

How Does the Increasing Volume of Interbank Funds Affect Bank Efficiency?

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Abstract

This paper attempts to find out the relationship between interbank funds and efficiencies of Turkish commercial banks for the period of 2001-2006. The emphasis is on the post crisis period because we aim to see the transformation in interbank funds after 2001 and its effect on the bank efficiency. Data Envelopment Analysis (DEA) is used to find the efficiencies of the banks in each period. DEA is followed by the fixed effects panel data regression in which the dependent variable is the efficiency scores obtained in the first step. Explanatory variables are the ratio of interbank funds to other earning assets, bank capitalization, loan ratio, ratio of total assets to number of employees, return on assets and number of branches. The results of the fixed effects panel data regressions show that interbank funds are negatively correlated with bank efficiency while other explanatory variables like bank capitalization and loan ratio have positive effects on efficiency. Similar to earlier studies, we also find that profitability is not significant in explaining bank efficiency.

Keywords: Turkish Banking Sector, Interbank Funds, Data Envelopment Analysis, Efficiency, Panel Regression

JEL Classification: E32, G1, G21

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1. Introduction

The aim of this paper is to assess the effects of interbank funds on the efficiency scores of the banks. Together with investment securities, interbank funds are among the major components of other earning assets which constitute one of the outputs used commonly in measuring the banks' efficiency. This paper has two steps in analyzing the role of interbank funds on efficiency. First, the efficiency scores are calculated with a non-parametric estimations, namely through Data Envelopment Analysis (DEA). Later, the efficiency scores obtained in the first stage are regressed on the potential determinants of bank efficiency discussed heavily in the literature. In addition to the existing determinants of efficiency, this paper particularly focuses on the role of interbank funds in explaining the efficiency scores. The regression specifications have also other independent variables like the profitability ratio, number of branches and loan ratio which are shown to have a relationship with the efficiency of a bank in the existing studies.

The reason why this paper especially focused on this component of other earning assets is attributable to the developments in Turkish banking sector especially after 1994 and 2001 crises. Banking industry in Turkey was strictly regulated before 1980. The government had restrictions on the foreign exchange reserves, interest rates paid by banks to depositors, market entry and even on the number of branches. Even though this closed system appears to provide a safe environment for the banks in the financial sector, it hindered the financial system to develop through competition and innovation. After 1980 a financial liberalization

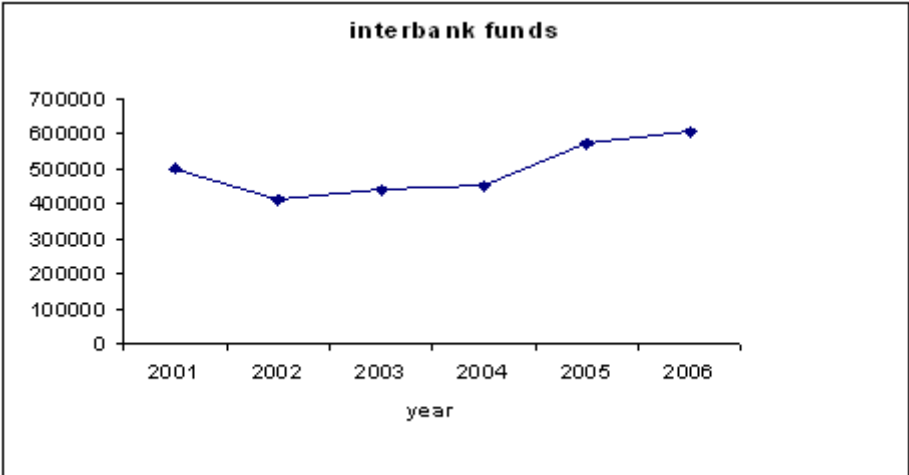
program was initiated in which limitations on foreign exchange reserves and market entries from abroad were removed. Together with these regulations, domestic banks also started to open new branches abroad and became able to borrow and lend among themselves by the establishment of Interbank Money Market in 1986. However, the financial system was still subject to government interventions and later this resulted in a financial crisis in 1994. These government interventions to the domestic debt market caused the system to be more prone to liquidity risk because of increased maturity mismatches between assets and liabilities. In the restructuring period of the crisis, monetary policies mainly aimed at shifting domestic borrowing from the Central Bank of Turkey to commercial banks. Starting from 1996, public debt was financed through short term government bonds and treasury bills with high interest rates. The main motivation of commercial banks in purchasing the government securities was to be immune to the credit risk while receiving high profits. However, this way of financing the public debt increased the vulnerability of the financial sector and together with other factors like currency risks and maturity mismatches, ultimately led the Turkish economy to more severe crises¹. (Özatay and Sak, 2002, Turhan, 2008)

Interbank money market is a useful intermediary between banks when they have liquidity shortages. Figure 1 shows the change in the amount of interbank funds between 2001 and 2006. For each period, the averages of the amount of interbank funds are taken. The initial observations point out that except 2001, interbank funds have an increasing trend and this fact confirms the increasing importance of interbank funds for recent years. Hence, we investigate whether this increase in the volume of interbank funds has an effect on efficiencies of banks in Turkey. The main problem with interbank money market is the volatility of its overnight rates. This volatility was attempted to be reduced in 1996 and 1997 to maintain the

¹ Also see Al and Aysan (2006), Aysan and Ceyhan (2008-b), Aysan and Ceyhan (2008-c).

financial stability. However the consequences were not as expected. In 2001, the government abandoned the strict monetary policy pursued and shifted to the floating exchange rate regime. The monetary policy before the crisis aimed at reducing the inflation and interest rates. Nevertheless, in November of 2000 an economic volatility shook this stable environment while the political tension erupted. The stabilization program adopted suffered from lack of credibility issue. In only one day, 7.5 billion dollar was drawn from Central Bank of Turkey and the overnight interest rates rose up to 7500 percent. The financial crisis also accounts for the decline in the interbank funds in 2001 since the overnight interest rates showed a dramatic hike.

Figure 1: Change in Interbank Funds between 2001 and 2006



Source: Author's calculation

The 2001 economic crisis caused especially small and medium scale businesses around Turkey to be shut down and many people to lose their jobs. After the crisis, banks changed the way they report their balance sheets and started to use inflationary accounting. Due to this change, balance sheet items before 2001 are not consistent with those after 2001. In addition, political and macroeconomic environment is more stable since then. Hence taking

pre- and post-2001 periods together may bias the efficiency scores given that the conditions changed dramatically. Due to this reason, this paper only focuses on the post-crisis period.

As the system gets more open to abroad and free from government interventions, a more competitive environment was achieved. Previously, it was sufficient for banks to establish a good reputation for keeping their existing clients or reaching potential ones. However, after the liberalization efforts they need to offer more branches and become more technologically developed to compete with their rivals and survive in the market. Another major change was the improvements in how the banks operate. The main cash flow of banks is from loans, since banks invest the sizable fractions of the deposits collected in loans to the individuals and firms. Alternative ways of utilizing deposits are through government and other securities transactions and interbank funds. Hence, banks operating in Turkey shifted some of their resources from the traditional way of banking to these alternatives.

The aim of the new banking laws such as Turkish Privatization Law and institutions like Istanbul Stock Exchange and Interbank Money Market is to foster competition and efficiency in Turkey's financial sector. However, the country suffered from the macroeconomic and political instability during 1980s. Hence, the end product of the program was not as expected. Chronically high inflation rates and operational risks like military intervention diverted the banks to short term lending such as treasury bills, to assure themselves and maintain their operations during the political and economic turmoil.

In modeling the efficiency and choosing the set of inputs and outputs, this paper relies essentially on Stavarek (2003). The paper also improves Stavarek (2003) by incorporating off-balance sheet items and other earning assets into analysis. Other earning assets are critical in

measuring the efficiency of banking in Turkey since its components play a considerable role in the banking operations in Turkey. The establishment of Interbank Money Market for Turkish Lira in 1986 enables banks to fund each other so that they can meet their liquidity needs in the short term. Hence interbank funds emerge also an alternative way of investing the available deposits. The another alternative to extending the loans as mentioned before is dealing with investment securities, that is, giving loan especially to the government or to other institutions through buying their issued papers. Off-balance sheet items need to be included among the list of outputs since their ignorance results in miscalculation of the efficiency scores.

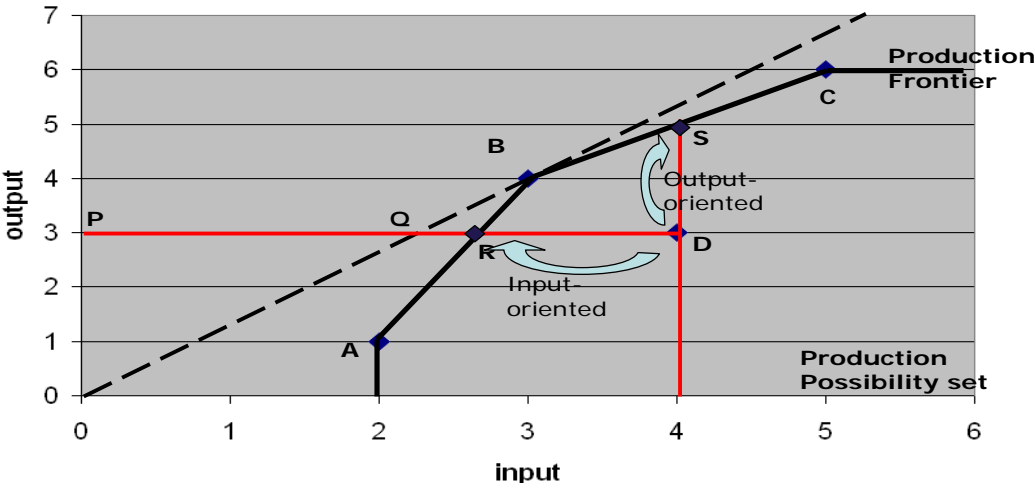
The organization of this paper is follows. The methodology used, namely Data Envelopment Analysis (DEA), is briefly explained in the following section. In section 3, the data set and the empirical setting are described and the reasons behind the selection of the variables in the two stages of the empirical model are given. In section 4, nonparametric estimation results are presented and analyzed with the regression specifications. In section 5, a cluster analysis of the banks in Turkey for the year 2006 is carried out based on the results of earlier sections. The cluster analysis is also visually presented in this section as well. Conclusions are relegated to the final section.

2. Methodology

The paper has two phases in terms of the methodology used. In the first step, efficiency scores are estimated with and without other earning assets in the output set where the nonparametric technique of Data Envelopment Analysis (DEA) is used. DEA measures the relative efficiencies of a set of entities, namely decision making units (DMUs), as

compared to each other. An efficient DMU, a DMU with an efficiency score of 1, is not necessarily efficient compared to the universal set of entities, but is efficient only when compared with the group of entities selected for the model. Input oriented BCC (Banker, Charnes, Cooper, 1984) model is selected from various types of DEA models, because it can handle negative values in the output set, which is the case for our data set. The difference of BCC from other DEA models is that it assumes variable returns to scale, which means that its production frontier is piecewise linear and concave. Figure 2 illustrates the variable returns to scale nature of BCC model.

Figure 2: Efficiency Frontier for the BCC model, illustrated for a hypothetical model with one input



In Figure 2, there are four decision making units (A, B, C and D) and three of them (A, B, and C) are efficient since they are enveloping the inefficient one (D) with the polyline connecting them. R and S are the projections of decision making unit D on the efficient frontier. R is the input-oriented projection while S is the output-oriented one. The uppermost

DMUs are the most efficient ones because the output/input ratio is maximized and hence productivities are maximized at these points. The productivity of an inefficient DMU such as D is given by the ratio PR/PD. The reference set for D is composed of B and C, which means in order to be efficient, D should set these two DMUs as benchmark. The critical issue here is the shape of the efficient frontier. It is not linear, since it is not exhibiting constant returns to scale at all points; rather it is a concave curve where it has increasing returns to scale in the first solid line segment, followed by decreasing returns to scale in the second part and at the intersection of two, there is constant returns to scale.

The model was first proposed by Banker, Charnes and Cooper (1984). The mathematical model for the input-oriented BCC Model (Cooper et al., 2006) is given below and is solved for each DMU to compute its efficiency:

$$\begin{aligned}
 (BCC_o) \max \quad & \theta_B \\
 & \theta_B x_0 - X\lambda \geq 0 \\
 & Y\lambda \geq y_0 \\
 & e\lambda = 1 \\
 & \lambda \geq 0
 \end{aligned}$$

Where $X=(x_j)$ is the matrix of input variables and $Y=(y_j)$ is the output matrix of variables, λ is a column vector and e is the row vector of 1's. θ_B is the input oriented efficiency score for the DMU that the model attempts to find out.

In order for a DMU to be efficient, there are two conditions that should be satisfied:

- i. $\theta_B=1$
- ii. There should not be input excesses and output shortfalls

In this study, after obtaining efficiency scores using DEA, a balanced fixed effects panel regression is run in the second stage of the empirical analysis. The dependent variable is the efficiency scores with and without other earning assets obtained in the first step, such that

the effect of different variables on efficiency and their significance can be observed. The set up for the fixed effects panel analysis is:

$$Y_{it} = \alpha + \beta \cdot X_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = u_i + v_{it}$$

$$i = 1, \dots, N \text{ and } t = 1, \dots, T$$

Where Y_{it} stands for the efficiency scores, α is the constant for the regression model, X_{it} is the matrix of independent variables and ε_{it} is the random error in the regression. u_i represents the individual-specific, time-invariant effects, which are assumed to be fixed over time for each bank in this model.

This two step empirical methodology emerges to be widely used in recent studies². For example, a similar study was conducted by Arestis et al. (2006) where they assessed the relationship between financial deepening and efficiency in some non-OECD countries. They have used a two-phase procedure. After measuring the efficiency scores, they regressed them on some variables representing financial deepening.

3. Data and Empirical Setting

In this study, decision making units in DEA are Turkish commercial banks within the years 2001 through 2006, whose data for inputs and outputs are obtained from the Banks Association of Turkey. The variables used in the data set are as follows:

Inputs:

- i. Personnel expenses:* Represents the cost of labor, covering wages and all associated expenses
- ii. Fixed assets:* Stands for the cost of capital

² Also see Aysan and Ceyhan (2007), Aysan and Ceyhan (2008-a).

iii. Total deposits: The sum of demand and time deposits from customers and interbank deposits

Outputs:

i. Net interest income: The difference between interest income and interest expenses

ii. Off balance sheet items: Guarantees and warranties (letters of guarantee, bank acceptance, letters of credit, guaranteed pre-financing, endorsements and others), commitments, foreign exchange and interest rate transactions as well as other off-balance sheet activities

iii. Total loans: The net value of loans to customers and other financial institutions

iv. Other earning assets: Interbank funds (sold) and investment securities (treasury and other securities)

In the literature, different studies use different models where almost all variables change due to the approach applied. Since there exist no universally accepted set of inputs and outputs, it is crucial to explain why these variables are selected for DEA analysis. The reason why personnel expenses and fixed assets are chosen as inputs is obvious. Without necessary equipment, building and human resource it is not possible for a bank to operate. Therefore, their existence and functioning are vital in determining the efficiency of a bank.

Total deposits are included as well because money collected by banks from their customers is used for investments in the form of like loans, securities or interbank funds. The banks operate as if they convert these inputs, like time and effort of personnel, equipment and deposits from customers into outputs like the loans to firms, to individuals, to government

through treasury bills or to other banks. Hence, the loans and other earning assets are also taken as outputs.

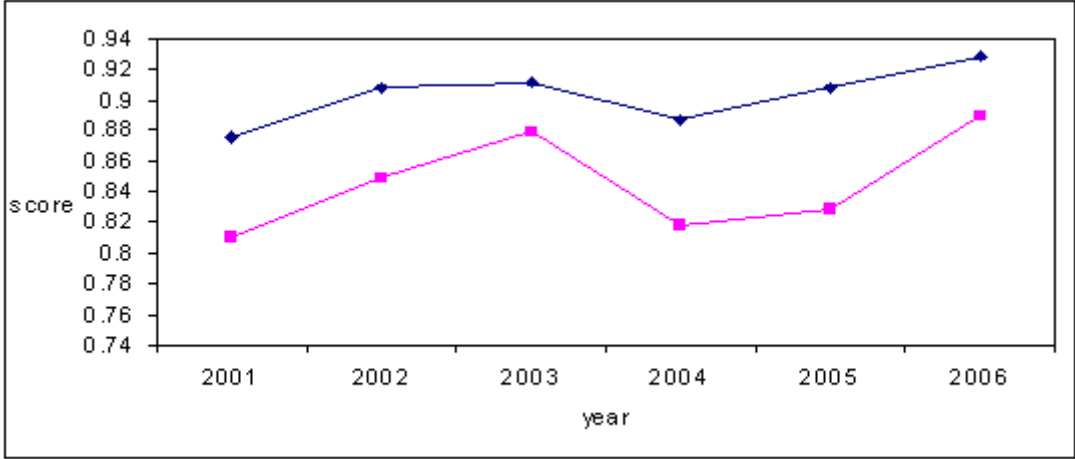
The net interest income is the output of a bank where interest expenses and interest income are the inputs. The literature on efficiencies on banking supports the idea that off balance sheet items need to be included in the measurement in addition to balance sheet items. According to Siems and Clark (2002) excluding off balance sheet items leads to an underestimation of the efficiency scores, given that non-traditional ways of banking like the letters of credit, futures or forwards are not taken into account otherwise. Hence by considering off balance sheet items in the output set, we do not ignore banks' asset management activities. DEA is conducted with and without other earning assets to see the difference between these two efficiency scores. The computations are conducted using the DEA-Solver software (Cooper et al., 2006).

The results of DEA are presented in the Appendix where average efficiencies for all banks over the selected time frame are given (see Table A.1). The most obvious outcome in Table A.1 is that the exclusion of other earning assets in the outputs decreases the efficiency scores. There are fifteen banks that are efficient in all periods. Only one of them, Ziraat Bankası, is a state bank. Hence other state banks may take Ziraat Bankası as a benchmark to enhance their efficiency scores. Six banks out of fifteen efficient banks are foreign banks. This result shows that, the foreign banks have not systematically performed better as compare to their domestic counterparts. Based on the average efficiency scores, one also concludes that more efficient banks usually come from the groups of private banks and foreign banks. This finding supports the idea that these groups of banks have invested more to improve their technology and used their resources more productively in the post crisis period. In the last

column of Table A.1, percentage differences between the efficiency scores of including the other earning assets and excluding them are presented as well. The efficiency scores of Toprakbank and Turkishbank display an extreme difference (194 percent and 100 percent) between these two different calculations, Other than these two banks, the percentage differences are always positive and are at most 20 percent.

Figure 3 shows the average efficiency scores of all banks for the years 2001-2006. The time series above in Figure 3 shows the scores with the other earning assets included, whereas the time series below shows the scores with the other earning assets excluded. There is an increasing trend in both series implying that the commercial banks in Turkey improved their productivities in the restructuring period. However, excluding other earning assets in the output set causes efficiency scores to be underestimated.

Figure 3: Efficiency Scores between 2001 and 2006



Source: Authors' calculation

Having included the other earning assets in the computations, we obtain the efficiencies for every bank over the selected years. Figure 4 shows the improvements in the efficiencies for all the 48 banks that existed for at least one year through 2001-2006, plotted

using Miner3D software³. In the figure, *Year* is mapped to the X axis, *DMUs* are mapped to the Y axis, and *efficiency scores* are linearly mapped to colors of the glyphs (data points). The light colors denote higher efficiency scores. The darkest colors denote that the bank did not exist in that year. For example, the bank WLG existed in 2001, but did not exist through 2002-2006.

Table 1: Number of Efficient Decision Making Units

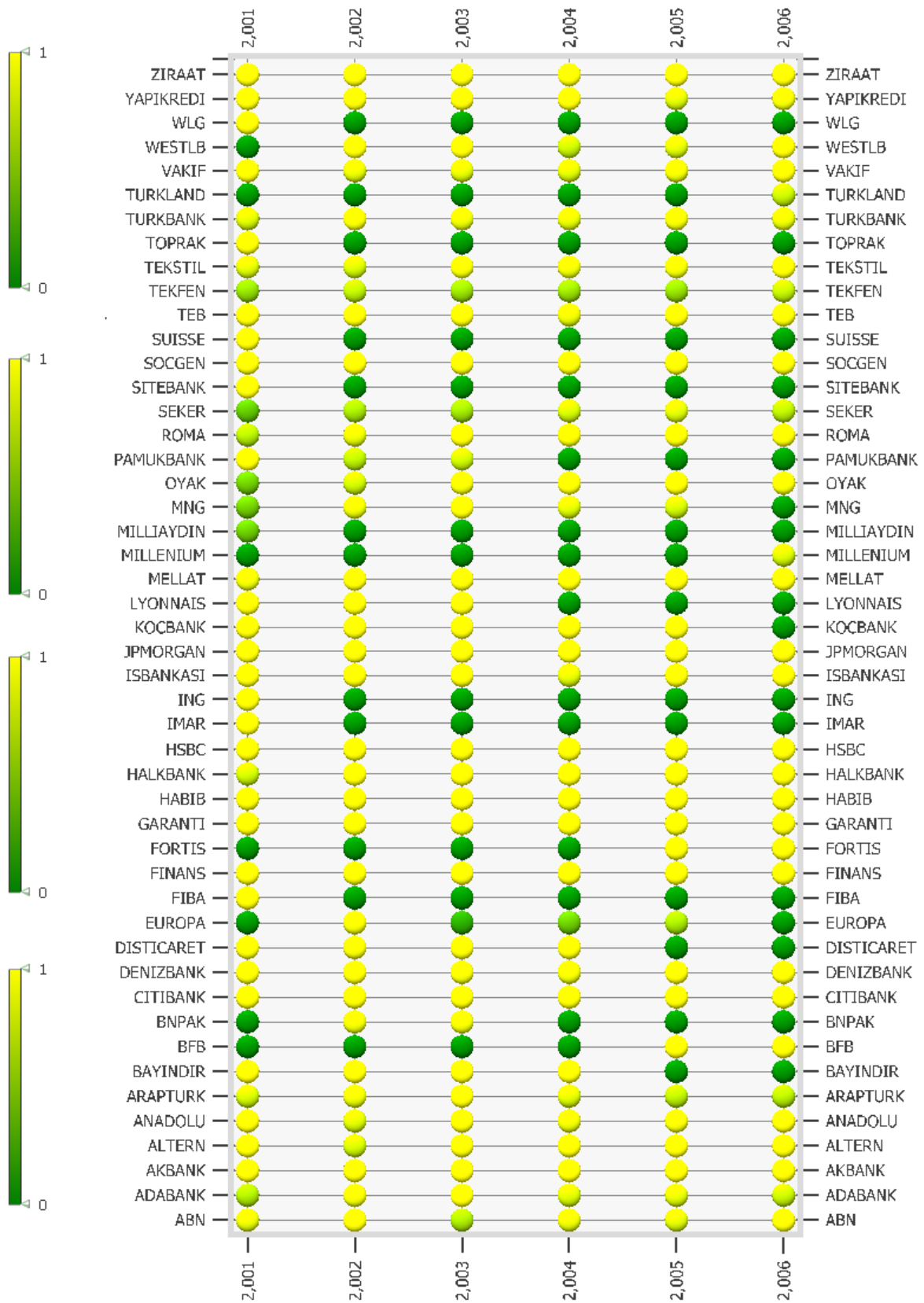
Year	Total number of banks	Number of efficient banks with OEA	Number of efficient banks without OEA
<i>2001</i>	42	28	23
<i>2002</i>	36	20	18
<i>2003</i>	36	25	23
<i>2004</i>	33	16	11
<i>2005</i>	33	18	15
<i>2006</i>	32	21	19

Source: Authors' calculation

³ For the details on the computer program see the official web page: www.miner3d.com

Figure 4: Change of Efficiency Scores over 2001-2006 for Turkish Banks

(Other Earning Assets is included in the DEA model)



In the second part of the analysis, the efficiency scores are regressed on the following independent variables: interbank funds, bank capitalization, loan ratio, total assets/number of employees, return on assets (ROA), number of branches, foreign/domestic and state/private dummies.

The critical variable that this paper aims to evaluate is the interbank funds and its ratio in the other earning assets is included in the regression specifications. The effect of interbank funds on the efficiency is expected to be negative because high investment in interbank market is an indicator for inefficiency, confirming that the bank could not invest in more profitable assets or loans with greater returns than the interbank funds (Adenso-Diaz and Gascón, 1997). The loans are expected to yield higher returns for the banks. However, the interbank loans tend to offer lower interest rate returns and hence provide less profit opportunities for the banks.

The loan ratio and bank capitalization are expected to have positive impact on efficiencies. The loan to asset ratio indicates how much loan an asset can generate. Therefore, an increase in this ratio implies that the bank uses its assets more efficiently. The bank capitalization is gauged as the ratio of equity to total assets. As this share increases, the amount of assets transferred into equity increases. Since the equity is a vital source for the survival of the bank and its operations, it is expected to have a positive relationship with efficiency. Moreover, it is expected that when the owners of the banks put more capital (equity) into their banks, the banks are expected to run more efficiently while alleviating the moral hazard problem.

The total assets to number of employees is another indicator showing the performance of an employee in asset generating activities and it is tested in Isik and Hassan, (2002). For the period of 1988 and 1996, Isik and Hassan demonstrated its relationship with the efficiency. Hence we attempt to figure out if this relationship exists in recent years as well. If the relationship still remains, it is expected to be positive because per employee asset needs to be higher for the more efficient banks. Among profitability ratios, Return on Assets (ROA) is taken and it is the net income over total assets. As a bank performs better, it becomes more profitable through managing its assets more successfully and increasing its income. Hence there needs to be a positive relationship with ROA and efficiency scores.

The number of branches denotes the accessibility of the banks to the existing and potential customers and directly affects the amount of deposits. Thus this variable is expected to have a positive relationship with the efficiency scores. The effects of state/private and foreign/domestic dummies on the efficiency scores are ambiguous. There are mixed evidence on the effects of different ownership structure on efficiency. However, the private commercial banks and the foreign banks in general tend to be more efficient than the state banks (Isik and Hassan, 2002).

Table 2: Descriptive Statistics

Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
<i>Interbank/Other Earning Assets</i>	212	0.463	0.543	0.001	6.978
<i>Efficiency with Other Earning Assets</i>	212	0.902	0.164	0.150	1.000
<i>Efficiency without Other Earning Assets</i>	212	0.845	0.209	0.138	1.000
<i>Bank Capitalization</i>	212	0.175	0.168	-0.353	0.850
<i>Loan Ratio</i>	212	0.296	0.187	0.000	0.733
<i>Asset/Employee</i>	212	2508	1994	90	16879
<i>Return on Asset</i>	212	-0.008	0.099	-0.641	0.322
<i>Number of Branches</i>	212	149	268	0	1504

Source: The Banks Association of Turkey and Authors' calculation

Table 3: Correlation Matrix

	<i>Interbank</i>	<i>Efficiency with OEA</i>	<i>Efficiency without OEA</i>	<i>Bank Capitalization</i>	<i>Loan Ratio</i>	<i>Asset/Employee</i>	<i>ROA</i>	<i>Number of Branches</i>
<i>Interbank</i>	1.000							
<i>Efficiency with OEA</i>	-0.236	1.000						
<i>Efficiency without OEA</i>	-0.197	0.822	1.000					
<i>Bank Capitalization</i>	0.093	0.054	0.160	1.000				
<i>Loan Ratio</i>	-0.174	0.124	0.244	-0.379	1.000			
<i>Asset/Employee</i>	0.070	0.210	0.135	-0.028	-0.214	1.000		
<i>ROA</i>	-0.035	0.171	0.160	0.070	0.105	0.228	1.000	
<i>Number of Branches</i>	-0.205	0.171	0.183	-0.171	0.059	-0.033	0.105	1.000

Source: The Banks Association of Turkey and Authors' calculation

The correlation matrix is presented in Table 3. Even though the bank capitalization and loan ratio have positive impacts on efficiency, they are negatively correlated with each other. Hence, an attempt to increase efficiency through increasing one of them is likely to cause the other variable to worsen. The same result is also valid for the assets/employee ratio since it is negatively correlated with both the bank capitalization and loan ratio while all of them have positive relationship with efficiency. The interbank to other earning assets ratio is weakly related with the bank capitalization, while their correlations with efficiency are adversely related. The negative correlations between interbank/other earning assets and loan ratio are as expected given that the banks have fewer assets to use for the interbank funds as the loan ratio increases.

4. Empirical Results

The main contribution of this study is to analyze how the efficiency scores are affected by the increasing volume of interbank funds. The results of the analysis are evaluated in two parts given that the dependent variable is either the efficiency scores with other earning assets or without it.

In Table 4, the results of the regression on the efficiency with two dependent variables are presented. The coefficients and t-values (in the parenthesis) are presented in the table. In the first fixed effect panel regression specification, the explanatory variables are regressed on the efficiency scores with other earning assets included as output. The interbank/other earning asset is significant and affects the efficiency scores adversely, as expected. The loan ratio and bank capitalization are significant in explaining efficiencies and they have a positive relationship with efficiency. This supports the view that when the banks turn their assets into more lucrative investments, their efficiency scores improve. Interestingly, the ROA and asset-

employee ratio are not significant in explaining the dependent variable. Finally, number of branches and foreign domestic dummies are not significant, either.

In the second panel, the dependent variable stands for the efficiency scores without the other earning assets. The aim of this second regression specification is to uncover whether the other earning assets drastically alter the main findings. The results are not much different from the findings of the previous regressions. The interbank funds, the bank capitalization and loan ratio are still significant. The interbank funds variable has a negative relationship with efficiency while the bank capitalization and loan ratio are positively correlated with the efficiency scores. Similar to earlier results, other variables are found to be insignificant in explaining the banks' efficiencies.

Table 4 Fixed Effects Panel Regressions

Independent Variables	Dependent variable <i>Efficiency with Other Earning Assets</i>	Dependent variable <i>Efficiency without Other Earning Assets</i>
<i>Interbank/Other Earning Assets</i>	-0.068 (-4.44)***	-0.049 (-2.47)**
<i>Bank Capitalization</i>	0.251 (-2.89)***	0.457 (-4.01)***
<i>Loan Ratio</i>	0.239 (-3.69)***	0.432 (-5.16)***
<i>Assets/Employees</i>	0.00001 (-1.74)*	0.00001 (-0.61)
<i>Return on Assets</i>	0.015 (-0.14)	-0.149 (-1.09)
<i>Number of Branches</i>	-0.00002 (-0.12)	-0.00002 (-0.29)
<i>Foreign/Domestic</i>	-0.022 (-0.28)	-0.007 (-0.07)
<i>Constant</i>	0.804 (-19.48)***	0.656 (-12.31)***
<i>R-square</i>	0.736	0.729
<i>Number of Observations</i>	212	212

Source: Authors' calculations

* indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level

5. Cluster Analysis

In section 4, the interbank funds, banks capitalization and loan ratio were determined to be highly significant in determining the average efficiency scores over the years 2001-2006. In this section, a cluster analysis is carried out for the year 2006 using the above factors, and efficiency scores for 2006 computed with and without OEA, with a total of five variables. The cluster analysis results are combined with the data on two other attributes of the banks, namely data regarding the status of the bank, being State/Private and Foreign/Domestic.

Table 5 shows the results of cluster analysis, which was carried out using the k-means clustering algorithm implemented within Miner3D software. Table A.1 lists the clusters that each of the banks that exist in 2006 belong to.

Banks in clusters 1 and 2 (first two rows in Table 5) exhibit similar characteristics as can be seen from similar bar levels under each column. These are also the two clusters with the most elements (last column), and are almost all efficient in both DEA models (with and without OEA). These two clusters mainly differ from each other with respect to their interbanks/OEA values, as can be seen from the large difference in the bars under the column `AVG(2006_Interbank/OEA)`. After combining data on the ownership status of banks, it is also observed that these two clusters differ significantly with respect to their Foreign/Domestic ownership. 71 percent of the banks in cluster 2 are foreign, whereas only 17 percent of banks in cluster 1 are foreign. Thus a careful analysis of clustering results revealed that among efficient banks that operate similarly (low bank capitalization, high loan ratio), domestic banks have low interbank/OEA values, whereas foreign banks have high interbank/OEA values.

Table 5: Results of Cluster Analysis for the Year 2006

ClusterNo	AVG(2006_Interbank/OEA)	AVG(2006_BankCapitalization)	AVG(2006_LoanRatio)
1	0.19	0.10	0.55
2	0.67	0.15	0.63
3	0.62	0.13	0.35
4	0.45	0.12	0.57
5	0.67	0.12	0.12
6	0.13	0.17	0.39
7	0.11	0.12	0.33
8	0.93	0.83	0.00
9	0.73	0.59	0.01
AVG(Column)	0.44690625	0.17871875	0.4091875

ClusterNo	AVG(2006_Eff_Excluding)	AVG(2006_Eff_Including)	PercOfForeign	PercOfPrivate	NoOfBanks
1	0.97	0.99	0.17	0.83	6
2	1.00	1.00	0.71	1.00	7
3	0.56	0.92	0.00	1.00	2
4	0.67	0.70	0.00	0.33	3
5	1.00	1.00	1.00	1.00	4
6	0.61	0.63	0.50	1.00	2
7	0.93	0.98	0.20	0.40	5
8	0.68	0.68	0.00	1.00	1
9	1.00	1.00	0.50	0.50	2
AVG(Column)	0.88984375	0.92809375	0.34	0.79	

Two clusters are composed of a small percentage of private banks: Cluster 4, which is composed of three banks, contains two state banks and one private bank (hence the percentage of private value of 33 percent). Cluster 7 is composed of five banks, three of them state banks, and two of them private banks (hence the percentage of private value of 40 percent). Even though these two clusters are characterized by the felt presence of state banks, their average efficiency scores differ significantly: average efficiency for cluster 4 is 0.70 in the second DEA model, whereas average efficiency for cluster 7 is 0.98. A curious investigation of the values under other tables reveals differences that can explain this significant difference. The banks in cluster 4 have a high average value of 0.45 for interbank/OEA for 2006, whereas banks in cluster 7 have a low average value of 0.11. The values under the bank capitalization column are the same. However, the values under average loan ratio column also differ significantly (0.57 vs. 0.33). The interbank/OEA values and loan ratios were proven to have negative effect on efficiency scores by the panel regression in section 4. Thus, it is only natural that cluster 7 has a higher average efficiency compared to cluster 4.

6. Conclusions

Starting from the beginning of 1980s, the banking sector in Turkey was liberalized through the new banking laws and the establishments of regulatory financial agencies. The traditional way of banking where loans are the main output of the banking operations started to change in this process. Banks began to lend other banks through Interbank Money Market and to give loans to the government through treasury bills. Therefore, this paper aims to find out the developments in the interbank funds and its effect on the bank efficiencies for the periods 2001-2006. Turkish economy suffered from major financial crises in 2000 and 2001. In the post-crisis episode, the banking sector in Turkey has better performed its intermediary role between borrowers and lenders. Hence, the focus is on post-crisis period to find out the effects of increasing volume of interbank funds in recent years.

After conducting Data Envelopment Analysis to find efficiency scores, fixed effects panel regressions are carried out to uncover the role of certain selected factors on the efficiencies of the banks in Turkey. Besides showing the statistically significant factors that affect efficiency including the interbank funds, a historical summary of efficiencies of banks operating in Turkey and the results of a cluster analysis for the year 2006 are presented.

The effect of interbank funds stands to be negative and statistically significant. This result supports the idea that the higher amount of investment in the interbank funds is an indicator of inefficiency. The bank capitalization and loan ratio are other significant variables and they are positively correlated with efficiency. The profitability and efficiency are not significantly associated to each other, confirming the earlier findings of Abbasoğlu et al. (2007). The asset-employee ratio, measuring the amount of asset an employee can create, and

the number of branches are found to be insignificant in affecting efficiency. Finally, foreign/domestic dummy is found to be insignificant as well. Overall, this paper uncovers the adverse effects of the interbank funds on the efficiencies while the loan ratio enhances the efficiency scores. Hence, the empirical findings of this paper confirms the argument for an emerging market economy that the bank efficiency is enhanced through extending relatively longer term loans as opposed to extending shorter term loans to other banks.

APPENDIX

Table A.1 Average Efficiency Scores of DMUs

DMU Abbreviation	DMU Full Name	Cluster No (in 2006)	Excluding OEA	Including OEA	Percentage Change in Efficiency
<i>ABN</i>	<i>ABN Amro Bank</i>	7	0.7	0.84	0.20
<i>ADABANK</i>	<i>Adabank</i>	8	0.74	0.78	0.05
<i>AKBANK</i>	<i>Akbank</i>	1	1	1	0
<i>ALTERN</i>	<i>Alternatifbank</i>	2	0.94	0.95	0.01
<i>ANADOLU</i>	<i>Anadolubank</i>	3	0.76	0.93	0.22
<i>ARAPTURK</i>	<i>Arap Türk Bankası</i>	6	0.68	0.77	0.13
<i>ROMA</i>	<i>Banca di Roma</i>	2	0.86	0.9	0.05
<i>EUROPA</i>	<i>Bank Europa</i>		0.49	0.5	0.02
<i>MELLAT</i>	<i>Bank Mellat</i>	2	0.89	0.98	0.10
<i>BAYINDIR</i>	<i>Bayındırbank</i>		1	1	0
<i>BFB</i>	<i>Birleşik Fon Bankası</i>	9	1	1	0
<i>BNPAK</i>	<i>Bnp-Ak Dresdner Bank</i>		0.9	0.92	0.02
<i>CITIBANK</i>	<i>Citibank</i>	5	0.99	1	0.01
<i>LYONNAIS</i>	<i>Credit Lyonnais Turkey</i>		1	1	0
<i>SUISSE</i>	<i>Credit Suisse First Boston</i>		1	1	0
<i>DENIZBANK</i>	<i>Denizbank</i>	2	0.89	0.97	0.09
<i>DISTICARET</i>	<i>Dış Ticaret Bankası</i>		0.88	0.98	0.11
<i>FIBA</i>	<i>Fibabank</i>		1	1	0
<i>FINANS</i>	<i>Finansbank</i>	2	1	1	0
<i>FORTIS</i>	<i>Fortisbank</i>	1	0.89	0.99	0.11
<i>GARANTI</i>	<i>Garanti Bankası</i>	1	1	1	0
<i>HABIB</i>	<i>Habib Bank</i>	5	1	1	0
<i>HALKBANK</i>	<i>Halkbank</i>	7	0.8	0.95	0.19
<i>HSBC</i>	<i>HSBC</i>	2	1	1	0
<i>ING</i>	<i>ING Bank</i>		1	1	0
<i>IMAR</i>	<i>İmarbank</i>		1	1	0
<i>ISBANKASI</i>	<i>İşbankası</i>	7	0.94	0.97	0.03
<i>JPMORGAN</i>	<i>JPMorgan Chase Bank</i>	9	0.95	1	0.05
<i>KOCBANK</i>	<i>Koçbank</i>		0.99	1	0.01
<i>MILLENIUUM</i>	<i>Millenium Bank</i>	4	0.75	0.75	0
<i>MILLIAYDIN</i>	<i>Milli Aydın Bankası</i>		0.31	0.36	0.16
<i>MNG</i>	<i>MNG Bank</i>		0.71	0.75	0.06
<i>OYAK</i>	<i>Oyakbank</i>	1	0.81	0.82	0.01
<i>PAMUKBANK</i>	<i>Pamukbank</i>		0.68	0.78	0.15
<i>SITEBANK</i>	<i>Sitebank</i>		1	1	0
<i>SOCGEN</i>	<i>Societe Generale</i>	5	0.89	1	0.12
<i>SEKER</i>	<i>Şekerbank</i>	6	0.55	0.59	0.07

TEB	TEB	1	0.97	0.97	0
TEKFEN	Tekfenbank	4	0.49	0.56	0.14
TEKSTIL	Tekstilbank	2	0.86	0.87	0.01
TOPRAK	Toprakbank		0.34	1	1.94
TURKBANK	Turkish Bank	3	0.43	0.86	1.00
TURKLAND	Turkland Bank	4	0.66	0.68	0.03
VAKIF	Vakıfbank	1	0.76	0.87	0.14
WESTLB	West LB AG	5	0.88	0.89	0.01
WLG	Westdeutsche Landesbank		1	1	0
YAPIKREDI	Yapı Kredi Bankası	7	0.93	0.95	0.02
ZIRAAT	Ziraat Bankası	7	1	1	0

Source: Authors' calculations

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