Chapter 7
Banking Efficiency and Financial Stability: Which Causes Which? A Panel Analysis

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Abstract This paper attempts to investigate the relationship between banking efficiency and financial stability using a sample of 12 MENA countries, over the period from 2005 to 2014. Using panel analysis according to fixed effect model, results indicate that hypotheses regarding the significance of this impact could be accepted. Also, robustness checks, using dynamic effect model, assure the significance of these effects.

Keywords Bank efficiency • Data envelopment analysis • Financial stability

7.1 Introduction

Efficiency is an aspect of firm performance that is measured with respect to an objective; it can be measured with respect to maximization of output, maximization of profits, or minimization of costs. Scale economies, scope economies, and X-efficiency are different aspects of performance. Scale and scope economies refer to selecting the appropriate outputs, while X-efficiency refers to selecting the appropriate inputs. Typically, scale economies refer to how the firm's scale of operations (its size) is related to cost. Scope economies refer to how the firm's choice of multiple product lines is related to cost (Mester 2003, p. 2).

Data envelopment analysis (DEA) is a mathematic technique developed in operations' research and management science, and over the last 40 years, the field of its usage has been extensively updated. DEA is a nonparametric linear programming technique that measures the relative efficiency of a group of decision-making units (DMUs) which receive multiple inputs to produce multiple outputs.

DEA, first proposed by Charnes et al. (1978) and applied by Sherman and Gold (1985), is based on earlier work initiated by Farrell (1957). DEA has become a popular technique in bank efficiency analysis since its first application by Berger and Humphrey (1997) provides an international survey of efficient frontier analysis

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of financial institution performance. Maletić et al. (2013, p. 845) address the basics of DEA methods: Charnes, Cooper, and Rhodes (CCR); Banker, Charns, and Cooper (BCC); and AP (Andersen and Petersen).

Regarding financial stability, many global, regional, and governmental bodies are established for its promotion. The Financial Stability Board (FSB) is established to address financial system susceptibilities and to drive the development and implementation of strong regulatory, supervisory, and other policies which enhance financial stability. Also, the Financial Stability Forum (FSF) has been set up by the G-7 in the wake of the Asian crisis in 1999, with an expanded membership (drawn mainly from the G-20).

In the USA, the legislation Restoring American Financial Stability Act of 2010 focuses on how to promote the financial stability. The UK Financial Services Authority (FSA) requires stricter capital rules than those proposed by the Basel Committee on Banking Supervision (BCBS). The European Central Bank (ECB) is in charge of monitoring and assessment of financial stability. Presently, the Committee of European Banking Supervisors (CEBS) provides regular bank sector analysis and performs assessments on banking risks, to be reported to the European Union political institutions.

Swamy (2011) analyzes the determinants of banking sector soundness, as measured by banking stability index (BSI) in the context of an emerging economy banking sector. This study considers the core set of soundness indicators for the construction of the index for the Indian financial system during the 1997–2009 period.

It's important to analyze the relationship between stability and market structure, within the structure-conduct-performance paradigm, the market structure that the firm stays will influence the conduct decision of the firm, and then influence the firm's performance.

In brief, this study tries to answer these two main questions:

- Does "banking efficiency" affect the "financial stability" as applied on Arabian banks?
- Does "financial stability" affect the "banking efficiency" as applied on Arabian banks?

The paper is arranged as follows: after this introduction, Sect. 7.2 reviews research literature that has concerned with "banking efficiency" and "financial stability". Section 7.3 explains how to develop hypotheses and measure variables. Section 7.4 is for empirical work, presenting results, discussing how these results answer research questions with a robustness check. Section 7.5 summarizes the paper and provides remarks about conclusions.

7.2 Literature Review

This section tries to present some of previous work, which has been conducted in the fields of banking efficiency and financial stability.

Regarding "banking efficiency," Athanassopoulos and Giokas (2000) examine 47 branches of the Commercial Bank of Greece and use the DEA results to implement the proposed changes in the bank performance measurement system.

Carvallo and Kasman (2005) investigate the cost-efficiency of a sample of 481 Latin American and Caribbean banks in 105 countries over the years from 1995 to 1999 using a stochastic frontier model (SFA). They use three inputs, loans, deposits, and other earning assets, and three prices of factors of production, the price of labor, the price of purchased funds, and the price of physical capital. Results indicate that on average, very small and very large banks are significantly more inefficient than large banks.

Efficiency of Canadian banks has been investigated by Avkiran (2006) and Wu et al. (2006). Avkiran (2006) applies DEA using a sample of 24 Canadian foreign bank subsidiaries in year 2000. The outputs include loans, securities, and noninterest income, while inputs include deposits, noninterest expenses, and equity multiplier. Wu et al. (2006) integrates the DEA and neural networks (NNs) to examine the relative branch efficiency of a big Canadian bank. The authors observe 142 banks in Canada and monitor the number of employees and costs for input indicators, while for output they monitor deposits, income, and bank loans.

Şakar (2006) in Turkey analyzes 11 banks and monitors input, branch numbers, employees per branch, assets, loans, and deposits, and outputs, ROA, ROE, interest income, and noninterest income (assets). Hassan and Sanchez (2007) examine banking performance using DEA. The authors estimate and compare the efficiency and productivity of seven Latin American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, and Venezuela) during the period from 1996 to 2003. The study finds that most of the sources of inefficiencies are regulatory rather than technical. This means that bank managers do not choose the correct (optimal) input and output mix, because they are not forced to do so by the environmental conditions (either government regulations or market conditions).

Moh'd Al-Jarrah (2007) uses DEA approach to investigate cost-efficiency levels of banks operating in Jordan, Egypt, Saudi Arabia, and Bahrain over 1992–2000. The estimated cost-efficiency is further decomposed into technical and allocative efficiency at both variable and constant return to scale. Later on, the technical efficiency is further decomposed into pure technical and scale efficiency. Results show that cost-efficiency scores range from 50 to 70 % with some variations in scores depending on bank's size and geographical locations. Avkiran (2009) applied non-oriented network slacks-based measure in domestic commercial banks of United Arab Emirates (UAE), using non-oriented, non-radial SBM modeling.

Alber (2011) considers the effects of banking expansion on profit efficiency of the Saudi banks. This has been conducted using a sample of six 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. 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. Al-Farisi and Hendrawan (2012) examines the impact of capital structure on performance of conventional and Islamic banks, by using profit efficiency approach. They measure profit efficiency score for each bank in Indonesia during the period from 2002 to 2008 by using distribution-free approach (DFA). Results indicate that banks' capital ratio has a negative effect on their profit efficiency.

Maletić et al. (2013) uses DEA technique in case of measuring operation efficiency of the banking sector in Serbia, which currently has 33 banks. Input and output indicators differ according to the used models A and B. According to model A, inputs include interest expenses and noninterest expenses, while outputs include interest income and net noninterest income. According to model B, inputs include deposits and employees, while outputs include loans and operating income.

Shafiee et al. (2013) evaluates the efficiency of an Iranian bank using dynamic SBM model in DEA during three consecutive terms considering net profit as a good link and loan losses as a bad link. Each branch in each term expends money on labor salaries and operating expense as inputs to produce loans as output. In each term some loans become nonperforming, because of borrowers unable to make full or even partial payment. Dynamic SBM efficiency is compared with its static efficiency to check the validity of described model. In addition, input-bad link excesses and output-good link shortfalls (slacks) are analyzed, and further suggestions to the management are provided.

Thayaparan and Pratheepan (2014) focus on total factor productivity growth and its decomposition of commercial banks in Sri Lanka, as applied on two state banks and four private banks over the period 2009–2012. By using DEA, total factor productivity and its components are measured in terms of efficiency change, technical efficiency change, pure efficiency change, and scale change. Interest income and loans are considered as outputs, and deposits, total assets, number of staff, and interest expenses are considered as inputs. Results indicate that all six banks operate averagely at 87.2 % of overall efficiency and that less performance is achieved due to the less progress in technical change than efficiency change. The overall results conclude that private banks are more efficient than state banks.

Alber (2015) aims at analyzing the effects of bank size, age, and ownership on efficiency of both Egyptian banks, as measured by data envelopment analysis (DEA) bank ownership according to CCR method. This has been conducted using Wilcoxon signed-rank test, as applied on a sample of ten banks during the period from 1984 to 2013. Results indicate that efficiency scores differ significantly, according to "size," "age," and "ownership" of the Egyptian banks, where small, old, and private banks seem to be more efficient than big, young, and public ones. Also, robustness check assures the "age" and "ownership" effects, using panel data analysis.

Regarding "banking stability," Demirgüç-Kunt and Detragiache (2011) study the effect of compliance with the Basel core principles for effective banking supervision

on bank soundness. Using data for more than 3000 banks in 86 countries, the authors find that neither the overall index of compliance with the Basel core principles nor the individual components of the index are robustly associated with bank risk measured by *Z*-scores. This may cast doubt on the usefulness of the Basel core principles in ensuring bank soundness.

Dobravolskas and Seiranov (2011) investigate the reasons of financial instability, during the 2007–2008 crisis, and study the ways of rebuilding financial stability in the process of post-crisis regulatory reforms. Findings show that violation of stability is a result of deregulation processes in major financial markets since 1980s on the one hand and a result of inadequacy of national micro-prudential regulators on the other hand. The article studies how these targets are met in post-crisis regulatory reforms, in the USA, the European Union, and Lithuania.

De Nicolò et al. (2011) develop a dynamic model of a bank exposed to both credit and liquidity risk and analyze the impact of capital regulation, liquidity requirements, and taxation on banks' optimal policies and metrics of efficiency of intermediation and social value. The authors argue that the inverted U-shaped relationship between bank lending, bank efficiency, social value, and regulatory capital ratios indicates the existence of optimal levels of regulatory capital. Results indicate that mild capital requirements increase bank lending, bank efficiency, and social value relative to an unregulated bank. Also, findings show that liquidity requirements reduce bank lending, efficiency, and social value significantly.

Buston (2012) shows the net impact of two opposing effects of active risk management at banks on their stability. This has been applied on US BHCs using a sample of an unbalanced panel containing 7253 observations and 2276 banks, from 2005 to 2010. Empirical evidence supports the effects of active risk management at banks on their stability and shows that active risk management banks are less likely to fail during the crisis of 2007–2009.

Schaeck and Cihák (2013) assemble a panel dataset from Bankscope for European banks for the period 1995–2005. The sample covers Austria, Belgium, Denmark, France, Italy, Germany, Luxembourg, the Netherlands, Switzerland, and the UK and consists of 17,965 bank-year observations for 3325 banks. Results indicate that competition robustly improves stability via the efficiency channel.

Comparing with previous work, the current study tries to investigate the mutual effect of both financial stability and banking efficiency, while previous work tends to address them separately without this framework.

7.3 Measuring Variables and Developing Hypotheses

Banking efficiency is measured by DEA technique according to CCR approach, and financial stability is measured by *Z*-score that indicates the number of standard deviations that a bank's profit must fall to drive it into insolvency; where ROA is return on assets, E/A denotes the equity to asset ratio, and σ ROA is the standard deviation of return on assets. Table 7.1 illustrates this as follows.

Table 7.1 Measuring banking efficiency and financial stability

Variable	Calculation	Sign
Banking efficiency	Measured by DEA technique according to CCR approach	CCR
Financial stability	$= (\text{ROA} + E/A)/\sigma\text{ROA}$	Z

Table 7.2 Descriptive statistics of research variables

Variables	Minimum	Maximum	Mean	Std. deviation
CCR	0.7945	1.00	0.8983	0.0491
Z	2.6098	24.1539	11.9501	8.1842

Table 7.3 The effect of banking efficiency on financial stability

Model	α	β_1	F	R^2
Fixed effect	**0.765** (0.008)	**0.093** (0.010)	17.818	0.261 (0.0879)
Random effect	**0.714** (0.019)	**0.135** (0.018)	19.277	0.264 (0.0868)

Bold values indicate very high level of statistical significance

This paper aims at testing the following two hypotheses:

- There's no significant effect of "banking efficiency" on "financial stability."
- There's no significant effect of "financial stability" on "banking efficiency."

Regarding the first hypothesis, the null hypothesis H_0 states that $\beta_1 = 0$, while the alternative hypothesis H_1 states that $\beta_1 \neq 0$ where:

$$Z = \alpha + \beta_1 \text{ CCR} \tag{7.1}$$

Regarding the second hypothesis, the null hypothesis H_0 states that $\beta_2 = 0$, while the alternative hypothesis H_1 states that $\beta_2 \neq 0$ where:

$$\text{CCR} = \alpha + \beta_2 Z \tag{7.2}$$

7.4 Testing Hypotheses

Table 7.2 illustrates descriptive statistics of banking efficiency and financial stability using a sample of 12 MENA countries, over the period from the 2005 to 2014.

To investigate the effect of banking efficiency on financial stability, a panel data analysis has been conducted using each of fixed and random effect models and provides the following results (Table 7.3).

The above-shown table supports the significance of banking efficiency effect on financial stability with explanation power ranged from 26.1 % (using fixed effect model) to 26.4 % (using random effect model) at p-value of 1 %. Each of these two

Table 7.4 The effect of financial stability on banking efficiency

Model	α	B_2	F	R^2
Fixed effect	**2.397** (0.008)	**0.702** (0.019)	65.614	0.559 (0.1593)
Random effect	**2.458** (0.019)	**0.541** (0.023)	45.277	0.497 (0.1768)

Bold values indicate very high level of statistical significance

models could be considered as a robustness check for the other one. So, for the first hypothesis, the null hypothesis is rejected, and the alternative one could be accepted.

To investigate the effect of financial stability on banking efficiency, a panel data analysis has been conducted using each of fixed and random effect models and provides the following results (Table 7.4).

The above-shown table supports the significance of financial stability effect on banking efficiency with explanation power of 55.9 % (using fixed effect model) and of 49.7 % (using random effect model) at *p*-value of 1 %. Each of these two models could be considered as a robustness check for the other one. So, for the second hypothesis, the null hypothesis is rejected and the alternative one could be accepted.

7.5 Summary and Concluded Remarks

This paper attempts to investigate the relationship between banking efficiency and financial stability using a sample of 12 MENA countries, which include Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Palestine, Saudi Arabia, Syria, UAE, Oman, and Yemen, over the period from 2005 to 2014.

Using panel analysis according to fixed effect model, results indicate that hypotheses regarding the significance of this impact could be accepted.

Also, robustness checks, using dynamic effect model, assure the significance of these effects.

This means that banking efficiency and financial stability may affect each other, as applied on a sample of 12 MENA countries, over the period from the 2005 to 2014. More empirical work as applied on different countries and different periods is suggested.

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