Determining the Factors of Bank Performance with a Focus on Risk and Technical Efficiency

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Abstract: Unlike in the non-financial sector, the measurement of bank performance has to incorporate the multi task nature of banking and reflect the requirements of various stakeholders besides shareholders such as the regulators and the depositors who are equally important. To incorporate these features we measure a bank’s technical efficiency, and various types of risk exposure and examine the impact of these measures on market to book values. We use panel regression to analyze the relationship of bank criteria with market to book values and our results show technical efficiency is priced in the market as well as the risk measures such as short-term repricing gap, adjusted return on solvency as well as the adjusted income cost ratio. We also find the takeovers to have a positive impact on market to book value.

Key-words: X-efficiency, Data Envelopment Analysis, Turkish Banking Sector, Short-term repricing gap, Return on solvency, risk

1 Introduction

Measuring the performance of a bank is a multidimensional task. On one side is the goal of maximizing shareholder return, on the other hand, the responsibility to satisfy other stakeholders that are equally influential like depositors who entrust their money and the regulators who oversee the safety of deposits, the stability of the financial system as well as the impact of banking operations on the whole economy. Therefore, besides profitability, financial strength of the banks which can be observed by analyzing exposures of the banks to various risks as well as technical efficiency in generating a business volume should be incorporated in measuring performance.

Banking operations, specifically intermediation activities, result in various types of mismatches, leading to risks that range from market risk to liquidity risk. Without doubt, the various risks that a bank carries is a part of the bank management strategy and has a direct effect on profitability and share value.

Shareholder value in the banking industry is a topic that has not attained the attention it deserves. Although extensive analyses have been made both covering US banks as well as European banks in measuring the performance efficiencies of banks, a few studies have discussed the unquestionable effect of bank efficiency on shareholder value. A few studies, examining this relation, define shareholder value as a new performance measurement. Hughes et al. (2004) analyze the relationship between efficiency and stock values by calculating the shortfall of a market’s value from its highest potential market value. Fiordelisi (2007) brings the shareholder value efficiency concept which he defines as a bank producing maximum possible shareholder value given particular outputs. The marketability efficiency, developed by Seiford and Zhu (1999), uses the output of profitability efficiency evaluated via a non-parametric model as an input to calculate marketability efficiency. Luo (2003) compares the profitability and marketability efficiencies obtained by adopting the Seiford and Zhu model, and shows that profitability efficiency is better in predicting likelihood of bank failures.

This study incorporates the much discussed technical efficiency, various risk measurements as well as income cost ratio and market share while incorporating
Banking sector in the 2000’s. The third section describes methodology, and the fourth section discusses empirical findings followed by conclusion.

2 Overview of X-Efficiency Literature

The literature on bank performance has focused mostly on the measurement of X-efficiencies in the last two decades. The level of efficiency is defined as the ratio of the observed output to an ideal or, in other words, a virtual potential output that can be obtained with the same amount of input. The units with observed output equal to the ideal output are said to be perfectly efficient and shapes the efficient frontier.

X-efficiency measurements are evaluated to address various banking topics observed in EU, USA and developing economies. Bos and Schmiedel (2007) in their cross border comparison examine bank efficiency among European Banks and estimate a meta-frontier that would incorporate the elements of country specific frontiers. In the cross country level, Barros et al (2006) analyze the EU banks to identify factors that explain the probability of a bank being a best or worst performer. Valverde et al. (2007) also analyze large banks within the EU and check cross country differences in banking efficiency. Bos and Schmiedel (2006) examine whether in Europe there exists a common cost or profit frontier. Molyneux et al. (1996) make an analysis and review of efficiency in Europe. Halkos et al. (2004) in their analysis of Greek Banks’ performance use financial ratios as output where they use data envelopment analysis to complement financial ratio analysis. Havrylchyk (2005) investigate the efficiency of Polish banking industry and the role of foreign banks and how different bank characteristics influence efficiency ratios. In their analysis of the Czech-banking system, Matousek and Taci (2005) conclude that the increase in efficiency over time indicate that banks become more alike over time indicating an increase in efficiency over time. Isik and Hassan (2002) examine the impact of bank characteristics on the performance of Turkish banks by measuring their cost and profit efficiency and find that Turkish banks are highly profit efficient but the same conclusion cannot be drawn for cost efficiency probably due to the less competitive environment during the period analyzed. Isik and Hassan (2003) measure the productivity growth, efficiency change and technical progress in Turkish commercial banks during the deregulation of financial markets between 1980 and 1990 and find that Turkish banks have substantially improved their performance after deregulation. Zaim (1995) compare allocative efficiencies of Turkish Banks between 1981 and 1990
and find evidence that banks’ efficiency levels improved with the deregulation of the financial system. Denizer et al. (2000) in their study of the Turkish Banking system efficiency uses a two stage process where they use both the production and intermediation approaches find that efficiency after liberalization has a downward trend and also the efficiency of state and private banks converge after 1980. Mercan et al. (2003) measure the performance of Turkish Banking System by using the CAMEL framework and form a performance index to observe the effects of size differences and of ownership on Banking Performance by using selected financial ratios as input-output vector. Damar (2006) measures the effects of sharing ATM networks on the efficiency of Turkish Banks and concludes that there are no positive effects on efficiencies of small to medium sized banks unlike the big banks.

There are two alternative major methods to calculate X-efficiency, namely non-parametric and stochastic methods. Stochastic methods incorporate econometric techniques utilizing random error measurements or dummy variables to obtain inefficiencies. An econometric function, either cost or profit function, is defined, in which output is a function of inputs, inefficiency and random error and estimated to obtain inefficiencies. On the other hand, non-parametric model involves implementing linear programming techniques of data envelopment analysis (DEA), which picks the most efficient units and constructs an efficient frontier. Efficient banks can be defined as the units whose inputs or outputs can’t be improved without worsening some of its other inputs or outputs [7]. Both parametric and non-parametric methods have some advantages and disadvantages. Stochastic methods need to make some assumptions, such as the functional form of the econometric function and the distribution of the efficiency term. Another problem is that only one output can be defined to be assessed. The major advantage of stochastic methods is that it implements an error term to incorporate the noise in measurement. This issue is, on the other hand, the major disadvantage of the DEA. Therefore, the evaluated inefficiency, or in other words, the deviations from the efficient frontier, may indeed result from measurement errors or other noise factors. To summarize, it is impossible to say that one is better than the other. We follow the studies which use DEA analysis in measuring bank performance since it performs well with small data sets (Evanno and Israilevich 1991). (Berger et al., (1997), Isik and Hassan (2003), Oral and Yolalan (1990), Mercan et al (2003), Halkos et al (2004), Zaim (1995) and Havrylck (2005) use DEA in their studies among others.

There have been developed many extensions to the basic DEA model, since it is pioneered by Farrell (1957). Some of these extensions include inclusion of nondiscretionary inputs and outputs, categorical inputs and outputs, incorporation of judgment and a priori analysis, and window analysis [7]. Window analysis, developed by Charnes et. al. (1985), allows implementation of DEA when a panel data, which is comprised of observations for various decision making units (DMUs) over a given period of time, is used. The performance of each DMU over time is considered as if it is a different DMU. To put it another way, if there are observations for n different DMUs over k periods time, it is treated as if there are n x k different DMUs. In this method, the data set, with “n x k” observations, are divided into overlapping subsets. These clusters, called as windows, are obtained by shifting the subset over time. In other words, a window constitutes w periods, and a new window is obtained by adding a new period into the window, while moving out the earliest period. For a given set of “n x k” observations, there will be “k-w+1” separate windows with a size of “n x w”. These windows are analyzed separately. Then a moving average for each observation of DMUs is calculated by taking average of its scores from each window that attends. There would be w efficiency scores for each observation and the average of these scores is used as the efficiency measurements for the corresponding observation.

3 Turkish Banking in the ‘00s

The Turkish financial markets have undergone major changes since 2001 and the banking industry has become more integrated with the international banking environment and thus has shown significant improvement in terms of control and performance.

According to Berger (2003), the number of banks declined over the 17 year period at average annual rates of 3.3 % even though the gross total assets grew by 3 % per year. And while the number of largest size class of 10 billion $ and over has been increasing that of the smallest size fell by more than half. The same trend has been observed in the Turkish banking industry in the past several years. Bank consolidation during this period has accelerated and the number of banks in the system has decreased from 81 in 1999 to 46 in 2007.

After the financial crisis that took place at the beginning of 2001, the banking law has been changed where the regulations for the capital adequacy, the internal controls have improved with higher audit
standards and the regulatory supervision has become much stricter with the Banking Regulatory and Supervisory Agency and the Supervisory Depository Insurance Fund actively monitoring the institutions. After 2001 crisis, the rapid improvement of the general outlook of the economy coupled with favorable global environment and highly liquid financial markets, has positively impacted funding costs especially in the syndicated loans market. With the effect of improving market conditions and regulatory environment, banks started to introduce new products like mortgages and consumer loans. Whereas an increase in local currency loans have been observed, the foreign currency denominated deposits and loans have kept their significant levels.

Meanwhile the flow of direct foreign capital has increased substantially with the improving economic outlook. The major beneficiary from the flow of direct foreign capital to the country has been banks; where the foreign ownership of banks has increased from 3 % in 1999 to 42 % in 2007. The entry of foreign direct capital has increased credibility and competition; thus the profitability and the efficiency of the sector improved.

4 Methodology

As of 2007 there are 3 state and 29 privately owned banks in Turkey. Of the privately owned banks 16 are commercial banks with branch networks. We have included 9 of these banks that are currently trading at the Istanbul Stock Exchange for which we collect the financial data excluding the three state banks and the non-deposit banks. Two banks merged during the analysis period and therefore were excluded. Quarterly data is used covering the period January 2003- June 2007. Both foreign and Turkish banks are included in the analysis. It should be noted that some of the Turkish banks have been taken over by foreign banks during the period analyzed. We obtained the financial statements data from the Turkish Banking Association official website, the stock market data from the Istanbul Stock Exchange, and the Treasury bill rates from the official website of the Turkish Central Bank.

In the first part of the analysis, a window DEA is implemented to measure the technical efficiencies (TE) of the banks in the data set, to be used as an explanatory variable in the regression analysis. The mean and standard deviation of the outcome are given in Table 1, with the other independent variables. Figure 1 demonstrates the development of the technical efficiency scores of banks through time. As, it is seen, there is an overall improvement in efficiencies, which may be a sign of convergence of banks since 2001.

Next, a panel data analysis is performed, to figure out the effect of technical efficiency obtained from the DEA analysis, along with risk parameters.

To maintain long-term competitive presence, commercial banks seek solid and stable revenue streams. For this purpose they focus on their mainstream activities that are to generate income on client balances and transactions rather than making trading profits. With this in mind, in measuring the technical efficiency of banks we selected our input and output measures from among factors pertaining to client business.

We have gone beyond the usual set of variables in our input and output measures where we believed the variable we used was more informative. As such the inputs in our optimization model are 1) free capital 2) personnel expenses and 3) interest rate spread. Free capital is calculated by deducting from own means non-interest earning assets like fixed assets, participations, non-performing loans as well as non-cash revenue items. We used free capital as an input measure because it is a scarce resource utilized by banks as a buffer/ liquidity as well as a regulatory requirement against credit lines they grant to their clients.

Personnel expenses may be the most crucial resource for banks to serve their clients in a competitive way. Equally important are technology and systems related expenses. However these figures are not traceable in bank financial reports whereas personnel expenses are distinctly available items as such can be reliable data in comparing banks’ technical efficiency. The interest rate spread is the difference between the interest received from the debtors and the interest expense paid to the depositors. This measure has been used as an output in measuring efficiency by Halkos et al.(2004). However, we consider this item as a cost to the bank because as this spread is increasing the cost of creating loans and deposits is decreasing for the bank and thus should be treated as an input.

We choose the outputs that ensure sustainability in the long-term. The outputs are; 1) deposits 2) loans 3) fee income. Deposits have been used in various studies as both input and output. Sealey and Lindley (1977) refer to studies that have been used at both ends even though they advocate the use of deposits as inputs. However following Berger and Humphrey (1993) in this study deposits are considered as output. Client
base in itself is seen as a significant value of a bank with the potential to sell and cross sell its products and services and deposits proxy for the size of the client base. The final output, fee income excludes interest income and trading profits and comprises fees and charges collected from clients against financial services rendered. As such is considered to be a major indicator of a commercial bank’s performance representing a solid and stable revenue stream and client base. Such level of commissions and charges collected is considered as an indicator for the level of service quality and technology as well as breadth and depth of client relationships and loyalty.

The results of the DEA optimization give us the relative performance of each bank in terms of their technical efficiencies. A bank will be more efficient and ensure long-term sustainability of its operations if it has a higher share of deposits and loans in the market and generate high fee income.

In the second part of the analysis we use a panel regression where we use the efficiency measures of banks in combination with return on solvency (ROS), adjusted income cost ratio (ICR), short-term repricing gap (STRG), capital adequacy (CAR) and market share (MS) to determine their impact on market to book value.

In measuring profitability, return on equity is an extensively used and comprehensive ratio that indicates profit performance. Not only does it show shareholder return on capital, it also gives an idea of the leverage of the firm. However, ROE has drawbacks. The risk profile in generating profits is of great concern in evaluating profitability. The quality and sustainability of the profits depends on the risk profile of the bank. Therefore a need to measure the profit performance of a bank incorporating the risk factor as well as the cost of capital has resulted in the industry analysts using ratios such as RAROC, EVA, ROS, etc. In our case, we use the Return on Solvency ratio (ROS) adjusted for the cost of free capital. ROS is the revenues net of the cost of free capital divided by the adjusted risk weighted assets of the firm - adjusted for Government Bonds such that these bond are 100% risk weighted in our calculations. The reason for using free capital is that some of the banks are heavily invested in non-interest earning assets and they would have a disadvantage against the banks who earn interest on their capital when the cost of capital is being measured and deducted from revenues. Ozdinciler and Ozylidirim (2006). In measuring the cost of capital short-term treasury bond rates are used.

Besides incorporating the risk into the analysis by using the ROS ratio, we examine the impact of two additional risk measures. Primarily, we evaluate the long-term risk bearing capacity of the firm by measuring the CAR. CAR gives the level of capital maintained by banks against their risk weighted assets. Capital serves as a buffer to absorb unexpected losses as such a higher CAR represents financial strength to weather downturns in the market although there is always a trade off between risk aversion and profit maximization. Therefore banks target to optimize capital levels in a balancing act between most efficient use of capital and keeping their credibility high or at least satisfying the regulatory capital requirements.

We also incorporate short-term liquidity risk. Many banks in recent history have defaulted not because of lack of profits but because of short term liquidity problems. Banks run a liquidity risk if they have a STRG between their assets and liabilities and this can cause problems for a bank especially in sharp economic downturns. They may fail to meet their obligations if they cannot roll due to lack of liquid assets and new funding sources as well. The bank may end up in great amount of losses if the interest rates move the wrong way for STRG. Therefore we measure the gap between the assets and liabilities for the 3 months period that is considered to be more critical. We expect that prudent banks should not run such a risk however we should also note that banks can realize significant amount of profits by running a mismatch between their short term assets and liabilities because the profits from borrowing short and investing in the long-term are a considerable source of income.

We also include in the analysis the adjusted income cost ratio ICR. Analysts and regulators view income cost ratio as the key measure of bank efficiency (Berger, 2003; Vennet, 2002). In this study, we use the revenues adjusted for the cost of free capital divided by total operating expenses. We expect that those banks who work more efficiently in terms of total operating costs thus having a higher revenue per unit of cost should have a higher market value.

Lastly the market share (MS) is used as an input to measure banks’ performance. Many studies have shown that scale is an important factor in an industry such as banking where overheads can be prohibitively high in the face of regulations and intense competition. The market share is measured by the ratio of bank deposits to total deposits in the sample. Banks that have an established share will be less vulnerable to
market fluctuations and are expected to dominate the market in the future.

<table>
<thead>
<tr>
<th>Table 1: Summary Statistics of the Data Set</th>
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<tr>
<td>DEA Input Parameters</td>
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<td>Free Cap.</td>
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<td>Int. Spread</td>
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<tr>
<td>Per. Exp.</td>
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<tr>
<td>DEA Output Parameters</td>
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<td>Fee Inc.</td>
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<td>Credits</td>
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<td>Deposits</td>
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<td>Regression Dep. Var.</td>
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<tr>
<td>Mv/Bv</td>
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<td>STRG</td>
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<tr>
<td>ROS</td>
</tr>
<tr>
<td>MS</td>
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<tr>
<td>ICR</td>
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<tr>
<td>CAR</td>
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<tr>
<td>Tech. Eff</td>
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</table>

Figure 1: TE of the banks in the Data Set

5 Empirical Findings
The summary statistics of the dependent and independent variables are given in Table 1. Three different methods, namely, Fixed Effects, Random Effects and Ordinary Least Squares (OLS) regressions, are performed and the outcomes are reported in Table 2. A Hausman test is implemented to select the appropriate model. The null hypothesis that there is no correlation between the explanatory variables and unobserved firm-specific effects term can’t be
rejected. Then the Random Effects is consistent and the more efficient alternative compared to Fixed Effects. A more detailed explanation of panel data analysis can be found in Wooldridge (2001) and Baltagi (2005).

ROS is positively and significantly affecting market values. This ratio shows the pricing of risk adjusted for the cost of capital therefore confirms that the market values an increase in net banking revenues controlled for risk.

STRG is significant and positive. Banks can face serious problems in the short term in case of running a maturity mismatch between their short-term assets and liabilities. Even if they can meet their obligations their interest rate losses may wipe their profits. Therefore a STRG should be discounted by the market. This problem is partly responsible for the liquidity crisis in 2001. However, our analysis shows that the market value increases with increased STRG. This can only be explained by the previously mentioned high profit potential from running such a short position.

ICR is significant but negative. This is unexpected in that we expect that a higher ICR should imply a higher market value as a result of increased efficiency in operations. In order to explain this unexpected result maybe we should look more closely into the components of the total operating expenses item and what exactly it constitutes of. The market might view the increase in total expenses as an investment for the future if for instance the percentage of total expenses on technology in total operating expenses is high. Also an important phenomenon of the period analyzed is that it has been quite a busy period in terms of takeovers in the Turkish Banking industry. The banks that have been taken over by foreign banks have gained huge premiums in market value. These banks as well as their competitors have been incurring high expenses for sales & marketing and for establishing their names in the market and increase market share which might be a part of the reason of this controversial result.

MS and CAR are not significant. Market share not being significant can possibly be attributed to the takeovers in the market which have had a positive impact on market values which are not necessarily large banks and the premiums attached to these banks distorting figures in favor of these banks. CAR is not significant but ROS incorporates the risk of the assets that have been invested in already therefore we cannot conclude that the market does not price risk.

Finally, the recent takeovers in banking which have been quite significantly affecting not only the banking shares but the overall market may have had a greater impact on the market values of the banks than performances of these banks have dictated. Therefore in our study we also incorporated the effect of takeovers and found a significant positive relation between market to book values and takeovers.

Table 2: log(Mv/Bv) Regression Results

<table>
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<tr>
<th></th>
<th>FE</th>
<th>RE</th>
<th>OLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE</td>
<td>0.8384</td>
<td>0.7500</td>
<td>1.42815</td>
</tr>
<tr>
<td></td>
<td>(-2.64)***</td>
<td>(-2.43)***</td>
<td>(-3.12)***</td>
</tr>
<tr>
<td>CAR</td>
<td>0.0085</td>
<td>0.0123</td>
<td>0.007859</td>
</tr>
<tr>
<td></td>
<td>(0.76)*</td>
<td>(1.15)</td>
<td>(0.56)</td>
</tr>
<tr>
<td>MS</td>
<td>-9.2665</td>
<td>-3.7345</td>
<td>-0.0269</td>
</tr>
<tr>
<td></td>
<td>(-1.75)</td>
<td>(-0.97)</td>
<td>(-0.01)</td>
</tr>
<tr>
<td>ROS</td>
<td>1.1538</td>
<td>1.1083</td>
<td>0.835577</td>
</tr>
<tr>
<td></td>
<td>(6.22)***</td>
<td>(6.06)***</td>
<td>(2.67)***</td>
</tr>
<tr>
<td>ICR</td>
<td>0.3589</td>
<td>0.3533</td>
<td>0.2186</td>
</tr>
<tr>
<td></td>
<td>(-3.64)***</td>
<td>(-3.6)***</td>
<td>(-1.32)</td>
</tr>
<tr>
<td>STRG</td>
<td>-6.29E-08</td>
<td>-5.15E-08</td>
<td>-4.7E-08</td>
</tr>
<tr>
<td></td>
<td>(-2.72)***</td>
<td>(-2.36)**</td>
<td>(-1.38)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.2158</td>
<td>-0.5862</td>
<td>-1.454</td>
</tr>
<tr>
<td></td>
<td>(-0.5)</td>
<td>(-1.2)</td>
<td>(-3.58)***</td>
</tr>
<tr>
<td>R²</td>
<td>0.77</td>
<td>0.77</td>
<td>0.24</td>
</tr>
</tbody>
</table>

The values in parenthesis are t-stats. *, **, *** stands for 1%, 5% and 10% significance level correspondingly.

6 Conclusion

Financial institutions like other institutions want to maximize profits. However, in achieving this goal they have to control other factors as well. They have to keep an eye on their risk exposure while increasing their revenues, be prepared for possible short-term liquidity problems and establish themselves in the market such that they will be around in the long-term.

This paper aims to examine the influence of technical efficiency along with various risk and cost measures of banks on their market to book values. The study primarily uses measurement criteria which have not previously been used in measuring bank performance such as adjusted return on solvency and short-term

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repricing gap. Secondly, a better coverage of risk has been attained by incorporating short term liquidity risk, capital adequacy and return on solvency. Thirdly, we incorporate the cost of capital in measuring revenue related ratios to eliminate the revenues obtained from investing the capital where market rates are quite high and thus to compare banks on an identical setting.

The results show that the market rewards banks that are more X-efficient. This finding indicates that X-efficient banks will be around in the long-term and this is priced in by the markets. The other most important result is that banks that have a better pricing of risk have higher market to book values. On the other hand, a high income cost ratio has a negative impact on market value. The Turkish market is undergoing a major transformation since the 2001 crisis. As the integration with the world economy deepens through the entry of more foreign capital, the race for the survival of the fittest continues. In this respect we suspect total expenses are treated as an investment because these expenses incorporate heavily either technology and/or marketing expenses in an attempt to establish market share.

The short-term liquidity risk positively effects market to book value. Considering the fact that the underlying market has suffered severe losses and a number of bank failures occurred due to such maturity mismatch it is not clear whether the markets have a short memory or banks are better hedging their risks by means of better risk management techniques. This remains a question to be answered.

References


