

DETERMINING EFFICIENCY OF INVESTMENT BANKS AFTER FINANCIAL CRISIS BY BOOTSTRAP DATA ENVELOPMENT ANALYSIS (BDEA) : A CASE OF TURKEY

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—Abstract —

Data Envelopment Analysis (DEA) is a mathematical programming formulation based technique that provides an efficient frontier to suggest an estimate of the relative efficiency of each decision making unit (DMU) in a problem set. DEA is developed around the concept of evaluating the efficiency of a decision alternative based on its performance of creating outputs in means of input consumption. Besides its advantages, criticisms about the potential bias of efficiency estimates of DEA has been arised. One criticism about DEA is on the sampling variation of the estimated frontier which may affect the accuracy of results. The bootstrap method is a statistical resampling method used to perform inference complex problems. The basic idea of the bootstrap method is to approximate the sampling distributions of the estimator by using the empirical distribution of resampled estimates obtained from a Monte Carlo resampling. DEA estimators introduced an approach based on “bootstrap techniques” to correct and estimate the bias of the DEA efficiency indicators. The purpose of this study is to measure the efficiency of small amount of investment banks in Turkey after the financial crisis in 2010 with the Bootstrap DEA (BDEA).

Key Words: *Bootstrap DEA, Investment Banks, Efficiency Analysis*

JEL Classification: C10, C14, C24

1. INTRODUCTION

Investments banks are usually specialized in creating and selling securities in primary markets. Their traditional services can be classified as acquisition and merger consultancy, underwriting, and sale of securities. Various new financial services and products have become a part of investment banking due to financial

globalisation, market development, regulatory and supervisory rules and technological changes (Gardener and Molyneux, 1995).

Traditionally defined as intermediation for public offerings along with acquisition and merger consultancy for individuals and companies, investment banking is a dynamic sector which is in constant change thanks to the new fields the financial sector penetrated into every day. Investment banking also facilitates asset redistribution in financial markets by changing the financial instruments for savings, and the combination of risk, return and liquidity levels of assets (Hughes and Mester, 2008). Financial globalisation, market development, regulatory and supervisory rules and technological changes brought about a variety of financial services and introduced new products and services into investment banking. With globalisation “global investment banking” became a current issue and new services based on ideas and needs emerged at national as well as cross-border levels (Radić et al., 2011).

A close look at the investment banking activities in Turkey tells us that there is no real investment banking sector in our country because the number of public offerings, mergers and acquisitions is very low. Another look at institutions that perform these activities reveals that such institutions - initially founded as investment banks - steer away from capital market activities towards company loans, and their source of income is interest yield.

In this study, the efficiency of public, private and foreign banks in Turkey for 2010 were identified using failure modes and efficiency analysis BDEA method with the R software environment and their levels of efficiency following the financial crisis were compared.

2. INVESTMENT BANKING IN TURKEY

In countries where capital markets are developed, investment banks act as an intermediary, and advise corporate investors with funds to buy and sell securities. Also, they supply enterprises with medium- and long-term funds rather than direct loans. In other words, by issuing bills and stocks these banks act as intermediaries between companies and state institutions willing to have long-terms resources and persons and institutions willing to invest in securities. The development and effectiveness of capital markets is imperative for the effective function of investment banks (Frazer, 2008).

In a general sense the extent of investment banking is broader. Organisations which operate in capital formation services including transferring of existing wealth, circulating stocks and bills and managing securities can be considered investment banks in a broader meaning. Further, the basic criterion for investment banking is acting as an intermediary in public purchasing of securities and bills issued by industrial and commercial institutions. In a sense, these banks are intermediary firms in indirect exportation of securities and bills. They can also act as intermediary organisations in importing private bills and securities and as commissioners and traders in secondary markets. The main services of investment banking are;

- Company valuation
- Public listing and security offering
- Block sales (Private placement)
- Company transfers (Mergers And Acquisitions)
- Privatisation consultancy
- Joint-Venture consultancy
- Public offering for bonds, bills and securities
- Restructuring of companies
- New financing tools and techniques (Şen, 2004).

Investment banking is a topic of interest for financial regulatory bodies and industrial businesses. Two countries where investment banking is highly developed are the USA and the UK. There are three phases in the development of investment banking. The first phase is the intermediary services in public offerings, also known as classical investment banking. Such services include collecting funds in capital markets for companies and state institutions, which is called "*underwriting*" in international literature. The second phase is intermediary services in buying and selling of capital market tools and trading those tools by utilizing their own funds. This service also covers managing of funds. Intermediary services in public offerings are still the main activity of investment banking. It is also the most profitable service. The third phase includes takeovers, acquisitions and mergers which have become the distinctive elements of investment banking activities since industrial restructuring started to gain importance (Türeoğlu, 1991).

Although investment banking has not been very popular in the Turkish banking system, it has still come a long way. By mid-2010, total assets increased in all deposit banks. In development and investment banks total assets increased by 22 percent. The increase in exchange rates from June 2009 to June 2010 caused assets to retract in dollars (\$) in all banks (excluding public banks). Table 1 shows the total assets and percentage changes in the sector.

Table 1: Turkish Banking System Total Assets and Percentage Change (June 2010)

	Million TL	Million \$	June 2009-June 2010 Percentage (%) Change	
			TL	\$
Deposit Banks	712.747	467.805	16	-7
Public Banks	231.247	151.777	26	1
Private Banks	377.733	247.921	14	-9
Banks in the Fund	785	515	1	-19
Foreign-capital Banks	102.982	67.592	7	-15
Development and Investment Banks	25.029	16.428	22	-2
Total	737.776	484.233	17	-7

Source: <http://www.tbb.org.tr>

Development and investment banks started to emerge in Turkey in order to assure country's economic development. These banks have been at the forefront of various development phases with certain goals and objectives. When such goals were achieved either wholly or completely, or when urgent needs came up, the agenda changed not only for the society but also for the investment banks. The goals and primary services for development and investment banks during the 1950-1990 period are below:

1950-1958: Orientation of the private sector towards manufacturing industry, and support for all kinds of manufacturing industry projects.

1958-1965: Rehabilitation of previously established facilities

1965-1973: Rapid growth, import substitution and the development of the capital market

1973-1980: Support for regional development, foundation of labour-public-region companies, and small-medium sized labour intensive industries.

1980-1990: Support for exportation projects, completion and rehabilitation of previous investment projects, and tourism projects

1990 onwards: Growth oriented towards global competition and sustainable development as well as previously set goals.

As seen in the abovementioned services, the “investment” part of development and investment banks refers more to investment activities necessary for capital accumulation and economic development than traditional investment banking activities. During the above period, development and investment banks pioneered the support for and financed investment projects. Generating and dispersing information through macroeconomic research and studies, sectoral research, foreign market surveys and documentation services are among development and investment banking activities (Bacak, 2007).

The banks established during the initial years of investment banking in Turkey are: Türkiye Kalkınma Bankası A.Ş. (Development Bank of Turkey established in 1975 as State Industry and Labour Bank), Türkiye Sınai Kalkınma Bankası A.Ş. (Industrial Development Bank of Turkey), Sınai Yatırım ve Kredi Bankası A.Ş. (Industrial Investment and Credit Bank est. in 1963), Türkiye İhracat Kredi Bankası A.Ş. (Export Credit Bank of Turkey), İller Bankası A.Ş. (Provincial Bank established in 1933 as Municipality Bank) and T.C Turizm Bankası A.Ş. (Tourism Bank).

Established at the end of 1980s, mostly foreign-capital banks and their partners are Türk Merchant Bank A.Ş. (Bankers Trust Co.), Yatırım Bank A.Ş. (Trans-Arabian Investment Bank E.C.), Birleşik Yatırım Bankası A.Ş. (Dollarda Exchange Company of Kuwait, Trade Union Insurance Company of Bahrain), Tekfenbank Tekfen Yatırım ve Finansman Bankası A.Ş. (Banco Espanol de Credito T.S.T. International Finance S.A), and Avrupa Türk Yatırım Bankası (Banque Indosuez, Amuro Bank, Generale Banque, Societe Generale de Belgique).

The demand for establishing investment banks increased considerably in the 1990s. This demand stemmed mostly from the exempting regulations in the Banking Law no. 3182. As of 2010, there were 13 development and investment banks in the system.

Table 2: Development and Investment Banks in the Turkish Banking System (June 2010)

Development and Investment Banks	Group Share (%)		Sectoral Share (%)		Total Equity (Million TL)
	Total Assets	Total Credits	Total Assets	Total Credits	
<i>Public Capital</i>	<i>58.4</i>	<i>68.1</i>	<i>2.0</i>	<i>3.1</i>	<i>9.494</i>
İller Bankası	29.5	35.3	1.0	1.6	5.719
Türk Eximbank	24.4	28.5	0.8	1.3	3.284
Türkiye Kalkınma Bankası A.Ş.	4.5	4.3	0.2	0.2	491
<i>Private Capital</i>	<i>34.5</i>	<i>25.6</i>	<i>1.1</i>	<i>1.1</i>	<i>1.528</i>
Türkiye Sınai Kalkınma Bankası A.Ş.	25.2	22.7	0.9	1.0	900
İMKB Takas ve Saklama Bankası A.Ş.	6.6	0.0	0.2	0.0	268
Aktifbank (Çalık) Yatırım Bankası A.Ş.	1.4	1.4	0.0	0.1	165
GSD Yatırım Bankası A.Ş.	0.3	0.4	0.0	0.0	65
Diler Yatırım Bankası A.Ş.	0.4	0.5	0.0	0.0	78
Nurul Yatırım Bankası A.Ş.	0.6	0.6	0.0	0.0	52
<i>Foreign Capital</i>	<i>7.1</i>	<i>6.3</i>	<i>0.2</i>	<i>0.3</i>	<i>543</i>
BankPozitif Kredi ve Kalkınma Bankası A.Ş.	6.2	6.3	0.2	0.3	439
Credit Agricole Yatırım Bankası Türk A.Ş.	0.2	0.0	0.0	0.0	46
Merrill Lynch Yatırım Bank A.Ş.	0.6	0.0	0.0	0.0	40
Taib Yatırım Bank A.Ş.	0.1	0.0	0.0	0.0	18
	100.0	100.0	3.3	4.5	11.565

Source:<http://www.tbb.org.tr>

As shown in Table 2, investment banks in Turkey are divided into three groups, the main group being the public capital banks. Not only in total assets but also in market share and total equities, public capital banks make up the larger part of total share.

3. BOOTSTRAP DEA METHOD

The standard DEA approach has come under criticism owing to the potential bias of efficiency estimates. The accuracy of DEA results may be affected by the sampling variation of the estimated frontier. This means that the distances to the frontier are underestimated in the case where the best performers in the population

are not included in the sample. Another reason of the potential bias of DEA efficiency estimators is related to the non measurement of random error, and therefore to the incorrect definition of overall deviation from the frontier as inefficiency. This research Project addresses these inherent limitations of DEA, by applying a more advanced approach proposed by Simar and Wilson (1998, 2000), which by combining the DEA model with bootstrapping techniques, enables us to provide bias corrected estimates of DEA efficiency scores, as well as confidence intervals. The bootstrap method attempts to simulate a true sampling distribution, by imitating a specific Data Generating Process (DGP), using the DEA results. The DGP based on a set of assumptions (namely a specific statistical model) formulated by Simar and Wilson (2000). The new dataset created in this way, is used in turn for re-estimation of efficiency scores. Repeating this process ensures a reliable approximation of the true distribution of the sampling. The complete bootstrap algorithm applied in this study is extensively described in Simar and Wilson (1998). The same bootstrap algorithm is adopted in order to test the assumptions about the returns to scale of the underlying technology, which have to be made before employing DEA (Halkos and Tzeremes, 2010).

According to Simar and Wilson (1998, 2000, 2008) DEA estimators were shown to be biased by construction. They introduced an approach based on bootstrap techniques (Efron 1979) to correct and estimate the bias of the DEA efficiency indicators. Several authors have point out the essence of bootstrap techniques as an alternative method of conducting inference where the sample size is not large or sampling distributions are analytically intractable, due to nonlinearity or pretesting, etc. (Tu and Zhang 1992; Alonso et al., 2006).

The bootstrap bias estimate for the original DEA estimator $\hat{\theta}_{DEA}(x, y)$ can be calculated as:

$$BIAS_B \left(\hat{\theta}_{DEA}(x, y) \right) = B^{-1} \sum_{b=1}^B \hat{\theta}_{DEA,b}^*(x, y) - \hat{\theta}_{DEA}(x, y) \quad (1)$$

Furthermore, $\hat{\theta}_{DEA,b}^*(x, y)$ are the bootstrap values and B is the number of bootstrap replications (2000 replications in this paper).

Then a biased corrected estimator of $\theta(x,y)$ can be calculated as:

$$\hat{\theta}_{DEA}(x,y) = \hat{\theta}_{DEA}(x,y) - BIAS_B \left(\hat{\theta}_{DEA}(x,y) \right) = 2\hat{\theta}_{DEA}(x,y) - B^{-1} \sum_{b=1}^B \hat{\theta}_{DEA,b}^*(x,y) \quad (2)$$

However, according to Simar and Wilson (2008) this bias correction can create an additional noise and the sample variance of the bootstrap values $\hat{\theta}_{DEA,b}^*(x,y)$ need to be calculated. The calculation of the variance of the bootstrap values is illustrated below:

$$\hat{\sigma}^2 = B^{-1} \sum_{b=1}^B \left[\hat{\theta}_{DEA,b}^*(x,y) - B^{-1} \sum_{b=1}^B \hat{\theta}_{DEA,b}^*(x,y) \right]^2 \quad (3)$$

In addition it is needed to avoid the bias correction illustrated in (3) unless:

$$\frac{BIAS_B \left(\hat{\theta}_{DEA}(x,y) \right)}{\hat{\sigma}} > \frac{1}{\sqrt{3}} \quad (4)$$

Finally a straight forward rule according to Daraio and Simar (2007) when the Bias is larger than the standart deviation (σ), the bias-corrected estimates have to be preferred to the original values.

4. EMPIRICAL ANALYSIS

In this study, the efficiency of 13 investment and development banks were detected for 2010 with a failure modes and efficiency analysis with BDEA method. Because the total number of banks was low and there was a risk of based DEA estimations, BDEA method was opted for unbiased estimations for small sample groups. A literature review shows that in a study by Grifell-Tatje and Lovell (1995), using output-oriented constant returns to scale (CRS) is more appropriate when researching the banking sector. Departing from this, the input and output variables are shown in Table 3.

Table 3: Input and output variables

Input	Output
Equities/total assets	Profit for the period/total assets
Credits obtained/total assets	Total operating income/total assets
Liquid assets/total assets	

BDEA results for R software environment are shown in Table 4. (Number of iteration 1500)

Table 4: BDEA efficiency results

Banks	Efficiency score	Bias corrected	Bias	Standard error	LB	UB
<u>İller Bankası A.Ş.</u>	0.9456	0.9675	0.3421	0.0012	0.8821	0.9745
<u>Türk Eximbank</u>	1	0.8763	0.0675	0.0391	0.9231	0.9954
<u>Türkiye Kalkınma Bankası A.Ş.</u>	0.8567	0.7921	0.1753	0.0024	0.8736	0.8903
<u>Aktif Yatırım Bankası A.Ş.</u>	0.8045	0.7790	0.4211	0.0010	0.7487	0.8320
<u>Diler Yatırım Bankası A.Ş.</u>	1	0.8650	0.0827	0.0428	0.9821	0.9935
<u>GSD Yatırım Bankası A.Ş.</u>	1	0.8430	0.0953	0.0387	0.9736	0.9987
<u>İMKB Takas ve Saklama Bankası A.Ş.</u>	0.7861	0.9122	0.2679	0.0007	0.7563	0.8154
<u>Nurul Yatırım Bankası A.Ş.</u>	0.9456	0.9304	0.4061	0.0376	0.9187	0.9662
<u>Türkiye Sınai Kalkınma Bankası A.Ş.</u>	1	0.8960	0.2840	0.0011	0.9804	0.9906
<u>BankPozitif Kredi ve Kalkınma Bankası A.Ş.</u>	0.92433	0.8760	0.4907	0.0006	0.8923	0.9564
<u>Credit Agricole Yatırım Bankası Türk A.Ş.</u>	1	0.8796	0.2284	0.0015	0.9932	0.9986
<u>Merrill Lynch Yatırım Bank A.Ş.</u>	1	0.8804	0.0948	0.0220	0.9735	0.9927
<u>Taib Yatırım Bank A.Ş.</u>	0.8765	0.7932	0.1266	0.0009	0.8644	0.8921

As shown in Table 4, 6 of the 13 development and investment banks are observed as effective. The restructuring period for Turkish banks yielded lucrative results which also reflect in investment banking activities. Studies on investment banking demonstrate that the number of effective banks were never as low as half of the total number of banks. This signalizes the growth of investment banking in Turkey.

5. CONCLUSION

Investments banks are usually specialized in creating and selling securities in primary markets. Their traditional services can be classified as acquisition and merger consultancy, underwriting, and sale of securities. In the past commercial banks and investment banks performed intermediary financial services using different strategies and products. Today, their strategies and products overlap making the differences less visible. Investment banks, which used to have high

rates of profits, nowadays face with lower profitability ratios due to a growing competition. Lower profitability led some of the banks to cut down on capital, while others continued to grow by turning their local power towards global investment banking.

The activities of investment banks in Turkey are limited. Public offerings as well as merger and acquisition consultancy can be performed by intermediary institutions with the necessary authorization certificate. For investment banks do not hold authorization to act as an intermediary for buying and selling of stocks in the stock market, they cannot compete against intermediary institutions. Buying and selling activities in secondary markets are considered very profitable for investment banks in the world, and can also serve to hedge the risks of investment banking operations. The abovementioned authorization will help investment banks diversify their income items and will increase the funds in capital markets. Further it will make it possible for investment banking institutions with strong equities outside capital markets to enter the field.

Investment banks, development banks and intermediary institutions with necessary authorization in Turkey provide services for publicly listed companies and offer investment advice about stocks by doing researches. For Turkish capital market is not very-well developed, the main problem investment banks face in Turkey is that traditional investment banking activities are limited and that they cannot compete against intermediary institutions.

In this study, the effectiveness of 13 investment and development banks were analysed with BDEA method covering the post-crisis period of 2010. For the number of investment and development banks in the Turkish banking system is low, a BDEA was employed for the bias-corrected estimations. Turkish banking system, strengthened with a restructuring program, managed to maintain its solid composition without being affected by the global crisis. Hence, the number of effective investment banks increased. State regulations and foreign relations with publicity campaigns are necessary for these banks to diversify their functions and operate effectively.

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