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Does Competition Affect Bank Efficiency in MENA Countries? A Double Bootstrapping-DEA Approach

Nidhal Ziadi Ellouz[1]

[1] Faculty of Sciences of Tunis,University of Tunis El Manar, Tunis, Tunisia

Correspondence: Nidhal Ziadi Ellouz, Faculty of Sciences of Tunis, University of Tunis El Manar, Tunis, Tunisia. E-mail: nidhal.ziadiellouze@fst.utm.tn

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Abstract

This paper aims to examine the effect of competition on the technical efficiency of Middle Eastern and North Africa (MENA) banks during the period 2004-2014. To do so we use the two-stage bootstrap approach introduced by Simar and Wilson (2007). In the first stage, efficiencies scores were obtained using Data Envelopment Analysis (DEA) with Bootstrap technique to control for potential bias. In the second stage, the bootstrap truncated regression was used to assess the effect of competition on bank efficiencies. Furthermore, we utilize Lerner index to measure competition at bank level. Using a sample of 88 banks from thirteen MENA countries, we find that the technical efficiency with bias correction shows no obvious trend during the period of the study, however, the level of efficiency varies significantly across countries. In addition, we find a negative relationship between competition and technical efficiency which supports the information generation hypothesis and rejects the quiet life hypothesis. To the best of our knowledge, this is the first study that examines the effect of competition on bank efficiency in MENA banking industry using the double bootstrapping-DEA approach.

Keywords: competition, technical efficiency, DEA, Bootstrap, Truncated Regression, MENA countries

1. Introduction

The aim of this paper is to examine the effect of competition on efficiency in Middle East and North Africa (MENA) banking industry. During the last decade, MENA countries authorities have started to implement reforms of their banking sector in order to increase bank efficiency and competitiveness. Indeed, MENA countries have initialized financial liberalization process and deregulation of their banking sector to meet the requirements of international monetary fund (IMF) and the World Trade Organization (WTO). These changes have affected governance structure of banks in MENA countries since the banking system has become more open to foreign investors and to foreign banks which in turn has prompted home-buyers to embark on mergers and acquisitions and privatization processes in order to improve their competition and efficiency vis-à-vis foreign banks.

It is therefore of interest to study how these changes in the MENA countries have impacted efficiency and competitiveness of their banking industry and how does competition affects the bank efficiency.

the scope of this study is twofold. First, I examine the level of competition and efficiency of banks in MENA countries. Second, I analyze how the relationship between competition and banks efficienciesExamining the effect of competition on bank efficiency is interest for many reasons and practical problems. First, as competition increases, banks need to ensure they are providing high-quality customer service to attract and retain customers. This can pose a challenge as banks may have to invest more resources in training staff, improving response times, and enhancing overall customer experience to remain efficient. Second, intense competition can create a demand for banks to maintain cost efficiency. This may involve optimizing operations downsizing personnel and implementing measures to reduce expenses while ensuring standards of service quality and compliance. Third, under a competitive environment, banks may need to continually adapt and incorporate new technology to remain ahead of the competition. This can entail spending money on cutting-edge banking software, mobile banking apps, internet portals, and electronic payment methods. The difficult part of using these technologies is weighing the costs of doing so against the possible efficiency advantages they may offer.

Based on previous literature, the relationship between competition and efficiency finds its root in two competing

hypotheses: The Quiet Life Hypothesis (QLH) and the Information Generation Hypothesis (IGH).

According to the Quiet Life Hypothesis developed by Berger and Hannan (1998), banks tend to become less effective when there is less market rivalry. This theory is predicated on the idea that fierce competition encourages banks to use more creative and efficient methods in an effort to draw in and keep clients. Banks must continually work to enhance their offerings, save expenses, and provide better interest rates in order to stay ahead of the competition when there is a lot of it. In order to increase efficiency, they are therefore likely to use technology and procedures like simplifying processes, improving digital banking services, or investing in staff training. Banks are motivated to find and execute cutting-edge solutions that boost productivity and improve resource allocation as a result of this competitive pressure.

On the other side, banks may grow comfortable and less inclined to invest in efficiency-improving initiatives when the amount of competition declines. Banks may be content with their market position if there is little competitive pressure, and as a result, they may put less effort into increasing their operating efficiency. This can result in a lack of innovation, a delay in the uptake of new technology, and a diminished focus on cost-cutting strategies. In summary, the Quiet Life Hypothesis suggests that decreased competition can lead to reduced efficiency in banks, as the absence of competitive pressure may hinder their motivation to invest in innovative practices and cost-cutting measures

Contrary to the QLH hypothesis, the IGH hypothesis initiated by Marquez and Hauswald (2002) establishes a negative relationship between competition and banking efficiency. Indeed, Marquez and Hauswald (2002) state that when there is strong competition between banks, there is a reduction in the banks' ability to collect information about their customers, which increases the likelihood of the selection of borrowers. This leads to a decline in efficiency. Casu and Girardone (2006) demonstrated that competition can improve efficiency by encouraging bank managers to reduce costs in order to remain competitive in a competitive environment. On the other hand, other authors, such as Claessen and Leaven (2004) and Casu and Girardone (2009), argue that the relationship between competition and efficiency is actually more complex.

From empirical point of view, studies having examined the effect of competition on banking efficiency reported mixed results. This includes studies by Casu and Girardone (2006, 2009), Chen et al. (2009), Fang et al. (2011), Fu and Heffernan (2009), Kirkpatrick et al. (2008), Koetter et al. (2008, 2012), Maudos and Guevara (2007), Pruteanu-podpiera et al. (2008), Schaeck and Cihak (2008), Turk Ariss (2010).

The majority of studies on banks have tested these two assumptions in the context of developed countries such as the United States and Europe. However, few studies have examined the relationship between competition and efficiency in the context of developing countries, and particularly in the MENA countries. Still, the MENA countries offer a fertile ground for examining the relationship between efficiency and banking competition state why the problem deserves new research.

2. Literature Review

2.1 Competition and Bank Efficiency: Theoretical Underpinning

The relationship between competition and efficiency stems from two competitive assumptions: The "Quiet Life" (QLH) hypothesis and the "Information Generation" hypothesis (IGH). According the QLH, developed by Hicks (1935), it’s assumed that market power will reduce pressure to efficiency. That is, banks with a large market share tend to be less efficient because they concentrate their efforts mainly on risk reduction. Indeed, the work of Hicks 1935 and the structure-behavior-performance paradigm developed by Bain (1939) are the first to analyze the effect of competition on the efficiency of banks. As Hicks (1935) and Berger and Hannan (1998) point out, managers can exercise the market power of banks to obtain super-normal profits without making efforts to monitor costs to increase the efficiency of banks. Thus, the increase in monopoly results from a reduction in efficiency while competition promotes efficiency and therefore there is a positive association between banking competition and efficiency according to the HQL hypothesis.

However, following the IGH hypothesis, in the banking sector, information has a leading role. Moreover, and according to Freixas and Rochet (2008), the management of problems of adverse selection and moral hazard is a central element of the banker's profession. Indeed, an intensification of competition makes it more difficult to set up and maintain a long-term relationship. These privileged results allow the banks to have information about their customers and to reduce the problems of moral hazard. From a slightly different perspective, Hauswald and Marquez (2006) show that exacerbated competition reduces the investment in information retrieval by banks. All these approaches highlight the fact that market power, by facilitating access to information, can improve banking efficiency. Marquez and Hauswald (2002) show that if the market is concentrated, the existing banks will have

better knowledge on the market in its totality. This, in turn, reduces the problems of adverse selection.

2.2 Competition and Bank Efficiency: A Review of Empirical Studies

A review of empirical studies of the relationship between competition and banking efficiency shows that the results are mixed. There are those who find a positive association while others find a negative association between the two concepts.

Casu and Girardone (2009) contribute to the literature on the one hand by analyzing the relationship between competition and efficiency of commercial banks in France, Germany, Italy, Spain and the United Kingdom between the years 2000 and 2005. On the other hand, they test the orientation of the causal relationship. The results provide empirical evidence on the monopoly power that can have a positive effect on efficiency if it allows banks to operate at lower cost.

Ben Ali and Sghaier (2012) provide an empirical analysis of the impact of competition on efficiency in 10 Tunisian commercial banks during the 1990-2009 period. Using the ratio of concentration and HerhindhalHirshman index noted HHI to measure competition and the method of the stochastic boundary to estimate the level of efficiency of banks. Empirical evidence suggests that the link between competition and efficiency is positive, while the increase in concentration negatively affects banking efficiency.

Using the Tobit regression, Castellanos and García (2013) study the relationship between competition and efficiency in the Mexican banking sector during the period 2002 to 2012. They find a positive association between banking competition and efficiency. In the same vein, when examining the association between banking competition and efficiency, Arrawatia et al. (2015) have used the Lerner index as a measure of competition and the nonparametric technique of data wrapping technique noted DEA for the efficiency evaluation of banks. They also find that competition has a positive impact on efficiency.

Weill (2003) examines the relationship between banks' competition and efficiency in 12 European countries for the period 1994 - 1999. Competition is measured by the H statistic while efficiency is estimated by the stochastic boundary method. The author shows that there is a negative relationship between competition and banking efficiency.

Casu and Girardone (2006) focus on the relationship between banking competition, concentration and efficiency and the determinants of banking competition. Specifically, they seek to analyze the role of bank's efficiency in the competitive conditions of the European Union banking systems. Using banking data for commercial and savings banks in the 15 EU countries over the period (1997-2003), they use the Panzar-Rosse approach to estimate the degree of competition and the AED method to measure the Efficiency in the European market. The results seem to indicate little evidence that the most efficient banking systems are also more competitive. The relationship between competition and bank efficiency is negative. In particular, they show that the relationship is complex and dynamic. In this sense, increased competition has forced banks to become more efficient, but increased efficiency does not appear to favor more competitive EU banking systems.

Furthermore, using the Granger causality test, Andries and Capraru (2012) assess the link between competition and efficiency in the banking systems of 27 European Union countries during the period (2001-2009). They prove the existence of a negative relationship between competition and efficiency.

Uddin and Suzuki (2014) examine the influence of competition on bank performance. They retained a sample of 39 banks in Bangladesh from 2001 to 2011. They found that competition had a negative impact on performance in terms of profitability and efficiency.

Recently, Apergis and Polemis (2016) have examined the relationship between competition and efficiency in 10 MENA countries during the period (1997-2011). They use the H statistic of Panzar and Rosse to measure the degree of competition and the nonparametric DEA method for the efficiency estimation of banks. Therefore, what is worth noting is that the empirical results are more consistent and robust than those found in previous studies providing monopolistic competition in all MENA countries and a negative relationship between competition and efficiency.

Discuss the relevant related literature, but do not feel compelled to include an exhaustive historical account. Assume that the reader is knowledgeable about the basic problem and does not require a complete accounting of its history. A scholarly description of earlier work in the introduction provides a summary of the most recent directly related work and recognizes the priority of the work of others. Citation of and specific credit to relevant earlier works are signs of scientific and scholarly responsibility and are essential for the growth of a cumulative science. In the description of relevant scholarship, also inform readers whether other aspects of this study have been reported on previously and how the current use of the evidence differs from earlier uses. At the same time,

cite and reference only works pertinent to the specific issue and not those that are of only tangential or general significance. When summarizing earlier works, avoid nonessential details; instead, emphasize pertinent findings, relevant methodological issues, and major conclusions. Refer the reader to general surveys or research syntheses of the topic if they are available. Demonstrate the logical continuity between previous and present work. Develop the problem with enough breadth and clarity to make it generally understood by as wide a professional audience as possible (Beck & Sales, 2001). Do not let the goal of brevity lead you to write a statement intelligible only to the specialist.

2.3 Hypotheses Development

The current study is designed to test the link between competition and banking efficiency in the MENA countries. As mentioned above, and according to the hypothesis of calm life (QLH), a positive relationship can exist between competition and the efficiency of banks. However, competition appears to have a negative impact on efficiency under the Information Generation Assumption (IGH). Moreover, reading empirical studies of the relationship between efficiency and competition in the banking sector shows that the empirical results are mixed. Indeed, some authors find a negative association in the sense that the greater the banking competition, the more the efficiency of banks decreases. Ben Ali and Sghaier (2012) find that banking competition makes it possible to improve the efficiency of banks.

On the basis of previous theoretical and empirical studies, I postulate the following hypothesis:

H: Competition has a significant effect on bank efficiency in MENA countries;

Ha: According to the QLH hypothesis, competition positively affects banking efficiency in MENA countries.

Hb: According to the IGH hypothesis, competition adversely affects banking efficiency in MENA countries.

3. Research Methodology

3.1 Estimation of Efficiency Using the DEA-Bootstrap Method

In the first step of our estimation, I calculate the efficiency score of banks. To do this, I use the Data Envelopment Analysis (DEA) method and I run the VRS (Variable Return to Scale) model. To measure productive efficiency with variable scale returns, I use the DEA-oriented model where inputs are minimized and outputs are maintained at their initial levels (Banker et al., 1984) The chosen model is as follows:

$$\theta^* = Min\theta, s.c$$

$$\sum_{j=1}^{N} \lambda_j x_{i,j} \leq \theta x_{i0} i = 1,2,\dots,M$$

$$\sum_{j=1}^{N} \lambda_j y_{r,j} \geq y_{r0} r = 1,2,\dots,S$$

$$\sum_{j=1}^{N} \lambda_j = 1$$

$$\lambda_j \geq 0 \quad j = 1,2,..,N$$

With "bank0" is one of the N banks and x_{i0} and y_{r0} are the ième input and the rème output of the bank " bank0", respectively.

If $\theta^* = 1$, then the current level of the inputs cannot be minimized further indicating that the bank bank0 is on the verge of efficiency i.e. it is totally efficient. However, if $\theta^* < 1$, then the bank " bank0" is said to be inefficient and θ^*represents its efficiency score.

In particular, I follow the approach of Simar and Wilson (2000) which is described as follows:

1. Calculate the efficiency scores $\widehat{\theta^*}$ for each bank according to the optimization model described above.

2. Generate a random sample of size N $\{\theta^*_{1b}, \dots, \theta^*_{Nb}\}$ with replacement from estimates $\{\tilde{\theta}_{1b}, \dots, \tilde{\theta}_{Nb}\}$. I mainly use the bootstrap method with smoothing.

3. Calculate a set of pseudo-data $\{(x_{jb}, y); j = 1, \dots, N\}$, with $x_{jb} = \frac{\theta_j}{\theta^*_{jb}}$ in order to construct the technology of Bootstrap.

4. Calculate the Bootstrap estimate θ^*_{jb} of the efficiency scores θ_j for each bank, j = 1, ..., N, solving the linear program presented above.

5. Repeat steps 2 to 4 R times, in order to have a set of Bootstrap estimates $\{\hat{\theta}^*_{jb}, b = 1, \ldots, R\}$ for j=1,2,….,N. Following Simar and Wilson (2000), R should be equal to 2000 for a reasonable approximation of confidence intervals.

After calculating the efficiency scores using the Bootstrap method, it is now necessary to calculate the confidence intervals for the efficiency scores from the distribution of the point estimates $\{\hat{\theta}^*_{jb}, b = 1, \ldots, R\}$obtained by the Bootstrap method.

Similarly, the Bootstrap method makes it possible to calculate the level of the bias of the point estimates of the efficiency scores $\hat{\theta}_j$, j=1,2,…,N as follows:

$$\widehat{Biais}_j(\hat{\theta}_j) = R^{-1}\sum_{r=1}^{R}\hat{\theta}^*_{jb} - \hat{\theta}_j$$

From this equation, the corrected efficiency score for the bias level can be obtained as follows:

$$\hat{\hat{\theta}}_j = \theta_i - \widehat{Biais}_j(\hat{\theta}_j)$$

3.2 Description

The data used in this study can be described in two categories. First, data on inputs and outputs which are used in estimating bank efficiency scores. Then, the second category consists of data concerning the estimation of banking competition and the control variables. All these data are collected from the database of BANKSCOPE for the period from 2004 to 2014. Data are from banks operating in 17 countries of the MENA zone. After bank eliminations with missing data, the final sample is composed of 84 banks, i.e. 968 bank-year observations. able 1 shows the distribution of sample size by country.

Table 1. Sample distribution by country

Country	#Banks	%
Bahreïn	77	7.95
Iran	11	1.14
Israël	33	3.41
Jordan	121	12.5
Kuwait	77	7.95
Lebanon	132	13.64
Malta	22	2.27
Morroco	22	2.27
Qatar	44	4.55
KSA	99	10.23
Tunisia	110	11.36
UAE	154	15.91
Oman	66	6.82
Type of bank		
Commercial banks	759	78.41
Investment banks	88	9.09
Islamic banks	121	12.50
Total	968	100

3.3 Variables Measures

3.3.1 Inputs and Outputs Choice for the Calculation of Efficiency

The choice of variables to play the role of inputs and outputs in estimating efficiency depends on the approach used to calculate efficiency scores. Based mainly on literature, there are two approaches allowing for fixing these variables: the intermediation approach and the production approach (Sealey and Lindley, 1977). According to the

production approach, banks are seen as productive units that produce services for their clients using a set of resources such as labor, technology and equipment. On the other hand, under the intermediation approach, banks are observed as financial intermediaries that employ a set of resources such as labor inputs, customer deposits and physical capital to generate loans and other investments. According to Berger and Humphery, the intermediation approach is the most preferred and most used in the literature. Thus, in the present study, we adopt the intermediation approach and we use three inputs and three outputs. The three inputs are interest expense, personnel expenses and other operating expenses. Outputs consist of net interest income, total commissions and other operating revenues.

3.3.2 *Measurement of banking competition*

Following previous literature, I use the Lerner index as a measure of bank competition. The Lerner index has commonly been computed in recent studies on bank competition (e.g. Carbo et al., 2009; Fang et al. Marton, 2011). The Lerner index captures the level of market power of the bank and measures the difference between the price set by the bank (Pit) and the marginal cost (MCit) divided by the price. The Lerner index is obtained as follows:

$$LERNER_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}}$$

With Pit is the total asset price measured as the ratio of the total income of the bank to the total assets of bank i in year t (Kasman and Kasman, 2015). $MC_{i,t}$ is the marginal cost of bank i in year t. The marginal cost is obtained by deriving the Translog cost function with a single output (Kasman and Kasman, 2015). The Translog function is estimated using the stochastic boundary technique with an output (total active) and three inputs (physical capital, labor factor and capital).

3.3.3 *Control variables*

Following earlier studies, such as Castellanos et al. (2013); Phan et al. (2016) and with regard to the competition variable, we have introduced other control variables into the truncated regression. These variables are the size of the bank, credit risk, bank profitability, degree of capitalization and net interest margin. The size of the bank (SIZE) is measured as the logarithm of the active total. Previous studies have reported ambiguous relationship between bank size and efficiency. While some studies, including those by Ataullah et al. (2004), Hauner (2005), and Chen et al. (2005) showed a positive association, others, including those by Isik and Hassan (2003), Girardone et al. (2004), and Weill (2004) found a negative link between bank size and efficiency. However, depending on the type of efficiency taken into account, Ab-Rahim et al. (2012) discovered different associations. The credit risk (CREDIT) is obtained as the ratio between the amount of credits granted and total assets. It is well established that changes in credit risk may reflect changes in the health of a bank's loan portfolio (Cooper et al., 2003), which may affect the performance of the bank, since poor asset quality is the single most important cause of bank failures. The level of profitability is measured by the ROA ratio. The efficiency of banks may be impacted differently by higher bank profits. Banks with larger profits may be able to upgrade their managerial capabilities and technology to increase efficiency, but higher earnings also tend to encourage waste. Consequently, I may anticipate a positive or negative connection between bank earnings and efficiency. The degree of capitalization is estimated as total capital divided by total assets (AQTA). AQTA reflects the capital strength of banks and high levels of equity may mitigate the risk of insolvency and the cost of borrowed funds, thus suggesting a positive relationship with bank efficiency. According to Isik and Hassan (2003) well capitalized banks are more technically efficient, thus the expected sign of AQTA with bank efficiency is positive. The net interest margin (NIM) is calculated as the difference between interest received and interest paid. Demirguc-Kunt and Huizinga (1999) claim that wider margins imply lower banking competition which reflects a degree of lower bank efficiency. The expected sign between NIM and bank efficiency is then supposed to be negative. Table 2 reports the descriptive statistics of the independent variable, the Lerner index, and the control variables.

Table 2. Descriptive statistics for selected variables

Variables	N	Mean	S.D	Median	Minimum	1st Q	3rd Q	Maximum
SIZE	968	8.625	1.517	8.648	2.609	7.702	9.805	11.803
ROA	968	0.015	0.032	0.014	-0.682	0.008	0.021	0.226
AQTA	968	0.129	0.084	0.118	-0.516	0.084	0.150	0.752

NIM	968	0.024	0.010	0.024	-0.032	0.020	0.029	0.109
CREDIT	968	1.996	4.956	1.353	0.116	1.142	1.813	119.680
LERNER	968	0.131	0.513	0.202	-5.461	-0.163	0.482	5.386

Based on what has been advanced, our econometric model is as follows:

$$EFF_{i,t} = \beta_0 + \beta_1 LERNER_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 NIM_{i,t} + \beta_5 CREDIT_{i,t} + \beta_6 AQTA_{i,t} + \varepsilon_{i,t}$$

.

4. Empirical Result

4.1 First Step: Efficiency Scores Using The DEA-Bootstrap Method

The results of estimation of efficiency scores by the DEA method following the approach of Simar and Wilson (2000) are reported in Tables 3 and 4. Table 3 reports the average values of the efficiency scores per bank and Table 4 reveals the average values of the efficiency scores by year and bank type. In fact, the two tables show the efficiency scores by the classical DEA method (θ), the bias corrected efficiency scores (θ ^ *), the bias amount (BIAS) and the confidence interval using the Bootstrap method of efficiency scores (LB: lower bound and UB: upper bound). On the one hand, by observing the efficiency values θ by the classical DEA method, no bank of our sample is totally efficient, ie having a value of θ = 1. On the other hand, we find that the bias level (BIAS) is positive, which indicates that the scores obtained by the classical DEA method overestimate the actual level of technical efficiency. This demonstrates the need to take precautions when using the conventional AED method.

Table 3. Mean efficiency scores by bank using VRS DEA-Bootstrap approach

Bank	Country	$\hat{\theta}$	$\overline{\hat{\theta}^*}$	BIAS	LB	UB
APS Bank Limited	Malta	0.4090	0.2906	0.1185	0.1892	0.6288
Abu Dhabi Commercial Bank	UAE	0.7592	0.5417	0.2175	0.3561	1.1622
Abu Dhabi Islamic Bank - Public Joint Stock	UAE	0.6226	0.4415	0.1811	0.3000	0.9452
Ahli Bank QSC	Qatar	0.6226	0.4523	0.1704	0.3281	0.9172
Ahli United Bank BSC	Bahrain	0.5895	0.4269	0.1626	0.3014	0.8776
Ahli United Bank KSC	Kuwait	0.6126	0.4552	0.1574	0.3434	0.8817
Al Rajhi Bank Public Joint Stock Company	KSA	1.0000	0.5967	0.4033	0.1928	1.8072
Albaraka Banking Group B.S.C.	Bahrain	0.4536	0.3334	0.1201	0.2450	0.6622
Amen Bank	Tunisia	0.5801	0.4072	0.1729	0.2939	0.8663
Arab Bank Group (Combined)	Jordan	0.6935	0.4874	0.2061	0.3342	1.0528
Arab Bank Plc	Jordan	0.5343	0.3648	0.1694	0.2508	0.8177
Arab Bank for Investment & Foreign Trade-Al Masraf	UAE	0.8484	0.5680	0.2804	0.3392	1.3576
ArabBanking Corporation (Jordan)	Jordan	0.4014	0.2902	0.1112	0.2082	0.5946
ArabBanking Corporation - Tunisie	Tunisia	0.2321	0.1563	0.0758	0.1039	0.3602
Arab Jordan Investment Bank	Jordan	0.4207	0.3101	0.1107	0.2256	0.6159
Arab National Bank Public Joint Stock Company	KSA	0.7114	0.4938	0.2177	0.3209	1.1019
ArabTunisian Bank	Tunisia	0.3792	0.2549	0.1243	0.1723	0.5860
Attijari Bank	Tunisia	0.3664	0.2560	0.1104	0.1904	0.5424
Attijariwafa Bank (Combined)	Morocco	0.6347	0.4272	0.2076	0.2674	1.0021
B.L.C. Bank S.A.L	Lebanon	0.3061	0.2197	0.0865	0.1540	0.4582
BBAC sal	Lebanon	0.3091	0.2188	0.0903	0.1558	0.4624
BBK B.S.C.	Bahrain	0.4999	0.3620	0.1379	0.2774	0.7225
Bank AlJazira JSC	KSA	0.7120	0.4739	0.2380	0.2794	1.1446
Bank Audi SAL	Lebanon	0.4462	0.3146	0.1316	0.2167	0.6758
Bank Dhofar SAOG	Oman	0.5218	0.3646	0.1572	0.2507	0.7929
Bank Muscat SAOG	Oman	0.5935	0.4126	0.1810	0.2897	0.8974
Bank Tejarat	Iran	0.5324	0.3485	0.1839	0.2214	0.8435
Bank al Etihad	Jordan	0.5259	0.3779	0.1479	0.2680	0.7837
Bank of Beirut S.A.L.	Lebanon	0.3989	0.2929	0.1060	0.2086	0.5893
Bank of Sharjah	UAE	0.8245	0.5597	0.2648	0.3493	1.2996
Bankmed, sal	Lebanon	0.2925	0.2057	0.0868	0.1373	0.4478
Banque BEMO Sal	Lebanon	0.2506	0.1813	0.0693	0.1346	0.3667
Banque Centrale Populaire SA	Morocco	0.6096	0.4087	0.2009	0.2380	0.9812
Banque Internationale Arabe de Tunisie - BIAT	Tunisia	0.4883	0.3447	0.1436	0.2513	0.7254

Banque Libano-Francaise	Lebanon	0.3762	0.2722	0.1040	0.1996	0.5528
Banque Nationale Agricole	Tunisia	0.3635	0.2594	0.1041	0.1904	0.5366
Banque SaudiFransi JSC	KSA	0.8875	0.6373	0.2502	0.4518	1.3232
Banque de Tunisie et des Emirats SA	Tunisia	0.4439	0.3112	0.1327	0.2084	0.6793
Banque de l'Habitat	Tunisia	0.3884	0.2747	0.1137	0.2001	0.5768
Banque de l'Industrie et du Travail SAL	Lebanon	0.2553	0.1850	0.0703	0.1276	0.3831
Byblos Bank S.A.L.	Lebanon	0.4500	0.3229	0.1271	0.2236	0.6764
Cairo Amman Bank	Jordan	0.4206	0.2937	0.1269	0.2069	0.6342
Commercial Bank International P.S.C.	UAE	0.5090	0.3737	0.1354	0.2804	0.7377
Commercial Bank of Dubai P.S.C.	UAE	0.8673	0.6312	0.2361	0.4659	1.2687
Commercial Bank of Kuwait K.P.S.C. (The)	Kuwait	0.9803	0.7141	0.2662	0.4725	1.4880
Crédit Libanais S.A.L.	Lebanon	0.3113	0.2215	0.0897	0.1595	0.4630
Doha Bank	Qatar	0.6627	0.4722	0.1904	0.3366	0.9887
DubaiIslamic Bank PJSC	UAE	0.5563	0.4078	0.1485	0.3006	0.8121
First Gulf Bank	UAE	0.9513	0.6370	0.3143	0.3481	1.5546
Fransabank sal	Lebanon	0.3714	0.2681	0.1033	0.1876	0.5552
Gulf Bank KSC (The)	Kuwait	0.8341	0.6095	0.2247	0.4162	1.2521
Gulf International Bank BSC	Bahrain	0.5459	0.4002	0.1457	0.2953	0.7965
HSBC Bank Malta Plc	Malta	0.4385	0.3046	0.1339	0.2146	0.6624
HSBC Bank Oman	Oman	0.4850	0.3270	0.1580	0.2066	0.7633
Housing Bank for Trade & Finance (The)	Jordan	0.5492	0.3730	0.1762	0.2463	0.8521
Invest Bank	Jordan	0.5589	0.4021	0.1568	0.2695	0.8483
Jordan Ahli Bank Plc	Jordan	0.3553	0.2474	0.1079	0.1765	0.5342
Jordan Commercial Bank	Jordan	0.3704	0.2640	0.1065	0.1811	0.5597
Jordan Islamic Bank	Jordan	0.5092	0.3691	0.1401	0.2752	0.7432
Kuwait & Middle East Financial Investment Company	Kuwait	0.5682	0.3615	0.2067	0.1519	0.9845
Kuwait Finance & Investment Company K.S.C	Kuwait	0.5509	0.3358	0.2152	0.1433	0.9586
Kuwait Finance House	Kuwait	0.8417	0.5658	0.2759	0.3449	1.3384
Kuwait Finance House B	Bahrain	0.5392	0.3726	0.1666	0.2492	0.8293
MEAB SAL	Lebanon	0.2973	0.2052	0.0920	0.1383	0.4562
Mashreqbank PSC	UAE	0.7670	0.5297	0.2373	0.3501	1.1839
Mercantile Discount Bank Ltd.	Israel	0.4098	0.2898	0.1201	0.2078	0.6119
MizrahiTefahot Bank Ltd.	Israel	0.5574	0.4132	0.1441	0.3039	0.8108
National Bank of Abu Dhabi	UAE	0.9305	0.6681	0.2624	0.4445	1.4165
National Bank of Bahrain	Bahrain	0.7759	0.5672	0.2087	0.4173	1.1345
National Bank of Fujairah PJSC	UAE	0.7011	0.4966	0.2045	0.3533	1.0490
National Bank of Kuwait S.A.K.	Kuwait	0.8556	0.5954	0.2602	0.3897	1.3215
National Bank of Oman (SAOG)	Oman	0.4368	0.3164	0.1204	0.2369	0.6366
National Bank of Umm Al-Qaiwain PSC	UAE	0.8792	0.6191	0.2601	0.4166	1.3418
National Commercial Bank (The)	KSA	0.9007	0.5591	0.3416	0.2725	1.5289
Oman Arab Bank SAOC	Oman	0.5554	0.3762	0.1792	0.2540	0.8568
Oman International Development and Investment Co.	Oman	0.5391	0.3718	0.1673	0.2572	0.8211
Qatar National Bank	Qatar	0.8953	0.5904	0.3050	0.3007	1.4900
Riyad Bank	KSA	0.7786	0.5362	0.2424	0.3695	1.1877
Samba Financial Group	KSA	0.9928	0.6616	0.3312	0.3455	1.6400
Saudi British Bank JSC (The)	KSA	0.9255	0.6456	0.2799	0.4102	1.4408
SaudiHollandi Bank	KSA	0.6621	0.4793	0.1829	0.3575	0.9667
Sharjah Islamic Bank	UAE	0.5564	0.3991	0.1574	0.2845	0.8284
The Commercial Bank (QSC)	Qatar	0.7802	0.5415	0.2386	0.3584	1.2020
Union Bancaire pour le Commerce et l'Industrie	Tunisia	0.3247	0.2256	0.0990	0.1639	0.4854
Union Bank of Israel Ltd	Israel	0.4021	0.2775	0.1246	0.1801	0.6240
Union Internationale de Banques	Tunisia	0.3736	0.2570	0.1166	0.1793	0.5678
Union National Bank	UAE	0.8906	0.6404	0.2502	0.4301	1.3511
United Gulf Bank (BSC) EC	Bahrain	0.8110	0.5569	0.2541	0.3180	1.3039

Table 4. Mean efficiency scores by year and by bank type using VRS DEA-Boostrap approach

Year	θ	θ^*	BIAS	LB	UB
Panel A : overall sample					
2004	0.5682	0.3981	0.1701	0.2569	0.8794
2005	0.5430	0.3605	0.1825	0.2147	0.8714
2006	0.5057	0.3164	0.1893	0.1722	0.8392
2007	0.6154	0.4401	0.1753	0.3040	0.9268
2008	0.5896	0.4048	0.1847	0.2521	0.9271
2009	0.6095	0.4415	0.1680	0.3013	0.9177
2010	0.5864	0.3923	0.1941	0.2507	0.9221
2011	0.5332	0.3376	0.1956	0.2060	0.8604
2012	0.5960	0.4267	0.1693	0.2982	0.8937
2013	0.6134	0.4596	0.1538	0.3383	0.8886
2014	0.6300	0.4814	0.1485	0.3637	0.8962
Panel B : Commercial banks					
2004	0.5554	0.3921	0.1633	0.2588	0.8520
2005	0.5124	0.3420	0.1704	0.2096	0.8152
2006	0.4879	0.3094	0.1785	0.1750	0.8008
2007	0.5964	0.4306	0.1658	0.3056	0.8872
2008	0.5639	0.3880	0.1759	0.2457	0.8820
2009	0.6074	0.4411	0.1664	0.3027	0.9122
2010	0.5954	0.3968	0.1986	0.2531	0.9377
2011	0.5452	0.3470	0.1982	0.2150	0.8755
2012	0.6037	0.4336	0.1700	0.3072	0.9001
2013	0.6259	0.4679	0.1580	0.3444	0.9074
2014	0.6463	0.4964	0.1499	0.3779	0.9147
Panel C : Investment banks					
2004	0.5849	0.3900	0.1949	0.2131	0.9567
2005	0.6922	0.4571	0.2351	0.2470	1.1374
2006	0.5441	0.3238	0.2203	0.1425	0.9458
2007	0.7167	0.4906	0.2261	0.2898	1.1436
2008	0.6675	0.4571	0.2104	0.2655	1.0694
2009	0.6207	0.4482	0.1725	0.2930	0.9485
2010	0.5009	0.3498	0.1512	0.2322	0.7696
2011	0.3672	0.2291	0.1382	0.1312	0.6032
2012	0.5217	0.3611	0.1605	0.2248	0.8185
2013	0.4675	0.3637	0.1038	0.2734	0.6616
2014	0.3921	0.2919	0.1002	0.2203	0.5640
Panel D: Islamic bank					
2004	0.6359	0.4413	0.1946	0.2771	0.9947
2005	0.6269	0.4068	0.2201	0.2233	1.0305
2006	0.5893	0.3550	0.2342	0.1761	1.0024
2007	0.6610	0.4630	0.1980	0.3043	1.0178
2008	0.6943	0.4725	0.2218	0.2824	1.1062
2009	0.6142	0.4396	0.1746	0.2987	0.9296
2010	0.5921	0.3945	0.1975	0.2486	0.9355
2011	0.5786	0.3577	0.2209	0.2041	0.9531
2012	0.6019	0.4310	0.1710	0.2955	0.9084
2013	0.6415	0.4771	0.1643	0.3473	0.9357
2014	0.7004	0.5253	0.1751	0.3789	1.0219

4.2 Second Step: The Relationship Between Competition and Banking Efficiency Using Overall Sample

Table 5 reports the estimation results by truncated regression and is based on the Bootsrap technique. The value of the coefficient of LERNER variable is positive (coef = 0.073) and is significant at the 1% threshold (p-value = 0.000). This result indicates that the higher the level of competition, the lower the level of efficiency. Indeed, for

a unit increase in the level of competition, the technical efficiency decreases by 0.073 units. which implies the higher the level of competition, the lower the level of efficiency. This result suggests the rejection of the QLH hypothesis and the confirmation of the IGH hypothesis. Our findings are in line with the work of Maudos and Guevara (2007) and Schaeck and Cihak (2008) in the European context, the study of Pruteanupodpiera et al. (2008) for the case of the Czech banks and the study by Fang et al. (2011) for the cases of the six countries in transition in Eastern Europe.

Tableau 5. Effect of competition on bank efficiency: Truncated Régression with Boostrap

Variables	Coefficient	Err. Std	Z	P>|z|
CONSTANTE	-0.178***	0.029	-6.080	0.000
LERNER	**0.073***	**0.009**	**8.290**	**0.000**
SIZE	0.057***	0.003	19.750	0.000
ROA	0.780***	0.148	5.280	0.000
NIM	-0.159	0.463	-0.340	0.732
AQTA	0.548***	0.056	9.800	0.000
CREDIT	0.002**	0.001	2.150	0.032

Note. (***)(**) indicate significance at 1% and 5% levels, respectively.

4.3 Robustness Check

Although we use the methodology of truncated regression with Bootstrap to test the effect of competition and control variables on the technical efficiency of banks, this method may also be subject to some limitations. Indeed, the truncated regression presents strict assumptions such as the linearity of the model and the requirement that the terms of errors follow a truncated normal law. To address these limitations and to test the robustness of my results, I employ the Tobit regression. Tables 6 reports the estimation results yielded from the use of Tobit regression. As illustrated in Table 6, the coefficient on the LERNER variable is positive (coef=0.0220) and statistical significant at 1% level (p-value=0.000). The results of estimation hold even after using alternative estimation method.

Table 6. Effect of competition on bank efficiency: Tobit Regression

Variables	Coefficient	Err. Std	Z	Pr(>|z|)
Intercept	0.0894***	0.030	2.961	0.003
LERNER	**0.0220***	**0.004**	**6.194**	**0.000**
SIZE	0.0310***	0.003	9.856	0.000
ROA	0.8910***	0.149	5.965	0.000
NIM	0.3422	0.449	0.761	0.446
AQTA	0.3677***	0.049	7.467	0.000
CREDIT	0.0003**	0.000	2.136	0.033

Note. (***) et (**) indicate significance at 1% and 5% levels, respectively.

5. Conclusion

The objective of this paper is to examine the effect of competition on the technical efficiency of banks. To reach this end, we used a sample of banks operating in 13 MENA countries.

To avoid the problem of bias in the estimation of the efficiency score and to introduce the stochastic aspect in the DEA approach, we started with using the Bootstrap technique as suggested by Simar and Wilson (2000) Bias-adjusted efficiency scores. Then, we used the truncated regression technique with Bootstrap to test the effect of competition on the technical efficiency of banks.

Generally, the results indicate that there is a significant difference between the efficiency scores obtained by the standard DEA method and those obtained by the DEA-Bootstrap method. Concerning the effect of competition on efficiency, the results suggest that competition has a negative and significant effect on technical efficiency leading to the rejection of the QLH hypothesis and the acceptance of the IGH hypothesis. Indeed, the information generation hypothesis finds its root in the idea that banks are considered as delegated monitors which implies the collection of private information about borrowing firms. However, in more fiercely competitive markets, each bank has specialized knowledge about a limited number of borrowers, thus the spread of information may impair banks' ability to screen potential borrowers, raising the likelihood that they will receive loans, and so increasing bank inefficiency. Furthermore, as competition intensifies, banks will lower their fees in order to attract customers. This will make it easier for customers to switch from their current bank to one that provides them with additional benefits. Consequently, the reduced ability of banks to gather information about their clients, caused by their switching, leads to inefficiency within the banking industry.

Therefore, the results of our study have several implications. From a political point of view, the findings of the current paper support the need to draw the attention of decision-makers to a deeper review of regulatory and competition policies in the banking sectors of the MENA area. Indeed, authorities play a fundamental role in the balance between competition and prudential regulation activities. Policy makers should therefore opt for reforms that promote competition while improving the quality and independence of prudential supervision.

Despite the importance of the findings and the implications, this study is subject to some limitations which can subsequently be a topical issue.

First, we used a single measure to assess the level of competition. However, literature offers other measures such as the Boone index, or the model of Panzar and Rose. The use of other measures to estimate competition can be important to test the robustness of our results.

The second limitation is that we have assumed a unidirectional relation of competition to efficiency; however, according to the efficient structure of Demsetz (1973), efficiency can also cause competition. So, it will be important to test the interrelationship between efficiency and competition.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal and publisher adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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References

Ab-Rahim, R., Md-Nor, N. G., Ramlee, S., & Ubaidillah, N. Z. (2012). Determinants of cost efficiency in Malaysian banking. *International Journal of Business and Society, 13*(3), 355-374.

Ajisafe, R. A., & Ajide, F. M. (2014). Bank competition and economic growth: evidence from Nigeria. *Journal of Emerging Trends in Economics and Management Sciences*, *5*, 419-425. https://hdl.handle.net/10520/EJC163080

Andries, A. M., & Capraru, B. (2012). Competition and efficiency in eu27 banking systems. *Baltic Journal of Economics*, *12*, 41-60. https://doi.org/10.1080/1406099X.2012.10840510

Apergis, N., & Polemis, M. (2016), Competition and efficiency in the mena banking region: a non-structural DEA approach. *Applied Economics*, *48*, 5276-5291. https://doi.org/10.1080/00036846.2016.1176112

Apergis, N., Fafaliou, I., & Polemis, M., (2015). New evidence on assessing the level of competition in the european union banking sector: a panel data approach. *International Business Review*, *25*, 395-407. https://doi.org/10.1016/j.ibusrev.2015.07.003

Arrawatia, R., Misra, A., & Dawar, V. (2015). Bank competition and efficiency: empirical evidence from Indian market. *International Journal of Law and Management*, *57*, 217-231. https://doi.org/10.1108/IJLMA-03-2014-0029

Ataullah, A., Cockerill, T., & Le, H. (2004). Financial liberalization and bank efficiency: a comparative analysis of India and Pakistan. *Applied Economics, 36*(17), 1915-1924. https://doi.org/10.1080/000368404200068638

Bain, J. S. (1939). The relation of the economic life of equipment to reinvestment cycles. *The Review of Economics and Statistics*, *21*, 79-88. https://doi.org/10.2307/1927759

Ben Ali, M. S., & Sghaier, A. (2012). Competition and banking efficiency: evidence from tunisian banking industry. *Journal of Islamic Economics, Banking and Finance*, *8*, 54-70.

Berger, A. N. (1993). Distribution-Free estimates of efficiency in the us banking industry and tests of the standard distributional assumptions, *Journal of Productivity Analysis*, *4*, 261-292. https://doi.org/10.1007/BF01073413

Berger, A. N., & Hannan, T. H. (1998). The efficiency cost of market power in the banking industry: a test of the "quiet life" and related hypotheses, *The Review of Econmics and Statistics*, *80*, 454-465. https://doi.org/10.1162/003465398557555

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: international survey and directions for future research. *European Journal of Operational Research*, *98*, 175-212. https://doi.org/10.1016/S0377-2217(96)00342-6

Bertrand, R., (2016). Mesure de degré de concurrence dans le système bancaire suisse a l'aide du modèle de panzar et rosse. *Revue Suisse d'économie Politique et De Statistique*, *135*, 21-40.

Caggiano, G., & Calice, P. (2016). Bank competition, financial dependence, and economic growth in the gulf cooperation council, Working Papers. https://doi.org/10.1596/1813-9450-7687

Carbo, S., Humphrey, D., Maudos, J., & Molyneux, P. (2009). Cross-country comparisons of competition and pricing power in European banking. *Journal of International Money and Finance, 28*, 115-134. https://doi.org/10.1016/j.jimonfin.2008.06.005

Castellanos, S. G., & Garza-Garcia, J. G. (2013). Competition and efficiency in the Mexican banking sector. Working Paper N° 13/29.

Casu, B., & Girardone, C. (2006). Bank competition, concentration and efficiency in the single european market. *The Manchester School*, *74*, 441-468. https://doi.org/10.1111/j.1467-9957.2006.00503.x

Casu, B., & Girardone, C. (2009). Testing the relationship between competition and efficiency in banking: a panel data analysis. *Economics Letters*, *105*, 134-137. https://doi.org/10.1016/j.econlet.2009.06.018

Casu, B., & Molyneux, P. (2003). A comparative study of efficiency in european banking. *Applied Economics*, *35*, 1865-1876. https://doi.org/10.1080/0003684032000158109

Cevdet D, A., Mustafa, D., & Murat, T. (2000). Measuring Banking Efficiency in the Pre- and Post-Liberalization Environment: Evidence from the Turkish Banking System. *Policy Research Working Paper*, *2476*.

Chen, X., Skully, M., & Brown, K. (2005). Banking efficiency in China: application of DEA to pre and post-deregulation eras: 1993-2000. *China Economic Review, 16*(3), 229-245. https://doi.org/10.1016/j.chieco.2005.02.001

Chen, Y., Cook, W. D., Li, N., & Zhu, J. (2009). Additive efficiency decomposition in two-stage DEA. *European Journal of Operational Research*, *196*, 1170-1176. https://doi.org/10.1016/j.ejor.2008.05.011

Claessens, S., & Laeven, L. (2004). What drives bank competition? Some international evidence. *Journal of Money, Credit and Banking*, *36*, 563-583. https://doi.org/10.1353/mcb.2004.0044

Cooper, M., Jackson, W., & Patterson, G. (2003). Evidence of predictability in the cross-section of bank stock returns. *Journal of Banking and Finance, 27*, 817-50. https://doi.org/10.1016/S0378-4266(01)00263-1

De Guevara, J. F., Maudos, J., & Perez, F. (2007). Integration and competition in the european financial markets. *Journal of International Money and Finance*, *26*, 26-45. https://doi.org/10.1016/j.jimonfin.2006.10.008

Fang, Y., Hasan, I., & Marton, K. (2011). Bank efficiency in South-Eastern Europe. *Economics of Transition, 19,* 495-520. https://doi.org/10.1111/j.1468-0351.2011.00420.x

Freixas, X., & Rochet, J. C. (2008). *Microeconomics of banking.* MIT Press.

Fu, X., & Heffernan, S. (2009). The Effects of Reform on China's Bank Structure and Performance. *Journal of Banking and Finance*, *33*, 39-52. https://doi.org/10.1016/j.jbankfin.2006.11.023

Girardone, C., Molyneux, P., & Gardener, E. P. M. (2004). Analysing the determinants of bank efficiency: the case of Italian banks. *Applied Economics, 36*(3), 215-227. https://doi.org/10.1080/0003684042000175334

Hannah, L., & Kay, J. A. (1977). Concentration in Modern Industry: Theory, measurement and the U. K. experience. Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-02773-6

Hauner, D., & Peiris, S. J. (2005). Bank efficiency and competition in low income countries; the case of Uganda. IMF Working Papers 05/240, International Monetary Fund. https://doi.org/10.5089/9781451862591.001

Hauswald, R., & Marquez, R. (2006). Competition and strategic information acquisition in credit markets. *Review of Financial Studies*, *19*, 967-1000. https://doi.org/10.1093/rfs/hhj021

Isik, I., & Hassan, K. M. (2003). Financial deregulation and total factor productivity change: an empirical study of Turkish commercial banks. *Journal of Banking and Finance, 27*(8), 1455-1485. https://doi.org/10.1016/S0378-4266(02)00288-1

Kasman, S., & Kasman, A. (2015). Bank competition, concentration and financial stability in the Turkish banking industry. *Economic Systems*, *39*, 502-517. https://doi.org/10.1016/j.ecosys.2014.12.003

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *The American Economic Review*, *80*, 1183-1200.

Kick, T., & Prieto, E. (2014). Bank risk and competition: evidence from regional banking markets. *Review of Finance Advance Access*, *19*, 1185-1222. https://doi.org/10.1093/rof/rfu019

Kirkpatrick C., Murinde, V., & Tefula, M. (2008). The measurement and determinants of x-inefficiency in commercial banks in Sub-Soharan Africa. *The European Journal of Finance*, *14*, 625-639. https://doi.org/10.1080/13518470701705769

Koetter, M, Kolari, J. W., & Spierdijk, L. (2012). Enjoying the quiet life under deregulation? Evidence from adjusted lerner indices for U.S. banks. *The Review of Economics and Statistics*, *94*, 462-480. https://doi.org/10.1162/REST_a_00155

Koetter, M., Kolari, J. W., & Spierduk, L. (2008). Efficient competition? testing the 'quiet life' of US banks with adjusted Lerner indices. Proceedings of the 44th 'Bank Structure and Competition' Conference, Federal Reserve Bank of Chicago.

Kwoka, J. (1985). The Herfindahl index in theory and practice. *Antitrust Bulletin*, *30*, 915-974. https://doi.org/10.1177/0003603X8503000405

Lerner, A. P. (1934). Economic theory and socialist economy. *The Review of Economic Studies*, *2*, 51-61. https://doi.org/10.2307/2967550

Marquez, R., & Hauswald, R. (2002). Competition and strategic information acquisition in credit markets. *Review of Financial Studies*, *19*, 967-1000. https://doi.org/10.2139/ssrn.302196

Maudos, J., & Guevara, J. F. (2007). The cost of market power in banking: Social welfare loss vs. cost inefficiency. *Journal of Banking & Finance*, *31*, 2103-2125. https://doi.org/10.1016/j.jbankfin.2006.10.028

Maudos, J., Pastor, J. M., Pérez, F., & Quesada, J. (2002). Cost and profit efficiency in European banks. *Journal of International Financial Markets, Institutions and Money*, *12*, 33-58. https://doi.org/10.1016/S1042-4431(01)00051-8

Panzar, J. C., & Rosse, N. J. (1987). Testing for `Monopoly' Equilibrium. *The Journal of Industrial Economics*, *35*, 443-456. https://doi.org/10.2307/2098582

Phan, H. T. M., Daly, K., & Akhter, S. (2016). Bank efficiency in emerging Asian countries. *In Research in International Business and Finance, 38*, 517-530. https://doi.org/10.1016/j.ribaf.2016.07.012

Pruteanu-Podpiera, A., Weill, L., & Schobert, F. (2008). Banking competition and efficiency: a micro-data analysis on the Czech banking industry. *Comparative Economic Studies*, *50*, 253-273. https://doi.org/10.1057/palgrave.ces.8100248

Schaeck, K., & Cihak, M. (2008). How does competition affect efficiency and soundness in banking? New Empirical Evidence. Working Paper No 932. https://doi.org/10.2139/ssrn.1240856

Sealey, C. W., & Lindley, J. T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *The Journal of Finance*, *32*, 1251-1266. https://doi.org/10.1111/j.1540-6261.1977.tb03324.x

Simar, L., & Wilson, P. (2000). Statistical inference in nonparametric frontier models: the state of the art. *Journal of Productivity Analysis*, *13*, 49-78. https://doi.org/10.1023/A:1007864806704

Simar, L., & Wilson, P. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, *136*, 31-64. https://doi.org/10.1016/j.jeconom.2005.07.009

Turk-Ariss, R. (2009). Competitive behavior in Middle East and North Africa banking systems. *The Quarterly Review of Economics and Finance*, *49*, 693-710. https://doi.org/10.1016/j.qref.2008.03.002

Turk-Ariss, R. (2010). On the implications of market power in banking: evidence from developing countries, *Journal of Banking & Finance, 34*, 765-775. https://doi.org/10.1016/j.jbankfin.2009.09.004

Turk-Ariss, R. (2012). Bank pricing under oligopsony-oligopoly: Evidence from 103 developing countries. Working Paper.

Uddin, S., & Suzuki, Y. (2014). The impact of competition on bank performance in bangladesh: an empirical study, *International Journal of Financial Services Management*, *7*, 73-94. https://doi.org/10.1504/IJFSM.2014.062293

Weill, L. (2003). On The Relationship Between Competition and efficiency in the EU banking sectors. *Kredit Und Kapital*, *37*, 1-24.

Weill, L. (2004). Measuring cost efficiency in European banking: a comparison of frontier techniques. *Journal of Productivity Analysis, 21*(2), 133-152. https://doi.org/10.1023/B:PROD.0000016869.09423.0c

Weill, L. (2006). Cost efficiency of Belgian banks during the 90s. *Brussels Economic Review*, *49*, 21-36.

Weill, L. (2013). Bank competition in the EU: how has it evolved? *Journal of International Financial Markets, Institutions & Money*, *26*, 100-112. https://doi.org/10.1016/j.intfin.2013.05.005