Impact of Disinflation on Profitability: A Data Envelopment Analysis Approach for Turkish Commercial Banks

Eren Ayaz and S. Emre Alptekin

Abstract—Data Envelopment Analysis (DEA) analysis has been applied to the banking industry by a significant number of researchers. In this paper, the aim is to investigate the direct influence of inflation on banks’ profitability. Doing so, the data of the period 1998-2003 when the inflation was relatively high is compared to the data of the period 2004-2008 when the inflation was higher. DEA’s ability to evaluate several inputs and outputs at the same time and give efficiency scores to each decision making unit is used to evaluate banks’ efficiencies. The results reveal which period is more profitable for commercial banks.

Index Terms—Data envelopment analysis, banking sector, efficiency

I. INTRODUCTION

Banks play a vital role in a country’s economic development and growth. In addition to their large economic significance, the existence of an increasingly competitive market highlights the importance of evaluating the banks’ performance in order to continuously improve their functions and monitor their financial condition [1]. When the case of Turkey is considered, we can observe that the major changes experienced in Turkish economy has altered the working environment of the Turkish banks. In this study, inflation will be the main point of interest and it will be used to determine the trends in the profitability of banks.

Before the 2001 crisis, high inflation ruled the Turkish economy. Due to huge governmental deficits, the state had been the most significant customer of the banks. Banks collected deposits through private, SME and commercial banking. They used these funds for purchasing government bonds. Loans per assets ratios were quite low in this high inflation period. On the other hand, government bonds per assets ratios were over 50%. After the 2001 crisis, inflation was taken under control. The state needed less financial assist. The new trend was capturing more private, SME and commercial customers. Banks had to sell loans in order to make profit and to survive. Moreover, risk rates of Turkish economy decreased and for this reason foreign banks began to enter to the Turkish market. Profit margins declined, but loan volumes increased sharply. By this way, banks continued to keep their profitability. However, it is a great source of debate whether the pre-crisis period or the post-crisis period is more profitable for Turkish banks. According to our hypothesis, the banks should have used advantages of low inflation between 2004 and 2008. In this paper, our research question is: “Did the Turkish banks really experience higher rates of profitability in the lower inflation era?” For this purpose, we have employed Slacks Based Measure (SBM) of DEA and Malmquist Productivity Index to compare the two periods (1998-2003 and 2004-2008). In addition, we have evaluated banks’ efficiencies with respect to correlations with bank size, ROA, ROE, age of bank, ownership, loan ratio, capital adequacy ratio, etc. and we have come up with policy recommendations depending on the correlations.

Data Envelopment Analysis (DEA) has been employed as the main methodology. DEA is a quite popular management tool which is used to evaluate the efficiency of a number of producers. A typical statistical approach is characterized as a central tendency approach and it evaluates producers relative to an average producer. In contrast, DEA compares each producer with only the best producers. For each producer, a set of inputs and a set of related outputs are taken. For instance, when the banking sector is in question, each bank has a certain number of tellers, a certain square footage of space, and a certain number of managers which can be characterized as inputs. The number of checks cashed and/or number of loan applications processed can be determined as the outputs. DEA approach aims at determining which of the banks are most efficient, and to point out specific inefficiencies of the other banks. In this research, DEA is used to observe multi-period changes with the Malmquist productivity index, a tool for measuring efficiency changes over time. Accordingly, effects of the inflation on the profitability of the banking system are identified.

The remaining part of the paper is structured as follows. Previous research in the related topic is represented in Section 2. Section 3 presents the main lines of the methodology. Section 4 gives the results of the application, before concluding the paper in Section 5.

II. RELATED LITERATURE

In literature, many research have compared the dynamics and the characteristics of the banking sector. Burdisso et al. have handled the bank privatization process in Argentina.
This study is to fill this gap. Comparing the inflation period and the disinflation period, as far as we know, literature lacks this type of study that makes the Turkish banks a great source of observation. As economy has a great scenario for this analysis and this comparison of the high inflation period with the disinflation period. We compare each year from two different periods, rather than comparing only the subsequent years. As mentioned above, with the disinflation period, Turkish banks’ working style has practically changed. They have sold much more loans instead of buying government bonds. With the low inflation, people have demanded much more rather than comparing only the subsequent years. As

Second, our main purpose is to accomplish a direct from these ones. First, our work considers more recent data. There are several reasons that differentiate our work on the usage of slacks (s+ , s- ). The systems with more from the conventional DEA methods to Slack Based Measurement (SBM) is done [18]. To extend the investigation on influence from slacks to Malmquist productivity index (MPI), Chen [19] has proposed a non-radial MPI, which is able to eliminate possible inefficiency represented by the non-zero slacks to measure the productivity change to three Chinese major industries.

In calculating MPI, the DEA is used as a measure of “relative efficiencies”. Therefore, when a DMU in time \( t \) is plugged into the data set of time \( t+1 \), it is not possible to observe the real changes accurately since there is a frontier shift. In order to get over this shortcoming, MPI is decomposed into two parts: technical efficiency change and the frontier shift of the whole data set. The below model measures the performance of DMU, at time \( t \) with respect to

\[
\text{MPI}_t = \frac{\text{DMU}_{t+1}}{\text{DMU}_{t}}
\]

1. All input-output data should be available and positive for all DMUs.
2. The inputs, outputs and DMUs chosen should be in the area of interest of the interpreter.
3. Different inputs and outputs do not necessarily have to be in the same unit of measurement.

This methodology has been a milestone for performance measurement and DEA has become a commonly used method for using in private and public sector. The first version of the DEA method has been named as DEA-CCR on behalf on its introducers, Charnes, Cooper and Rhodes [14]. The most important functionality of the model is its ability to evaluate several inputs and outputs at the same time and give efficiency scores to each DMU. Later, Banker et al. have come with the idea of a DEA model with “variable returns to scale” [15]. This has been another milestone and this methodology has been named based on its founders: Banker, Charnes and Cooper (DEA-BCC). The next form of DEA has been the Russell Measure that has been developed by Fare and Lovell [16] and later revised by Pastor et al. [17]. The next step has been the “additive model” or “Pareto – Koopmans (PK) model” that has been a non-radial model. The contribution of the model has been the usage of slacks (s+ , s- ), in other words input excesses and output shortfalls, in the objective function. Doing so, the model has depended on the amount of essential decreasing in the inputs or the amount of essential increasing in the outputs.

Since the objective function of the PK model was only dealing with the opportunities of improvements of inputs and outputs, it was not giving efficiency scores for DMUs. In order to overcome this deficiency, the smooth transition from the conventional DEA methods to Slack Based Measure (SBM) is done [18]. To extend the investigation on influence from slacks to Malmquist productivity index (MPI), Chen [19] has proposed a non-radial MPI, which is able to eliminate possible inefficiency represented by the non-zero slacks to measure the productivity change to three Chinese major industries.

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the efficiency frontier at time $t+1$:

$$D^*_{x,y}(x_t,y_t) = \min_{\rho \in \mathbb{R}} \rho \left(1 - \frac{1}{m} \sum_{i=1}^{m} s_i^+ + s_i^-\right)$$

subject to

$$x_t^i = X^i + \lambda s_i^+ + s_i^-$$
$$y_t^i = Y^i - \lambda s_i^+ - s_i^-$$

with $x$ represents inputs and $y$ represents outputs. Based on this model, MPI, frontier shift and technological efficiency change values can be calculated. If these values exceed 1, it represents an improvement and the opposite means a decrease in the efficiency. If the value is equal to 1, it means no change has occurred.

IV. APPLICATION ON TURKISH BANKING INDUSTRY

There are 3 state banks, 11 Turkish based private banks, a monetary fund bank, 18 foreign banks and 13 development and investment banks in Turkey at the end of 2008. 22 of these banks which have suitable number of branches and employees were chosen. These banks are categorized into two groups as primary banks and secondary banks on the issue of customer loyalty. In other words, there are three state banks and four private banks (Iş Bankası, Akbank, Garanti and Yapı Kredi) and in Turkey in the banking sector nearly all customers have at least one account in these banks and they execute basic banking transactions through these banks (credit cards, salary payments, rental payments, money transfers, etc.). Therefore, these 7 banks can be defined as ‘primary’ banks. The rest of the banks are relatively smaller banks that can be defined as secondary banks and they should be more competitive to acquire higher shares from the market.

<table>
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<tr>
<th>Approach</th>
<th>Inputs</th>
<th>Outputs</th>
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<tbody>
<tr>
<td>Production Approach 1</td>
<td>Number of employees, Number of branches, Paid in capital</td>
<td>Deposits, Loans</td>
</tr>
<tr>
<td>Production Approach 2</td>
<td>Employee expenses, Interest costs, Paid in capital</td>
<td>Deposits, Loans</td>
</tr>
<tr>
<td>Intermediation Approach 1</td>
<td>Deposits, Interest costs, Employee expenses, Physical assets</td>
<td>Loans, Bonds, Interest revenue</td>
</tr>
<tr>
<td>Intermediation Approach 2</td>
<td>Deposits, Interest costs, Physical assets</td>
<td>Loans, Bonds</td>
</tr>
<tr>
<td>Profit-based Approach 1</td>
<td>Number of employees, Number of branches, Equity capital</td>
<td>Net profit, Total revenue</td>
</tr>
<tr>
<td>Profit-based Approach 2</td>
<td>Number of employees, Non-interest costs</td>
<td>TL deposits, FX deposits, Income, Net profit</td>
</tr>
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When using DEA, the selection of the input output combination is crucial to maintain accurate and meaningful conclusions. We have benefitted from some papers in the literature and have identified 6 different input-output combinations that are commonly used (Table 1). The chosen 22 banks were evaluated with DEA using SBM applied to the profit-based approach 1 in a single period (2008) as the aim was to evaluate the profitability of the banks.

The correlations presented in Table II can be interpreted as follows. First of all, ROA and ROE are the basic banking profitability indicators that are commonly used, which are highly correlated with the SBM scores (0.7046 and 0.7606). These results enable us to make the assumption that high SBM scores are indicators of high profitability for the banks chosen. The correlation value of age (0.5546) shows that long-established banks have a greater advantage in terms of profitability. Similarly, the correlation of market shares is also quite high (0.68). Turkish based and state based banks have higher profitability scores according to the positive correlation values (0.4741 and 0.3127). Average employee cost has a negative correlation (-0.297) with SBM scores. Obviously, recruiting employees with higher salaries is not a beneficial strategy for banks. Marketing and selling consumer loans are of benefit for the banks according to the correlation value of consumer loans per total loans (0.2937). Therefore, if a commercial bank sets a certain marketing budget for advertisements, especially consumer loans should be emphasized for higher profitability. The conversion rate of deposits to the loans (total loans per total deposits) is negatively correlated with the SBM efficiency scores (-0.3002). Thus, collecting high amounts of deposits is also crucial for the commercial banks in Turkey. The negative correlation (-0.4178) of interest revenue per total revenue shows that selling loans is not the only way to obtain profitability. In addition to the interest revenue, banks should obtain revenue from other customer services such as transaction fees, foreign exchange trading, stock exchange commission, etc. The correlation value of loans under follow-up per total loans (0.2369) can be interpreted in terms of risk management. The commercial bank acts usually in a conservative manner due to the high level of fear for the bad loans. However, the efficiency scores and correlation values show that taking more risk could result in higher profitability. In parallel with the loans under follow-up, the correlation of capital adequacy rate (-0.4906) also supports that higher risk means higher profitability.

<table>
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<th>Banking Data</th>
<th>Correlations</th>
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<tr>
<td>ROA</td>
<td>0.7046</td>
</tr>
<tr>
<td>ROE</td>
<td>0.7606</td>
</tr>
<tr>
<td>Age</td>
<td>0.5546</td>
</tr>
<tr>
<td>Turkish based</td>
<td>0.4741</td>
</tr>
<tr>
<td>State based</td>
<td>0.3127</td>
</tr>
<tr>
<td>Average employee cost</td>
<td>-0.2970</td>
</tr>
<tr>
<td>Market share</td>
<td>0.6800</td>
</tr>
<tr>
<td>Total loans / Total assets</td>
<td>-0.0137</td>
</tr>
<tr>
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</table>

Turkish banking sector has been evaluated for a single period (2008) so far. In this stage, we have analyzed the fluctuations caused due to inflation observed in the
The SBM efficiency scores obtained are presented in Table III. Among the 22 commercial banks in Turkey, Akbank is the most efficient one over the ten-year period by achieving the top score for every year. Garanti also seems to be the bank that is well adopted to the new working environment. Halkbank is rated as efficient nine times and takes the place of being the third most profitable bank. Akbank is the most efficient one over the ten-year period by achieving the top score for every year. Garanti also seems to be the bank that is well adopted to the new working environment. Halkbank is rated as efficient nine times and takes the place of being the third most profitable bank. Akbank is the most efficient one over the ten-year period by achieving the top score for every year. Garanti also seems to be the bank that is well adopted to the new working environment. Halkbank is rated as efficient nine times and takes the place of being the third most profitable bank. 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Moreover, the profitability scores were assessed depending on some correlations. According these correlations, older banks are more profitable since they have already formed their customer base and technological infrastructure. The banks that take more risks, while incurring loans, also have higher profitability. Therefore, the commercial banks should keep their capital adequacy ratio close to the lower limit that is 8% and sell loans as much as they can. Surprisingly, the state banks are more profitable than the private banks since they can easily collect deposit from state institutions and from public with the help of high trust of people. Also Turkish banks are more profitable than the foreign capitalized banks. One of the most significant factors for high profitability is being a primary bank. The four big primary banks are much more profitable than the small sized banks. Finally, average employee expense has a negative correlation with the profitability scores, meaning that the commercial banks should recruit employees with lower salaries.

V. CONCLUSION

Turkish banking system can be evaluated from many different aspects since the Turkish economy and the banking system is highly fluctuating. With the crisis and bankrupts, many changes have occurred in the banking system over time. For instance, within the disinflation period the basic working styles and strategies have changed. The commercial banks have focused on marketing more loan products to individual and SME customers instead of purchasing government bonds. They have opened more branches and recruited marketing staff for the branches. In this new environment, the operational and employee expenses have increased sharply but loan volumes have also increased. New loan products have been launched. In this paper, we have investigated the question of: “Were the Turkish banks more profitable between 1998 and 2003 or between 2004 and 2008?” Two periods that have completely opposite characteristics were compared by using Slacks Based Measure version of Data Envelopment Analysis. According to the results, the disinflation period (2004-2008) has created a more profitable environment for the banks than the inflation period (1998-2003). Hence, it has been found out that high inflation could cause problems, and create high risks for the whole economy and it also prevents profit opportunities for the commercial banks. In the high inflation period, the commercial banks located in Turkey benefitted from the state’s budget deficits. By financing the state, they could capture high profit margins. However, due to lower loan volumes, they could not maintain as high profitability as they did in the disinflation period.

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