

## THE EFFECT OF BANKING EXPANSION ON PROFIT EFFICIENCY OF SAUDI BANKS

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### Abstract

This paper aims at analyzing the profit efficiency of the Saudi banks, and testing how it could be affected by banking expansion. This has been conducted using a sample of 6 commercial banks (out of 11), and covering the period from 1998 to 2007. Profit efficiency has been measured, using the ratio of actual profitability to the best one, which a similar bank (in size) can realize. Tests indicated that we could accept hypotheses regarding the effects of "availability of phone banking", "number of ATMs" and "number of branches" on profit efficiency of Saudi banks, also referred to the need to reject the hypotheses regarding the effects of "number of POSs", "availability of PC banking" and "availability of mobile banking".

**Keywords:** profit efficiency, banking expansion

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### Introduction: Nature of the Problem

Financial services firms, especially banks, provide financial products and payment services, which offer vehicles for investment of savings, and availability of credit, and consequently enable their customers to participate in the broader economy.

Saudi banks play an important role, not only as a financial intermediate serving depositors and borrowers

and encouraging economic growth, but also as the largest Arab banks, and this is why it's important to concern with the analysis of their performance efficiency.

Saudi banks have expanded their activities, which are reflected by the growing assets during the last decade, and consequently, numbers of branches, number of ATMs, and number of POSs have been increased. The following table illustrates these developments:

**Table 1.** Development of Saudi banks from 2002 to 2007

At end of	Assets By million S.R.	No. of Branches	No. of ATMs	No. of POSs
2002	508237	1203	3120	24291
2003	545208	1209	3676	29060
2004	655382	1216	4104	35521
2005	759075	1224	4588	44253
2006	861088	1289	6079	52784
2007	1075221	1353	7543	61557

Source: Saudi Arab Monetary Association (2007), Annual Report 43.

Profit maximization doesn't express efficiency, as it doesn't take in account the bank size. So, profitability is common to be used as a measure of efficiency. However, it doesn't imply - precisely - that there is a significant inference among banks' efficiency in terms of their profitability. In case of having two banks, where the first has ROA of 10%, and the second has ROA of 12%, we can't argue that the second is better than the first, until we investigate the maximum ROA, which each of them can realize. If the maximum ROA is 10% and 15% for these two banks consequently, then the profit efficiency of the first one will be better than the second.

This paper addresses a main question about

determinants of Saudi banks' profit efficiency, where it's measured by "how well bank performs relative to best practice institution that produces the same output bundle under the same exogenous" (Berger& DeYoung, 2001, p.9). Determinants of profit efficiency, to be examined, are variables related to banking expansion, concerning with banking branches, and other innovations regarding using IT technology to substitute or help with branches as traditional marketing channels.

The paper unfolds as follows: after this introduction, section 2 reviews research literature that has concerned with tools of "banking expansion", and their potential effects on banks' performance. Section 3 explains how to

measure variables representing "banking expansion" and "profit efficiency", and illustrates how to test the hypotheses. Section 4 is for empirical work, presenting results and discussing how these results answer research questions. Section 5 summarizes the paper and provides brief conclusions.

## Literature Review

Financial Institutions are experiencing an era of rapid changes, which are fueled by innovative improvements in technologies and data processing. White (1997, p.7) and Frei, Harker & Hunter (1997, p.1) shed light on the importance of (1) power and low cost of new technology; (2) economic changes; (3) intensified international competition; and (4) deregulation that has been influential in inducing innovation (it can, also, inhibit it). All of these causes and effects are mutually interacting, and consequently affecting each other.

Sinkey (2002, p.26) concerns with the Information technology, as one of the most important five issues, which affect the banking performance. Sinkey' TRICK are Transparency, Risk exposure, Information technology, Competition for customers, and Kapital (German spelling).

Technological innovation in retail banking industry has been spurred on by forces of new distribution channel systems, such as PC banking (Frei et al, 1997, p.8). So, the evaluation of banking channels of distribution is, to a great extent, an evaluation of banking technological innovations.

Branches remain the major delivering vehicle of banking services (Soteriou & Zenios, 1997, p.4), and it's interesting to note that, despite the "hype" that branch delivery is dead, most customer still frequent the branch, where number of branches is increasing, including supermarket-based locations (called "in-store" branches) and kiosk-like branches (Frei et al, 1997, p.10).

Berger & DeYoung (2001) assesses the effects of geographic expansion on bank efficiency, for 7000 U. S. banks, over the period 1993-1998. The results imply that there may be no particular optimal geographic scope for banks. Also, Akhavein, Frame & White (2001) finds that number of branches and size are positively related to the diffusion (i.e., probability and timing) of the adoption of new technology by its "first movers". Soteriou & Zenios (1997) has indicated that analyzing banks' efficiency should include branches, service quality, operations, and profitability, simultaneously.

Technologies and data processing are "the heart of financial services" White (1997, p.1). On the other hand, the blend of innovation and behavior change "lies at the heart of modern banking organization" (Frei et al, 1997, p.12).

ATMs began to be introduced in the 1970s, in forms of internal ATMs, off-premise ATMs, or remote ATMs, as a distribution channel, which serves banks and customers. Scholnick et al (2006) analyzes the value of ATM network to its users, where it's influenced by its number

of locations (network effect) and its number of users (production scale effect). Saloner & Shepard (1995) discusses the network effect, and finds that the greater the number of branches a bank has, the earlier will have introduced the new ATMs, which is consistent with findings of Akhavein et al (2001).

Banks have invested heavily in ATM machines, due to their cost advantages on a per-transaction basis, where it's less than teller or telephone human operator. This has led banks to attempt to change customer behavior through the additional of fees (the "stick") and the variety of rebates (the "carrots"), to migrate customers away from high-cost delivery systems (Frei et al, 1997, p.11, 12). Also, Massoud et al (2006) finds that the level of ATM surcharge is positively related to market share of large banks, while Prager (2001) finds it negatively related to market share of small banks.

POSs systems were introduced in 1970s and they were developed in 1980s, to be as PC-based system. Many POS systems are performing other functions, more than the primary function of moving funds electronically, as they are integrated systems for management, inventory, marketing and accounting.

Utilization of POSs couldn't have been analyzed separately, as it's influenced by other available types of payments, degree of competition among banks, types of products to be purchased and transaction size. Bounie & Francois (2006) explains the determinants of the probability of using cash, check or POS, as applied on French population from March to May 2005, using dataset of 11945 transactions. It's found that the larger the transaction, the lower the probability of being paid in cash, and the higher of being paid in check or using POS.

(Scholnick et al, 2006) concludes that ATM and POS transactions are substitutes, and that ATM surcharges impacts POS volume positively. This result has been depended on database of 1242 observations about prices and quantities of ATM and POS transactions, as applied on Spanish saving banks, from 1997 to 2003.

Banks are introducing new ways for customers to access their accounts balances, transfer funds, pay bills and buy goods and services, without using cash, mailing checks or leaving home. At the surface, one could consider the PC channel similar to the Phone Center, in that a customer is simply contacting the bank remotely, in one case over the phone, in the other by the PC, but the implications resulting in each model are different (Frei et al, 1997, p.9, 12).

PC Banking (also called Home Banking, Office Banking, Internet Banking, or Online Banking) was first introduced in the early 1980s, using Banks' Proprietary Software, but the trial was abandoned before the end of the decade, as the service couldn't attract enough customers to make the system pay for itself, and consequently let the bank break even (Frei et al, 1997, p.15).

As these systems couldn't achieve economies of scale, the next development in the early 1990s, came with Banking with Third Party Software, using a middle-ware

piece, and this makes customers think that banks are operating in a real time environment. Also, this software market has attracted interest from banks, as it has steady revenue streams by way of upgrades, updates and the sale of related products (Frei et al, 1997, p.13, 15, 16).

The new direct access, introduced by Citibank in 1996, is considered as the first major improvement in PC Banking, through Banking via Online Services. This development is demonstrated by explosive growth from 40000 subscribers to 190000, as it allows Citibank to setup retail branches on subscriber-based online services. The developments are enhancing speed of access and convenience, which led to bypass-based online, services (Frei et al, 1997, p.13, 16, 17).

Customers are demanding any-time any-where delivery of financial services, and this could be realized through "Mobile Banking", which refers to provision and availability of banking and financial services with the help of mobile telecommunication devices. The scope of offered services may include facilities to conduct bank and stock market transactions. (Tiwari & Buse, 2006) finds out that 15% of banks' customers in Germany are willing to change their bank if it fails to provide mobile services. Also, Daniel (2000) finds that PC banking leads to increased number of customers.

Mobile banking can be expected to follow in the footsteps of PC banking, as a new distribution channel. It can be traced back to mainly following factors (Tiwari et al, 2006): (1) penetration of society by mobile phones; (2) power of mobile devices; (3) necessity of mobility; (4) following "fit for future" strategy; and (5) taking the "early mover" advantage.

Daniela& Octavia (2006) illustrates three technical ways of stocking financial information in the mobile phone. They are (1) using only one chip, where the SIM card has functionalities of WIM (Wireless Identity Module); (2) using two cards, the SIM and the WIM and (3) using dual slot, for the two cards, with a card reader for the bank card.

Khalfan& Alshawaf (2004) illustrates factors that inhibit PC banking applications in Oman. The major factors are "the lack of top management support" and "information privacy and security issues". El-Bannany (2002) finds that investment in IT systems affects bank

profitability positively in the UK, while the relation has not been supported in Egypt.

Researchers have examined new banking products in context of different sub-disciplines, including banking, financial economics, monetary economics, macroeconomics, network economics, regulatory economics, industrial organization, and consumer behavior (Scholnick et al, 2006, p. 3).

Prasad & Harker (1997) examines the effect of IT investments on both productivity and profitability in the retail banking sector, as applied on 115 banks in the United States for the years 1993-1995. The additional investment in IT capital may have no real benefits, and may be more of strategic necessity to stay even with competition. However the results indicate that there're substantially high returns to increase IT labor, and that the retail banks need to shift emphasis in IT investments from capital to labor.

The cost savings came largely through back office automation, but the key to profitability is through revenue enhancement. The banking industry is moving from "cost- saving" to "revenue- enhancing" innovation (Frei et al, 1997, p.8, 9).

Berger& DeYoung, (2001) uses cost efficiency, as the ratio of bank costs, to the minimum bank cost across all the banks in the sample. Also, Profit efficiency, is measured as the ratio of bank profits, to the maximum bank profits across all the banks in the sample.

## Data Description and Hypothesis Test

In this study, the sample contains 6 Saudi commercial banks, out of 11 ones working in the Saudi banking market. Data are collected to cover the period from 31/12/1998 to 31/12 2007, and for each bank/ year observations, the following data have been collected: Net Profit (P), Assets (A), Equity (E), Capital (C), Number of Branches (BRA), Number of ATMs (ATM), Number of POSs (POS), Availability of Phone Banking (PHO), Availability of PC Banking (PCB), and Availability of Mobile Banking (MOB).

Using these raw data, variables representing profitability and banking expansion, could be calculated as follows:

$$\text{ROA} = P / A \quad (1)$$

Where: ROA = Return On Assets

$$\text{ROE} = P / E \quad (2)$$

Where: ROE = Return On Equity

$$\text{ROC} = P / C \quad (3)$$

Where: ROC = Return On Capital

$$\text{BRA} = \text{Number of Branches} \quad (4)$$

$$\text{ATM} = \text{Number of ATMs} \quad (5)$$

$$\mathbf{POS} = \text{Number of POSs} \quad (6)$$

$$\mathbf{PHO} = 1 \text{ (if phone banking is available), } = 0 \text{ (if not)} \quad (7)$$

$$\mathbf{PCB} = 1 \text{ (if PC banking is available), } = 0 \text{ (if not)} \quad (8)$$

$$\mathbf{MOB} = 1 \text{ (if Mobile banking is available), } = 0 \text{ (if not)} \quad (9)$$

$$\mathbf{Z} = -1/ \text{Bank Assets (by milliards S.R.)} \quad (10)$$

After having calculated the previous variables, for each bank in the sample, over the study period, the steps of test design could be illustrated as follows.

**The first step** is to investigate the relationship between profitability and size, by estimating the following quadratic functions:

$$\mathbf{ROA}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (11)$$

$$\mathbf{ROE}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (12)$$

$$\mathbf{ROC}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (13)$$

where:  $\mathbf{ROA}_{n,t}$  = ROA of bank n at time t.,  $\mathbf{ROE}_{n,t}$  = ROE of bank i at time t.,  $\mathbf{ROC}_{n,t}$  = ROC of bank n at time t., and  $\mathbf{Z}_{n,t}$  = Size of bank n at time t.

**The second step** is to use the previous analysis to estimate the optimal point, which represents the size by which the bank maximizes profitability.

$$\mathbf{Max ROA}_{n,t} : \mathbf{ROA}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (14)$$

$$\mathbf{Max ROE}_{n,t} : \mathbf{ROE}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (15)$$

$$\mathbf{Max ROC}_{n,t} : \mathbf{ROC}_{n,t} = \mathbf{f}(\mathbf{Z}_{n,t}) \quad (16)$$

By finding the first derivative and equalize it with zero, we can reach the maximum value of profitability indicators  $\mathbf{ROA}_n^*$ ,  $\mathbf{ROE}_n^*$  and  $\mathbf{ROC}_n^*$ , where the second derivative is supposed to be negative.

**The third step** is to estimate the relationship

$$\mathbf{ROA}_n^* = \mathbf{f}(\mathbf{Z}_n) \quad (17)$$

$$\mathbf{ROE}_n^* = \mathbf{f}(\mathbf{Z}_n) \quad (18)$$

$$\mathbf{ROC}_n^* = \mathbf{f}(\mathbf{Z}_n) \quad (19)$$

It's important to ascertain that each of optimal profitability indicator  $\mathbf{ROA}_n^*$ ,  $\mathbf{ROE}_n^*$  and  $\mathbf{ROC}_n^*$  is determined by bank size  $\mathbf{Z}_n$ . This is why we can estimate the optimal profitability indicator, for any bank and at any time, according to its size. By other words, given the existence of "optimal profitability-size" combination for each bank, it's argued that these optimal points could

between optimal points for each bank, to build up the full picture, which represents the efficient frontier of profitability indicators, for all Saudi banks covered in this study. This could be shown as follows:

explain the relationship between profitability and size, and consequently, illustrate the maximum profitability for each size.

**The fourth step** is to estimate the profit efficiency, which represents the ratio of actual profitability indicator to optimal one, where:

$$\mathbf{EF1}^* = \mathbf{ROA} / \mathbf{ROA}^* \quad (20)$$

$$\mathbf{EF2}^* = \mathbf{ROE} / \mathbf{ROE}^* \quad (21)$$

$$EF3^* = ROA / ROA^* \quad (22)$$

**The fifth step** is to examine the effects of variables where:  
representing banking expansion on profit efficiency,

$$EF1 = f (BRA, ATM, POS, PHO, PCB, MOB) \quad (23)$$

$$EF2^* = f (BRA, ATM, POS, PHO, PCB, MOB) \quad (24)$$

$$EF3^* = f (BRA, ATM, POS, PHO, PCB, MOB) \quad (25)$$

Using these three previous functions, it's easy to calculate the coefficients of regression, which describe how profit efficiency is affected by banking expansion. These coefficients are B1, B2, B3, B4, B5 and B6, where they represent coefficients of regression due to BRA, ATM, POS, PHO, PCB, and MOB consequently. These functions, also, illustrate the six hypotheses of this paper, where:

H1a: Number of Branches makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H1a: B1 # 0 versus null hypothesis that B1 = 0.

H2a: Number of ATMs makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H2a: B2 # 0 versus null hypothesis that B2 = 0.

H3a: Number of POSs makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H3a: B3 # 0 versus null hypothesis that B3 =

0.

H4a: Availability of Phone Banking makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H4a: B4 # 0 versus null hypothesis that B4 = 0.

H5a: Availability of PC Banking makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H5a: B5 # 0 versus null hypothesis that B5 = 0.

H6a: Availability of Mobile Banking makes positive (or negative) contribution to Profit Efficiency of Saudi Banks. This means that H5a: B6 # 0 versus null hypothesis that B6 = 0.

### Results of Empirical Study

**The first step** is to investigate the relationship between profitability and size, by estimating equation (1), using quadratic function. The results are as follows:

**Table 2.** Estimation of ROA for each bank

Bank	R <sup>2</sup>	F (Sig.)	a	B <sub>1</sub>	B <sub>2</sub>
1	0.652	3.75 (0.121)	-1.4597	-594.98	-41176
2	0.545	2.99 (0.140)	-0.1574	-117.58	-3764.7
3	0.479	3.22 (0.102)	-0.4395	-52.000	-564.99
4	0.902	32.30 (0.000)	0.0916	-86.364	-3297.5
5	0.876	24.79 (0.001)	-0.8137	-249.40	-11494
6	0.806	14.58 (0.003)	0.5368	-100.04	-8560.5

Values under F represent the corresponding p-values.

**Table 3.** Estimation of ROE for each bank

Bank	R <sup>2</sup>	F (Sig.)	a	B <sub>1</sub>	B <sub>2</sub>
1	0.627	3.36 (0.139)	0.0285	-48.367	-2134.4
2	0.682	5.36 (0.057)	0.1874	-14.228	-554.53
3	0.626	5.87 (0.032)	-0.5101	-54.157	-582.13
4	0.915	37.74 (0.000)	0.0718	-30.603	-1179.1
5	0.951	68.40 (0.000)	-0.2866	-101.48	-4761.2
6	0.653	6058 (0.025)	-0.2135	-120.61	-6916.0

Values under F represent the corresponding p-values.

**Table 4.** Estimation of ROC for each bank

Bank	R2	F (Sig.)	a	B1	B2
1	0.731	5.43 (0.072)	-0.0131	-14.865	-1174.7
2	0.660	4.86 (0.067)	0.0307	-0.4937	-38.279
3	0.305	1.53 (0.280)	-0.0045	-0.7498	-7.1931
4	0.901	31.74 (0.000)	0.0354	0.2091	-35.874
5	0.883	26.39 (0.001)	-0.0677	-17.807	-794.95
6	0.670	7.11 (0.021)	-0.0130	-11.945	-724.23

Values under F represent the corresponding p-values.

**The second step** is to use the previous analysis to estimate the optimal point, which represents the size by which the bank maximizes profitability. This has been conducted for each bank using the three profitability indicators (ROA, ROE, and ROC), and the results are as follows:

**Table 5.** Profitability- Size Relationship for each bank

Bank	Using ROA		Using ROE		Using ROC	
	ROA*	Size	ROE*	Size	ROC*	Size
1	0.68818	-0.00722	0.30250	-0.01133	0.03395	-0.00633
2	0.76067	-0.01562	0.27868	-0.01283	0.03229	-0.00645
3	0.76144	-0.04619	0.74959	-0.04652	0.02404	-0.05212
4	0.34341	-0.02185	0.27042	-0.01298	0.03570	-0.00291
5	0.53919	-0.01085	0.25429	-0.01066	0.03198	-0.01134
6	0.82939	-0.00584	0.31234	-0.00872	0.03628	-0.00825

**The third step** is to estimate the relationship between optimal points for each bank, to build up the full picture, which represents the efficient frontier of profitability indicators for all Saudi banks (included in the sample). This could be shown as follows:

**Table 6.** Estimation of profitability frontier for each indicator

Profitability Indicator	R2	F (Sig.)	a	B
ROA	0.949	27.67 (0.012)	0.0127	-0.00005
ROE	0.986	102.95 (0.002)	0.0067	-0.00004
ROC	0.983	87.86 (0.002)	0.0004	-0.0000007

Values under F represent the corresponding levels of significance.

**The fourth step** is to estimate the profit efficiency, which represents the ratio of actual profitability indicator to optimal one. This has been conducted for each bank using each of profitability indicators.

**The fifth step** is to examine the effects of variables representing banking expansion on profit efficiency and the results of this last step could be illustrated as follows:

**Table 7.** The effects of banking expansion on profit efficiency

Profit Efficiency Indicator	R2	F (Sig.)	B1	B2	B3	B4	B5	B6
Using ROA	0.637 (0.543)	48.27 (0.000)	---	-0.0007 (-3.32)***	---	0.982 (8.51)***	---	---
Using ROE	0.500 (0.635)	18.03 (0.000)	-0.00016 (-2.04)**	-0.00084 (-3.19)***	---	0.973 (6.79)***	---	---
Using ROC	0.851 (0.724)	72.17 (0.000)	---	-0.00088 (-3.19)***	---	1.404 (9.91)***	---	---

Values under R2 represent standard error, and values under F represent level of significance. Values under B coefficients, between brackets, are t values, while \*, \*\*, and \*\*\* represent levels of significance 10%, 5%, and 1% consequently.

The results indicate that the "number of POSs", the "availability of PC banking" and the "availability of mobile banking" may have no benefits in term of "profit efficiency". This means that we could accept the null hypothesis, for each of the third, fifth and sixth hypothesis, at a p-value of 1%.

Regarding the first hypothesis, the results show no strong evidence about the effect of "number of branches" on "profit efficiency", as this effect appears only when using "profit efficiency of ROE", and at a p-value of 5%.

Tests indicated that we could strongly accept the second and fourth hypotheses regarding the effects of "number of ATMs" and "availability of phone banking" on profit efficiency of Saudi banks.

## Summary and Conclusions

This paper considers the effects of banking expansion on profit efficiency of the Saudi banks. This has been conducted using a sample of 6 commercial banks (out of 11), and covering the period from 1998 to 2007. Profit efficiency has been measured using the ratio of actual profitability to the best one, which a similar bank can realize.

The significance of this paper is due to two main issues; the first is shedding light on profit efficiency development of Saudi banks during the period 1998-2007, and the second is concerning with examining the determinants of profit efficiency, assuming that it's influenced by banking expansion.

Tests indicated that we could accept hypotheses regarding the effects of "availability of phone banking", "number of ATMs" and "number of branches" on profit efficiency of Saudi banks, also referred to the need to reject the hypotheses regarding the effects of "number of POSs", "availability of PC banking" and "availability of mobile banking".

Regarding the ATMs, it's important to consider that shared ATMs and networks let customers benefit more regardless their bank. So, the reliability of "number of ATMs", which is belonging to a certain bank, may not be reliable as an indicator to transactions done using ATMs. Also, there are still many outstanding issues and questions about pricing, surcharging, and other costs. Ausubel (1991) highlights two possible costs in seeking to change credit card products, where customers have to find information on alternative providers (search cost), and have to switch to alternative one (switching cost). This puzzle is affected by asymmetric information and consumer behavior. It's, also, could be based on "tacit collusion" between banks (Knittle & Stango, 2003). For the "availability of PC banking" and the "availability of mobile banking", it's argued that the "pricing puzzle" is

still one of the outstanding issues.

The results show that the most important determinants of "profit efficiency" are the "availability of phone banking" and the "number of ATMs". Thus, this result is consistent with the idea that "availability of phone banking" rather than any other determinant, in this study, is what affects profit efficiency, as it illustrates the behavior of profit efficiency (using ROA), giving R2 of 0.564, while adding "the availability of ATMs" raises R2 to 0.637 (by only 0.073).

For further research, it will be important to study variations of profit efficiency among banks within the same period, and variations among periods for the same bank, using other determinants, related to risk, service quality, or organizational development.

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