table 4. Estimates of the Fixed Effects Model for the Profit Efficiency Function

Parameter	Estimate	t-Statistic
α_0	0.035	1.832
β_1	0.017	2.924
β_{11}	0.002	2.944
γ_1	-0.010	-1.092
γ_2	0.018	3.477
γ_{11}	0.003	0.836
γ_{12}	-0.008	-2.447
γ_{22}	0.002	1.502
δ_1	-0.009	-2.376
δ_{11}	-0.001	-1.017
η_{11}	-0.004	-2.800
η_{12}	0.002	2.348
ζ_{11}	0.000	0.224
ϕ_{11}	0.003	2.543
ϕ_{21}	0.001	0.860
μ_1	-0.002	-0.487
μ_{11}	0.001	0.419
ψ	0.000	0.764

Adj. R^2 0.618

H_0 : No inefficiency effects

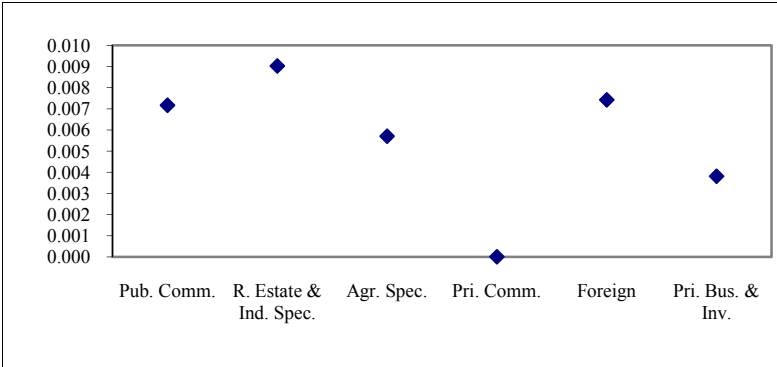
$\chi^2(5) = 52.587$

P-value = 0.000

Notes:

1. Large-sample critical values for the t -statistic at the 1 percent, 5 percent and 10 percent significance levels are 2.576, 1.960 and 1.645, respectively.
2. The test statistic for joint significance of the fixed effects is chi-squared distributed with degrees of freedom equal to the number of independent constraints under the null hypothesis of no inefficiency effects.

Figure 2. Profit Efficiency in Banks



Note: A higher value indicates a less efficient bank group. The benchmark value of zero signifies best practice.

5. CONCLUSION

The Egyptian banking sector has undergone major changes towards a market-oriented system. The reform effort included upgrading the regulatory framework to strengthen banks’ solvency and implementing a bank privatization program to reduce market concentration and segmentation. The empirical analysis of cost and profit efficiency under these reform policies using panel data shows that the performance results of the public and private sector banks are mixed. This holds after controlling for asset quality in a period that witnessed a privatization effort and the adoption of a more liberal regime to improve competitiveness and economic efficiency.

While cost efficiency is higher in foreign and private sector business and investment banks, the discrepancy in efficiency scores between these banks and the public sector ones is artificially limited by the lower wage rates and tighter budget constraints in the public sector. There is also evidence of lower profit efficiency in the public sector banks, which can be explained by political influence on management decisions. In the mean time, the cost efficiency of the private sector commercial banks is found lowest among the various bank groups whereas their profit efficiency is found highest. This suggests the willingness of these banks to incur higher costs on financial intermediation in return for higher revenues and profits.

The banking sector reform in Egypt started early in the mid-1970s with phased-in financial liberalization under the open door policy and gathered pace in the post-1990 period of privatization and prudential regulations. The reform effort is consistent with—and began years before the establishment of—the General Agreement on Trade in Services (GATS) of

the World Trade Organization in 1995 to create well-functioning markets. Bank restructuring is expected to induce technical progress through increasing market competition and efficiency. However, this should be accompanied by improving corporate governance in banks to strengthen their compliance with regulatory policy for financial safety purposes. The banking sector can then play a more effective role in providing financial services to businesses and promoting economic activity.

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