Impact of Firm Attributes on the Efficiency of Brokerage Houses

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Abstract

Financial markets exist in order to bring together buyers and sellers of securities. Financial intermediaries, also known as financial institutions play an important role in financial markets. The most important contribution of financial intermediaries is a steady and relatively inexpensive flow of funds from savers to final users or investors. Thus efficiency of financial intermediaries is of importance for efficient markets. Brokerage houses efficiency is closely related to efficiency of financial markets due to the transaction costs and speed of transacting.

This study analyzes the factors influencing the efficiency of brokerage houses by using Stochastic Frontier Analysis (SFA). The results show that several firm attributes have impact on efficiency. The results indicate that age of brokerage houses and numbers of employees have positive impact on efficiency, however, other firm attributes such as number of branches, firm size, financial leverage, and service ratio (Stock transactions/Total transaction) have negative impact on efficiency of brokerage houses.

Key Words: *Efficiency, Brokerage Houses, Stochastic Frontier (SFA), Financial Markets, Financial Intermediary,*

JEL Classification: *G14, G18, G24*

Özet – Aracı Kurum Firma Özelliklerinin Etkinlik Üzerindeki Etkisi

Finansal piyasalar, menkul kıymet alım ve satımını yapanları bir araya getiren piyasalardır. Finansal kurumlar olarak da sınıflandırılan finansal aracılar finansal piyasalarda önemli rol oynarlar. Finansal aracıların en önemli katkısı fonların tasarruf sahiplerinden fon talep edenlere göreli olarak ucuza aktarmasıdır. Dolayısıyla, aracı kurumların etkinliği işlem maliyetleri ve hızı açısından değerlendirildiğinde finansal piyasaların etkinliğiyle yakından ilgilidir.

Bu çalışma da, aracı kurumların etkinliğini etkileyen faktörler Stochastic Frontier Analizi (SFA) kullanılarak irdelenmektedir. Sonuçlar bazı aracı kurum özellikleri etkinliği etkilediğini göstermektedir. Sonuçlara göre ; aracı kurumun yaşı ve çalışan sayısı etkinlik üzerinde olumlu etkiye sahip iken, şube sayısı, aracı kurum büyüklüğü, finansal kaldıraç ve hizmet rasyosu (Hisse senedi işlem büyüklüğü/Toplam işlem büyüklüğü) olumsuz etkiye sahip olduğunu ortaya koymaktadır.

Anahtar Kelimeler : *Etkinlik, Aracı Kurumlar, Stochastic Frontier (SFA), Finansal Piyasalar, Finansal Kurumlar.*

JEL Sınıflaması: *G14, G18, G24*

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1. Introduction

Financial markets exist in order to bring together buyers and sellers of securities, *i.e.* they are mechanisms created to facilitate the exchange of financial assets. There are many ways to distinguish financial markets. One way of distinguishing financial markets is the life span of financial assets. Money markets typically involve financial assets which their maturities are one year or less, whereas capital markets typically involve financial assets with life spans of greater than one year. Financial intermediaries, also known as financial institutions play an important role in financial markets. The most important contribution of financial intermediaries is a steady and relatively inexpensive flow of funds from savers to final users or investors (Fabbozzi, Modigliani and Ferri, 1994). They are organizations that provide services such as (i) exchanging financial assets on behalf of costumers or for their own accounts, (ii) transforming financial assets acquired through the market into different and more preferable financial assets which become their liabilities, (iii) providing investment advices to other market participants, (iv) managing the portfolios of other market participants, and (v) assisting in the creation of financial assets for their customers, and then selling those financial assets to other market participants.

Every modern economy has financial intermediaries that perform aforementioned key financial functions for market participants. Hence, efficiency of financial institutions is of importance for well functioning economies. The market efficiency has been and is one of the major topics in finance literature; market efficiency accounts for channeling the funds to the right investments that will provide the most return. Therefore, the policy makers encourage the establishment of allocationally efficient markets. An allocationally efficient market has to be externally and internally efficient (West, 1975). Immediate and wide dissemination of new information and rapid price adjustments to the new information in an unbiased manner forms the external (or pricing) efficiency whereas internal (or operational) efficiency is one where brokers and dealers compete fairly so that the transaction costs are low and the speed of transacting is high.

A brokerage house is an entity that acts on behalf of an investor who is willing to buy or sell securities. In essence a brokerage house can be defined as an

"agent" of the investor. It receives a commission for the services it performs, and commission is a "transaction cost" for the securities market. Investors wish to obtain transaction services as cheaply as possible *i.e.* they prefer to be in an internally efficient market. As a consequence the brokerage commission and the speed of transacting are two significant factors that are closely related to market efficiency for investors to invest in a market. From this point of view, it is clear that performance of each brokerage house stimulates investment in an economy. In capital markets brokerage commissions vary time to time. There were times that fixed brokerage commissions were charged but the performance of brokerage industry was poor. However, adoption of more competitive systems in capital markets that allow negotiation in determining brokerage commissions increased the efficiency of brokerage houses.

Governments regulate the financial markets due to their prominent roles in economies. The regulatory power of governments tries to influence the evolution and development of the financial markets and institutions. The aim of governmental regulations is to let financial market function efficiently in producing its products and services. In addition, governments put emphases on regulations in order to avoid "market failure". A market failure can simply be defined as the lack of requirements to maintain competition in the market. The main purpose of these regulations and rules is to stabilize the functioning of a complex system, namely, financial markets. Thus, the regulatory power establishes the rules in order to (i) encourage competition, (ii) avoid defrauding, (iii) restrict the activities of foreign investors that destabilize the domestic market equilibrium, and (iv) promote the stability of financial institutions.

The scope of this study is to focus on efficiency of brokerage houses in Turkey and to find out the factors that influence the efficiency of these intermediaries. It is reasonable that efficient functioning of brokerage houses is directly related to market efficiency. The commissions received are the main revenues of brokerage firms; consequently increasing efficiency of brokerage houses will result lower transaction costs for investors. Utilization of technology is another significant factor in terms of increasing the transacting speed, and hence, efficiency of the market. Besides, in this study it also has been investigated why some of brokerage

houses are more efficient than the others under the same regulatory environment, and what lies behind this?

The structure of the study is as follows: Next section briefly describes the legal framework and development of brokerage houses in Turkey. The third section involves literature survey. The fourth section explains data set, the design of the research, and the methodological approach. The fifth section presents empirical results of the analysis. The final section is the conclusion remarks of the study.

2. Brokerage houses in Turkey

Legal framework of financial intermediaries in Turkey is constituted by Capital Market Law Articles 30 and 31[1]. Article 30 defines intermediation as "buying and selling of capital market instruments in the framework of Article 31 by authorized institutions in their own name and for their own account, in the name and for the account of another, and in their own name for the account of another". The communiqué Serial: 5, No. 46 of Capital Market Board describes the intermediary activities and capital market activities of brokerage houses (Articles 3 and 4).

Capital Market Law permits banks to engage in intermediary activities by obtaining a Certificate of Authorization. Thus, brokerage houses can be classified as none bank origin and bank origin entities that act on behalf of an investor who is willing to buy or sell securities. This study focuses on only none bank origin brokerage houses because bank origin entities perform other functions of financial institutions as well.

As of 2009 there are 144 brokerage houses in Turkey. Table 1 illustrates the number of brokerage houses during the period 1990 and 2009. The number of brokerage houses (both none bank-origin and bank-origin) increased from 99 to 184 during the period of 1990-2001. Rapid growth of capital markets and lack of regulations related to brokerage services had stimulated the rise of brokerage houses until the 2001. However, deep economic crisis that Turkey encountered in 2001 had changed the trend conversely. Especially, tight regulations and financial problems of bank industry caused decrease of bank origin brokerage services in Turkish capital markets.

[1] Article 30 is the legal framework for capital market activities of financial intermediaries (institutions); Article 31 defines the permission procedures for financial institutions which are engaged in capital market activity.

Table 1. Number of Brokerage Houses (1990-2009)

	1990	1995	2000	2001	2002	2003	2006	2007	2008	2009
None bank origin	48	103	129	126	119	118	106	104	104	103
Bank origin	51	62	73	58	48	44	40	41	41	41
Total	99	165	202	184	167	162	146	145	145	144

Source: Istanbul Stock Exchange, http://www.imkb.gov.tr

A set of relevant data related to brokerage houses is given in Table 2. Rapid increases in total assets, total equity, net commission revenues, and net profit of brokerage houses are observed during the last ten years. However, net profit /total equity ratio dramatically decreases after the year 2001. This can be interpreted as the result of tight regulations after the economic crisis in 2001, that financial intermediaries were forced to strengthen their equity structures in order to avoid market failures. It is also reasonable to say that after 2001 brokerage houses try to cut labor expenses in order to increase efficiency. Table 2 illustrates that number of employees gradually decreased from 1999 to 2008.

The communiqué Serial: 5, No. 46 of Capital Market Board article 20 defines the structure of field offices for brokerage houses. Capital Market Board permits brokerage houses to establish branches, contact offices, and agencies in accordance with the regulations. Table 3 presents the main differences among branches, contact offices, and agencies in terms of accounting record keeping, authorization, and legal framework. Referring back to the Table 2, as the number of branches and contact offices decreases the number of agencies increases.

Table 2. Relevant Data for Brokerage Houses (none bank origin and bank origin) (Turkish Lira, TL)

	Total Assets	Total Equity	Net Commission Revenues	Net Profit	Net Profit/ Total Equity	Emplo-yees	Branches	Contact Offices	Agencies
1999	454.821.671	187.389.632	136.132.913	74.710.395	39.,87%	6.650	162	75	3.232
2000	669.094.810	325.281.880	376.516.277	117.361.515	36,08%	8.336	211	88	3.412
2001	949.963.220	573.903.074	340.915.902	218.349.801	38.05%	7.156	219	88	3.948
2002	1.009.6896.473	719.647.176	387.241.312	104.562.735	14.53%	6.626	243	96	3.813
2003	1.295.321.785	895.570.112	515.061.214	137.448.113	15.35%	6.035	227	73	3.688
2004	1.026.574.963	810.180.458	537.270.103	86.672.722	10.70%	5.906	224	67	4.450
2005	2.563.550.886	1.500.873.956	672.914.01	273.193.594	18.20%	5.916	234	69	4.406
2006	2.684.842.872	1.499.548.359	692.084.346	187.850.501	12,53%	5.899	246	64	4.514
2007	3.808.563.671	2.152.576.180	845.762.933	356.284.166	16,55%	5.861	231	52	4.775
2008	4.162.750.963	2.149.710.452	714.174.789	177.008.998	8,23%	5.102	185	44	5.664

Source: The Association of Capital Market Intermediary Institutions of Turkey,

Table 3. Structural Differences among Field Offices (Branches, Agencies, and Contact Offices) of Brokerage Houses

	Branch	Agency	Contact Office
Record Keeping	Accounting records are kept at the headquarter of brokerage houses	Agency does not keep accounting records.	It keeps all accounting records by its own
Authorization	It has all the authority as the brokerage house	Agency only conveys orders to the head quarter	It only performs buying and selling services
Legal Framework	It is legal organ of brokerage house.	It is a unit of brokerage house to promote the operations.	It is independent of brokerage house and is only bound by a contract

Source: Istanbul Stock Exchange, Capital Markets Manual 17, 2002

The decrease in the number of employees and branches and contact offices can be interpreted as the result of technological development in financial intermediation. Especially, intense use of internet has increased in the last years in capital markets. In Turkish capital markets the use of internet has begun in 1999. Utilization of technology provided high speed transactions and stimulated commission revenues for brokerage firms. Table 4 illustrates the evolution of stock transactions via internet. While only 10 brokerage houses offered internet services in 1999 as of 2008 this number has increased to 69. Similarly, the number of customers transacting via internet, and the number of internet orders demonstrate the similar behavior as a result of intense utilization of internet by brokerage houses. Hence, in a competitive environment brokerage houses should improve their technology in order not to deteriorate their operating profits, or to lessen their operating expenses.

Table 4. Transaction Data for Buying and Selling Stocks via Internet

	Number of Brokerage Houses	Number of Customers	Number of transmitter orders	Number of realized order	Volume of transmitter orders (Thousand TL)	Volume of realized orders (Thousand TL)
1999	10	8.248	287.748	164.378	222.411	100.577
2000	20	167.959	1.847.009	1.308.952	1.237.311	729.379
2001	35	64.654	4.907.892	2.668.815	3.908.708	2.397.047
2002	42	77.367	7.361.641	3.650.861	9.607.078	4.437.113
2003	47	85.836	8.991.490	4.715.364	16.554.790	8.715.017
2004	50	128.266	16.777.374	9.191.243	39.109.516	20.130.516
2005	61	118.800	19.410.605	10.858.346	58.901.301	30.285.230
2006	61	181.801	-	13.018.098	-	43.333.890
2007	68	186.622	-	15.339.686	-	15.339.686
2008	69	202.700	-	18.853.084	-	61.612.375

Source: The Association of Capital Market Intermediary Institutions of Turkey,

As mentioned above under the pressure of intense competition, tight regulations, and in a volatile economic environment, can brokerage houses improve their efficiencies? What are the factors that a manager should focus on in order to control and monitor the efficiency? These questions are the main motivation behind this study.

3. The Related Literature

In the recent years, developments in technological innovations and rapid globalization of financial system put competitive pressure on the financial markets. Therefore, the need to enhance the competitiveness of financial system against this pressure and to compete in a more liberalized environment has become one of the major issues of managers, governments and other economic actors. The result of these changes has moved financial institutions to be more market-oriented rather than being traditional intermediaries. Thus, the efficiency of financial institutions is of importance for a well functioning economy.

Considering the importance of the financial system in attaining the overall economic performance with changes in the regulatory environment and the globalization of financial markets, a great amount of study has been conducted to investigate the efficiency of financial institutions by using parametric or non-parametric frontier techniques. The performance of financial institutions has been

and is one of the major topics in finance literature. Researches on efficiency of financial intermediaries mainly concentrate on managerial performances of these institutions, informing policy makers by assessing the effects of regulations and mergers on efficiency, and comparing different efficiency techniques (non-parametric and parametric techniques). Berger and Humphrey (1997) surveyed the results of 130 financial institution efficiency studies. The results of the survey exhibit that researches intensely focus on efficiency of banks and insurance firms as financial institutions.

Studies mainly concentrate on the effects of deregulation and financial liberalization on the efficiency of the bank industry. Zaim (1995) analyzed the efficiency of banking industry and concluded that after the liberalization policies in Turkey banks improved their efficiencies. In response to the deregulation of interest rates in the early 1980s in U.S. banks raised fees for deposit services, reduced branch operating costs, and shifted to higher earning assets in order to improve profit efficiency (Humphrey and Pulley, 1997). Pasiouras et al (2009) suggest that banking regulations that enhance market discipline and empower the supervisory power of the authorities increase both cost and profit efficiency of banks. In contrast, stricter capital requirements improve cost efficiency but reduce profit efficiency, while restrictions on bank activities have the opposite effect, reducing cost efficiency but improving profit efficiency.

A study conducted by Weill (2003) concluded that if the level of equity is ignored, a bank is considered as inefficient even though it behaves optimally given the risk preferences of its manager. This is because of the managers of a bank are more risk-averse so that they can hold a higher equity level than cost minimizing equity level. Kauko (2008) also investigated the impact of managers on cost efficiency in banking by applying SFA to a unique Finnish data and concluded that the impact of the age on efficiency depends on the degree of education.

In terms of macroeconomic environment, Thoraneenitiyan and Avkıran (2010) studied the impact of restructuring and country-specific factors on the efficiency of post-crisis East Asian banking systems by using an integrating DEA with SFA. They focused on restructuring measures related to bank ownership. The results indicated that although domestic mergers produce more efficient banks, overall, restructuring does not lead to more efficient banking systems. Banking system

inefficiencies are mostly attributed to country-specific conditions, particularly, high interest rates, concentrated markets and economic development. Evidence of financial integration and convergence are considered of importance in assessing the outcome of EU deregulation policies aimed at improving the efficiency and performance of banking sectors. Specifically, Weill (2009) and Casu and Girardone (2009) evaluated the integration and convergence in EU banking markets. The results of the study seem to supporting evidence of convergence of efficiency levels towards an EU average. Nevertheless, there is no evidence of an over all improvement of efficiency levels towards best practice.

Other studies focus on the effects of mergers on the efficiency. For example, evidence from the merger cases of Australian trading banks shows that acquiring banks are more efficient than target banks (Avkıran, 1999). Some other studies aim to determine the changes in efficiency during the period of financial disruption and economic crisis. Aktaş (1999) has concluded that overall efficiency remained almost the same during the economic crisis period in Turkey.

Specifically, studies about the efficiency of insurance firms intensify on the methodological approach in determination of efficiency. For example, Brockett *et al* (2005) argue that "financial intermediary approach" in determining the efficiency of insurance firms is more appropriate than the alternative approach referred to as "production approach" by Berger and Humphrey (1997)[2]. However, "production approach" also is used by other articles in determination of efficiency of insurance firms such as Cummins and Weiss (1993), and Cummins, Weiss, and Zi (1999).

Among huge amount of efficiency studies for banking and insurance industry in finance literature, however, there exists a few number of articles dealing with the performance of brokerage houses. Fukuyama and Weber (1999) examined the overall cost efficiency and productivity change of Japanese securities firms (brokerage firms) for the period 1988-93. They have concluded that overall cost efficiency of four big security firms is higher than the small ones. Gündüz *et al* (2001), and Aktaş and Kargın (2007) analyzed the efficiency of brokerage houses

[2] See Brockett et al (2005) for a discussion of "intermediary approach" and "production approach" in determination of efficiency for insurance firms.

in Turkey by using Data Envelop Analysis (DEA) and concluded that efficiency of brokerage houses is low during the period of analysis.

As emphasized before brokerage houses play an important role in financial markets and their performances are closely related to efficiency of financial markets. Therefore, the factors that influence the efficiency of brokerage houses should be examined carefully by managers and policy makers, so that new policies and strategies can be developed in order to establish well functioning markets. Wang *et al* (2003) studied the efficiency of brokerage houses and analyzed the factors that affect their efficiency by using DEA analysis and a regression model.

The goal of this study is also the determination of the factors that influence the efficiency of brokerage houses in Turkey via Stochastic Frontier Analysis (SFA).

4. Data Set and Methodology

4.1 Methodology

In the literature different types of estimation methodologies have been employed in assessing the efficiency of the firms. Non-parametric and parametric approaches are the two main techniques. Non-parametric approaches[3] require the non-probabilistic assumption and behave as if the noise and inefficiencies are combined. In addition, non-parametric approaches assume deterministic process rather than stochastic process (Berger and Mester, 1997; Coelli et al., 2003). Parametric approaches[4], on the other hand, are probabilistic and attempt to separate noise from inefficiencies (Lee, 2002).

It is especially is not straight forward to determine which of the approaches dominates the other since each approach has its own advantages and disadvantages. Although DEA requires fewer assumptions, less data and a less sample, the key drawback for DEA is the assumption of having no random error and no measurement error in the construction of the frontier. As a result, this assumption can lead to severe problems in positioning and shaping the frontier. In addition to these drawbacks, due to the use of relative efficiency measures instead

[3] The non-parametric approaches consist of Data Envelopment Analysis (DEA), and the Free Disposal Hull (FDH). See Charnes at al. (1978) for a detailed analysis of DEA and Tulkens (1993) for more information about FDH.
[4] The parametric approaches include the Stochastic Frontier Analysis (SFA), the Distribution Free Approach, and the Thick Frontier Approach (TFA).

of absolute measures, it may not make sense to use DEA as an efficiency measurement for the comparison among firms (Schmidt, 1986).

Due to these drawbacks of DEA in this study Stochastic Frontier Analysis (SFA) is considered as the appropriate approach in order to measure the performance of brokerage houses[5].

Aigner et al. (1977) and Meeusen and van den Broeck (1977) proposed SFA independently in the measurement of efficiency. A considerable number of studies applied this method in efficiency literature. Stevenson (1980), for example, proposed the truncated normal distribution, whereas Greene (1990) used the two-parameter gamma distribution. Richmond (1974) introduced the COLS estimators as a different estimator in SFA, and Battase and Corra (1977) introduced a new variance parameter. Coelli (1995) argued that in SFA analyses, the use of one-sided Log-likelihood statistics may provide more sensitive results than the Wald statistics. Kumbhakar et al (1991) and Reifschneider and Stevenson (1991) and Battese and Coelli (1995) defined the reasons for inefficiency in terms of a second disturbance or error term. Coelli (1992) and Coelli (1996) developed a computer program called FRONTIER for the estimation of stochastic frontier models. This program stimulated SFA analyses.

Stochastic frontier analysis (SFA) is a functional form for the relationship between input and an output. This method includes an error term which has two components, one to account for random effects and another to account for technical inefficiency.

In this study we used the Battase and Coelli (1995) model specification. The Battase and Coelli (1995) model specification can be expressed as follows:

$$Y_{it} = x_{it}\beta + (V_{it} - U_{it}), \qquad i = 1,...,N, \quad t = 1,...,T. \qquad (1)$$

where Y_{it}, is the logarithm of the production of the i-firm, x_{it}, vector of input quantities of the i-firm, β is vector of unknown parameters, the V_{it} are random variables which are assumed to iid. $N(0,\sigma v^2)$, and independent of the U_{it} which are non-negative random variables which are assumed to account for technical

[5] A detailed discussion of advantages and disadvantages of DEA and SFA can be found in Coelli et al., (2005).

inefficiency in production and assumed to be independently distributed as truncations at zero of the $N(m_{it}, \sigma u^2)$ distribution; where:

$$m_{it} = z_{it}\delta, \qquad (2)$$

Where z_{it} is a px1 vector of variables which may influence the efficiency of a firm; and δ is an 1xp vector of parameters to be estimated.

Technical inefficiency effects can be defined as follows:

$$TE_{it} = \exp(-u_{it}) \qquad (3)$$

For the frontier model, defined by equation 1, the null hypothesis ($H_0 = \sigma^2 = 0$) indicates that there are no technical inefficiency effects. The null hypothesis can be tested against the alternative hypothesis $H_i : \sigma^2 > 0$. The test statistic is calculated as

$$LR = -2\left[\ln\left[L(H_0)/L(H_1)\right]\right] = -2\left\{\ln\left[L(H_0)\right] - \ln\left[L(H_1)\right]\right\} \qquad (4)$$

Where $L(H_0)$ and $L(H_1)$ are the values of the likelihood function under the null and alternative hypothesis, respectively. If H_0 is accurate, this test statistic is usually assumed to be asymptotically distributed as a chi square random variable with degrees of freedom equal to the number of restrictions involved. Finally, if the test statistic obtained is greater than the critical value, the null hypothesis is rejected (Coelli 1996 and Coelli et al. 2005).

4.2 Data Set

Analysis is conducted for the period 2005-2008. The data set for the analysis involves 78 brokerage houses operating in Turkey (represents 80% of active none bank origin brokerage houses). The brokerage firms with incomplete data are excluded from the analysis.

As mentioned before this study focuses on the determination of the factors that influence the efficiency of brokerage houses in Turkey via SFA method. In the measurement of efficiency usually there are two steps in SFA method. In the first

step the functional form is established and then, the determinants of efficiency (or inefficiency) are analyzed.

The first step begins with the determination of output and inputs. The output is considered as total revenues of the brokerage houses. In efficiency studies different variables such as transaction volume and commission revenues are considered as output (Fukuyama and Weber 1999, Gündüz *et al*, 2001, Aktaş, 2007). Wang et al (2003) subdivided total revenues into three categories (brokerage, equity, and underwriting revenues) as outputs. We only used total revenues (TR) as output because it involves revenues of the operations motioned above. On the input side, three types of inputs are distinguished: equity (E), cost of goods (services) sold (C), and operating expenses (O), one of or more than one of these inputs are considered as inputs by Fukuyama and Weber (1999), Gündüz *et al*, (2001), and Aktaş, (2007).

In the second step of SFA, the factors that influence the efficiency are distinguished. In efficiency studies, efficiency has been attributed to a number of firm specific features such as firm size, services diversification, location, operating risk, and branches of a firm, etc. (Rangan *et al* 1988, Goldberg and Rai, 1996, Wang *et al*, 2003). In the light of this information we concentrated on age of brokerage house (ABH), number of branches (NB), number of employees (NEMP), service ratio (SR), number of active accounts (NAA), total assets (or firm size) (TA), and financial leverage (FL) as firm-specific attributes.

We think that age of brokerage houses (ABH) is a significant factor because brokerage services are specific and technical services so that experience is needed in terms of efficiency. Thus, we believe that experience has a positive impact on efficiency.

The number of branches (NB) was considered as the enlargement of the geographical coverage of the market so the expectation is a positive impact on efficiency (Wang et al, 2003). However, our view is that this factor has a negative impact on the efficiency because of rapid improvements in internet technology. Therefore, the strategy to increase the number of branches does not have a positive impact on efficiency. Table 4 illustrates intense utilization of internet in brokerage transactions in Turkey while the number of branches decreasing during the analysis period (Table 3).

The NEMP defines the number of full-time employees and is expected to have a positive impact on the efficiency. At the first glance it seems that increasing the number of employees has an inverse impact on efficiency. However, we think that due to the sophisticated and specific transactions, capable employees can help to promote operations of the brokerage houses, hence, to improve efficiency.

Brokerage transactions in Turkey can be categorized as stock, fixed income security, and financial derivative transactions. We define service ratio (SR) as the weight of the stock transactions in total brokerage transactions (Stock transactions/Total brokerage transactions). The SR is relevant variable because concentrating on specific transactions that stimulate higher revenues has a positive impact on efficiency. Therefore, if the analysis shows that SR ratio has a positive impact on efficiency it should be interpreted as the brokerage houses should concentrate on much more stock transactions, otherwise they put emphasis on fixed income securities, and derivative transaction.

The number of active account (NAA) variable indicates the actual customers of brokerage houses therefore; it is expected to have a positive impact on the efficiency.

Total assets (or firm size) (TA) is a significant variable because in general, firms can benefit from economies of scales as their size expand, and suffer diseconomies of scale beyond an optimal size. Thus, it is expected to have positive impact on efficiency.

Generally, risk is a significant factor that influences efficiency. Well-functioning of operations of a firm is closely related to the risk. Financial leverage (FL) is considered as the measure of risk in this study. Thus, it is expected that any increase in FL will influence efficiency negatively.

Table 5 exhibits descriptive statistics of the relevant variables. As can be seen from Table 5, among the variables, increase in total revenues and decrease in total assets are interesting in terms of efficiency.

Table 5. Descriptive statistics of the relevant variables

	2005		2006		2007		2008		Total	
	Mean	Sd.	Mean	Sd.	Mean	Sd.	Mean	Sd.	Mean	Sd.
Total Revenues (Million TL)	301,86	804.37	97.78	232,00	67,33	196,86	40,94	142,96	126,98	445.88
Equity (Million TL)	2,14	3,46	1,020	1,68	0,91	1,92	0,72	1,66	120	2,36
Operating Expenses (Mil.TL)	0,87	1,15	0,43	0,58	0,34	0,47	0,27	0,40	0,48	0,75
Cost of Goods Sold (Million TL)	302,30	804,52	97,74	231,98	67,63	196,71	40,75	142,93	127,11	445,97
Age of Brokerage Firm	14,01	4,29	15,01	4,29	16,01	4,29	17,01	4,29	15,51	4,42
# of Branches	49,26	143,87	49,26	143,87	49,26	143,87	49,26	143,87	49,26	143,18
# of Employees	63,22	67,55	63,83	70,78	64,59	71,10	53,63	64,05	61,32	68,25
Service Ratio	0,69	0,31	0,68	0,32	0,60	0,32	0,55	0,32	0,63	0,32
# of Active Accounts	5.725	11.980	6.533	13.237	5.778	11.672	6.031	12.675	6.017	12.350
Total Assets (Million TL)	28,43	52,13	34,16	71,83	45,95	147,09	50,32	175,22	39,71	122,42
Financial Leverage	0,37	0,21	0,35	0,21	0,41	0,60	0,31	0,23	0,36	0,35

5. Empirical Results

5.1. The Results of Hypothesis Tests

In the first stage of the analyses, hypothesis tests were conducted in order to determine the functional forms. The following four different functional forms are used in this study: (1)the Cobb-Douglas production function (CD), (2)the Cobb-Douglas production function incorporating technological change (CDt), (3) the production function no technological change (HN), (4) the Hicks neutral production function (HNt).

The hypothesis test results reported in Table 6. The hypothesis test was conducted by using Equation 4 in section 4.1. All forms have been tested against the translog production function, which is accepted as alternative form.

Table 6. Hypotheses Test Results

H_0	Log-likelihood	Test statistics	Critical	Decision
CD (all β_{ij}= 0 and β = 0)	-139.618890	218.886	17.670	H_0 reject
CDt (all β_{ij}= 0)	-137.376100	214.400	16.274	H_0 reject
HN (β_{14}= β_{24}= β_{34}= β_{44}= β_4 = 0)	-49.771314	39.191	10.371	H_0 reject
HNt (β_{14}= β_{24}= β_{34}= 0)	-45.340986	30.330	8.761	H_0 reject
TPF (no technological change) $\gamma = \delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$	-41.899079	365.507	10.371	H_0 reject

Table 6 shows the log likelihood values, and the log likelihood ratio test statistics. Furthermore, Table 6 involves the critical values obtained from the distribution table of Kodde and Palm (1986). Accordingly, all the null hypotheses were rejected in favor of the alternative hypotheses. Thus, it was decided that the translog production function - an alternative hypothesis - should be used for the analysis of the inefficiency effects. With the variables used, the translog production function was formed in the following way:

$$y_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j x_{jit} + \beta_t t + \frac{1}{2} \sum_{j=1}^{3} \sum_{h=1}^{3} \beta_{jh} x_{jit} x_{hit} + \beta_{tt} t^2 + \sum_{j=1}^{3} \beta_{jt} x_{jit} t + V_{it} - U_{it} \quad (5)$$

Where y is the log total revenues and x is a vector of the logarithms of the three inputs considered (j,h = E,C,O)[6] where the technological change can be specified as an additional input (time trend t) representing the rate of technical change or the shift in the production function over time.

An additional hypothesis test is conducted in order to determine whether there are efficiency effects or not. This hypothesis test is applied inefficiency effects function as an alternative hypothesis against translog production function which is the null hypothesis. Here, inefficiency effects function includes inefficiency effect variables (These variables are denoted as δ s in Table 7). As can be seen in Table 6 the null hypothesis is rejected *i.e.* inefficiency effects function is accepted.

5.2. The Results of Inefficiency Effects

Referring to Table 7 the age of brokerage houses (ABH) decreases inefficiency *i.e.* it has a positive impact on efficiency[7]. This result is parallel to our expectations. Brokerage firms serve sophisticated and specific transaction to their customers. Thus, experience is a significant factor for brokerage firms' performance.

The results show that number of branches (NB) has negative impact on efficiency. Our discussion about the branches in previous sections is supported by the final result of this analysis. The rapid improvements in internet technology in the world as well as investments in internet infrastructure in Turkey during the last

[6] Section 4.2 includes the definition of these three variables.

[7] In Table 7 negative (positive) values of δ s imply a positive (negative) impact over the efficiency.

years have stimulated the intense utilization of internet by brokerage houses. The firms transacting via internet are more efficient than the firms with little or any use of internet.

As the third variable NEMP has a positive impact on efficiency. The NEMP defines the number of full-time employees. At the first glance it seems that increasing the number of employees has an inverse impact on efficiency. However, due to the sophisticated and specific transactions, capable employees (such as analyst at the headquarters etc.) can help to promote operations of the brokerage houses, hence, to improve efficiency.

Service ratio (SR) defined as the weight of the stock transactions in total brokerage transactions (Stock transactions/Total brokerage transactions) seems to have a negative impact on efficiency. This indicates that brokerage firms should concentrate on other transactions (fixed income security and derivative transaction) then stock transactions. One possible explanation for this result is that the derivatives market is new in Turkey and the commissions are high in derivative transactions.

The firm size, total assets (TA), has a negative effect on efficiency contrary to our expectations. In general, firms can benefit from economies of scales as their size expand, and suffer diseconomies of scale beyond an optimal size. This result can be an indication of big but not optimal sized brokerage firms exist in Turkey. This will deteriorate the financial position of the firms, hence increasing the financial risk.

The results of the analysis show that financial leverage (FL) also has a negative impact on efficiency. This result is parallel with our view. As risk increases efficiency decreases due to increases in several costs such as cost of borrowing, or cost of bankruptcy etc.

Lastly, number of active account (NAA) variable has no statistically significant relationship with efficiency.

Table 7. The results of Efficiency effects

Parameter	Veriable	Coefficient	t-ratio
β_0	constant	0.673	0.692
β_1	ln (equity)	-0.192	-1.552
β_2	ln(cost of good solds)	0.149	0.891
β_3	ln(operating expenses)	0.997	17.875
β_4	t	-0.226	-2.076
β_{11}	$0.5*\ln(equity)^2$	0.054	2.719
β_{22}	$0.5*\ln(cost\ of\ good\ solds)^2$	-0.024	-0.897
β_{33}	$0.5*\ln(operating\ expenses)^2$	0.024	4.671
β_{44}	t^2	0.070	4.004
β_{12}	ln(equity)* ln(cost of good solds)	-0.004	-0.219
β_{13}	ln(equity)* ln(operating expenses)	-0.034	-5.242
β_{14}	ln(equity)*t	0.011	1.168
β_{23}	ln(cost of good solds)* ln(operating expenses)	0.046	4.324
β_{24}	ln(cost of good solds)*t	0.006	0.442
β_{34}	ln(operating expenses)*t	-0.036	-7.700
δ_0	constant	-3.192	-2.799
δ_1	ABH	-0.097	-0.444
δ_2	NB	0.097	2.213
δ_3	NEMP	-0.630	-3.958
δ_4	SR	0.251	12.609
δ_5	NAA	0.128	1.783
δ_6	TA	0.194	2.984
δ_7	FL	0.106	2.434
σ^2		0.207	13.973
η		0.931	144.772

Table 8 shows the average and standard deviation of efficiency scores. In all years average efficiency scores are quite high. A possible explanation to this is that in Turkey financial institution are subject to tight regulations and auditing, therefore, all institutions operate in the similar legal framework and high competition environment. Hence, efficiency is of importance to maintain the operations of financial institutions. The analysis period is the period of application of tight regulations. Some brokerage houses, on the other hand, had problems to comply with the tight regulations whereas the others improved their operations, thus, as can be seen in Table 8 the standard deviations of efficiency scores rapidly increased in 2007 and 2008. This indicates a divergence among the brokerage firms in terms of efficiency.

Table 8. Mean and standard deviation of efficiency scores

	2005	2006	2007	2008
Mean	0.923	0.929	0.901	0.902
Std.	0.025	0.025	0.116	0.066

6. Conclusion

Based on the 2005-2008 data sets of brokerages houses in Turkey, this study applied SFA in order to determine the firm attributes that influence the efficiency of brokerage houses. The SFA results show that age of brokerage houses and number of full-time employees has positive impact on efficiency, whereas firm size, financial leverage, and service ratio defined as stock transaction/total transactions have negative impact on efficiency. There exists no statistically significant relationship between number of active accounts and the efficiency.

Based on the information of efficiency scores a divergence among the brokerage houses is observed for the periods 2005-2006 and 2007-2008. A possible explanation for this may be that some brokerage houses are successful in coping with tight regulations and competition and whereas some are not.

The economic implications of the results can shed light on the managers of brokerage houses in terms of decision making. Managers should put emphasis on the qualifications of their employers due to the sophisticated and specific transactions; capable employees (such as analyst at the headquarters etc.) can help to promote operations of the brokerage houses, hence, to improve efficiency. On the other hand, technological improvements, such as internet, mobile phone utilization etc., ease to decrease cost of transactions for brokerage houses. Therefore, managers should focus on technological investments in order to contribute to the efficiency of brokerage houses. Managers also should investigate ways to benefit from experience and know how.

In this study, due to the lack of information about brokerage houses in Turkey, the data sets cover the period between 2005 and 2008. The further studies with larger sample sizes and longer periods will contribute to the results of the study. Other research topics can focus on comparison of efficiency of brokerage houses in different countries. However, there are constraints to reach the data sets.

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Table 9. Effeciency Scores of Brokerage Houses

Parameter	Veriable	2005	2006	2007	2008
1	Acar Yatirim Menkul Değerler A.Ş	0.933	0.939	0.939	0.907
2	Ak Yatirim Menkul Değerler A.Ş	0.930	0.935	0.929	0.881
3	Akdeniz Menkul Değerler A.Ş	0.942	0.911	0.921	0.691
4	Alan Menkul Değerler A.Ş	0.909	0.927	0.937	0.932
5	Alternatif Yatirim A.Ş	0.951	0.940	0.885	0.972
6	Anadolu Yatirim Menkul Kiymetler A.Ş	0.937	0.935	0.939	0.890
7	Ata Yatirim Menkul Kiymetler A.Ş	0.941	0.951	0.944	0.927
8	Ataonline Menkul Kiymetler A.Ş	0.937	0.939	0.922	0.934
9	Ayborsa Menkul Değerler A.Ş	0.925	0.938	0.940	0.934
10	Bahar Menkul Değerler A.Ş	0.919	0.937	0.918	0.947
11	Bgc Partners Menkul Değerler A.Ş	0.933	0.935	0.944	0.917
12	Camiş Menkul Değerler A.Ş	0.903	0.920	0.942	0.928
13	Censa Menkul Değerler A.Ş	0.908	0.927	0.907	0.981
14	Citi Menkul Değerler A.Ş	0.960	0.944	0.946	0.926
15	Credit Agricole Cheuvreux Menkul Değerler A.Ş	0.934	0.939	0.949	0.671
16	Daruma Menkul Değerler A.Ş	0.859	0.851	0.580	0.917
17	Deha Menkul Kiymetler A.Ş	0.927	0.944	0.947	0.934
18	Delta Menkul Değerler A.Ş	0.942	0.943	0.935	0.891
19	Deniz Yatirim Menkul Kiymetler A.Ş	0.940	0.945	0.946	0.935
20	Deniztürev Menkul Değerler A.Ş	0.939	0.940	0.936	1.000
21	Deutsche Securities Menkul Değerler A.Ş	0.937	0.954	0.949	0.942
22	Eczacibaşi Menkul Değerler A.Ş	0.945	0.952	0.947	0.937
23	Efg İstanbul Menkul Değerler A.Ş	0.949	0.946	0.932	0.904
24	Egemen Menkul Kiymetler A.Ş	0.927	0.935	0.940	0.917
25	Ekinciler Yatirim Menkul Değerler A.Ş	0.910	0.941	0.948	0.925
26	Ekspres Yatirim Menkul Değerler A.Ş	0.928	0.878	0.511	0.889
27	Entez Menkul Değerler A.Ş	0.930	0.938	0.937	0.931
28	Eti Yatirim A.Ş	0.939	0.948	0.940	0.891
29	Euro Yatirim Menkul Değerler A.Ş	0.943	0.943	0.910	0.819
30	Evgin Menkul Değerler A.Ş	0.928	0.940	0.942	0.927
31	Finans Yatirim Menkul Değerler A.Ş	0.935	0.948	0.944	0.921
32	Fortis Yatirim Menkul Değerler A.Ş	0.934	0.923	0.931	0.919
33	Galata Menkul Değerler A.Ş	0.928	0.940	0.934	0.952
34	Garanti Yatirim Menkul Kiymetler A.Ş	0.919	0.938	0.918	0.889
35	Gedik Yatirim Menkul Değerler A.Ş	0.940	0.946	0.941	0.918
36	Gfc General Finans Menkul Değerler A.Ş	0.898	0.930	0.941	0.911
37	Global Menkul Değerler A.Ş	0.906	0.938	0.946	0.940
38	Güney Menkul Değerler A.Ş	0.918	0.936	0.941	0.932
39	Güven Menkul Değerler A.Ş	0.927	0.934	0.941	0.929
40	Hak Menkul Kiymetler A.Ş	0.929	0.936	0.934	0.906
41	Hedef Menkul Değerler A.Ş	0.934	0.940	0.930	0.897
42	Hsbc Yatirim Menkul Değerler A.Ş	0.903	0.834	0.718	0.906
43	İnfo Yatirim A.Ş	0.896	0.929	0.942	0.937
44	Ing Menkul Değerler A.Ş	0.933	0.919	0.936	0.800
45	İş Yatirim Menkul Değerler A.Ş.	0.915	0.936	0.933	0.902
46	J.P. Morgan Menkul Değerler A.Ş.	0.910	0.939	0.914	0.875
47	Kalkinma Yatirim Menkul Değerler A.Ş	0.942	0.942	0.131	0.936
48	Kapital Menkul Değerler A.Ş	0.964	0.946	0.947	0.942
49	Kare Yatirim Menkul Değerler A.Ş	0.855	0.896	0.950	0.908
50	Lehman Brothers Menkul Değerler A.Ş	0.885	0.917	0.929	0.946
51	Marbaş Menkul Değerler A.Ş	0.942	0.936	0.866	0.901
52	Meksa Yatirim Menkul Değerler A.Ş	0.928	0.932	0.943	0.941
53	Metro Yatirim Menkul Değerler A.Ş	0.935	0.932	0.897	0.863
54	Mira Menkul Değerler A.Ş	0.881	0.941	0.937	0.926
55	Öner Menkul Kiymetler A.Ş	0.850	0.835	0.700	0.707
56	Oyak Yatirim Menkul Değerler A.Ş	0.915	0.934	0.941	0.941
57	Pay Menkul Değerler A.Ş	0.889	0.935	0.920	0.835
58	Polen Menkul Değerler A.Ş.	0.947	0.928	0.933	0.928
59	Pozitif Menkul Değerler A.Ş	0.941	0.877	0.853	0.968
60	Prim Menkul Değerler A.Ş	0.936	0.887	0.831	0.949
61	Sardis Menkul Değerler A.Ş	0.930	0.927	0.855	0.871
62	Sayilgan Menkul Değerler A.Ş	0.927	0.929	0.929	0.969
63	Standard Ünlü Menkul Değerler A.Ş	0.929	0.943	0.927	0.948
64	Strateji Menkul Değerler A.Ş	0.907	0.938	0.933	0.928
65	Tacirler Menkul Değerler A.Ş	0.922	0.940	0.945	0.924
66	Taksim Yatirim A.Ş	0.935	0.864	0.823	0.917
67	Teb Yatirim Menkul Değerler A.Ş	0.953	0.945	0.936	0.915
68	Tera Menkul Değerler A.Ş	0.919	0.937	0.902	0.959
69	Ticaret Menkul Değerler A.Ş	0.933	0.952	0.936	0.747
70	Turkish Yatirim A.Ş	0.908	0.940	0.944	0.925
71	Ubs Menkul Değerler A.Ş	0.868	0.921	1.000	0.983
72	Ulus Menkul Değerler A.Ş	0.921	0.913	0.837	0.835
73	Unicorn Capital Menkul Değerler A.Ş	0.929	0.935	0.911	0.712
74	Unicredit Menkul Değerler A.Ş	0.921	0.908	0.911	0.741
75	Vakif Yatirim Menkul Değerler A.Ş	0.941	0.944	0.932	0.870
76	Yapi Kredi Yatirim Menkul Değerler A.Ş	0.941	0.937	0.903	0.843
77	Yatirim Finansman Menkul Değerler A.Ş	0.826	0.941	0.939	0.916
78	Ziraat Yatirim Menkul Değerler A.Ş	0.937	0.940	0.939	0.925
	MEAN	0.923	0.929	0.901	0.902
	STANDARD DEVIATION	0.025	0.025	0.116	0.066