The Determinants of Efficiency in Turkish Banking Sector After Global Finacial Crisis

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Abstract

In this study, we analyzed the efficiency changes of the Turkish banking sector between the years 2005-2014, when the global financial crisis was experienced. Data Envelopment Analysis (DEA) methodology was applied to obtain efficiency scores. Then, panel regression analysis was performed to explore the main determinants of efficiency changes. The findings have shown that internal factors are more effective than external ones on banks efficiency. The financial crisis was found to have a slight impact on banks' efficiency in managing their financial resources. GDP and inflation had negative relationship with bank efficiency due to the unanticipated inflation rate and volatile economic growth. The empirical findings imply that more efficient banks generate higher returns accordingly.

Keywords: Bank Efficiency, Financial Crisis, Data Envelopment Analysis, Panel Regression Analysis

Introduction

The banking industry is the key factor for the economical prosperity of all countries, and its capacity of intermediation between the borrower and the lender facilitates the economic activities as a part of the financial sector. Furthermore, it should be noted that the efficiency of the banking sector plays an important role for the monetary transmission mechanism and for the stability of the financial system.

A financial crisis is a disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities (Mishkin, 1997).

The global financial crisis that broke out in 2007 has shown the close connection between financial fragility and current-account imbalances, and between banking and currency crises. The global financial crisis was a result

of unregulated mortgages and credit boom that were pushed by the low interest rate. The expansion in risky mortgages to subprime borrowers primarily resulted in the outbreak of the global financial crisis.

The financial crisis that started in the United States of America and other industrialized economies has contaminated other parts of the world in four different ways (Kibritçioğlu, 2011):

•The wealth effect (pure contagion): State and private players lost parts of their savings invested in industrialized and emerging economies.

•The financial effect (financial contagion): In order to restore their liquidity and avoid additional risks, investors from all over the world withdrew their capital from developing countries and cancelled new investments. Furthermore, liquidity bottlenecks arose because banks worldwide limited the extension of new credit.

•The real economic effect (trade contagion): Owing to the cooling down of the global economy, the demand for goods exported by developing countries shrank, thus causing their external revenues to plummet.

•The transfer effect: Likewise, developing countries' revenues from transfers such as remittances and development assistance decreased as well.

The analysis of efficiency determinants is important as guidance towards enhancing economic growth since banks contribute to economic growth and stability. Several approaches have been used to estimate banks' efficiency and its determinants. In banking efficiency literature, DEA seems to be used much more compared to other analyses. DEA is used to measure and analyse the relative efficiency and managerial performance of banks that have similar inputs and outputs.

Casu and Molyneux (2003) investigated whether there had been any improvement and convergence of productive efficiency across European banking markets (France, Germany, Italy, Spain and England) since the creation of the Single Internal Market. The DEA results revealed that country-specific factors were still important determinants in explaining differences in bank efficiency levels across Europe.

Das and Ghosh (2006) investigated the performance of Indian commercial banking sector during the post-reform period 1992–2002 by using DEA. The findings suggested that medium-sized public sector banks performed reasonably well and were more likely to operate at higher levels of technical efficiency. A close relationship was observed to exist between efficiency and soundness as determined by bank's capital adequacy ratio. The empirical results also showed that technically more efficient banks were those that had, on an average, less nonperforming loans.

Aysan and Ceyhan (2007) analyzed the performance of the Turkish banking sector during 1990-2006 by conducting a panel data fixed effects regression analysis. The results have revealed that the efficiency change is

negatively related to the number of branches. They found a positive relationship between loan ratio and efficiency change, and also suggested that bank capitalization was positively related to efficiency change. The return on equity was not statistically significant in explaining any of the efficiency measurements. There was also no robust relationship between foreign ownership and efficiency.

Pasiouras et al. (2007) analysed the cost efficiency of Greek banks and its determinants. They applied a DEA approach to estimate technical, allocative and cost efficiency, using additionally a tobit regression to find the internal and external factors influencing the level of bank efficiency. They found that GDP per capita and unemployment influenced banks' efficiency adversely. The degree of capitalization, the number of branches and quantity of ATMs influenced bank efficiency differently, depending on the measure of efficiency used.

Hermes et al. (2009) analysed whether the relationship between financial liberalization and efficiency was conditional on the quality of bank regulation in a multi country setting. They evaluated bank efficiency measurements at the individual bank level by using SFA model, and pointed out that the positive impact of financial liberalization on bank efficiency was conditional on the quality of bank regulation and supervision.

Sufian (2010) investigated the efficiency of the Malaysian and Thailand banking sectors in and around the Asian financial crisis 1997 by using the DEA. The empirical findings from the multivariate regression analysis suggested that more efficient Malaysian banks had greater loans intensity, higher proportion of income coming from non-interest sources and more profitable.

Diler (2011) analysed the impacts of 2007 global financial crisis on the efficiency and productivity of Turkish banks, during 2003-2010 periods by using Data Envelopment Analysis (DEA) and Malmquist Productivity Index. The analysis indicated that in the pre-crisis period banking sector's risk taking measurement was positive, but in the post-crisis period, it was negative depending on the reduced efficiency scores. However, during the pre-crisis period, moderate credit growth rates were accompanied by reduced NPLRs

Methodology

Data envelopment analysis (DEA), introduced by Charnes et al. (1978) based on Farrell's work (Farrell, 1957), is a nonparametric technique for measuring the relative efficiency of a set of similar units, usually referred to as decision making units (DMUs). DEA is capable of handling multiple inputs and outputs without requiring any judgement on their importance.

In DEA, the most efficient DMU's are identified by DEA efficiency equal to one. Any DMU with efficiency less than one would be considered relatively inefficient, which denotes the existence of banks having greater efficiency within the data set of banks analyzed. Using DEA will let us determine the amount of excess inputs utilized by each inefficient bank and determine by how much the outputs need to be increased without any change in the number of inputs. In other words, a more efficient bank would achieve the same amount of outputs by using less amount of inputs, or it achieves the same level of output by using less amount of inputs.

Table 1. DEA Input oriented Model

Input-oriented	
Envelopment model	Multiplier model
$\min \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right)$	$\max z = \sum_{r=1}^{s} \mu_r y_{ro}$
subject to	subject to
$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{io} \quad i = 1, 2, \ldots, m;$	$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$
$\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = y_{ro} \quad r = 1, 2, \ldots, s;$	$\sum_{i=1}^{m} v_i x_{io} = 1$
$\lambda_j \geq 0 \quad j = 1, 2, \ldots, n$	$\mu_r, v_i \geq \varepsilon > 0$

We assume that there are n DMUs to be evaluated. Each DMU consumes varying amounts of m different inputs to produce s different outputs. Specifically, DMU_j consumes x_{ij} of input i and produces y_{rj} of output r. We also assume that $x_{ij} > 0$ and $y_{rj} > 0$. s_i^- and s_r^+ are slack variables. u_r = weight chosen for output r and v_i = weight chosen for input i.

The basic DEA - CCR model implies the assumption of constant returns to scale. This assumption was later relaxed to allow for the evaluation of variable returns to scale and scale economies. BCC model implies the assumption of variable returns to scale. The BCC model is obtained by simply adding a convexity constraint $\sum_{j=1}^{n} \lambda j = 1$ to the dual of the CCR model. A bank exhibits constant returns to scale if a proportionate increase or decrease in inputs or outputs move the firm either along or above the frontier. A bank which is not on the frontier is defined as experiencing non-increasing returns to scale if the hypothetical bank with which it is compared exhibits either constant (CRS) or decreasing returns to scale (DRS). A similar definition applies for non-decreasing returns to scale. A firm which is efficient under the assumption of variables returns to scale (VRS) is considered technologically efficient; the VRS score represents pure technical efficiency (PTE), whereas a firm which is efficient under the assumption of constant returns to scale (CRS) is technologically efficient and also uses the

most efficient scale of operation. Aly *et. al.*, (1990), suggest that, from the measures of technical (TE) and pure technical (PTE) efficiency, it is possible to derive a measure of scale efficiency (SE):

SE = TE / PTE

where $0 \leq SE \leq 1$, since CRS ≤ VRS. If the value of SE equals 1, the firm is scale efficient and all values less than 1 reflect scale inefficiency. If scale inefficiency exists *(SE < 1)*, the source of inefficiency is the result of operating at either increasing or decreasing returns to scale.

Data on banks' inputs and outputs are required to estimate bank efficiency, using the DEA approach. According to the literature, there are three approaches that can be used in defining and selecting banks' inputs and outputs. These are the production approach, the intermediation approach, and profit approach. According to the production approach, a bank is viewed as a producer by using inputs such as capital and labour to produce loans and deposits. The intermediation approach defines a bank as an intermediary that transfers assets from the surplus units to deficit units. The profit approach regards banks as financial institutions, trying to maximize profit through competition.

Data and Analysis of Variables

This paper measures and evaluates the relative efficiency of annual data of 20 commercial Turkish Banks through 2005 - 2014, using three approaches of Data Envelopment Analysis (DEA) in this study. The first is the intermediation approach in which deposits, equity and funds borrowed are inputs; total loans and receivables and securities are outputs. The second is the profit approach in which interest expenses, personnel expenses and other operating expenses are inputs; interest income and other operating income are outputs. The third is the production approach in which interest expenses, personel expenses and non interest expenses are inputs; interest income and non interest income are outputs. The data used in this study are taken from The Bank Association of Turkey, Turkish Statistical Institute and Banking Regulation and Supervision Agency.

The effects of some selected internal and external factors on efficiency are analyzed by a least square estimation of panel data in the second stage. The bank specific (internal) variables included in the regression models are TL-TA (total loans divided by total assets), ROE (return on equity), ROA (return on assets), EQASS (equity over total assets) NPL_TL (non performing loan over total loans) and II_TA (interest income over total assets). GDP (gross domestic product) and INF (inflation) are employed as a proxy for economic conditions. The dummy variable is included in the regression model to see the effect of global financial crisis on the efficiency of Turkish banking sector.

Hausman test is used to differentiate between fixed effects model and random effects model in panel data in OLS. In this case, random effects (RE) is preferred under H_1 hypothesis. Using the efficiency changes as dependent variables, internal and external factors as independent variables can be defined in the multivariate regression models as follows:

$$\Delta TE_{it}^{*} = \beta_0 + \beta_1 (ROE) + \beta_2(ROA) + \beta_3(II\_TA) + \beta_4 (EQASS) + \beta_5 (NPL\_TL) + \beta_6 (INF) + \beta_7(TL\_TA) + \beta_8 (GDP) + \beta_9 (DUMMY) + \varepsilon_{it}$$

Empirical Findings

The efficiency change in the banking sector between 2005-2014 was examined by using both CCR and BCC models under intermediation, profit and production approaches.

Efficiency results summarized in Table 2 indicate that domestic banks, especially state banks, are more efficient than foreign banks. The restructuring programs implemented especially for the state banks following 2001 crisis, is an important factor for the increase in the efficiency of state banks. Isık and Hassan (2003) pointed out that foreign banks were found to be more efficient in Turkey. The global financial crisis might be the reason behind the efficiency decrease in foreign banks between years 2007 and 2014.

The pure technical efficiency for banks is quite high, using three models compared with technical efficiency. These results could reveal that there have been some improvements in inputs and outputs used, reflecting that PTE allows efficiency to vary with bank size. The results also show that most of the technical efficiency is in the form of scale inefficiency.

Table 2. Efficiency Scores According to Intermediation, Profit and Production Models

	Intermediation			Profit			Production		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
2005	0,90	0,95	0,95	0,93	0,97	0,96	0,94	0,96	0,98
2006	0,94	0,96	0,98	0,89	0,94	0,95	0,96	1,00	0,96
2007	0,96	0,99	0,98	0,96	0,99	0,97	0,95	0,99	0,96
2008	0,95	0,98	0,96	0,97	0,99	0,98	0,90	0,96	0,94
2009	0,96	0,98	0,98	0,92	0,98	0,94	0,94	0,98	0,96
2010	0,95	0,96	0,99	0,93	0,97	0,95	0,95	0,97	0,98
2011	0,94	0,97	0,97	0,95	0,98	0,97	0,90	0,94	0,95
2012	0,92	0,96	0,96	0,93	0,98	0,95	0,90	0,93	0,96
2013	0,94	0,98	0,96	0,88	0,96	0,91	0,92	0,96	0,96
2014	0,92	0,97	0,95	0,82	0,96	0,85	0,90	0,95	0,95

Turkey's banking system demonstrated a much stronger structure, considering the financial global crisis in 2007, mainly due to the legal regulations implemented a few years earlier. Foreign banks experienced inefficiency during the financial global crisis. State and private banks were not affected as much as foreign banks but prudent bank operations led credit

mechanism to slow down during the global financial crisis. The results, on the technical efficiency, show that only a few Turkish banks were inefficient in generating profit. The financial crisis was found to have a slight impact on the banks' efficiency in managing their financial resources.

Table 3. Effects of Internal and External Factors on Efficiency Change

	Intermediation			Profit			Production		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.
C	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(2.013)	(2.630)	(3.353)	(1.635)	(2.719)	(2.444)	(1.718)	(2.238)	(2.579)
INF	0.0244	0.1151	0.0438	0.7660	0.7718	0.0000	0.4528	0.8111	0.4457
	(-2.270)	(-1.583)	(-2.030)	(0.298)	(-0.290)	(-4.523)	(0.752)	(0.239)	(-0.764)
EQA SS	0.7847	0.5449	0.0146	0.7338	0.2324	0.8692	0.9627	0.2912	0.9549
	(0.273)	(-0.606)	(-2.465)	(0.340)	(1.198)	(-0.164)	(-0.046)	(1.058)	(-0.056)
NPL_TL	0.0755	0.0193	0.1394	0.4341	0.4325	0.6527	0.0806	0.0157	0.4351
	(-1.787)	(-2.361)	(1.484)	(0.783)	(-0.786)	(-0.450)	(1.757)	(-2.439)	(-0.782)
ROE	0.1533	0.1263	0.9788	0.1425	0.3476	0.2934	0.2671	0.7043	0.1224
	(1.433)	(1.536)	(0.026)	(-1.472)	(0.941)	(-1.053)	(-1.113)	(0.380)	(-1.552)
ROA	0.1485	0.0956	0.9094	0.0194	0.9543	0.0507	0.2763	0.3085	0.0998
	(-1.451)	(-1.675)	(0.113)	(2.357)	(-0.057)	(1.967)	(1.092)	(1.021)	(1.654)
TL_TA	0.3081	0.0768	0.0004	0.3776	0.1672	0.2417	0.8467	0.7179	0.3996
	(-1.022)	(-1.779)	(3.626)	(-0.884)	(-1.386)	(-1.174)	(-0.193)	(0.361)	(0.844)
GDP	0.4597	0.6856	0.0581	0.0524	0.5267	0.3036	0.2963	0.0260	0.1988
	(-0.740)	(-0.405)	(1.906)	(-1.952)	(-0.634)	(-1.031)	(-1.047)	(2.245)	(1.289)
II_TA	0.2830	0.9655	0.0384	0.1905	0.8381	0.0009	0.1069	0.1843	0.7636
	(-1.076)	(-0.043)	(-2.085)	(-1.314)	(0.204)	(3.365)	(-1.620)	(-1.332)	(0.301)
DUMMY	0.5659	0.3605	0.0025	0.9743	0.8075	0.3221	0.4936	0.0215	0.7550
	(-0.575)	(-0.916)	(3.061)	(0.032)	(0.243)	(-0.992)	(-0.686)	(2.319)	(-0.312)
R-squared	0.067614	0.093104	0.168709	0.100968	0.078576	0.347869	0.085266	0.183471	0.078203
Adjusted R-squared	0.020890	0.047769	0.127145	0.056006	0.032505	0.315262	0.039617	0.142645	0.032113
S.E. of regression	0.076093	0.059786	0.039698	0.092636	0.056253	0.059582	0.069612	0.056173	0.046098
F-statistic	1.448.060	2.053.240	4.058.975	2.246.903	1705.533	1.066.868	1.864.007	4.493.930	1.696.756
Prob(F-statistic)	0.170720	0.036013	0.000093	0.021089	0.090570	0.000000	0.059966	0.000024	0.092622
Mean dependent var	0.362634	0.606980	0.450055	0.674013	0.714381	0.565533	0.400241	0.414869	0.318209
S.D. dependent var	0.083330	0.069412	0.054123	0.099537	0.061960	0.078976	0.079140	0.069331	0.055298
Sum squared resid	1.015.002	0.643378	0.283660	1.544.666	0.569688	0.639010	0.872262	0.567981	0.382513
Durbin-Watson stat	1.604.376	1.060.439	1.365.551	1.291.457	1876.335	1.353.767	0.993006	1.565.808	1.868.773
Hausmann Test	Chi-Sq. Statistic			Chi-Sq. d.f.			Prob.		
	0.000000			9			1.000		

The effects of internal and external factors on bank efficiency are summarized in Table 3. The impacts of ROA on technical efficiency and scale efficiency are positive under profit approach since more efficient banks generate higher returns accordingly.

NPL represents credit risk. The negative coefficient of NPL_TL with bank efficiency under intermediation approach implies that greater credit risk reduces the degree of bank efficiency. On the other hand, there is a positive coefficient of NPL_TL with bank efficiency under production approach. The empirical finding is consistent with the analysis of Sufian (2010) and skimping hypothesis of Berger and DeYoung's (1997). Under the skimping hypothesis, a bank maximising the long run profits may rationally choose to have lower costs in the short run by skimping on the resources devoted to underwriting and monitoring loans, but bear the consequences of greater loan performance problems.

TL_TA is a measurement of bank's loans intensity calculated as the ratio of total loans to bank total assets. The findings imply that banks with higher loans to asset ratios tend to be more efficient. The scale efficiency under intermediation approach is positively related to TL_TA consistent with that of Sufian (2010).

Bank performance is sensitive to macroeconomic conditions. Generally, higher economic growth encourages banks to lend more, permits them to charge higher margins, and improves the quality of their assets. GDP exhibits negative relationship with bank efficiency under profit approach but positive relationship with scale efficiency under intermediation approach and pure technical efficiency under production approach. However, during the period under study, Turkish economy had experienced a volatile economic growth, which could result in banks to suffer from lower demand for their financial services, increasing loan defaults, and thus lowering output. The empirical finding under profit approach is consistent with that of Pasiouras et al (2007).

The positive coefficients of GDP (under both models) reveals that Turkish banking sector has exhibited a higher efficiency. Demand for financial services tends to grow as economies expand and societies become wealthier. The high economic growth have encouraged Turkish banks to lend more, permiting them to charge higher margins, as well as improving the quality of their assets. The similiar results reported earlier by Hermes et al. (2009) and by Sufian (2010) suggest that GDP has positive relation with bank efficiency.

INFL is negatively related to Turkish banks' efficiency under intermediation approach and profit approach. The results have shown that, during the period under study, the levels of inflation have not been anticipated by Turkish banks, resulting in the banks' costs to be more than their revenues, consequently having adverse effects on the efficiency.

Conclusion

The financial crisis was found to have a slight impact on banks' efficiency in managing their financial resources. The empirical results have shown that more efficient banks generate higher returns. GDP and inflation had negative relationship with bank efficiency because of the unanticipated inflation rate and volatile economic growth. Besides, high credit risk causesed inefficiency in managing banks' financial resources. Compared to external factors, internal factors seem to have been more effective on efficiency changes of Turkish banks during the analysis period. Furthermore, banks should focus on the efficiency to become more competitive. Through the banking sector with high competitive power, economic dynamism would be promoted, and economic stability would be ensured. It should be noted

that the critical points for the efficient banking sector are optimal usage of resources, concentration on intermediary function, diversification of product and services, efficient risk management, regulation and supervision.

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