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CONTENTS

Detecting the Manipulation of Financial
Information by Using Artificial Neural Network Models
Güray Küçükkocaoğlu & Yasemin Keskin Benli
& Cemal Küçüksözen ……1

Impact of Audit Opinions on Stock
Returns in Istanbul Stock Exchange (ISE)
Hakan Aygören & Süleyman Uyar.....27

Pricing Mortgage Assets
Cem Karakaş & Onur Özsan …….....49

Asymmetric Responses in Volatility Between Positive and Negative
Shocks: New Evidence From Turkish Data by Using TAR-GARCH Model
Cüneyt Akar …….....69

Global Capital Markets……...……..77

ISE Market Indicators……..…..87

ISE Publication List……...91

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DETECTING THE MANIPULATION OF FINANCIAL INFORMATION BY USING ARTIFICIAL NEURAL NETWORK MODELS

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Abstract
Despite their widespread usage, models of accrual based methods in detecting false financial statements have been subject to significant criticism. An alternative to the accruals approach is to use binary probit and logit models and some other multivariate statistical techniques where they combine accruals and some other financial ratios and/or indexes. The objective of this paper is to explain the historical evolution of the accrual based methods where they provide some evidence of earnings management practices and than extend to some other alternative methods in detecting manipulative practices in financial reporting. This paper also, introduces a new method that has been widely used in detecting financial distress companies. An Artificial Neural Network Model, which is based on the concept of using artificial neurons, to estimate the manipulative financial reporting practices of the companies listed in the Istanbul Stock Exchange (ISE). The results indicate that the proposed Artificial Neural Network Model outperforms the traditional statistical techniques used in earnings manipulation practices.

I. Introduction

It is quite hard to detect manipulation of financial information from publicly available financial statements. Academicians, who have less opportunity to access companies' information and have less authority as compared to regulatory bodies, are trying to generate some models to detect companies exercising earnings management practices[4]. In the earnings management literature, these models have a methodology through which falsified financial

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[4] The terms "earnings management", "manipulation of financial information", "earnings manipulation", "fraud", "falsified financial statements" are all used interchangeably to describe the act of intentional misrepresentation of a firm's financial statement by managers.
Key words: Earnings Management, Financial Ratios, Artificial Neural Network Model.

statements are found out as classifying indicators on the manipulation of financial information. In this context, first, Healy (1985) presented a model to the literature which is evaluating the effects of managements' nondiscretionary accruals and accounting policy changes. Following the work done by Healy (1985), models focus on the aggregate accruals to evaluate nondiscretionary accruals and try to estimate aggregate accruals which are determined as the difference between publicly available net income and net cash flow from operations. Estimated aggregate accruals are used in regression analyses with the variables like income (or cash receipts from customers), indicating working capital needs (i.e. receivables, inventory, trade credits), and gross tangible assets, indicating normal depreciation. According to Jones (1991), in a regression analyses, unexpected accruals constitute the unexplained part of the aggregate accruals (Küçüksözen and Küçükkocaoğlu, 2005).

As mentioned above, in the models which are designed to detect manipulation of financial information (or which are used to predict the possible act of earnings management practices), primarily, aggregate accruals are focused. In some studies, unexpected aggregate accruals (i.e. accrual amounts excessing the requirements of companies' activities) are estimated through indexing accrual amounts to the total assets or income amounts directly and abnormal accrual amounts accumulating in years are considered as indicator of earnings management practices.

In some studies, aggregate accruals are segregated into two parts one of which consists of accruals required by activities (i.e. nondiscretionary accruals) and the other one consists of accruals not required by activities (i.e. discretionary accruals) are indexed to companies' total assets or sales. Yearly trends in these indices are considered as the indicators of various practices of manipulation.

After the accrual based studies, ongoing studies in the literature are based on Logit and Probit models. It is observed that after the Beneish's (1997) first probit study on earnings management practices, different models with different calculations are presented to detect the earnings management practices on financial information. To contribute to this field of study, we have applied the Artificial Neural Network model along with the Beneish's indices on the companies listed in the Istanbul Stock Exchange (ISE).

To the best of our knowledge, first study using neural networks to determine manipulation of financial information was done by Fanning, Cogger and Srivastava (1995). Later on, Fanning and Cogger (1998) demonstrated that 8 out of 20 variables (trade receivables/sales, trade receivables/total assets, inventory/sales, tangible assets/total assets, total liabilities/equity, sales/total assets) have reasonable explanatory power in determining manipulation of financial information through changing the extent of the database which was used in their first study. As will be explained in the following parts of this study, a study of Küçüksözen and Küçükkocaoğlu (2005), in which similar ratios were tested on ISE, and a

study of Spathis (2002), in which similar ratios were tested on Athens Stock Exchange, showed that this kind of ratios are not sufficient enough to explain the manipulation of financial information. Contrarily, according to these studies, it is observed that the indices which were suggested by Beneish (1997) have more reasonable explanatory power.

In the following parts of this study, the models which focus on accruals as determining the manipulation of financial information will be mentioned. After that, various models which include alternative approaches and include analyses based on the information derived from financial statements will be presented. In section three, we applied neural networks model to determine earnings management practices through an empirical study. In the fourth and fifth section, results of this study will be summarized.

II. Models Related to Manipulation of Financial Information

This section of the study will focus on the accrual based models which have been first presented into academic literature by Healy in 1985 and have been later on become the research study of many academicians. In addition to Healy's study, models whose objectives are to predict manipulation of financial information through financial ratios and indexes, with alternative approaches, will be presented.

2.1. Accrual Based Models

The accrual based models which have been first introduced into academic literature by Healy (1985) and later improved by DeAngelo (1986), and Jones (1991), used under different calculation methods, along with different names. This section of the study focuses on the accrual based models which have been started by Healy in 1985 and improved by other academicians.

2.1.1. Healy Model

Healy, in his study of 1985, created the hypothesis that managers who get bonus schemes via premiums manipulate financial information by using total accruals in order to increase the amount of their incentives. Healy tested this hypothesis using the following model.

$$NDA_t = 1/n\Sigma_\tau(TA_\tau / A_{\tau-1})$$

NDA = Nondiscretionary accruals
TA = Total accruals
A = Total assets

2.1.2. DeAngelo Model

In 1986, DeAngelo studied the hypothesis that managers manipulate financial information in order to show the value of shares understated at the time when a publicly held company will be converted to a private company via buying out all the company's stocks from investors. DeAngelo tested this hypothesis using the following model.

$$NDA = TA_{t-1} / A_{t-2}$$

NDA = Nondiscretionary accruals
TA = Total accruals
A = Total assets

2.1.3. Jones Model

Jones (1991), tested whether American companies understated their profit via manipulation of financial information, in order to benefit from the protection of customs such as increase in customs tariffs or restriction of quotas within the sector that the company belongs, at the time that USA Commerce Commission examined their records.

$$TA_{it} / A_{it-1} = \alpha_i [1/A_{it-1}] + \beta_{1i} [\Delta REV/A_{it-1}] + \beta_{2i} [PPE/A_{it-1}] + \varepsilon_{it}$$

TA = Total accruals,
A = Total assets,
ΔREV = Change in Revenues,
PPE = Gross Plant, Property and Equipment

2.1.4. Modified Jones Model

According to Jones (1991) model, not only in the period of manipulation of financial information but also in the period of prediction, the indifference between the decision of nondiscretionary accruals and sales revenue is assumed. According to the study of Dechow, Sloan and Sweeney (1995), this model measures nondiscretionary accruals with errors; therefore, this assumption leads to problems in calculating nondiscretionary accruals. In this regard; instead of using only change in income, the use of change in income will be used by subtracting net change in receivables (current year's receivables minus previous year's receivables). In other words, change in income will be adjusted by taking the change in receivables into consideration. In this context, in modified Jones model, it is implicitly assumed that changes in the amount of sales on credit are generated from the manipulation of financial information. This assumption is based on the acceptance that the use of implicit rights in defining income generated from sales on credit can be implemented easily compared to defining income in cash sales as well as manipulation of financial information can be realized easily via sales on credit (Küçüksözen and Küçükkocaoğlu, 2005).

$$NDA_t = \alpha_1(1 / TA_{t-1}) + \alpha_2[(\Delta REV_t - \Delta REC_t) / TA_{t-1})] + \alpha_3(PPE_t / TA_{t-1})$$

NDA = Nondiscretionary accruals,
TA = Total Assets,
ΔREV = Change in Revenues,
ΔREC = Change in Receivables,
PPE = Gross Plant, Property and Equipment

2.1.5. Industry Model

In parallel to the Jones (1991) model, industrial model loosen the assumption that discretionary accruals are constant. Instead of directly modeling the determinants of nondiscretionary accruals, this model works via the assumption that the change in these determinants are the same in the same sector that all companies belong. This method is based on the use of median values of total accruals calculated through the scaled asset sizes of companies which belong to the same sector, except for the exemplary companies that have been examined.

$$NDA_t = \beta_1 + \beta_2 median_j (TA_t / TA_{t-1})$$

NDA = Nondiscretionary accruals
TA = Total Assets

Dechow, Sloan and Sweeney (1995), tested all the accrual based models leading to the manipulation of financial information. According to the results of their study, Modified Jones model is the strongest model in determining the manipulation of financial information compared to other models above. (Küçüksözen and Küçükkocaoğlu, 2005).

2.2. Mixed Models

The following mixed models which also include total accruals, try to predict earnings management practices via converting financial statement figures into financial ratios and indexes.

2.2.1. Logit and Probit Models

A new point of view has been improved for the determination of companies that manipulate financial information, especially with the innovation of Beneish in 1997. In addition to the use of linear regression in order to determine the change in accruals, Beneish emphasized that probit and logit models which focus on other variables can be used to determine the companies manipulated their financial information. Therefore, Beneish contributed to the earnings management literature in 1997 and 1999.

2.2.1.1. Beneish Model (Probit Model)

In his modeling studies at 1997 and 1997, Beneish emphasize his idea that companies that benefit from the manipulation of financial information do not always use accruals, aggressively. As well as he focuses on the idea that different variables should be used in order to determine the manipulation of financial information in companies. These variables are based on the information located on the financial statements and include characteristics that may help to determine the manipulation of financial information created by companies. Also, they are important to determine whether companies have any transactions contrary to the generally accepted accounting principles.

In his models, the data in the sense of explanatory variables which belong to both companies that manipulate financial information and control companies that are assumed not to manipulate financial information are all part of the probit analysis. Probit analysis is a method of regression analysis that is convenient for dependent variables (M_i; dual variable; value is 1 for manipulators, 0 for control companies) used in the below equation.

In his modeling studies at 1997 and 1999, Beneish find out coefficients for each variable by making probit analysis of the data of control companies as well as companies that manipulate financial information. By using these coefficients, it is possible to calculate whether each company manipulates financial information or not. In this context, if the result of M_i is close to zero, the firm is not a manipulator. Or, if M_i is close to 1, it is a manipulator.

Within the framework of Beneish Model (1997), (1999) (Probit Model)

$$M_i = \beta^i X_i + \epsilon_i$$

M_i= Dummy variable; for companies that manipulate financial information value = 1, companies that do not manipulate financial information value = 0,
β^i = Coefficient for each independent variable within the framework of the model
X_i = Matrix which constitute explanatory variables,
ϵ_i = Error term

Some of the major explanatory (independent) variables in the model;

- Days Sales in Receivables Index (DSRI)
- Gross Margin Index (GMI)
- Asset Quality Index (AQI)
- Depreciation Index (DEPI)
- SG&A Index (SGAI)
- Working Capital Accruals to Total Assets (TATA)
- Sales Growth Index (SGI)
- Days in Inventory Index (DII)
- Abnormal return in stock prices

According to Dechow, Sloan and Sweeney (1996), Beneish model provided the users of financial statements the opportunity to evaluate companies from different aspects by taking the picture of those companies' financial situation and financial performance in addition to the model of Jones (1991) which focuses on manipulation of financial information through receivables. Also, variables used in this model are related not only to the determination of manipulative transactions which took place within the company but also to the determination of intent for future manipulative transactions within the company.

On the other hand, according to Beneish (1997), his model makes Jones model (1991) stronger. With in this context, this model indicates correctly the implementation of financial information manipulation within the companies that use nondiscretionary accruals at great amounts. In this regard, nondiscretionary accruals can take place for the manipulation of financial information as well as for the decision companies towards their strategic goals within the framework of operating activities.

2.2.1.2. Spathis Model (Logit Model)

Different from indexes used in the probit model of Beneish in 1997 and 1999, Spathis focuses on financial ratios in this study in 2002. Instead of probit regression, he implemented logistic regression in his analysis. Accordingly the model which was created by Spathis in 2002 based on the equation below, his model makes logistic regression analysis to control companies and companies that manipulate financial information according to the independent variables.

$$E(y) = \frac{\exp(b_0 + b_1x_1 + b_2x_2 + ...b_nx_n)}{1 + \exp(b_0 + b_1x_1 + b_2x_2 + ...b_nx_n)}$$

In this equation; dependent variable E(y) is equal to 1 for the companies that disclosed false financial information and is equal to 0 for control companies. b_0 shows the value of intersection. $b_1,b_2,\ldots b_n$ constitute the coefficients of independent variables. x_1, $x_2,\ldots x_n$ indicate independent variables below.

FFS = b_0 + b_1(D/E) + b_2(Sales/TA) + b_3(NP/Sales) + b_4(Rec/Sales) + b_5(NP/TA) + b_6(WC/TA) + b_7(GP/TA) + b_8(INV/Sales) + b_9(TD/TA) + b_{10}(FE/GE) + b_{11}(Taxes/Sales) + b_{12} (Altman Z-score)

- Debt/Equity (D/E),
- Sales/Total assets (Sales/TA),
- Net profit/Sales (NP/Sales),
- Receivable/Sales (Rec/Sales),
- Net profit/Total assets (NP/TA),
- Working capital/total assets (WC/TA),
- Gross profit/Total assets (GP/TA),
- Inventories/Total assets (INV/Sales),
- Total debt/Total assets (TD/TA),
- Financial expenses/Operational expenses (FE/GE),
- Taxes/Sales (Taxes/Sales)
- Altman Z-score (Z-score),

In 2000, Spathis made logistic regression analysis of 76 companies using their financial statements at the Athens Stock Exchange. He tried to figure out the ratios to find out the financial statements which do not reflect the reality by using some of the value on the financial statements. According to his analysis, the following ratios have explanatory power in the detection of earnings management practices; Inventories to sales (INV/Sales), Total debt to total assets (TD/TA), and Altman Z Score.

According to a similar study conducted by Küçüksözen and Küçükkocaoğlu (2005) at the Istanbul Stock Exchange listed companies, Net income to total assets and Financing expenses to total operating expenses have some have explanatory power in the detection of earnings management practices.

2.2.2. Multivariate, Multi-Criteria Models

UTADIS methodology, which is being used in financial management, default prevision, credit risk analyses, calculations of country risk, portfolio choice and management etc., was used in determining manipulation of financial information by Spathis, Doumpos and Zopounidis (2004). Spathis, Doumpos and Zopounidis (2004), used the variables which were presented in Spathis' (2002) Logit Model and established a difference curve function, and classified companies as manipulators and non-manipulators through the determination of difference curve function's upper and lower limits. Even though they claim that their study has a %100 success, we believe that the conclusions of their study have a misleading structure due to their methodology, insufficient structure and extent of the database they used in the calculations.

3. Detection of False Financial Statements through Neural Network Models

Rapid advances in computer technology have enabled very complicated calculations to be performed in an instant. Nevertheless, processes like hand-writing, speech, and visual recognition remain a difficult challenge for

computers. This challenge has led scientists to develop alternative data processing systems which differ from the classical approaches used by computer. One of the first steps taken on this issue has been trying to benefit from some of the biological findings related to the operation of the human brain. The structural and operational characteristics of the neural networks inside the human brain are much too complex to be duplicated in terms sufficiently simple to facilitate a useful mathematical model. Studies of the neurophysiologists and psychologists have, however, been helpful in this regard. These types of mathematical models are named neural networks (Sungur, 1995).

Neural network refers to an artificial intelligence technology. It can produce successful results when multiple variables and complicated mutual interactions are present or where multiple solution groups obtain. Because of such features, artificial neural network technology is considered an appropriate means to be used in the financial failure field (Salchenberger, Çınar and Lash 1992; Wilson and Chong 1995; Koh and Tan 1999; Yıldız, 2001).

According to the neurophysiologists and psychologists, artificial neural networks are designed to explain the human brain's functions. On the engineers' side, the artificial neural networks are, before all else, alternative means of performing calculations. However, the bond between these two research motivations is strong. While the neurophysiologic findings constitute a source of inspiration for developing new mathematical models, the results of the studies and implementations made from such developed mathematical models have the ability to direct the neurophysiologic researches.

Robert Hecht-Nelson (1989), the first person to develop commercial artificial neural networks, identifies the artificial neural network as " a data processing system which processes the data by dynamically creating answers to the inputs delivered from outside, which is composed of simple elements associated with each other" (Yıldız, 2001). In another words artificial neural networks can be defined as a parallel and dispersed single or multi layered data processing system which is composed of many simple processor elements (artificial neurons). Each of these neurons has its own memory, capable of transaction, and communicates with other neurons through one-way signal channels (Gülseçen, 1995).

The structure of an artificial neural network, contains three main layers: the input layer where the interconnected nerves are present, the output layer, and the hidden layer.

The first (input) layer enables the intake of the exterior data into the artificial neural network. These exterior data are equivalent to the independent variables in statistics. The last (output) layer's function is to transmit the data out. Output variables are equivalent to the dependent variables in statistics. The other (hidden) layer inside the model is located between the input layer and the output layer. The nerves inside the hidden layer have no attachments

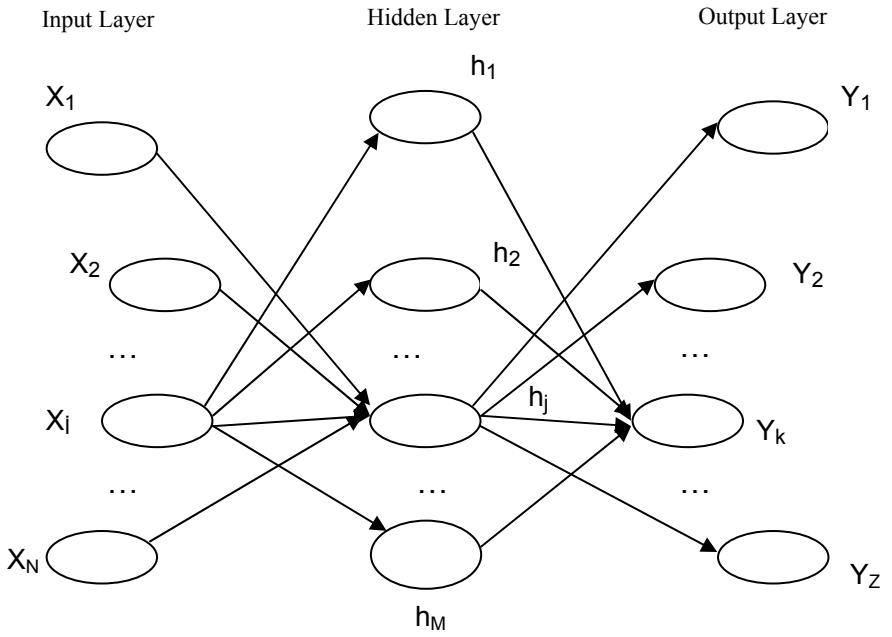
to the exterior environment. They only receive the signals coming from the input layer and transmit signals to the output layer.

The determination of the number of hidden neurons inside the hidden layer is very important. The definition of the size of the network is essential for assessing the performance of the network. Increasing or decreasing the number of the hidden neurons and layers, affects the structure of the network as being complicated or simple.

One of the most important elements inside the artificial neural network is the connection between the neurons enabling them to transmit data to each other. A connection, which enables data transfer from any (i) neuron to any other (j) neuron, has a weighted value (w_{ji}). Weights reflect the relative force that is used as an input inside a neuron. Inside an artificial neural network, each connection has a different weighted value. In this way the weights affect each input of each processor element (Yıldız, 2001).

In Figure 1, inside an artificial neural network structure, the inputs are labeled X, outputs received from the hidden layer are labeled h, and the outputs obtained at the end are labeled Y (Güneri, 2001).

Figure 1: Structure of the Artificial Neural Network



In the artificial neural network model, the weighted values of the connections between the nerves are produced randomly by the SPSS package program. The network is tested by using these values.

The data inside the data set are randomly separated into three parts: the training, validity and test sets. The training set data are used for training the network. The validity set, is used in accordance with the weights of a classifier. The validity set is used to select the number of hidden units inside an artificial neural network. The test set is used for evaluating the performance of the training. The data are allocated 80% to the training set, 10% to the validity set and 10% to the test set.

In order to remove the effect of the measurement unit, the data are standardized such that each data point contributes to the decisions or recommendations equally. The package program used standardizes the data initially. Then, the transition function is (in this study, the sigmoid function) is selected.

The difference between the actual output values and desired output values is measured and depending upon the result, the connection weights of the network model are modified. The return passage resulting from the weights of the connections is realized by the production of the network which starts with the connections of the output layers and ends with the connections of the input layers.

The number of nerves inside a layer can be automatically determined by the networks or can be arranged to be interconnected. In many cases, increasing the number of nerves develops the performance of the multiple layer networks on the training data.

The performance of the validity data is checked in order to evaluate the effect of the number of hidden layers inside a problem. The mean absolute error (MAE) and root mean square error (RMSE) are used to determine the performance of the network structure. The value where the mean absolute error and root mean square error are minimum determines the number of hidden layers to be used. The number of hidden layers was determined to be six to mean absolute error (MAE), four to root mean square error (RMSE).

Threshold value on artificial neural network application is determined 0.50. If the estimation value is greater than the threshold value, then the related companies considered as manipulative financial reporting companies, If smaller then considered as non-manipulative financial reporting companies. After this, these classification values are compared with the actual values, and then correct classification value has been calculated.

For the training of the network, 10.000 iterations were realized. At the end of artificial neural network analysis, correct classification tables for training, validity and test sets were obtained.

3.1. Companies Included In the Analysis

In our study, non-financial 126 Istanbul Stock Exchange listed companies were chosen. Banks, insurance companies and other financial companies were excluded as in other studies. The chosen companies' balance sheets and

income statements corresponding to the years 1992-2002 were analyzed in the context of our study.

Capital Markets Board of Turkey (CMBT), investigated these 126 companies' financial statements corresponding to the years 1992-2002, and detected earnings management practices in 168 observations and no signs of earnings management practices in 1.040 observations. To find out these investigations conducted by CMBT, where manipulation of financial information existed and the cases where manipulation of financial information did not exist, ISE's daily bulletins corresponding the dates between 01.01.1992 - 31.07.2004 and CMBT's weekly bulletins corresponding to the dates between 01.01.1996-31.07.2004 were investigated using some key words (financial statements, balance sheet, income statement, profit, loss, income, cost, audit report, capitalization, and restatement). According to the information gathered from these bulletins, the companies which were determined and announced to the public as having exercised manipulation of financial information as a result of the CMBT's investigations and/or the ones which received qualified audit opinion changing the values in their financial statements about their publicly available financial statements or the companies which had changed the values in their financial statements after balance sheet date were considered as the companies which exercised manipulation of financial information. In addition, the companies which had changed the information in their financial statements prepared to be registered with the Board during the investigations done by CMBT were also considered as the companies which exercised manipulation of financial information.

In the 1.040 observations which were set as control group, there might be companies which exercised manipulation of financial information but the fact is not publicly available because they may not been investigated by CMBT or the fact that they had not been closely examined by their auditors. Nonetheless, this condition is considered as type 1 error as in all other studies.

3.2. Definition of Variables and Data Resources

Most of the following explanatory (independent) variables in the model were picked from Beneish's studies (1997), (1999)[5];

i. Sales Growth Index (SGI)
ii. Days Sales in Receivables Index (DSRI)
iii. Gross Margin Index (GMI)
iv. Asset Quality Index (AQI)
v. Depreciation Index (DEPI)

[5] The explanation based on the calculation of indexes and proportions are given in the Appendix of our study. The data set and explanations related to 10 independent variables determined for our study are taken from the studies of Küçüksözen (2005) and Küçüksözen and Küçükkocaoğlu (2005).

vi. Sales, General and Administrative Expenses Index (SGAI)
vii. Leverage Index (LVI)
viii. Total Accruals to Total Assets Index (TATA)
ix. Days in Inventory Index (DII)
x. Financial Expenses Index (FEI)

As we have mentioned in previous paragraphs, Beneish in 1997 and 1999, pointed out that companies that benefit from the manipulation of financial information do not always constitute the companies which use accruals aggressively. Beneish emphasized the idea that different variables are required to estimate manipulation on financial information. These variables have necessary characteristics not only to determine companies' manipulations realized by using financial statements but also to figure out any illegal transactions of companies based on generally accepted accounting principles.

In this context, the independent variables that have been chosen for our study are mainly the same ones used by Beneish in 1997 and 1999. In addition to these variables, the following variables adopted to the artificial neural network model has been created by Küçüksözen and Küçükkocaoğlu in 2005; the proportion of inventory to sales (INV/Sales) and the proportion of financial expenses to sales (FEI/Sales), are given emphasis on this study as well.

For the analysis of artificial neural network, it was benefited from Neural Connection programming.

3.3. The Empirical Results

In the artificial neural network analysis, the model of the problem includes 10 input layers, due to 10 independent variables. In other words, the model is constituted by the indexes and the financial ratios used in the definition of the variables and data resources, so in the input layer ten neurons exist. In the output layer, due to the firms' classification that whether or not making manipulation of financial information, there is an output layer. Thus, only one neuron exists.

To be able to define the numbers of hidden layers, firstly, the hidden layer number is taken 1 and the errors are calculated for the 10-1-1 model. After these calculations, the number of hidden layers is increased and the mean square error (MSE) and the mean absolute error (MAE) of the data validity are calculated. The results are shown in Table 1.

Table 1: The Results of the Models Used In the Determination of the Number of the Hidden Layers

Model	MSE	MAE
10-1-1	0.305868	0.208335
10-2-1	0.307067	0.211865
10-3-1	0.306856	0.211334
10-4-1	**0.304201**	0.210488
10-5-1	0.307615	0.208804
10-6-1	0.304297	**0.206663**
10-7-1	0.307096	0.209142

Analyzing the Table 1, we can see the mean square error of the one hidden layer model (10-1-1) is 0.305868. While increasing the number of hidden layers, mean square error is increasing after the forth hidden layer. Thus, 4-hidden layer model (10-4-1) is chosen to constitute the prediction model due to its lowest mean square error.

Looking at the mean absolute error, we can see the mean absolute error of the 1 hidden layer model (10-1-1) is 0.208335. The 6 - hidden layer model (10-6-1 model) is chosen because it has the lowest mean absolute error.

As increasing the number of hidden layers, the network performance is also increasing because it shows the new characteristics of the every new hidden layer data set. It is possible to see a decrease in adding too much layer. The reason of this is the loss in the general power and the noise is going to be learned from the network data. Making error measurement from the validity data, we can decrease the danger of excess learning (Neural Connection, 1997; Güneri, 2001).

For the training of the network, 10.000 iterations are realized. The 80% of the data is training set, the 10% is validity set, and the 10% is test set. Thus, 966 data belongs to training set, 121 data belongs to validity set, and 121 data belongs to test set. To constitute the prediction model, 4- hidden layer model (10-4-1) and 6- hidden layer model (10-6-1) are treated for training, validity and test set, and the classification tables are determined. The results are shown in the tables below.

3.3.1. The Results of Four- Hidden Layer Model

Table 2: Classification of the Model for the Training Set (10-4-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**831**	**1**	**832**
manipulative financial reporting companies (1)	**132**	**2**	**134**
Total	**963**	**3**	**966**

Correct classification percentage for the training set is calculated as 86.231888. Incorrect classification percentage is 13.768116.

Table 3: Classification of the Model for the Validity Set (10-4-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**108**	**0**	**108**
manipulative financial reporting companies (1)	**13**	**0**	**13**
Total	**121**	**0**	**121**

Correct classification percentage for the validity set is calculated as 89.256195. Incorrect classification percentage is 10.743802.

Table 4: Classification of the Model for the Test Set (10-4-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**100**	**0**	**100**
manipulative financial reporting companies (1)	**21**	**0**	**21**
Total	**121**	**0**	**121**

Correct classification percentage for the test set is calculated as 82.644630. Incorrect classification percentage is 17.355371.

When we combine the results for training, validity and test set, we have Table 5 according to artificial neural network applications.

Table 5: Classification of the Model According To Artificial Neural Network Applications (10-4-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**1039**	**1**	**1040**
manipulative financial reporting companies (1)	**166**	**2**	**168**
Total	**1205**	**3**	**1208**

The general correction percentage according to artificial neural network applications is found as 86.175496. Incorrect classification percentage is 13.824503.

When we want to predict future situation of a new company added to the model, according to the artificial neural network application, the probability of prediction being correct is 86.175496 %.

3.3.2. The Results of Six-Hidden Layer Model

Table 6: Classification of the Model for the Training Set (10-6-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**832**	**0**	**832**
manipulative financial reporting companies (1)	**134**	**0**	**134**
Total	**966**	**0**	**966**

Correct classification percentage for the training set is calculated as 86.128365. Incorrect classification percentage is 13.871635.

Table 7: Classification of the Model for the Validity Set (10-6-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**108**	**0**	**108**
manipulative financial reporting companies (1)	**13**	**0**	**13**
Total	**121**	**0**	**121**

Correct classification percentage for the validity set is calculated as 89.256195. Incorrect classification percentage is 10.743802.

Table 8: Classification of the Model for the Test Set (10-6-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**100**	**0**	**100**
manipulative financial reporting companies (1)	**21**	**0**	**21**
Total	**121**	**0**	**121**

Correct classification percentage for the test set is calculated as 82.64463. Incorrect classification percentage is 17.355371.

When we combine the results for training, validity and test set, we have Table 9 according to artificial neural network applications.

Table 9: Classification of the Model According to Artificial Neural Network Applications (10-6-1)

Actual \ Prediction	non manipulative financial reporting companies (0)	manipulative financial reporting companies (1)	Total
non manipulative financial reporting companies (0)	**1040**	**0**	**1040**
manipulative financial reporting companies (1)	**168**	**0**	**168**
Total	**1208**	**0**	**1208**

The general correction percentage according to artificial neural network applications is found as 86.092715. Incorrect classification percentage is 13.907284.

When we want to predict future situation of a new company added to the model, according to the artificial neural network application, the probability of prediction being correct is 86.092715 %.

Both the results of 4-hidden layer model and 6-hidden layer model are summarized in Table 10.

Table 10: Four-Hidden Layer and Six- Hidden Layer Artificial Neural Network Models

10-4-1 (General Correction %)	10-6-1 (General Correction %)
86.175496	86.092715
10-4-1 (Incorrect Classification %)	10-6-1 (Incorrect Classification %)
13.824503	13.907284

The predicting power of a 4- hidden layer model (% 86.175496) is higher than the predicting power of 6-hidden layer model (% 86.092715), and incorrect classification percentage of the 4-hidden layer model (%13.824503) is lower than 6-hidden layer model. As a result of this, 4- hidden layer model is chosen as an artificial neural network model.

IV. Conclusions

The models presented in the literature, try to determine manipulated financial information through separating the companies into two groups one of which contains companies having exercised manipulation of financial information and the other one of which contains companies not having exercised manipulation of financial information.

With in this context, Küçüksözen and Küçükkocaoğlu's probit model (2005), which is based on Beneish Model and uses the database that is included in this study, is designed to estimate the probability of financial information based manipulation per company through calculating the values related with the independent variables corresponding to the years between 1993-2002 for each 126 listed companies and applying these values to the equation which is generated using data of year 1997. In fact, according to the results of probit model, Küçüksözen and Küçükkocaoğlu could estimate %38 (range between %33-57) of the companies having exercised manipulation of financial information and %61 (range between %43-74) of the companies not having exercised manipulation of financial information (control group). These ratios are similar to the ratios that exist in Beneish's (1999) study, especially

the ones for the companies having exercised manipulation of financial information.[6]

In this study, the companies having exercised manipulation of financial information and the companies not having exercised manipulation of financial information were separated using an artificial neural network model. According to our findings, the probability of true prediction could be %86.17 and the probability of false prediction could be %13.82. Even though these findings cannot be compared with the ones of probit model, we think that artificial neural network model enables us estimating true classification with a high probability. So we think that this model should be taken into consideration when detecting companies which exercise manipulation of financial information.

In conclusion, when the variables that are necessary to find out manipulation of financial information are known, artificial neural network approach could be used for determining the companies which will exercise manipulation of financial information.

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Appendix

The functions and calculation methods of 10 independent variables that have been determined for our empirical study are explained below[7].

Sales Growth Index (SGI)

$$(SGI) = \frac{\text{Gross Sales}_{t}}{\text{Gross Sales}_{t-1}}$$

can be calculated as above. Sales growth does not necessarily prove the manipulation of financial information. According to the professionals, growing companies that take sales growth into account are more inclined to manipulation of financial information compared to other companies; because, the structure of debt/equity and the needs of resources create pressure on managers in order to increase sales in these companies. If a decrease in the prices of common stock is observed related to slowing down on growth of these companies, the more pressure will be seen on managers in order to manipulate financial information in such a case.

Days Sales in Receivables Index (DSRI)

$$(DSRI) = \frac{\text{Receivables}_{t} / \text{Gross Sales}_{t}}{\text{Receivables}_{t-1} / \text{Gross Sales}_{t-1}}$$

can be calculated as above. This index shows the change in trade receivables at time t by comparing them at time t-1 according to sales. As long as there is no extreme change in the policy of credit sales of the company, this index is expected to have a linear structure. An important increase in this index is based not only on the accountancy of consignment sales recorded as trade receivables and sales toward the increase in income as well as profit of the company but also on the creation of trade receivables from current accounts of group companies. These two applications are considered as the indicators of the manipulation of financial information.

Gross Margin Index (GMI)

$$(GMI) = \frac{(\text{Gross Sales}_{t-1} - \text{Cost of Goods Sold}_{t-1}) / \text{Gross Sales}_{t-1}}{(\text{Gross Sales}_{t} - \text{Cost of Goods Sold}_{t}) / \text{Gross Sales}_{t}}$$

[7] The data set and explanations related to 10 independent variables determined for our study are taken from the studies of Küçüksözen (2005) and Küçüksözen and Küçükkocaoğlu (2005).

Can be calculated as above. If the index is greater than 1, it indicates that gross margin of the company is getting worsen. This indicator is a negative sign for future expectations of the company. In order to forward gross margin into a positive direction, it is assumed that companies will apply for manipulation of financial information within the objective of creating a picture of increase in sales revenue or decrease in cost of sales or both.

Asset Quality Index (AQI)

$$(\text{AQI}) = \frac{(1 - \text{Current Assets}_{t} + \text{PPE}_{t}) / \text{Total Assets}_{t}}{(1 - \text{Current Assets}_{t-1} + \text{PPE}_{t-1}) / \text{Total Assets}_{t-1}}$$

can be calculated as above. This index shows the change in other non current assets except current assets and plant, property and equipment within total assets by compared to previous year. If this index is greater than 1, it is an indicator that the company will capitalize its expenses instead of writing them as current period expenses on the income statement. In this context, this situation is considered as manipulation of financial information. Therefore, it is expected a positive correlation between asset quality index and financial information manipulation.

Depreciation Index (DEPI)

$$(\text{DEPI}) = \frac{\Delta\text{Depreciation}_{t-1} / (\Delta\text{Depreciation}_{t-1} + \text{PPE}_{t-1})}{\Delta\text{Depreciation}_{t} / (\Delta\text{Depreciation}_{t} + \text{PPE}_{t})}$$

can be calculated as above. In our study, depreciation expenses were not directly calculated by using data from balance sheet and income statement. For this reason, depreciation expense of any period is determined as the difference between accumulated depreciation of current period and accumulated depreciation of previous period. This amount may create difference in terms of current period's depreciation expense. In this context, in depreciable assets, the change in current period will vary the amount of accumulated depreciation without affecting depreciation expense very much. Also, as it is mentioned below, this approach is going to be more appropriate to calculate depreciation expense by considering that these companies belong to reel sector as well as there is no big change in their depreciable assets.

If this proportion is greater than 1, this situation indicates that the company decreases its depreciation expenses in order to declare high profit by considering that the expected useful life of plant, property and equipment will

be lengthened or the method of depreciation will be changed in such a way to reduce expenses.

On the other hand, it is expected that this index will not change very much by considering that companies which constitute our study are manufacturing companies in reel sector. In manufacturing industry, it is not expected that depreciable assets of these companies will increase or decrease very much in the context of purchases and sales. By taking this factor into account, if an important increase is observed on this index on a yearly basis, this situation is accepted as an indicator of financial information manipulation. For this reason, it is assumed that there is a positive correlation between depreciation expenses and financial information manipulation in our model.

Sales, General and Administrative Expenses Index (SGAI)

$$(\text{SGAI}) = \frac{(\text{Mkt. Sales Expenses}_{t} + \text{Gen. Adm. Expenses}_{t}) / \text{Gross Sales}_{t}}{(\text{Mkt. Sales Expenses}_{t-1} + \text{Gen. Adm. Expenses}_{t-1}) / \text{Gross Sales}_{t-1}}$$

can be calculated as above. It is expected that there is a correlation which will not change for a long time between marketing, sales, distribution and general administrative expenses and sales. These expenses will change according to main activities of the company; in other words, these expenses are variable expenses based on change in sales. In this context, it is accepted that sales are manipulated or expenses are under priced in case of important changes which take place in this variable, in other words, in case of an significant decrease in the proportional relationship between sales and these expenses, as long as there is no important increase in efficiency. Within the framework, it is assumed that there is a positive correlation between this index and financial information manipulation.

Leverage Index (LVI)

$$(\text{LVI}) = \frac{(\text{Long Term Debt}_{t} + \text{Short Term Debt}_{t}) / \text{Total Assets}_{t}}{(\text{Long Term Debt}_{t-1} + \text{Short Term Debt}_{t-1}) / \text{Total Assets}_{t-1}}$$

can be calculated as above. If this variable is greater than 1, it indicates that the proportion of obligation of the company has been increased. The reason behind this variable being in this model is to determine the manipulation of financial information applications which will provide the opportunity to get rid of any conditions on not meeting company's obligations.

Total Accruals to Total Assets Index (TATA)

$$(\text{TATA}) = \frac{\begin{array}{l}\Delta\,\text{Current Assets} - \text{Cash and Marketable Securities} - (\Delta\,\text{Short Term Debt} \\ - \Delta\,\text{Current Portion of the Long Term Debt} \\ - \Delta\,\text{Deferred Taxes and some other Legal Laibilities}) \\ - \text{Depreciation Expenses}_{t}\end{array}}{\text{Total Assets}_{t}}$$

can be calculated as above. When we calculate total assets index in such way, this shows the change in between debt-receivables and revenue-expense items within the framework of accrual basis and based on company's administrative initiatives. The reason behind this variable being in this model, is to determine any manipulation of financial information applications based on increase in revenue or decrease in expense or vice versa within the framework of accrual basis. In this context, if this variable, in other words, non-cash working capital increases or decreases dramatically, it is assumed that manipulation of financial information takes place.

Days in Inventory Index (DII)

$$(\text{DII}) = \frac{\text{Inventory}_{t} / \text{GrossSales}_{t}}{\text{Inventory}_{t-1} / \text{GrossSales}_{t-1}}$$

can be calculated as above. In order declare low or high profit, company's managers change general production overheads, cost of goods sold or inventory valuation methods such LIFO, FIFO or Weighed Average.

Financial Expenses Index (FEI)

$$(\text{FEI}) = \frac{\text{Financial Expenses}_{t} / \text{Gross Sales}_{t}}{\text{Financial Expenses}_{t-1} / \text{Gross Sales}_{t-1}}$$

can be calculated as above. In Turkey, one of the most often situation that we face on manipulation of financial information is to capitalize financing expenses by adding into accounts receivable, inventory, next year's expenses, associates, plant, property and equipment, intangible assets, and/or continuing investments instead of recording financing expenses as current period expenses on the income statement. In this regard, company's managers will be

able to reach their own final results by capitalizing important portion of financing expenses by increasing profit. Or, to decrease profit, they will record financing expenses as current period expense. Due to the flexible structure of tax law on the subject of recording financing expenses as expense for current period or capitalizing them, the applications of financial information manipulation are enchained. Within this framework, it is assumed that there is a correlation between this index and manipulation of financial information.

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IMPACT OF AUDIT OPINIONS ON STOCK RETURNS IN ISTANBUL STOCK EXCHANGE (ISE)

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Abstract
The purpose of this study is to analyze the impact of audit opinions on stock returns in the Istanbul Stock Exchange (ISE). In this sense, abnormal returns are calculated in order to see the reaction of the market to audit opinions around the issuance date. Data used in the study were obtained from the audit reports of 2004 and 2005 for randomly selected 101 companies traded in the ISE. We have used the event study methodology in our work, and maintain that the capital market is efficient at the intermediate level.

Based on the empirical findings, investors obtained abnormal or excess returns over the event window. It is also concluded that unqualified and qualified audit opinions do provide different information to investors. It should be also indicated that the perception of investors to audit reports in different time periods are dissimilar. Overall, from the findings it can be concluded that the ISE cannot be classified as a semi-strong form efficient market.

I. Introduction

Reliable information and transparent reporting are of importance for investors, managers, creditors, and regulators. Investors make use of financial statements in their decision making process. Therefore, information unveiled via financial statements must reflect the true status of a firm. External auditing is the process of evaluating financial statements and reporting the results to the public. Hence, external auditing plays a significant role for both private and public sectors as a reliable and independent source of information (Messier, 1997).

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According to the communiqué of Capital Markets Board of Turkey external (independent) auditing is defined as to report on financial statements of corporations and institutions of capital markets by auditors whether or not financial statements are consistent with the Generally Accepted Accounting Principles (GAAP), and reflect the true information.

External auditing in Turkey started in 1987 with banking sector. Then, Capital Markets Board of Turkey issued "Independent External Auditing in Capital Markets" guide dated on 13 December 1987. Later on, with various communiqués the scope of auditing was extended to publicly traded companies. As of 2006, external auditing has become mandatory for most of the companies in Turkey. The Article 5 of communiqué Serial: X, No:22 published in Official Gazette dated on 12 June 2006 has declared the firms that are subject to external auditing.

The Capital Markets Board of Turkey has also assessed the eligible auditing firms. As of June 2006 total amount of 92 auditing firms have been authorized for external auditing in Turkey. According to communiqué Serial XI, No:1 companies which their stocks are traded in stock exchange must submit the auditing reports and financial statements within 10 weeks following the end of the accounting period. In addition to that, financial statements and audit reports must be declared in a national newspaper within 30 days following the annual general meeting. The national gazettes declared audit reports must be submitted to The Capital Markets Board of Turkey within 6 days after its declaration. In order to prevent conflict of interest among external auditors and to provide reliability of financial reporting; auditing and consulting services were separated, and rotation of external auditing firms and establishing audit committees have become mandatory for firms in Turkey (The Capital Markets Board of Turkey, 2006).

Information that is made publicly available with auditing reports may influence the investors' decisions. Investors price assets based on the information available to them. Besides other factors, audit report is one of the sources of information (Madhavan and Smidt, 1991; Grossman, 1992; Huang and Stoll, 1994; Chan and Lakonishok, 1995; Keim and Madhavan 1996). The reflection of information to the prices is connected to the efficiency of the markets. Efficient Market Hypothesis (EMH) classifies markets as weak form efficient, semi-strong form efficient and strong form efficient. In a semi-strong form efficient market stock prices incorporate completely and instantaneously all publicly available information (Fama, 1970). Publicly available information contains all information available in newspapers, bulletins, web sites, and so on. Based on the EMH, because stock prices incorporate completely and instantaneously all new information that comes to the market, it is not possible to have abnormal or excess returns. On the other hand, investors may have abnormal or excess returns in markets that are not

efficient. In this sense, analysis of market reaction to audit reports can be a test of semi-strong form efficiency of a market.

II. Audit Opinions

Auditors issue results of auditing to public via audit reports and disclose four types of audit opinions in their reports. Audit reports can be classified as unqualified audit report for unqualified opinion, qualified audit report for qualified opinion, disclaimer audit report for disclaimer opinion, and adverse audit report for adverse opinion (Messier, 1997).

Auditors declare unqualified audit opinion if there are no departures regarding to Generally Accepted Accounting Principles (GAAP), scope limitation, and going concern. If there are any departures on above-mentioned issues, different types of audit opinions can be declared based on the significance level of the departures shown in Table 2.1.

Table 2.1: Types of Audit Opinions Based on Significance Level of Departure

Departures	Significance Level of Departure		
	Immaterial	**Material**	**Pervasively Material**
Generally Accepted Accounting Principles (GAAP) * Full Disclosure * Consistency	Unqualified Opinion	Qualified Opinion	Adverse Opinion
Scope limitation	Unqualified Opinion	Qualified Opinion	Disclaimer Opinion
Going Concern			

Source: Güredin, (2000).

As can be seen from the Table auditor declares unqualified audit opinion if there are immaterial departures with regard to GAAP, scope limitation, and going concern. Conversely, if there are material departures then auditor declares qualified audit opinion. Pervasively material departures related to GAAP, scope limitation and going concern lead auditors to declare adverse opinion, and disclaimer opinion, respectively.

Capital Markets Board of Turkey declared types of external audit reports and audit opinions in the Article 35 of communiqué No:16 published in Official Gazette (No:22570) dated on 04 March 1996 and it is consistent with Table 2.1.

III. Literature Review

Audit reports may be useful information sources for investors in their investment decisions. If auditor issues unqualified opinion in his/her report, investors may perceive this as favorable information, and therefore, reflect this positively to stock prices around audit report dates. In contrast, qualified, disclaimer and adverse opinions may influence stock prices negatively. Consequently, analysis of impact of audit opinions on stock returns will indicate whether or not investors can have abnormal returns. Particularly, in literature review that we have conducted in this study showed us that there is no empirical study on this topic for Turkish stock market, namely, Istanbul Stock Exchange (ISE). All of these reasons have convinced us to conduct this study and to test empirically how far the audit opinions effect the key decisions taken by investors in ISE.

Based on our literature review, the following conclusions were reached by several studies on the capital market reaction to audit reports and opinions: Womack (1996) concluded that generally positive and negative information disclosed to public effects decisions taken by investors. Chen *et al*. (2005) point out that change of auditors and audit opinions influence the investment decisions. Bomber and Stratton (1997) in their study on banking sector reached the conclusion that creditors take audit reports into account during their lending process. Taffler *et al.* (2004), Carlson *et al* (1998) discussed that going concern announcements in audit reports were evaluated by market players for a long period of time. On the contrary, Kennedy and Shaw (1998) stated that audit opinions have almost no information content during investment decision process. Chow and Rice (1982b) determined that there is a relationship between qualified audit opinion and the change of audit firm by the client. Lin *et al*. (2003) concluded that creditors perceive qualified audit opinions having a negative effect on reliability of companies.

Others studies specifically focused on the impact of audit opinions on stock returns. According to some of these studies, the market is able to anticipate the information disclosed in the audit report before it is available to public and this is discounted in the stock price before it becomes known. Consequently, the opinions and information disclosed via audit reports are irrelevant and not particularly useful. Especially, Anglo-American studies have showed that audit reports do not provide information to investors. Whittred (1980), Elliott (1982), Davis (1982), Dodd et al. (1984) concluded that investors already have knowledge of information content which they obtain from other sources. Therefore, stock returns are not influenced by the opinions and information disclosed via audit reports. Loudder *et al.* (1992) determined that there is no significant relationship between audit opinions and stock returns when capital market perceives departure from unqualified audit reports. Taffler *et al.* (2004), Carlson *et al* (1998) reached the conclusion that

going concern announcements in audit reports do not affect stock returns. According to the study conducted by Pucheta *et al.* (2004) qualified audit reports do not provide information content to investors and do not change stock prices in Spanish stock market.

Contrary to above discussion, some of the studies carried out in different periods suggest that opinions disclosed via audit reports have impact on stock returns (Chakravarty, 2001; Chow and Rice, 1982a). Fleak and Wilson (1994), Chen *et al.* (2000) computed negative abnormal returns as a result of opinions disclosed via audit reports. Chen and Church (1996) argue that the expectation of sharp decreases in stock prices is less for the companies, which take going concern qualifications. In addition, stock returns of companies with disclaimer audit opinions are more influenced by the disclosure of audit reports than that of companies with qualified audit opinions (Frost, 1994).

Based on all discussions above, it may be relevant to say investors are able to gain abnormal returns by using the information and opinions disclosed via audit reports. However, we did not encounter with any empirical study that dealt with the impact of audit opinions on stock returns for Turkish stock market in our literature survey. On the other hand, the impact of different events on stock returns, have been investigated by various researchers for Turkish stock market. For example, Mandacı (2003), Mandacı (2004), Çukur and Eryiğit (2006) analyzed impact of national elections, merger and acquisitions, bank merger and acquisitions on ISECI-100 index and stock returns, respectively. These studies concluded that investors gain abnormal returns around the dates of information released. Particularly, Tufan and Hamarat (2006) analyzed the effect of the weather on Istanbul Stock Exchange Composite Index (ISECI-100) returns and concluded that snowy days are influential. Yörük and Ban (2006), Şamiloğlu (2005) focused specifically on the food and leather sector in order to investigate the effects of mergers, and financial ratios on stock returns, respectively.

The purpose of this study is to analyze the impact of audit opinions on stock returns in ISE. In this sense, abnormal returns will be calculated in order to see the reaction of the market to audit opinions around the issuance date. Therefore, this study aims to fill the gap in the Turkish literature. We have used the event study methodology in our work, and maintain that the capital market is efficient at the intermediate level. This means that stock prices incorporate completely and instantaneously all new information that comes to the market (Fama, 1970; McWilliams and Siegel, 1997).

IV. Data, Methodology and Hypotheses

Data used in the study include the audit reports of 2004 and 2005[1] for randomly selected 101 companies traded in ISE, daily closing stock prices of those companies and daily closing ISECI-100 index values. We reached the audit reports (issuance dates, and types of audit opinions) of the selected companies from the web site of ISE. Daily closing index values for Istanbul Stock Exchange Composite Index (ISECI-100) and stock prices were obtained from the database and daily bulletins of ISE[2].

As mentioned in the previous section, our event study is to analyze the impact of audit opinions on the stock returns of the companies concerned. The event studies, which are based on the stock price changes, measure financial impact of a change in corporate policy, leadership or ownership more effectively than a methodology based on accounting returns. Furthermore, the event study method relatively easy to implement, because the only data necessary are the name of publicly traded firms, event dates, and stock prices (McWilliams and Siegel, 1997). The use of the event study methodology requires analyzing the definition of the event, the date on which event takes place, and the event window.

In our study, the event is identified as the issuance of audit reports, and event date is considered as the date of issuance. Using a long event window may severely reduce the power of the test statistics, therefore, lead to false inferences about the significance of an event. In addition short event window usually captures the significant effect of an event (Ryngaert and Netter, 1990). Because of these reasons in this study we have chosen event window length[3] as (-10,+10).

The event study method was developed to measure the effect of an anticipated event on stock prices. The standard approach is based on estimating a market model for each company[4] in calculating abnormal returns. These abnormal returns assumed to reflect the stock markets reaction to the arrival of new information. For a company "*i*" the abnormal return will be:

$$AR_{it} = R_{it} - E(R_{it}) \qquad (1)$$

[1] Audit reports for accounting periods 2004, and 2005 were issued in 2005 and 2006, respectively.
[2] For each company audit report issuance date is different, daily closing index values and stock prices were constructed with respect to event date.
[3] Most of the studies based on event study methodology the event window length is chosen as (-10,+10).
[4] In order to calculate abnormal returns Arbitrage Pricing Model (APT) can also be used.

Where, AR_{it} is the abnormal return of stock i at time t; R_{it}, is the actual return of stock i at time t; $E(R_{it})$ is the expected return for i at time t.

To calculate abnormal returns first we have to calculate actual and expected returns for each company under consideration. The following equation (Equation 2) can be used to calculate actual returns:

$$R_{it} = \frac{P_{it} - P_{it-1} + D_{it}}{P_{it-1}} \quad (2)$$

where R_{it}, is the actual return of stock i at time t; P_{it} is the daily closing price of stock i at time t; P_{it-1} is the daily closing price of stock i at time $t-1$; D_{it} is the dividend paid on share i at time t.

To calculate the expected returns, we used the market model. The market model is a statistical model that relates the return of a stock to the return of the market. The market model for a stock i is as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (3)$$

where R_{it} is the return of stock i at time t; R_{mt} is the actual return of the market at time t; α_i is the intercept term; β_i is the systematic risk of stock i, ε_{it} is the error term with $\left[E(\varepsilon_{it}) = 0, Var(\varepsilon_{it}) = \sigma_\varepsilon^2\right]$. The α_i and β_i parameters will be estimated by means of Ordinary Least Squares (OLS) for each stock. We use the Istanbul Stock Exchange Composite Index (ISECI-100) values to calculate actual market returns. The actual market returns will be calculated with Equation 4.

$$R_{mt} = \frac{I_t - I_{t-1}}{I_{t-1}} \quad (4)$$

where I_t, I_{t-1} are the daily closing values of ISECI-100 at times t and $t-1$, respectively.

Before estimating the market model, it is necessary to define the estimation window and event window. We have established 150 day estimation window (-161,-11) and 21 day event window (-10,+10) in order to calculate abnormal returns for each stock. Then the expected returns, $E(R_{it})$, over the event window will be:

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i R_{mt} \quad (5)$$

After calculating expected returns, abnormal returns can be calculated with the help of Equation 6 over the event window.

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \quad (6)$$

The abnormal returns can then be cumulated over a number of days, k (the event window), to derive a measure of the cumulative abnormal return (CAR) for each company:

$$CAR_i = (1/k^{0,5}) \sum_{t=1}^{k} AR_{it} \quad (7)$$

Thus, the average cumulative abnormal returns across n companies $(ACAR)$ over the event window can be calculated as:

$$ACAR_i = 1/n \sum_{i=1}^{n} \frac{CAR_{it}}{\sigma_i} \quad (8)$$

The test statistic is used to assess whether the average cumulative abnormal return is significantly different from zero. If the result of test statistic is significant, the cumulative abnormal return is assumed to measure the average effect of the event on the value of the n companies. In our study both average abnormal returns and average cumulative abnormal returns will be calculated and tested whether or not the abnormal returns are significantly different from zero over the event window. To do that, we propose the following several hypotheses:

Hypothesis 1:

H_0: Over the event window average and average cumulative abnormal returns are equal to zero.

$$AAR_{all} = 0\,,\ ACAR_{all} = 0$$

This hypothesis may be considered as a general hypothesis because it can be divided into several sub-hypotheses to see the effect of unqualified and qualified audit opinions on stock returns. The following two hypotheses are formulated on this ground. Our intention here is to focus on the effect of unqualified and qualified opinions because almost all of the audit reports have been issued as either unqualified opinion or qualified opinion over the analysis period.

Hypothesis 2:
H_0: Average and average cumulative abnormal returns of stocks, which their audit reports are issued with "unqualified" opinions, are equal to zero.

$$AAR_{unqualified} = 0\,,\ ACAR_{unqualified} = 0$$

Hypothesis 3:
H_0: Average and average cumulative abnormal returns of stocks, which their audit reports are issued with "qualified" opinions, are equal to zero.

$$AAR_{qualified} = 0\,,\ ACAR_{qualified} = 0$$

Hypothesis 4:
H_0: Audit reports with unqualified opinion do not provide investors with information content different from that of audit reports with qualified opinions.

$$AAR_{unqualified} = AAR_{qualified}\,,$$

This hypothesis may be considered as whether or not the investors perceive the information differently from unqualified and qualified audit opinions.

Hypothesis 5:
H_0: Audit reports do not provide investors information different from the audit reports of the previous year.

$$AAR_t = AAR_{t-1}\,,$$

This hypothesis may be considered as to figure out whether different periods provide similar information or not.

V. Empirical Findings

Based on the empirical findings of this study 10 days before and 3, 4, 7, and 8 days after the issuance of audit reports, it has been detected that there are statistically significant abnormal returns in 2005 as well as 1 day before the issuance date in 2006. Table 5.1 illustrates the results of statistical tests and average abnormal returns over the event window.

On Table 5.2, it has been detected that companies with unqualified audit reports have abnormal returns after the issuance date in 2006. Similarly, in 2005 investors obtained statistically significant abnormal returns 10 days before and 1, 4, and 7 days after the issuance date. However, while the effect of unqualified audit opinion was expected positive, abnormal returns turned out to be negative in years 2005, and 2006. In this case, it is reasonable that investors might have overestimated positive developments and reflected this to stock prices. Thus, over the event window they might have adjusted stock prices.

Table 5.3 shows the average abnormal returns and test statistics of companies with qualified audit opinions. Over the periods concerned in the study abnormal returns have been calculated only after the issuance dates of audit reports. In year 2005 abnormal returns occurred 1 and 8 days after the released of the audit opinions whereas it took place after 4 and 6 days in year 2006. It can be interpreted from Table 5.3 that investors' reactions were different over the event window in 2005 such that while the statistically significant average abnormal return was positive 1 day after the issuance dates, it turned out to be negative 8 days after the issuance dates. In year 2006 statistically significant average abnormal returns were both negative. Negative (positive) average abnormal returns can be interpreted as more optimistic (pessimistic) perception of investors about the companies concerned before the issuance of qualified audit opinions, and then an adjustment was made after the released of qualified opinions.

In the light of results of test statistics, it can be concluded that unqualified and qualified audit opinions reveal information to investors in ISE. Thus, Hypothesis 1, Hypothesis 2, and Hypothesis 3 are rejected.

The cumulative abnormal return is assumed to measure the average effect of the event on the value of the n companies. Table 5.4 shows average cumulative abnormal returns over the event period. Interestingly, we did not coincide any statistically significant average cumulative abnormal returns over the event window in 2006. However, in year 2005 significant average cumulative abnormal returns for different window lengths have been calculated.

Table 5.5 shows the average cumulative abnormal returns for the companies with unqualified audit opinions. As can be seen, statistically significant average abnormal returns occurred over the (-1,+1) and (0,+9) event windows in 2006. Similarly, there are much more significant average cumulative abnormal returns in 2005 when compared to 2006.

Table 5.6 shows that statistically significant average abnormal returns occurred over the (-1,+1) event window. Therefore, it can be derived that investors react to qualified audit opinions in a very short period of time. Empirical evidence present that investors react to qualified audit reports quicker than to unqualified audit opinions.

Hypothesis 4 was established in order to see whether or not audit reports with unqualified opinion provide investors with information content different from that of audit reports with qualified opinions. The results in Table 5.7 indicate that unqualified and qualified audit opinions do provide different information content to investors. Thus, Hypothesis 4 is also rejected.

This study also adds further empirical evidence to uncover if there is any different impact of audit opinions on stock returns in different time periods. Table 5.8 shows that investors' perceptions are not same to the information contents of audit opinions over different periods. This may be because of different points concerned in terms of the context of the audit reports even though the audit opinions are similar in different periods.

VI. Conclusion

Information that is made publicly available with auditing reports may influence the investors' decisions. Auditors may issue unqualified, qualified, adverse, and disclaimer opinions based on analysis of financial statements of companies. Various studies were conducted in order to analyze if audit opinions provide information to investors. Some of these studies reached the conclusion that audit opinions do influence stock returns while the others don't.

In this empirical study our general conclusion is that audit opinions do provide information to investors. In general, the following conclusions can be derived from results of our study based on the five hypotheses formulated:

Investors do obtain abnormal or excess returns over the event window in 2005 and 2006. Empirical evidence show that 10 days before and 3, 4, 7, and 8 days after the issuance of audit reports it has been detected that there are statistically significant abnormal returns in 2005 as well as 1 day before the issuance date in 2006.

In hypothesis 2, the impact of unqualified audit opinions on stock returns has been tested and it has been concluded that both in 2005 and 2006 abnormal returns have been obtained after the issuance date. However, abnormal returns turned out to be negative.

After the issuance of qualified audit opinions, it has been concluded that investors gained abnormal returns in ISE. Negative and positive abnormal returns have been detected for qualified audit opinions whereas only negative abnormal returns occurred for unqualified opinions.

Interestingly, we did not encounter with any statistically significant average cumulative abnormal returns in 2006 while there were number of statistically significant average cumulative abnormal returns in 2005. However, when the whole sample sub-divided into unqualified and qualified audit opinions, for each group statistically significant average cumulative abnormal returns have been detected.

In addition, we have analyzed whether unqualified and qualified audit opinions do provide different information to investors in hypothesis 4 and reached the conclusion that they do provide different information to investors. Lastly based on the hypothesis 5 we should indicate that the perception of investors to audit reports in different time periods are dissimilar.

Overall, empirical results of this study show us that audit opinions do provide information to investors in ISE and from the findings it can be concluded that ISE cannot be classified as a semi-strong form efficient market.

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Table 5.1: Average Abnormal Returns in 2005 and 2006 Over the Event Window

	Event Win.	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
2006	AAR	0,31%	-0,33%	-1,46%	-1,21%	0,15%	0,18%	-0,03%	1,52%	-1,06%	-0,43%	0,26%	-0,23%	0,19%	-0,64%	0,26%	-0,09%	-0,32%	-0,22%	0,04%	-0,97%	0,14%
	t	1,03	-0,60	-1,44	-1,19	0,49	0,60	-0,11	0,54	-1,07	-1,66***	0,96	-1,05	0,48	-1,24	0,36	-0,51	-0,70	-0,96	0,14	-1,31	0,66
	p	0,31	0,55	0,15	0,24	0,63	0,55	0,91	0,59	0,29	0,10	0,34	0,30	0,63	0,22	0,72	0,61	0,48	0,34	0,89	0,19	0,51
2005	AAR	-0,34%	0,20%	0,00%	-0,06%	0,16%	0,03%	-0,20%	0,09%	0,04%	0,09%	-0,08%	0,08%	-0,38%	-0,41%	-0,51%	-0,43%	0,21%	-0,89%	-0,51%	-0,22%	-0,03%
	t	-1,84***	0,71	-0,01	-0,27	-1,84	0,13	-0,92	0,31	0,14	0,28	-0,31	0,29	-1,34	-1,69***	-1,67***	-1,30	0,60	-3,95*	-2,06**	-0,92	-0,15
	p	0,07	0,48	0,99	0,79	0,53	0,90	0,36	0,75	0,89	0,78	0,75	0,77	0,18	0,09	0,10	0,20	0,55	0,00	0,04	0,36	0,88

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively.

Table 5.2: Average Abnormal Returns for Unqualified Audit Opinions in 2005 and 2006 Over the Event Window

	Event Win.	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
2006	AAR	0,30%	0,02%	-0,24%	-0,06%	0,04%	-0,03%	0,00%	1,85%	-1,29%	-0,32%	0,02%	-0,49%	-0,10%	-0,60%	0,57%	-0,15%	-0,22%	-0,13%	-0,02%	-1,11%	0,16%
	T	0,88	0,08	-0,82	-0,31	0,13	-0,09	-0,01	0,53	-1,05	-1,16	0,07	-2,12**	-0,37	-0,95	0,63	-0,76	-0,39	-0,52	-0,09	-1,21	0,70
	P	0,38	0,94	0,41	0,76	0,90	0,93	0,99	0,60	0,30	0,25	0,94	0,04	0,71	0,35	0,53	0,45	0,69	0,61	0,93	0,23	0,48
2005	AAR	-0,41%	0,17%	0,06%	0,05%	0,25%	0,07%	-0,16%	0,04%	0,18%	-0,14%	-0,19%	-0,40%	-0,36%	-0,40%	-0,60%	-0,45%	0,26%	-0,81%	-0,38%	-0,27%	-0,03%
	t	-2,19**	0,65	0,25	0,19	0,84	0,27	-0,69	0,13	0,63	-0,44	-0,69	-1,85***	-1,08	-1,45	-1,82***	-1,31	0,67	-3,96*	-1,37	-1,05	-0,11
	p	0,03	0,52	0,80	0,85	0,40	0,79	0,49	0,90	0,53	0,66	0,49	0,07	0,28	0,15	0,07	0,19	0,50	0,00	0,18	0,30	0,91

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively.

Table 5.3: Average Abnormal Returns for Qualified Audit Opinions in 2005 and 2006 Over the Event Window

	Event Win.	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
2006	AAR	0,36%	-1,78%	-6,40%	-5,83%	0,57%	1,00%	-0,15%	0,20%	-0,11%	-0,86%	1,23%	0,83%	1,37%	-0,84%	-0,98%	0,12%	-0,73%	-0,55%	0,28%	-0,43%	0,04%
	T	0,53	-0,69	-1,30	-1,16	0,70	1,11	-0,17	0,26	-0,26	-1,30	1,44	1,58	0,84	-1,29	-2,17**	0,24	-2,04***	-1,25	0,30	-0,97	0,08
	P	0,60	0,50	0,21	0,26	0,49	0,28	0,87	0,80	0,80	0,21	0,17	0,13	0,41	0,21	0,04	0,81	0,06	0,23	0,77	0,34	0,94
2005	AAR	-0,05%	0,30%	-0,29%	-0,56%	-0,24%	-0,14%	-0,34%	0,32%	-0,57%	1,07%	0,36%	2,18%	-0,48%	-0,43%	-0,11%	-0,36%	0,02%	-1,23%	-1,07%	-0,03%	-0,06%
	T	-0,09	0,32	-0,76	-1,18	-0,54	-0,22	-0,69	0,43	-0,89	1,09	0,44	2,01***	-0,96	-0,94	-0,14	-0,36	0,02	-1,50	-2,05***	-0,04	-0,12
	P	0,93	0,75	0,46	0,25	0,59	0,82	0,50	0,68	0,38	0,29	0,67	0,06	0,35	0,36	0,89	0,73	0,99	0,15	0,06	0,97	0,91

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively.

Table 5.4: Average Cumulative Abnormal Returns

	2006			2005		
Event Win.	**ACAR%**	**t**	**p**	**ACAR%**	**t**	**p**
(-10,+10)	-0,87%	-1,06	0,29	-0,69%	-2,24**	0,03
(-9,+9)	-1,01%	-1,20	0,23	-0,64%	-2,03**	0,04
(-8,+8)	-0,76%	-0,77	0,44	-0,67%	-2,29**	0,02
(-7,+7)	-0,44%	-0,47	0,64	-0,58%	-1,82***	0,07
(-6,+6)	-0,07%	-0,08	0,94	-0,36%	-0,98	0,33
(-5,+5)	-0,03%	-0,03	0,98	-0,50%	-1,53	0,13
(-4,+4)	-0,06%	-0,05	0,96	-0,42%	-1,41	0,16
(-3,+3)	-0,15%	-0,12	0,91	-0,21%	-0,75	0,45
(-2,+2)	-0,57%	-1,11	0,27	-0,11%	-0,40	0,69
(-1,+1)	-0,23%	-0,99	0,33	0,05%	0,16	0,87
(-10,0)	-0,64%	-0,53	0,59	-0,02%	-0,08	0,94
(-9,0)	-0,77%	-0,62	0,54	0,08%	0,28	0,78
(-8,0)	-0,70%	-0,54	0,59	0,02%	0,08	0,94
(-7,0)	-0,22%	-0,18	0,85	0,02%	0,09	0,93
(-6,0)	0,24%	0,18	0,86	0,05%	0,17	0,87
(-5,0)	0,18%	0,13	0,90	-0,01%	-0,04	0,97
(-4,0)	0,11%	0,08	0,94	-0,03%	-0,09	0,93
(-3,0)	0,14%	0,09	0,93	0,07%	0,24	0,81
(-2,0)	-0,71%	-1,14	0,26	0,02%	0,10	0,92
(-1,0)	-0,12%	-0,48	0,63	0,00%	0,01	0,99
(0,+1)	0,02%	0,08	0,94	0,00%	0,00	1,00
(0,+2)	0,12%	0,42	0,68	-0,22%	-0,70	0,49
(0,+3)	-0,22%	-0,59	0,55	-0,39%	-1,35	0,18
(0,+4)	-0,08%	-0,26	0,80	-0,58%	-1,78***	0,08
(0,+5)	-0,11%	-0,39	0,70	-0,70%	-2,02**	0,05
(0,+6)	-0,22%	-0,74	0,46	-0,57%	-1,47	0,14
(0,+7)	-0,28%	-0,96	0,34	-0,85%	-2,59*	0,01
(0,+8)	-0,26%	-0,84	0,40	-0,97%	-3,28*	0,00
(0,+9)	-0,55%	-1,53	0,13	-0,99%	-3,47*	0,00
(0,+10)	-0,48%	-1,37	0,17	-0,96%	-3,53*	0,00

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively

Table 5.5: Average Cumulative Abnormal Returns for Unqualified Audit Opinions

	2006			2005		
Event Win.	**ACAR%**	**t**	**p**	**ACAR%**	**t**	**p**
(-10,+10)	-0,40%	-0,49	0,62	-0,77%	-2,62*	0,01
(-9,+9)	-0,53%	-0,62	0,53	-0,70%	-2,37**	0,02
(-8,+8)	-0,29%	-0,28	0,78	-0,72%	-2,48**	0,02
(-7,+7)	-0,24%	-0,22	0,82	-0,69%	-2,23**	0,03
(-6,+6)	-0,21%	-0,18	0,86	-0,53%	-1,56	0,12
(-5,+5)	-0,17%	-0,13	0,89	-0,72%	-2,45**	0,02
(-4,+4)	-0,13%	-0,09	0,93	-0,68%	-2,29**	0,02
(-3,+3)	-0,36%	-0,22	0,82	-0,48%	-1,64	0,11
(-2,+2)	-0,98%	-1,66	0,10	-0,41%	-1,36	0,18
(-1,+1)	-0,46%	-2,02**	0,05	-0,42%	-1,53	0,13
(-10,0)	0,08%	0,07	0,95	-0,02%	-0,06	0,95
(-9,0)	-0,01%	-0,01	1,00	0,11%	0,34	0,73
(-8,0)	-0,02%	-0,01	0,99	0,06%	0,19	0,85
(-7,0)	0,07%	0,05	0,96	0,04%	0,12	0,90
(-6,0)	0,10%	0,06	0,95	0,02%	0,07	0,95
(-5,0)	0,09%	0,05	0,96	-0,08%	-0,27	0,79
(-4,0)	0,11%	0,06	0,95	-0,12%	-0,38	0,71
(-3,0)	0,12%	0,06	0,95	-0,05%	-0,16	0,87
(-2,0)	-0,92%	-1,22	0,23	-0,09%	-0,30	0,76
(-1,0)	-0,22%	-0,90	0,37	-0,23%	-0,78	0,44
(0,+1)	-0,34%	-1,59	0,12	-0,42%	-1,62	0,11
(0,+2)	-0,34%	-1,27	0,21	-0,55%	-2,03**	0,05
(0,+3)	-0,59%	-1,57	0,12	-0,67%	-2,49**	0,02
(0,+4)	-0,27%	-0,92	0,36	-0,87%	-2,97*	0,00
(0,+5)	-0,31%	-1,13	0,26	-0,98%	-3,43*	0,00
(0,+6)	-0,37%	-1,18	0,24	-0,81%	-2,53*	0,01
(0,+7)	-0,39%	-1,23	0,22	-1,04%	-3,57*	0,00
(0,+8)	-0,38%	-1,18	0,24	-1,11%	-4,03*	0,00
(0,+9)	-0,71%	-1,78***	0,08	-1,14%	-4,26*	0,00
(0,+10)	-0,63%	-1,62	0,11	-1,09%	-4,21*	0,00

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively

Table 5.6: Average Cumulative Abnormal Returns for Qualified Audit Opinions

	2006			2005		
Event Win.	**ACAR%**	**t**	**p**	**ACAR%**	**t**	**p**
(-10,+10)	-2,76%	-1,09	0,29	-0,37%	-0,344	0,735
(-9,+9)	-3,00%	-1,15	0,26	-0,36%	-0,332	0,744
(-8,+8)	-2,63%	-1,00	0,33	-0,45%	-0,479	0,638
(-7,+7)	-1,22%	-0,76	0,46	-0,13%	-0,12	0,906
(-6,+6)	0,46%	0,44	0,66	0,36%	0,268	0,792
(-5,+5)	0,55%	0,53	0,60	0,45%	0,38	0,708
(-4,+4)	0,23%	0,26	0,80	0,67%	0,709	0,487
(-3,+3)	0,69%	0,90	0,38	0,93%	1,165	0,259
(-2,+2)	1,10%	1,19	0,25	1,15%	1,469	0,159
(-1,+1)	0,69%	0,95	0,36	2,09%	1,953***	0,067
(-10,0)	-3,55%	-1,11	0,28	-0,04%	-0,046	0,964
(-9,0)	-3,84%	-1,16	0,26	-0,03%	-0,032	0,975
(-8,0)	-3,45%	-1,03	0,32	-0,13%	-0,202	0,842
(-7,0)	-1,40%	-0,72	0,48	-0,03%	-0,047	0,963
(-6,0)	0,76%	0,82	0,42	0,19%	0,229	0,822
(-5,0)	0,53%	0,66	0,52	0,29%	0,395	0,697
(-4,0)	0,13%	0,18	0,86	0,38%	0,582	0,568
(-3,0)	0,23%	0,29	0,77	0,59%	0,965	0,347
(-2,0)	0,14%	0,20	0,85	0,50%	0,952	0,354
(-1,0)	0,26%	0,31	0,76	1,01%	1,552	0,138
(0,+1)	1,46%	1,83***	0,08	1,80%	1,482	0,156
(0,+2)	1,98%	2,07**	0,05	1,19%	1,006	0,328
(0,+3)	1,30%	1,34	0,19	0,82%	0,824	0,421
(0,+4)	0,72%	0,82	0,42	0,68%	0,592	0,561
(0,+5)	0,71%	0,83	0,41	0,48%	0,346	0,734
(0,+6)	0,38%	0,46	0,65	0,45%	0,291	0,774
(0,+7)	0,16%	0,22	0,83	-0,01%	-0,012	0,99
(0,+8)	0,25%	0,30	0,77	-0,37%	-0,356	0,726
(0,+9)	0,10%	0,12	0,91	-0,36%	-0,359	0,724
(0,+10)	0,11%	0,13	0,90	-0,36%	-0,396	0,697

Not: *,**, *** 1%, 5% and 10% statistically significant, respectively.

Table 5.7: Comparison Average Abnormal Returns of Unqualified and Qualified Audit Opinions

		-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
2005	t	-0,59	-0,13	0,77	1,12	0,93	0,31	0,33	-0,34	1,07	-1,17	-0,63	-2,34**	0,21	0,05	-0,58	-0,09	0,24	0,49	1,16	-0,34	0,05
	p	0,56	0,90	0,45	0,27	0,36	0,76	0,75	0,74	0,30	0,26	0,53	0,03	0,84	0,96	0,57	0,93	0,81	0,63	0,26	0,74	0,96
2006	t	-0,09	0,69	1,25	1,14	-0,61	-1,09	0,16	0,46	-0,90	0,75	-1,36	-2,30**	-0,89	0,27	1,54	-0,49	0,75	0,81	-0,31	-0,67	0,22
	p	0,93	0,50	0,23	0,27	0,55	0,29	0,88	0,65	0,37	0,46	0,19	0,03	0,38	0,79	0,13	0,63	0,46	0,42	0,76	0,51	0,83

Not: **, 5% statistically significant.

Table 5.8. Comparison of Average Abnormal Returns of 2005 and 2006

	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
t	1,84***	-0,85	-1,41	-1,09	-0,04	0,38	0,45	0,51	-1,07	-1,27	0,90	-0,87	1,18	-0,42	0,97	0,89	-0,92	2,12**	1,50	-0,96	0,56
p	0,07	0,39	0,16	0,28	0,97	0,70	0,65	0,61	0,29	0,21	0,37	0,38	0,24	0,68	0,33	0,38	0,36	0,04	0,14	0,34	0,58

Not: **, *** 5% and 10% statistically significant, respectively.

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PRICING MORTGAGE ASSETS

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Abstract
Turkey, being one of the large economies of the world and an outstanding example among its emerging market counterparts, still lacks a robust mortgage lending system. Lenders tend to keep the home loans on their balance sheets. Without proper vehicles for securitization, the growing size of these assets will continue to be an impediment towards lowering the costs and expanding the primary market volume.

The to-be-instated mortgage regulation will provide the lenders with necessary tools to securitize. However, the issuers will have to deal with certain complexities of pricing a first issuance in Turkey. There are certain determinants of pricing an issuance. Among them, prepayment behavior of the consumers has crucial importance. Once the prepayment behavior is estimated and modeled into a mathematical function, the deviation in cash flow expectancy will be minimized and hence, the mortgage backed securities could be priced in a healthier fashion.
This study illustrates a prepayment modeling method utilizing binomial expansion for option pricing. It is concluded that, there should be special emphasis placed on modeling prepayment behavior of Turkish borrowers to allow for any secondary market issuance.

I. Introduction

One of the key indicators of the development levels of nations is the level utilization of the real estate assets. These real estate assets could be utilized in the capital markets through certain vehicles. Developed countries have advanced methods of this utilization. Unfortunately, in our country, these vehicles are quite underdeveloped, limited with only the regulation of certain asset backed securities which have only been seen in the markets once or twice over the last couple of decades. On the other hand, similar developing countries such as Colombia, Malaysia, Indonesia, Bulgaria, Guatemala and Jordan have achieved significant distance in development of a secondary mortgage market.

In this paper, pricing of MBS's and critical modeling assumptions are examined. The examples illustrated are not the most advanced techniques of pricing MBS's but simple methods of setting a base for pricing. The models and scales are developed according to the US consumer base.

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One of the critical assumptions in pricing of MBS's is the prepayment behavior of borrowers. Prepayments cause a fluctuation in the cash flow associated, and hence, create difficulties in pricing the bonds related to this cash flow. US consumers have been under the scope for a number of decades now and are easier to be modeled. However, due to cultural differences, it is not possible to apply these models to Turkish borrowers. For instance, the authors, in their professional lives, have examined the Turkish borrowers' prepayment frequency to be above the US average.[1]

As of December 2005, there is around 12,4 billion USD outstanding home loans. The amount which is under legal follow up is about 10,6 million USD which constitutes 0,08% of the balance.[2] Fore more efficient models, there is need to develop proper scales and models about the Turkish borrowers. Social scientists should be involved in these efforts.

First of all terminology will be explained, which will be followed by the explanations about the economic implications of mortgage assets, macroeconomic reasons of the securitization of these assets supported by certain international securitization cases. The explanation of the basic criteria of asset pricing will be followed by an example of MBS pricing technique with the utilization of option pricing theory coupled with the prepayment expectations.

a. Terminology Used in the Study

There are very limited scientific resources about real estate finance and mortgage backed financing mechanisms in our country, therefore, the terminology used in this paper may differ from those of other papers issued on similar topics. Some of the key terms are explained below:

Mortgage Asset: The monetary value which is created by placing a lien on the legal rights possessed by a real estate.

Mortgage Backed Security (MBS): The security which is connected to the cash flow generated by the returns on a loan extended in order to finance the transfer of ownership of a real estate. In this paper, the different types of MBS's are not outlined (such as pass-through, pay-through, CMO's, Pfandbriefe, etc.), the securities are referred to as MBS's.

Mortgage Loan: The loan extended to a borrower to purchase a real estate, against a legal lien placed on the title.

Prepayment: The loan being paid off at an earlier date than its maturity.

Refinancing: The loan being paid off by another loan with better terms.

[1] Observation without any scientific concern.
[2] http://www.tbb.org.tr

b. Mortgage Assets as Macroeconomic Values

It is a fact that the markets where real estate, which is considered to be one of the tree major macroeconomic production categories, change owner and the mechanisms ensuring the efficiency of these markets play crucial role in development of countries. In advanced markets, real estate values and the mortgage values constitute approximately 25% of the countries' total assets and credit stock.[3] The amount of mortgage holders among the new home buyers in Turkey is very low (less than 7%).[4]

Mortgage loan is the loan extended backed by the lien placed on the title of the real estate subject to the transaction. The title lien (mortgage) enables the lender to cash out the remaining balance in case of defaults.

The first efforts towards utilization of real estate values which constitute a significant portion of total national assets were seen back in the early 19th century. In 1840s the establishment of German mortgage banks within the framework of the Hypotekenbancken regulation were followed by the establishment of a national mortgage bank named Credit Foncier de France in France. Federal National Mortgage Association (Fannie Mae) a quasi governmental organization was established in the US after the great depression in order to inject the monetary values embedded in the huge real estate stock.[5] This system is based on issuance of securities which are tied to the cash flows generated by returns on loans extended to borrowers collateralized by the legal liens placed on the titles at the registry offices. The procedures may differ among countries and regulations. These securities are considered to be relatively low risk instruments as they are collateralized by actual real estate assets. Due to their low risk status, they could easily be traded at the secondary markets.

Securitization of real estate value accelerate the rate of return of real estate values, which constitute 70% of the country's total long term assets to the capital system, and also provide them with better hedging tools.[6] Development in MBS markets fosters the enhancement the construction sector all the relevant sub sectors which provides employment and transfer of labor force among sectors which yields to economic efficiency. Development of

[3] Organization of Work on Guidelines on Private Housing Finance Systems for Countries in Transition, UN Economic Commission for Europe, 8 July 2002.

[4] Ozsan O., Karakas C., Housing Finance Practices and Development of a Secondary Mortgage Market in Turkey, Housing Finance International, March 2005.

[5] Hardt, J., "Regional Roles in Market Development and Standardization", Developing Secondary Mortgage Markets in Southeast Europe Conference Proceedings, Bulgaria, 4-5 February 2003.

[6] Renaud, B., "Housing Finance in Emerging Markets: An Overview of Current Issues", Housing Finance in Emerging Markets Congress, 10 March 2003.

MBS markets also provide depth to capital markets and limit the effects of any possible macroeconomic fluctuation.[7]

It has been observed in the studies, which have been conducted to analyze the relationship between economic development and urbanization, that there is a positive correlation. It has been observed that urbanization ratio in less developed economies is around 20% where that of developed economies is 80%. In the progress of economic development, the ratio of real estate values to national production in developed economies is more than that of less developed ones. These ratios are 60% and 15% respectively. In 1900 the only nation on the globe where 50% urban population was UK, today more than 50% of the world population is urbanized.[8]

Mortgage backed securities and secondary mortgage markets are crucial in a countries macroeconomic development. The ratio of outstanding mortgage loans to GDP is 71% in the US, %46 in the EU where the same ratio is 11% in Chile and Jordan (1998), 6% in Mexico and Tunisia and 7% in South America Countries [9].

There are a number of reasons why the increase in the efficiency of MBS market would have a positive effect on the macroeconomic efficiency. Some of these reasons are listed below:

Increase in the turnover rates of the resources allocated to mortgage loans, better utilization of equity.

Raising funds trough investors instead of borrowers equity or time deposits.

Reducing the funding costs through issuance of securities which are low risk instruments (being backed by real estates).

Better asset – liability management through reducing duration gap.

Efficient utilization of funds raised for mortgage lending purposes.

II. Main Criteria in Pricing Mortgage Assets

There are certain criteria in pricing the mortgage values and securities backed by these assets. Although, certain risk management methods could be used to hedge the associated risks which could affect pricing, these tools could be very limited in number in less developed economies. There are certain aspects which have direct effect on the value of the mortgage assets, namely, appraisal, insurance, economic variables, prepayment risk and several others. These factors are briefly explained below.

[7] Adlington G. and others, "Developing Real Estate Markets in Transition Economies", Congress Presentation, UN Intergovernmental Congress, 6-8 December 2000.

[8] Renaud, B., a.g.e.

[9] Karakas C., Ozsan O., Turkey: Rapid Progress Towards a Secondary Mortgage Market, Housing Finance International, December 2005 and Real Estate Banking: 2002 Facts and Figures, Verband Deutscher Hypothekenbanken, 2003.

a. Appraisal

It is important to properly determine the value of the real estate which is subject to transaction before the loan is extended. This value is the expected value to be cashed out in case of default. Considering that the loan's maturity is 15-30 years, it is not only important to determine today's value, but also to be certain that the value of the real estate will always remain above the outstanding balance. Otherwise, the borrower will rationally tend to default.

During the course of securitization, investors put special emphasis on the appraisal value during the due diligence, especially if there is no mortgage insurance available. It is generally the preference of the investors to have licensed appraisers conduct the valuation process.

In developed countries, appraisal companies have completed their institutional evolution a few decades ago. They adhere to internationally accepted valuation standards. There is a lack of proper regulation and auditing in this field in our country. In this respect, the Capital Markets Board have issued a regulation on 15 August 2001. International Valuation Standards have also been translated and issued by the CMB.

b. Mortgage Related Insurances

As mentioned earlier, during the course of securitization, the extent to which insurance is provided against the risk associated with the mortgage assets is closely examined. There are certain insurance products utilized in mortgage backed financing, such as, real estate insurance, title insurance, life insurance, default insurance, etc. Life, casualty and earthquake insurances are types of insurance products which are commonly used. Since the title registration offices operate with minimal errors, and full guarantee of the government, title insurance does not seem to be a must for the time being.

Mortgage life insurance products are provided by insurance companies and are used to continue with the mortgage payments in case of death of the borrower. Today, this type of insurance product has even broader area of coverage such as loss of job, dismemberment, change in income level and certain other cases which would jeopardize the mortgage payments.

The cost of insurance products which are provided by the lender is reimbursed to the borrower, such as default insurance which is utilized if the borrower defaults. The risk which the lender undertakes is the difference between loan amount, value of the property and the coverage of the insurance. The lender is directly affected by this policy as the risk of loss of return is minimized.

c. Macroeconomic Variables

The quality of the mortgage assets could be affected by changes in the macroeconomic environment. Prepayment risk, which is explained in further detail in the upcoming chapters, is expected to increase due to macroeconomic fluctuations. Similarly, enhancement in the macroeconomic indicators could also trigger prepayments due to transfer of ownerships, which is a behavior commonly observed. During the long course of the loan, the value of the underlying asset could increase which is a factor that increases the value of the mortgage, whereas, the opposite could also happen which could lead to negative amortization. For instance, the amounts of outstanding loan balances extended in foreign exchange terms have dropped below the value of the real estates following crises in November 2000 and February 2001.

The most striking case of negative amortization is the 1985-1994 Japanese real estate crisis. Japanese economy which has moderately suffered from the 1980 petroleum crisis, as compared to the US economy which has been severely affected by the same crisis, achieved a 4-5% better growth rate and better foreign trade statistics. Following the Plaza Accord in 1985, the value of Japanese Yen has increased by 100% against US Dollar. The expectation for continuity of this trend has triggered the real estate prices all over Japan. The commercial real estate prices in Tokyo have increased by 54% only in 1985. The real estate prices have dropped significantly during the recession years starting from 1990 which yielded to negative amortization. In a research study conducted by the Japanese Ministry of Economics, among 300 finance companies, it has been observed that almost 63% of the outstanding loans have been covered by real estate. The defaulted loan balance reached $315 billion by 1994.[10] The Japanese case is a very striking example of how economic indicators could affect the value of mortgages.

d. Other Factors

The purpose of purchasing the property and the credit score of the borrower are factors which have effect on the asset value. Second homes (summer homes) are generally accepted to reduce the quality of the asset.

e. Prepayment Risk

Any payment which is done before the maturity stated in the payment plan which is registered at title office is considered to be prepayment. Prepayments tend to create fluctuations in the cash flow which is the main determinant of

[10] Renaud, B., "The 1985-94 Global Real Estate Cycle: Its Causes and Consequences", World Bank Policy Research Working Paper 1452, May 1995, and Mera K. and E.J. Heikkila, "The Linkage of Land Price with the Economy: Policy Making Failures of Japanese Government in the 1990s", Congress, American Real Estate and Urban.

the mortgage asset and the securities.[11] Therefore, it is very important to make an accurate projection of prepayment to conduct an efficient pricing analysis. For example, an MBS investor who invests in a security which is backed by a fixed rate (4.75%, 30yr) mortgage knows exactly what the cash flow would be like if there were no defaults of prepayments. The same investor, on the other hand, would never know what the life of the loan would actually be.

Although there could be a number of reasons why a loan would be prepaid, some of the factors which would trigger the prepayment behavior are summarized below:

Transfer of Ownership: Transfer of ownership of the real estate which has been acquired by a mortgage loan results in a prepayment. In this respect, since the increase in the real estate prices is expected to reduce the loan to collateral value ratio, faster than expected, the borrower may tend to sell the property to enjoy some profit. If the new owner accepts to continue with the loan which is registered to the title and is also underwritten by the lender, the loan does not get prepaid. This procedure complies with both Turkish and US regulation.

Refinancing of the Loan: The borrower may tend to prepay the existing loan with another loan which has better terms. This type of behavior is commonly seen during decreasing interest rate periods. The borrower should choose to refinance if it is economically rational to bear all the fees and costs associated with doing so. It is being stated that, around 75% of the refinances are done under there circumstances.[12]

Default: The amount of borrower default which results in the foreclosure of the loan and being prepaid is quite low. The average default rate in loans extended in the US is around 5%. This rate drops down to 0.5% in loans with more than 30 months maturity.

Partial Prepayment: Sometimes borrowers may choose to reduce the amount of their monthly payments or the remaining term by making partial prepayment. The average annual partial prepayment rate in the pools of Fannie Mae and Federal Home Loan Mortgage Corporation which comprises of long term loans are less than 0.5%.

Prepayment without refinance: This type of prepayment may occur in circumstances where natural disasters tear down the property where the insurance coverage is placed or in case of unexpected increase in the borrowers income where he may choose not to hold on to the loan through its life. Federal Housing Administration data indicates the prepayment rates in 30 year mortgage with less than 10 years of maturity left to be around 2-4% of the entire stock.

[11] Fabozzi Managing MBS Portfolios

[12] The Economic Contribution of the Mortgage Refinancing Boom, Homeownership Alliance, December 2002.

III. Prepayment Risk and Valuation Mechanisms

One of the main characteristics of mortgage backed securities is that they enable the borrower to make full payment of the mortgage loan at some time and settle the debt. Therefore, investors on mortgage backed securities are obliged to undertake both interest risk and prepayment risk as well. The reasons for the prepayment behavior have been discussed in detail in Chapter II. As mentioned in this discussion, the main reason for the prepayment behavior has been indicated to be the decrease of market interest rates relatively to the mortgage interest rate. Thus in such cases of prepayment, investors on mortgage securities find it difficult to redirect their investments converted into cash before than expected to proper investments in low interest rate opportunities.

There have been comprehensive studies on including the prepayment behavior in pricing models of mortgage assets and mortgage backed securities in the finance literature. Schwartz and Torous (1989) have conducted a regression study with dependent variables that may explain the prepayment behavior[13]. This empirical study aimed to model data of previous terms and the prepayment behavior in future terms. Thus, changes in past behavior patterns, which constitute the basis for the modeling, will substantially affect prediction capability of the model. Johnston and Van Drunnen (1988) and Stanton (1995) models have studied the effect of prepayment behavior on the price of mortgage backed securities by using the option pricing theory[14,15]. Both of these models backed by the option pricing theory are based upon the assumption that prepayment is the outcome of the change in market interest rates, and contrary to some other models they do not include the default risk in pricing.

The present study first discusses Static Cash Flow Pricing based upon cash flow yields. Following this pricing method, the prepayment option pricing is presented by the Monte Carlo simulation as a simple example of Johnston and Van Drunnen, and Stanton models.

a. Static Valuation

The yield on financial assets is the interest rate equalizing the net present value of cash flows expected to be generated by the related assets being priced to the current market value. The main factor making the yield calculation of mortgage backed securities difficult is the uncertainty of cash flows due to

[13] Schwartz, E.S. and W.N.Torous, "Prepayment and the Valuation of Mortgage Backed Securities", Journal of Finance, 44, 1989.

[14] Johnston, E. ve L. Van Drunnen, "Pricing Mortgage Pools with Heterogenous Mortgagors: Empirical Evidence", Working Paper, University of Utah, 1988.

[15] Stanton, R., "Rational Prepayment and the Valuation of Mortgage Backed Securities", The Review of Financial Studies, Vol.8, 1995.

prepayment risk. Thus, pricing mortgage backed securities requires a presumption concerning prepayment risk.

The US mortgage backed securities (MBS), which have been used as examples in this study, generate cash flows based upon monthly loan payment collection. As mortgage backed securities are characterized as the lowest risk assets after US government bonds in the securities market, the generally accepted rule in markets is to make comparison between yield on MBS cash flows and yield on government bonds with similar maturity. US government bonds generally make coupon payments once in six months, thus it is required to make the following correction before making comparison between yields on MBS and government bonds:

$$\text{Comparable Yield (Bond Equivalent Yield)} = 2 \times [(1 + i_{MBS})^6 - 1)]$$

i_{MBS}: Discount rate equalizing the present value of cash flows generated by mortgage backed securities to the present market value minus accumulated interest

The main assumption employed in the abovementioned calculation is that monthly cash flows may be revalued by interest at i_{MBS} rate and that no prepayment is made.

The difference between Comparable Yield calculated in this manner and yield on government bonds with similar maturity is called "Nominal Spread". Nominal spread covers the prepayment risk as well as risks of mortgage backed securities and government bonds. However, a static valuation study may not determine how much of nominal spread is caused by the prepayment risk. Therefore, option pricing theory is employed by using various simulation methods[16].

b. Option Valuation (OAS)

Option pricing theory may be utilized in valuation of fixed income securities which normally include options. There are two commonly used pricing methods (Binomial Model and Monte Carlo Model) within this regard.

Binomial model is considered as suitable for pricing of fixed income securities including call option which are used depending on a specific time value of the market interest rate. On the other hand, call option included by mortgage backed securities is dependent upon the movement of market interest rates throughout the whole term rather than the market interest rate at a specific time. Thus, prepayment rate of a mortgage backed security within a specific period is not only related to the market interest rate within that period

[16] Maris B. and W. Segal, "Analysis of Yield Spreads on Commercial Mortgage Backed Securities"

but also to whether market interest rates have created a prepayment opportunity in previous periods by refinancing[17].

Market interest rates that are possible throughout the time of asset (refinancing rates) are simulated many times in pricing technique by Monte Carlo simulation. The high number of simulations ensures a healthier outcome. The results obtained by Monte Carlo simulation give an opportunity to determine the possibility of prepayment. Prepayment rates determined by means of this method are used in calculation of cash flows generated by the asset.

c. Effects of Prepayment on Yield Determined by Option Pricing Approach

The example quoted in this study makes an attempt to determine theoretical value of a mortgage backed security by using option pricing theory. Comparison between this value and market transaction value of this security will give us the value of option the security includes. The example will follow these stages:

i. Calculation of market spot interest rates (i) and refinancing interest rates (R_t)
ii. Determination of prepayment assumptions
iii. Calculation of possible cash flows for mentioned security in the example
iv. Determination of present value of each cash flow alternative
v. Determination of theoretical value of the security

i. Determination of Market Spot Interest Rates and Refinancing Interest Rates by Binomial Modeling

The example model has supposed that i_0 = 3%, R_0 = 5%. Probability coefficients which determine the characteristics of market interest rates are supposed to be u = 1.2 and d = 1/1.2 = 0.8333. Par value of security is $1 million and interest rate is (WAC) = 5%. The security has been insured against default risk and the outstanding balance at the end of the 4th year will be paid in one go (bullet shot – balloon). The following interest rates have been obtained according to these assumptions.

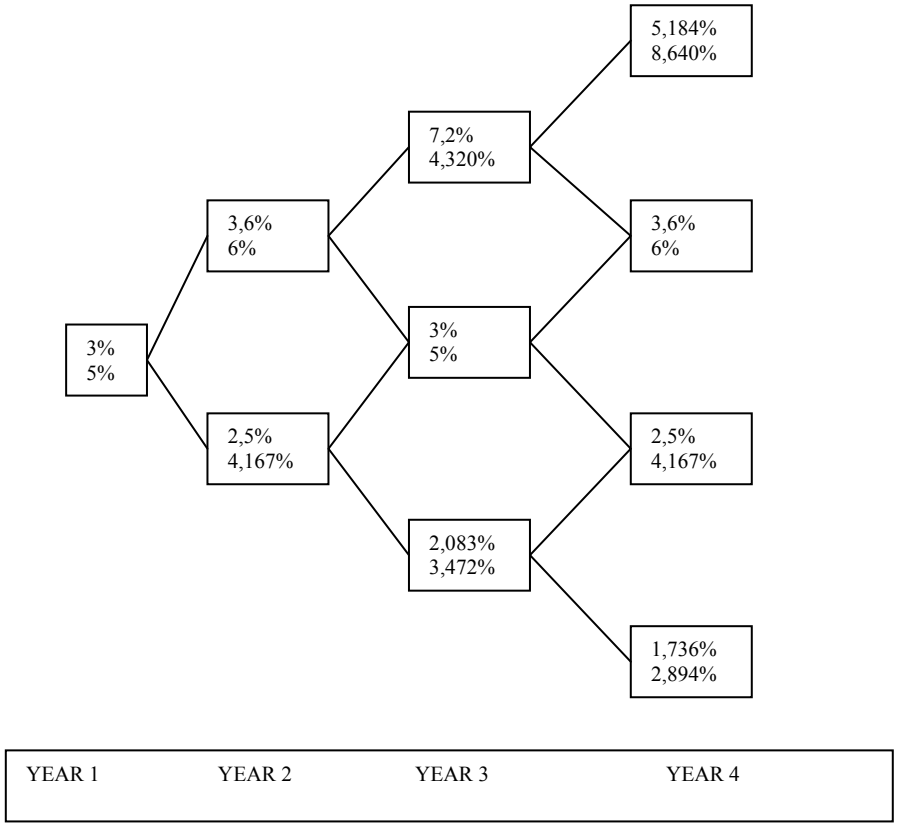
[17] Fabozzi, F., D. Yuen, "Managing MBS Portfolios", Frank J. Fabozzi Associates, PA, 1998.

Spot Interest Rates (R) Table

Year	1st Option	2nd Option	3rd Option	4th Option	5th Option	6th Option	7th Option	8th Option
1	3,000%	3,000%	3,000%	3,000%	3,000%	3,000%	3,000%	3,000%
2	3,600%	3,600%	3,600%	3,600%	2,500%	2,500%	2,500%	2,500%
3	4,320%	4,320%	3,000%	3,000%	3,000%	3,000%	2,083%	2,083%
4	5,184%	5,184%	3,600%	3,600%	3,600%	3,600%	2,500%	2,500%

Refinancing Rates (R) Table

Year	1st Option	2nd Option	3rd Option	4th Option	5th Option	6th Option	7th Option	8th Option
1	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%
2	6,000%	6,000%	6,000%	6,000%	4,167%	4,167%	4,167%	4,167%
3	7,200%	7,200%	5,000%	5,000%	5,000%	5,000%	3,472%	3,472%
4	8,640%	6,000%	6,000%	4,167%	6,000%	4,167%	4,167%	2,894%



Cash flows of the security given as an example will be as follows in case of no prepayment:

$$\rho = \frac{\text{Balance}}{\frac{1-(1/(1+i))^{t}}{i}} \qquad \rho = \frac{1.000.000}{\frac{1-(1/(1+5\%))^{10}}{5\%}}$$

Then, ρ = $139.104,69. According to this calculation;

YEAR	Balance	Installment	Amount of Interest	Capital Payment	Cash Flow
1	1.000.000,00	139.104,69	50.000,00	89.104,69	139.104,69
2	910.895,31	139.104,69	45.544,77	93.559,92	139.104,69
3	817.335,39	139.104,69	40.866,77	98.237,92	139.104,69
4	719.097,46	139.104,69	35.954,87	103.149,82	755.052,34

ii. Determination of Prepayment Assumptions

The extent to which and under which conditions the prepayment right of borrower, which is granted due to the nature of mortgage backed securities, will be exercised is the data required for pricing securities. As mentioned in previous chapters, econometric and behavioral studies have been conducted for modeling prepayment behavior in the US. The following simple behavior model has been developed in this example. According to this model, for instance, if the difference between refinancing rate and interest rate of the security (R – i) is below 1% and above 0.5%, then a prepayment rate of 20% occurs.

Prepayment Assumptions

R-*i* <	R-*i* >	Prepayment Rate (CPR)
0,00%		5%
0,50%	0	10%
1,00%	0,50%	20%
1,25%	1%	30%
2,00%	1,25%	40%
2,50%	2%	50%
3,00%	2,50%	60%
	3%	70%

iii. Calculation of Possible Cash Flows for Mentioned Security in the Example

Eight alternatives obtained by option pricing theory in the light of this prepayment model are as follows.

1st Option

Year	R	Balance	Installment	*i*	Amount of Interest	Amount of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	0,065	65.000,00	74.104,69	40%	370.358,12	509.462,81
2	6,000%	555.537,19	83.462,81	0,065	36.109,92	47.352,90	10%	50.818,43	134.281,24
3	7,200%	457.365,86	75.116,53	0,065	29.728,78	45.387,75	5%	20.598,91	95.715,44
4	8,640%	391.379,20	71.360,71	0,065	25.439,65	45.921,06	5%	17.272,91	416.818,85

2nd Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,40	370.358,12	509.462,81
2	6,000%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,200	101.636,86	185.099,67
3	7,200%	406.547,43	66.770,25	6,50%	26.425,58	40.344,67	0,050	18.310,14	85.080,39
4	6,000%	347.892,62	63.431,74	6,50%	22.613,02	40.818,72	0,100	30.707,39	370.505,65

3rd Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	0,065	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	6,000%	555.537,19	83.462,81	0,065	36.109,92	47.352,90	0,1	50.818,43	134.281,24
3	5,000%	457.365,86	75.116,53	0,065	29.728,78	45.387,75	0,4	164.791,24	239.907,78
4	6,000%	247.186,87	45.069,92	0,065	16.067,15	29.002,77	0,1	21.818,41	263.254,01

4th Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount Of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	6,000%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,1	50.818,43	134.281,24
3	5,000%	457.365,86	75.116,53	6,50%	29.728,78	45.387,75	0,4	164.791,24	239.907,78
4	4,167%	247.186,87	45.069,92	6,50%	16.067,15	29.002,77	0,5	109.092,05	263.254,01

5th Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount Of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	4,167%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,5	254.092,14	337.554,96
3	5,000%	254.092,14	41.731,41	6,50%	16.515,99	25.215,42	0,4	91.550,69	133.282,10
4	6,000%	137.326,04	25.038,84	6,5%	8.926,19	16.112,65	0,1	12.121,34	146.252,23

6th Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount Of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	4,167%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,5	254.092,14	337.554,96
3	5,000%	254.092,14	41.731,41	6,50%	16.515,99	25.215,42	0,4	91.550,69	133.282,10
4	4,167%	137.326,04	25.038,84	6,50%	8.926,19	16.112,65	0,5	60.606,69	146.252,23

7th Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	4,167%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,5	254.092,14	337.554,96
3	3,472%	254.092,14	41.731,41	6,50%	16.515,99	25.215,42	0,7	160.213,71	201.945,12
4	4,167%	68.663,02	12.519,42	6,50%	4.463,10	8.056,33	0,5	30.303,35	73.126,11

8th Option

Year	R	Balance	Installment	*i*	Amount Of Interest	Amount Of Capital	Prepayment Rate	Prepaid Capital	Cash Flow
1	5,000%	1.000.000	139.104,69	6,50%	65.000,00	74.104,69	0,4	370.358,12	509.462,81
2	4,167%	555.537,19	83.462,81	6,50%	36.109,92	47.352,90	0,5	254.092,14	337.554,96
3	3,472%	254.092,14	41.731,41	6,50%	16.515,99	25.215,42	0,7	160.213,71	201.945,12
4	2,894%	68.663,02	12.519,42	6,50%	4.463,10	8.056,33	0,7	42.424,68	73.126,11

iv. Determination of Present Value of Each Cash Flow Alternative

Discount rates for each alternative and at each time point should first be fixed in order to determine present values of cash flow alternatives. Supposing that mortgage loans from which securities originate have been insured against default risk, the only risk of great importance for investors is prepayment risk. Thus, the portion of expected yield on the mentioned security which remains above the market spot interest rate (option-adjusted spread) expresses prepayment risk of the mortgage.

In order to go further, OAS rate has been supposed to be 2%. Then, the following spot rates and discount rates to be used in reduction of cash flows are obtained:

$Z_t = S_t + k_t$
Z_t = discount rate at time t
S_t = spot interest rate at time t
k_t = OAS rate

Spot Discount Rates

Year	1st Option	2nd Option	3rd Option	4th Option	5th Option	6th Option	7th Option	8th Option
1	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%
2	5,600%	5,600%	5,600%	5,600%	4,500%	4,500%	4,500%	4,500%
3	6,320%	6,320%	5,000%	5,000%	5,000%	5,000%	4,083%	4,083%
4	7,184%	5,600%	5,600%	4,500%	5,600%	4,500%	4,500%	3,736%

Discount Rates

Year	1st Option	2nd Option	3rd Option	4th Option	5th Option	6th Option	7th Option	8th Option
1	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%	5,000%
2	5,300%	5,300%	5,300%	5,300%	4,750%	4,750%	4,750%	4,750%
3	5,639%	5,639%	5,200%	5,200%	4,833%	4,833%	4,527%	4,527%
4	6,023%	5,629%	5,300%	5,024%	5,024%	4,750%	4,520%	4,329%

Present values of cash flows generated by each option with mentioned discount rates are as follows:

Present Value of Cash Flows

Year	1st Option	2nd Option	3rd Option	4th Option	5th Option	6th Option	7th Option	8th Option
1	485.202,68	485.202,68	485.202,68	485.202,68	485.202,68	485.202,68	485.202,68	485.202,68
2	127.523,07	320.566,31	127.523,07	127.523,07	322.249,09	322.249,09	322.249,09	322.249,09
3	90.606,48	126.167,96	228.050,04	228.050,04	127.137,46	127.137,46	193.198,80	193.198,80
4	393.140,53	138.458,45	250.004,82	250.660,15	139.255,64	139.620,66	69.963,53	70.091,98
TOTAL	**1.096.472,75**	**1.070.395,41**	**1.090.780,61**	**1.091.435,94**	**1.073.844,87**	**1.074.209,89**	**1.070.614,10**	**1.070.742,55**

v. Determination of Theoretical Value of the Security

Theoretical value of the mentioned mortgage backed security and standard deviation may be calculated by using cash flows obtained as a result of the above calculations.

$$\overline{V} = \frac{1}{N} \sum_{i=1}^{N} V_i \qquad \text{Var}(V) = \frac{1}{N} \sum_{i=1}^{N} [V_i - \overline{V}]^2$$

Theoretical Value = $1.079.812,01

Standard Deviation = $11.055,22

OAS value has been supposed to be 2% in the abovementioned example. When market transaction price of the mentioned security is compared with the developed model, then it is possible to determine market-perceived OAS value, namely the premium put on prepayment risk by the market. Values of the mentioned security corresponding to different OAS values are as follows.

OAS	Value of Security
0,50%	1.095.455,54
1,00%	1.090.190,91
1,50%	1.084.976,64
2,00%	1.079.812,01
2,50%	1.074.696,32
3,00%	1.069.628,88
3,50%	1.064.608,99

IV. Conclusion

The contribution of mortgage assets and mortgage backed securities to development of economies may be observed in various countries. In our country, the amount of home loans, which constitute the primary market, has substantially increased due to decreasing home loan interests in recent years. Now it is being considered to reduce the burden of long-term receivables on balance sheets by securitization of the receivables stock. Studies for making some legal adjustments are still being conducted. However, academic studies related to this field remains very limited in our country.

One of the main problems encountered in pricing mortgage assets and mortgage backed securities is the opportunity provided to the borrower to settle the loan by making full payment regardless of the payment plan. There are many detailed studies in the finance literature concerning this concept of prepayment. An example has been given in this study with binomial modeling by utilizing option theory.

Market participants should be fully aware of the cash flow expressed by the mortgage asset for pricing the same asset in order to develop a market for these assets which constitute the basis for the home loan financing system.

Although there has been no study conducted for determining prepayment behavior of Turkish consumers, it is well known that it differs from consumer behaviors in developed economies. As may be seen in this pricing example based on binomial modeling, it will not be realistic to develop a reliable secondary market mechanism without determining consumer behavior patterns.

The aim of future studies should be to determine prepayment behavior pattern of Turkish consumers and to develop multidisciplinary projects accordingly.

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ASYMMETRIC RESPONSES IN VOLATILITY BETWEEN POSITIVE AND NEGATIVE SHOCKS: NEW EVIDENCE FROM TURKISH DATA BY USING TAR-GARCH MODEL*

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Abstract
The aim of this study is to investigate the asymmetric responses in volatility between positive and negative shocks in Turkish stock market. The daily closing values of Istanbul Stock Exchange 100 Index (ISE-100), cover the period from January 02, 1990 to December 29, 2004, are analyzed by using threshold autoregressive GARCH (TAR-GARCH) model. This study is the first one which examines the asymmetric volatility of stock index return in Turkish stock market by using TAR-GARCH model with daily data for a period of fifteen years. Results show that stock return volatility reacts asymmetrically to past information at a lag of one time period in the Turkish stock market.

I. Introduction

It is important to know the volatility structure of stock returns for the purpose of investment decision making and portfolio selection. Most researchers agree that stock returns volatility can be respond differently to negative and positive shocks. To model this kind of asymmetric effects in volatility, asymmetric GARCH models (EGARCH, GJR-GARCH etc.) are mostly used. Threshold autoregressive (TAR) models are motivated by some nonlinear characteristics of series such as asymmetry. Tsay (1989) proposes the testing and modeling procedure for TAR models. In recent years, increasing number of studies concern TAR models and their applications.

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JEL Classification: C50, G10
Keywords: Asymmetric Volatility, TAR-GARCH, Nonlinear Volatility

The aim of this study is to investigate the asymmetric responses in volatility between positive and negative shocks by using one of the nonlinear volatility models namely threshold autoregressive GARCH (TAR-GARCH) model in the Turkish stock market. This is the first study that examines the asymmetric volatility of returns in Turkish stock market by using TAR-GARCH model with daily data for a period of fifteen years.

The paper organized as follows. Literature is presented in section 2. Section 3 describes the data and econometric methodology. Section 4 give estimation results and Section 5 concludes.

II. Literature

A large body of financial economics literature examines the asymmetric volatility of stock returns. Christie (1982), French, Schwert, and Stambaugh (1987), Nelson (1991), and Schwert (1990) found that negative shocks to the market lead to larger return volatility than positive shocks of a similar magnitude. Engle and Ng (1993) compared different models for asymmetric volatility and tried to find the best one. Shields (1997) considered two emerging Eastern European stock markets and investigated the asymmetric effects on the volatility of stock returns. He found no asymmetry exist on either markets. Henry (1998) tried to model asymmetry of stock market volatility by using daily data of Hong Kong stock exchange. Bekaert and Wu (2000) investigated the asymmetric volatility at the firm and market level and Chiang and Doong (2001) investigated the time series behavior of stock returns for seven Asian stock markets and found an asymmetric effect on the conditional volatility for daily data by using TAR-GARCH model. Wu (2001), investigated the determinants of asymmetric volatility and found both the leverage effect and volatility feedback are important determinants of asymmetric volatility. Balaban, Bayar and Kan (2001) tested the asymmetry in volatility for daily stock index returns from 19 countries and found that six of them exhibit a significant asymmetric effect. Blair, Poon and Taylor (2002) investigated the asymmetric volatility responses of US stock prices to negative and positive stock returns. They found that majority of stocks have a greater volatility response to negative returns than to positive returns. McMillan and Speight (2003) examined the volatility asymmetries in high frequency FTSE-100 stock index futures by using asymmetric GARCH models. Chen, Chiang and So (2003) examined the hypothesis that both stock returns and volatility are asymmetrical functions of past information from the US market. They found strong evidence supporting this hypothesis. Chen, So, Gerlach (2005) examined five major financial markets and tried to find which financial returns on market indices exhibit mean and volatility asymmetries, as a response to past information from both the US market and the local market itself.

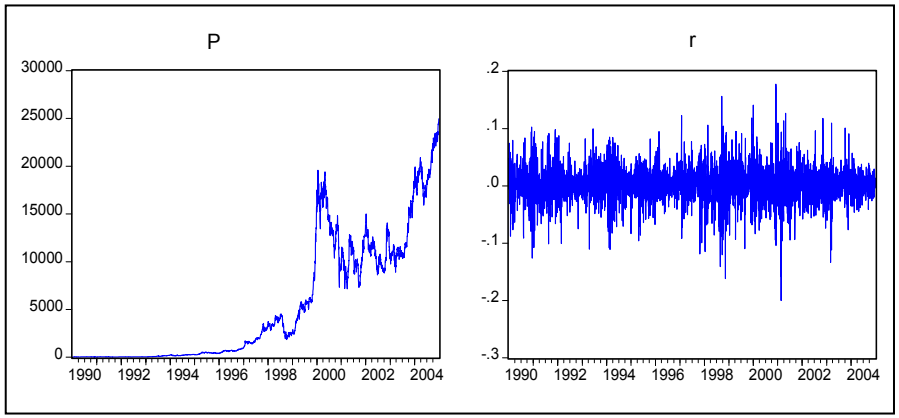
III. Data and Methodology

The daily closing values of Istanbul Stock Exchange 100 Index (ISE100) are used in this study. Data cover the period from January 02, 1990 to December 29, 2004. The data are taken from Istanbul Stock Exchange. The logarithmic return of ISE100 Index is calculated as follows.

$$r_t = \log(P_t) - \log(P_{t-1}) \quad (1)$$

where r_t and P_t are logarithmic return and closing value of ISE100 index at time t respectively. Figure 1 shows these series. According to the ADF test results in Table1, logarithmic return of ISE100 has not any unit root.[1]

Figure 1: Closing Values and Logarithmic Returns of ISE-100



[1] Zivot-Andrews unit root test procedure, which considers the break in intercept, trend or both, also suggests there is no unit root. Results are not reported here to save space, but they can be obtained from the author by request.

Table 1: ADF Unit Root Tests for Return Series

	r_t		
	None	**C**	**C&T**
ADF	-56.95*	-57.12*	-57.11*
AR(1)	-0.906*	-0.909*	-0.909*
Const		0.001*	0.002**
Trend			$-2.41.10^{-7}$

* **:** significant at %1 ** : significant at %5 **None**: No constant and trend **C:** Constant **C&T:** Constant and Trend

The Threshold autoregressive TAR–GARCH volatility model shown in equations (2) and (3) is used to be able to consider asymmetric effects of negative and positive shocks.

$$r_t = \beta_0 + \sum_{i=1}^{q} \beta_i r_{t-i} + u_t \quad (2)$$

where r_t is AR(q) and u_t follows GARCH (m, s) process, that is,

$$u_t = \varepsilon_t \sigma_t$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{m} \alpha_i u_{t-i}^2 + \sum_{j=1}^{s} \gamma_j \sigma_{t-j}^2 + I(u_{t-1}) \left(\phi_0 + \sum_{i=1}^{k} \phi_i u_{t-i}^2 + \sum_{j=1}^{p} \delta_j \sigma_{t-j}^2 \right) \quad (3)$$

$$\varepsilon_t \sim IID(0,1) \quad I(u_{t-1}) = \begin{cases} 1, & u_{t-1} > 0 \\ 0, & u_{t-1} \le 0 \end{cases}$$

In mean equation (2) r_t shows the logarithmic return of ISE100 index. u_t is serially uncorrelated deviation term which represents the deviation of ISE100 daily log return from its conditional expectation. In variance equation (3), σ_t^2 is conditional variance. u_{t-1} is used as threshold variable which is tested whether it is higher than zero. According to the TAR-GARCH model conditional variance indicates two different regimes depending on the sign of

u_{t-1}. If $u_{t-1} \leq 0$, the value of $I(u_{t-1})$ will be zero and conditional variance will follow typically GARCH model. Otherwise, $I(u_{t-1})$ will be one and the coefficient of u_{t-i}^2 and σ_{t-j}^2 will be $(\alpha_i + \phi_i)$ and $(\gamma_j + \delta_j)$ respectively instead of α_i and γ_j. Consequently, this kind of model usage allows us to consider asymmetric responses in volatility between positive and negative shocks.

IV. Estimation Results

The TAR-GARCH model is shown by using equations (2) and (3) is estimated by maximum likelihood estimation method. The results are presented in Table 2. All parameters are statistically significant. Diagnostic tests show that the model is adequate in modeling the serial dependence and conditional heteroscedasticity of the data. The results propose that volatility responds differently to positive and negative shocks.

$$\sigma_t^2 = \begin{pmatrix} 0.000058 + 0.1464u_{t-1}^2 + 0.8431\sigma_{t-1}^2 & if\ u_{t-1} \leq 0 \\ 0.000058 + 0.1464u_{t-1}^2 + 0.7386\sigma_{t-1}^2 & if\ u_{t-1} > 0 \end{pmatrix} \quad (4)$$

Equation (4) exhibits the volatility equations for negative and positive deviations. The only significant difference is coefficient of one lag of conditional variance. This coefficient is smaller when $u_{t-1} > 0$ than $u_{t-1} \leq 0$. The significant change in coefficient of u_{t-1}^2 can not be detected.

Table 2: Estimation Results

Mean Equation		
Parameters	**Values**	**p-values**
β_0	0.0013	0.0008
β_1	0.1066	0.0000
Variance Equation		
α_0	0.000058	0.0000
α_1	0.1464	0.0000
γ_1	0.8431	0.0000
δ_1	-0.1045	0.0000
Diagnostic Tests		
L-B Q(10)	18.325	0.061
L-B Q(20)	26.381	0.153
L-B Q(30)	38.832	0.129
L-B^2 Q(10)	17.764	0.059
L-B^2 Q(20)	32.915	0.053
L-B^2 Q(30)	42.994	0.068

*L-B Q(.):*Ljung-Box Q statistics of standardized residuals
*L-B^2 Q(.):*Ljung-Box Q statistics of standardized squared residuals

V. Conclusion

This study investigated the asymmetric responses of the volatility of returns for positive and negative shocks in Turkish stock market by using one of the nonlinear volatility models namely TAR-GARCH model. The findings clearly show that the volatility responds differently to negative and positive shocks. The negative deviations from conditional mean will result in more volatility than positive deviations. The results suggest that stock returns react asymmetrically to past information at a lag of one time period in the Turkish stock market.

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GLOBAL CAPITAL MARKETS

The global economy expended robustly in 2006 growing by 5.4 percent. Activity in the United States faced strong downturn in the housing market while private consumption spending continued to increase. The manufacturing sector has been weak, particularly in autos and sectors related to construction, as demand has slowed and inventories have risen. The US. economy has slowed noticeably over the past year. In the euro area, growth accelerated to its fastest pace in six years as domestic demand was boosted by increasing business confidence and improving labor markets. Activity in Japan slowed in the middle of the year, but regained traction toward year-end. Rapid growth in emerging markets and developing countries was led by China and India. China's growth rate was driven by investment and export growth.

Advanced economy equity markets remain close to all-time highs, supported by strong earnings growth. Long-term bond yields have generally receded since mid-2006, spreads on risky assets have narrowed in most market segments, and market volatility was extremely low until recently. Emerging bond and equity markets rebounded robustly from an earlier episode of turbulence in May-June 2006 as concerns about continued tightening of monetary policy in the United States eased. Capital flows to emerging markets were remained at high levels in 2006.

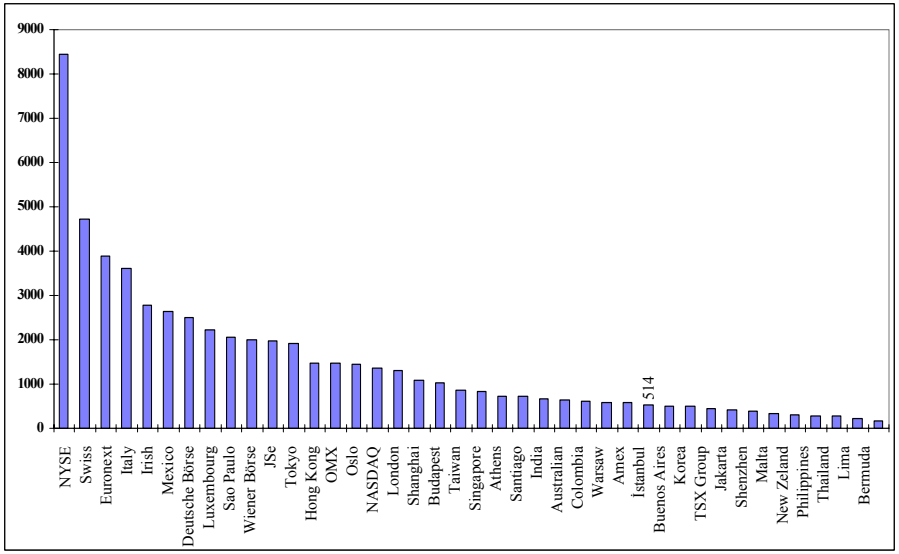
The performances of some developed stock markets with respect to indices indicated that DJIA, FTSE-100, Nikkei-225 and DAX changed by 16,4%, 27,3%, 5,7% and 38,4% respectively at January 3rd, 2007 in comparison with the December 30, 2005. When US $ based returns of some emerging markets are compared in the same period, the best performer markets were: China (109,8 %), Venezuela (99,0 %), Indonesia (73,1 %), Russia (70,7 %) and Poland (61,4 %). In the same period, the lowest return markets were: Saudi Arabia (-52,5 %), Turkey (-5,6 %) and Pakistan (3,4 %),. The performances of emerging markets with respect to P/E ratios as of end-2006 indicated that the highest rates were obtained in Taiwan (25,6), China (24,6), Chile (24,2), Malaysia (21,7) and Jordan (20,8) and the lowest rates in Thailand (8,7), Pakistan (10,8), Brazil (12,7) and Korea (12,8).

Market Capitalization (USD Million, 1986-2006)

	Global	Developed Markets	Emerging Markets	ISE
1986	6,514,199	6,275,582	238,617	938
1987	7,830,778	7,511,072	319,706	3,125
1988	9,728,493	9,245,358	483,135	1,128
1989	11,712,673	10,967,395	745,278	6,756
1990	9,398,391	8,784,770	613,621	18,737
1991	11,342,089	10,434,218	907,871	15,564
1992	10,923,343	9,923,024	1,000,319	9,922
1993	14,016,023	12,327,242	1,688,781	37,824
1994	15,124,051	13,210,778	1,913,273	21,785
1995	17,788,071	15,859,021	1,929,050	20,782
1996	20,412,135	17,982,088	2,272,184	30,797
1997	23,087,006	20,923,911	2,163,095	61,348
1998	26,964,463	25,065,373	1,899,090	33,473
1999	36,030,810	32,956,939	3,073,871	112,276
2000	32,260,433	29,520,707	2,691,452	69,659
2001	27,818,618	25,246,554	2,572,064	47,150
2002	23,391,914	20,955,876	2,436,038	33,958
2003	31,947,703	28,290,981	3,656,722	68,379
2004	38,904,018	34,173,600	4,730,418	98,299
2005	43,642,048	36,538,248	7,103,800	161,537
2006	54,194,991	43,736,409	10,458,582	162,399

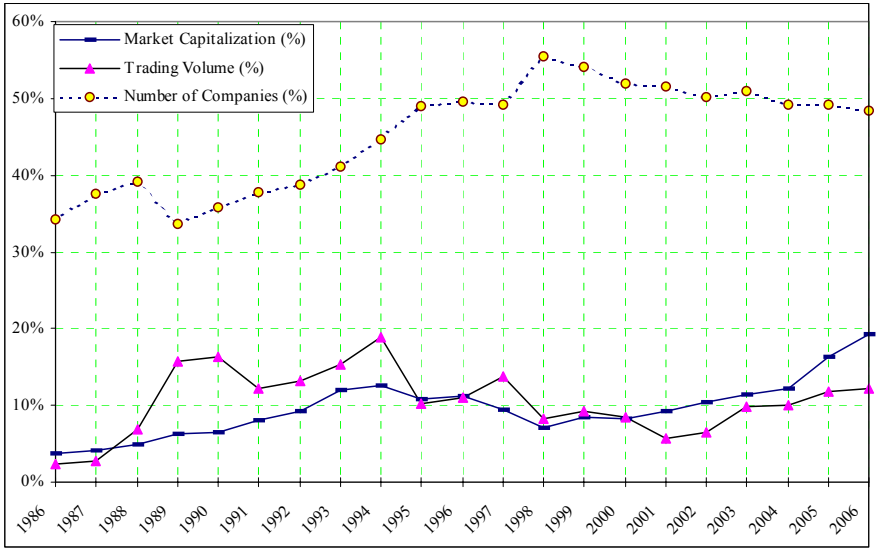
Source: Standard & Poor's Global Stock Markets Factbook, 2007.

Comparison of Average Market Capitalization Per Company (USD Million, December 2006)



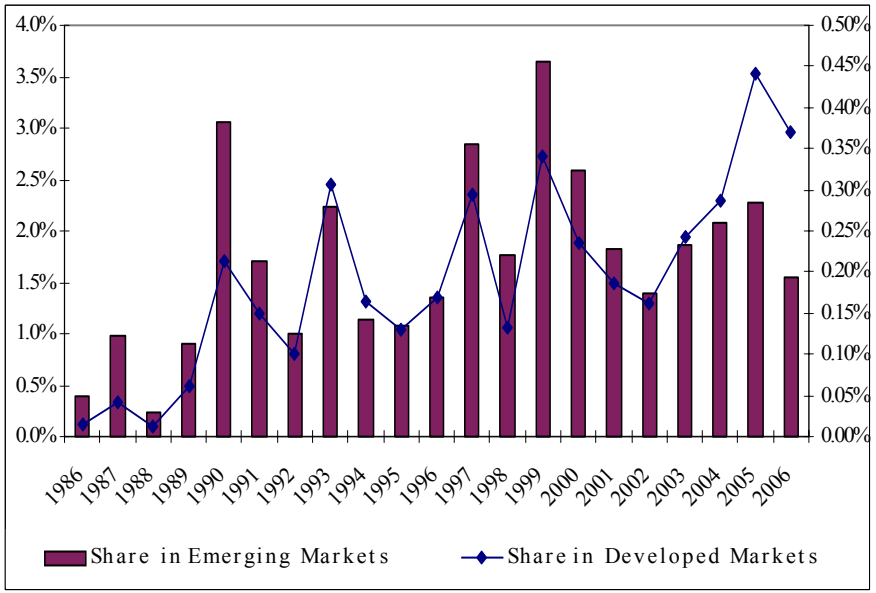
Source: FIBV, Monthly Statistics, December 2006.

Worldwide Share of Emerging Capital Markets (1986-2006)



Source: Standard & Poor's Global Stock Markets Factbook, 2007.

Share of ISE's Market Capitalization in World Markets (1986-2006)



Source: Standard & Poor's Global Stock Markets Factbook, 2007.

Main Indicators of Capital Markets (December 2006)

	Market	Monthly Turnover Velocity (Dec 2006) (%)	Market	Value of Share Trading (millions, US$) Up to Year Total (2006/1-2006/12)	Market	Market Cap. of Share of Domestic Companies (millions US$) December 2006
1	NASDAQ	269.90	NYSE	21,789,392	NYSE	15,421,168
2	Shenzhen	251.69	NASDAQ	11,807,491	Tokyo	4,614,069
3	Deutsche Börse	173.73	London	7,583,762	NASDAQ	3,865,004
4	Korea	171.41	Tokyo	5,824,867	London	3,794,310
5	Spanish (BME)	166.97	Euronext	3,805,260	Euronext	3,708,150
6	Italy	162.86	Deutsche Börse	2,741,608	Hong Kong	1,714,953
7	Shanghai	153.83	Spanish (BME)	1,941,227	TSX Group	1,700,708
8	Oslo	144.27	Italy	1,596,199	Deutsche Börse	1,637,610
9	Taiwan	141.75	Swiss	1,395,567	Spanish (BME)	1,322,915
10	Istanbul	141.59	Korea	1,339,638	Swiss	1,212,308
11	OMX	134.52	OMX	1,332,732	OMX	1,123,042
12	NYSE	134.28	TSX Group	1,282,478	Australian	1,095,858
13	Swiss	130.24	Australian	860,663	Italy	1,026,504
14	Tokyo	125.84	Hong Kong	832,386	Shanghai	917,508
15	London	124.83	Shanghai	738,859	Korea	834,404
16	Euronext	116.35	Taiwan	737,742	Bombay	818,879
17	Australian	88.40	Amex	601,188	India	774,116
18	Budapest	88.32	India	424,251	JSE	711,232
19	TSX Group	76.38	Shenzhen	423,699	Sao Paulo	710,247
20	Thailand	72.70	Oslo	406,469	Taiwan	594,659
21	India	67.80	JSE	312,296	Singapore	384,286
22	Hong Kong	62.09	Sao Paulo	276,076	Mexico	348,345
23	Irish	59.64	Osaka	262,954	Amex	282,801
24	Athens	58.56	Istanbul	224,610	Oslo	279,910
25	Singapore	58.17	Bombay	215,010	Malaysia	235,581
26	New Zealand	51.62	Singapore	180,440	Shenzhen	227,947
27	Wiener Börse	50.17	Athens	107,879	Athens	208,256
28	JSE	48.90	Thailand	100,654	Wiener Börse	192,770
29	Tel Aviv	46.60	Mexico	96,320	Osaka	183,512
30	Sao Paulo	45.49	Wiener Börse	82,245	Santiago	174,419
31	Warsaw	45.39	Irish	81,786	Irish	163,269
32	Jakarta	44.84	Malaysia	75,487	Istanbul	162,399
33	Malaysia	36.23	Tel Aviv	65,538	Tel Aviv	161,732
34	Bombay	31.91	Warsaw	56,061	Warsaw	148,775
35	Mexico	29.64	Jakarta	48,844	Thailand	140,161
36	Colombia	28.82	Budapest	31,000	Jakarta	138,886
37	Philippine	21.79	Santiago	29,691	Luxembourg	79,514
38	Santiago	19.04	New Zealand	22,185	Philippine	67,852
39	Ljubljana	17.58	Colombia	15,000	Colombia	56,204
40	Lima	15.82	Philippine	11,252	Buenos Aires	51,240
41	Colombo	14.46	Lima	5,492	New Zealand	44,817
42	Tehran	13.75	Buenos Aires	5,281	Budapest	41,784
43	Osaka	7.96	Tehran	4,886	Lima	40,022
44	Buenos Aires	7.23	Ljubljana	2,059	Tehran	36,315
45	Bermuda	6.32	Colombo	1,004	Ljubljana	15,182

Source: FIBV, Monthly Statistics, December 2006.

Trading Volume (USD millions, 1986-2006)

	Global	Developed	Emerging	ISE	Emerging / Global (%)	ISE/Emerging (%)
1986	3,573,570	3,490,718	82,852	13	2.32	0.02
1987	5,846,864	5,682,143	164,721	118	2.82	0.07
1988	5,997,321	5,588,694	408,627	115	6.81	0.03
1989	7,467,997	6,298,778	1,169,219	773	15.66	0.07
1990	5,514,706	4,614,786	899,920	5,854	16.32	0.65
1991	5,019,596	4,403,631	615,965	8,502	12.27	1.38
1992	4,782,850	4,151,662	631,188	8,567	13.20	1.36
1993	7,194,675	6,090,929	1,103,746	21,770	15.34	1.97
1994	8,821,845	7,156,704	1,665,141	23,203	18.88	1.39
1995	10,218,748	9,176,451	1,042,297	52,357	10.20	5.02
1996	13,616,070	12,105,541	1,510,529	37,737	11.09	2.50
1997	19,484,814	16,818,167	2,666,647	59,105	13.69	2.18
1998	22,874,320	20,917,462	1,909,510	68,646	8.55	3.60
1999	31,021,065	28,154,198	2,866,867	81,277	9.24	2.86
2000	47,869,886	43,817,893	4,051,905	179,209	8.46	4.42
2001	42,076,862	39,676,018	2,400,844	77,937	5.71	3.25
2002	38,645,472	36,098,731	2,546,742	70,667	6.59	2.77
2003	29,639,297	26,743,153	2,896,144	99,611	9.77	3.44
2004	39,309,589	35,341,782	3,967,806	147,426	10.09	3.72
2005	47,319,584	41,715,492	5,604,092	201,258	11.84	3.59
2006	67,912,153	59,685,209	8,226,944	227,615	12.11	2.77

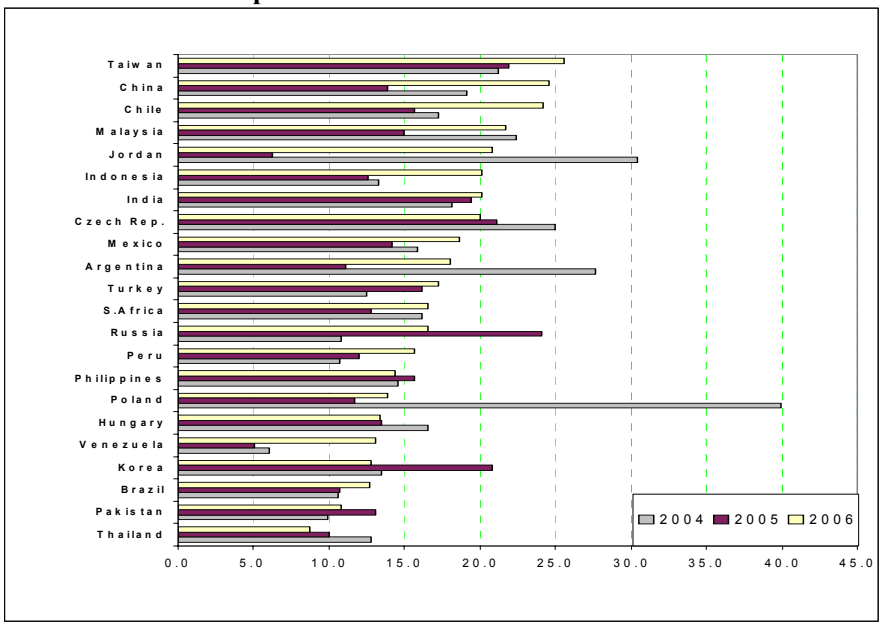
Source: Standard & Poor's Global Stock Markets Factbook, 2007.

Number of Trading Companies (1986-2006)

	Global	Developed Markets	Emerging Markets	ISE	Emerging / Global (%)	ISE/Emerging (%)
1986	28,173	18,555	9,618	80	34.14	0.83
1987	29,278	18,265	11,013	82	37.62	0.74
1988	29,270	17,805	11,465	79	39.17	0.69
1989	25,925	17,216	8,709	76	33.59	0.87
1990	25,424	16,323	9,101	110	35.80	1.21
1991	26,093	16,239	9,854	134	37.76	1.36
1992	27,706	16,976	10,730	145	38.73	1.35
1993	28,895	17,012	11,883	160	41.12	1.35
1994	33,473	18,505	14,968	176	44.72	1.18
1995	36,602	18,648	17,954	205	49.05	1.14
1996	40,191	20,242	19,949	228	49.64	1.14
1997	40,880	20,805	20,075	258	49.11	1.29
1998	47,465	21,111	26,354	277	55.52	1.05
1999	48,557	22,277	26,280	285	54.12	1.08
2000	49,933	23,996	25,937	315	51.94	1.21
2001	48,220	23,340	24,880	310	51.60	1.25
2002	48,375	24,099	24,276	288	50.18	1.19
2003	49,855	24,414	25,441	284	51.03	1.12
2004	48,806	24,824	23,982	296	49.14	1.23
2005	49,946	25,337	24,609	302	49.27	1.23
2006	50,212	25,954	24,258	314	48.31	1.29

Source: Standard & Poor's Global Stock Markets Factbook, 2007.

Comparison of P/E Ratios Performances



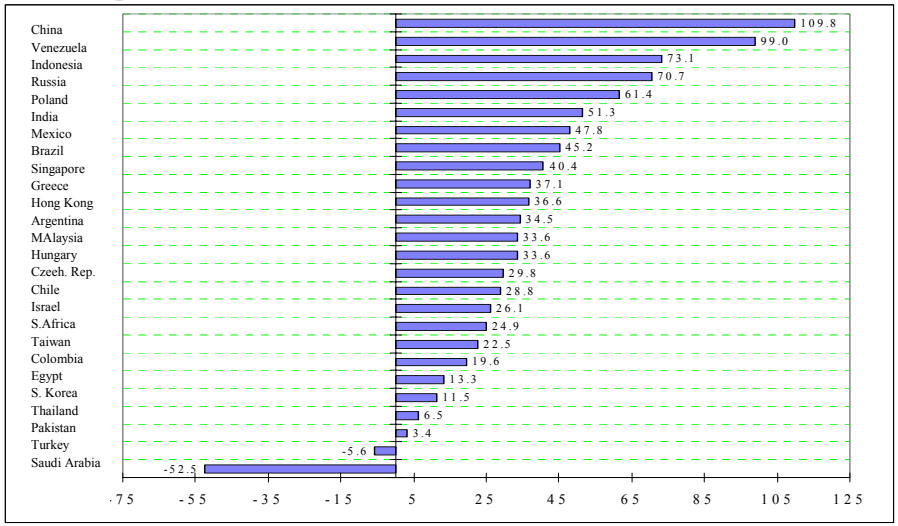
Source: IFC Factbook 2001. Standard & Poor's, Emerging Stock Markets Review, December 2006.

Price-Earnings Ratios in Emerging Markets

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Argentina	16.3	13.4	39.4	-889.9	32.6	-1.4	21.1	27.7	11.1	18.0
Brazil	12.4	7.0	23.5	11.5	8.8	13.5	10.0	10.6	10.7	12.7
Chile	14.7	15.1	35.0	24.9	16.2	16.3	24.8	17.2	15.7	24.2
China	34.5	23.8	47.8	50.0	22.2	21.6	28.6	19.1	13.9	24.6
Czech Rep.	37.1	-11.3	-14.9	-16.4	5.8	11.2	10.8	25.0	21.1	20.0
Hungary	27.4	17.0	18.1	14.3	13.4	14.6	12.3	16.6	13.5	13.4
India	15.2	13.5	25.5	16.8	12.8	15.0	20.9	18.1	19.4	20.1
Indonesia	10.5	-106.2	-7.4	-5.4	-7.7	22.0	39.5	13.3	12.6	20.1
Jordan	14.4	15.9	14.1	13.9	18.8	11.4	20.7	30.4	6.2	20.8
Korea	17.9	-47.1	-33.5	17.7	28.7	21.6	30.2	13.5	20.8	12.8
Malaysia	9.5	21.1	-18.0	91.5	50.6	21.3	30.1	22.4	15	21.7
Mexico	19.2	23.9	14.1	13.0	13.7	15.4	17.6	15.9	14.2	18.6
Pakistan	14.8	7.6	13.2	-117.4	7.5	10.0	9.5	9.9	13.1	10.8
Peru	14.0	21.1	25.7	11.6	21.3	12.8	13.7	10.7	12.0	15.7
Philippines	10.9	15.0	22.2	26.2	45.9	21.8	21.1	14.6	15.7	14.4
Poland	11.4	10.7	22.0	19.4	6.1	88.6	-353.0	39.9	11.7	13.9
Russia	8.1	3.7	-71.2	3.8	5.6	12.4	19.9	10.8	24.1	16.6
S.Africa	10.8	10.1	17.4	10.7	11.7	10.1	11.5	16.2	12.8	16.6
Taiwan	28.9	21.7	52.5	13.9	29.4	20.0	55.7	21.2	21.9	25.6
Thailand	-32.8	-3.6	-12.2	-6.9	163.8	16.4	16.6	12.8	10.0	8.7
Turkey	20.1	7.8	34.6	15.4	72.5	37.9	14.9	12.5	16.2	17.2
Venezuela	12.8	5.6	10.8	30.5	-347.6	-11.9	14.4	6.0	5.1	13.1

Source: IFC Factbook, 2004; Standard&Poor's, Emerging Stock Markets Review, December 2006
Note: Figures are taken from S&P/IFCG Index Profile.

Comparison of Market Returns in USD (30/12/2005-03/01/2007)



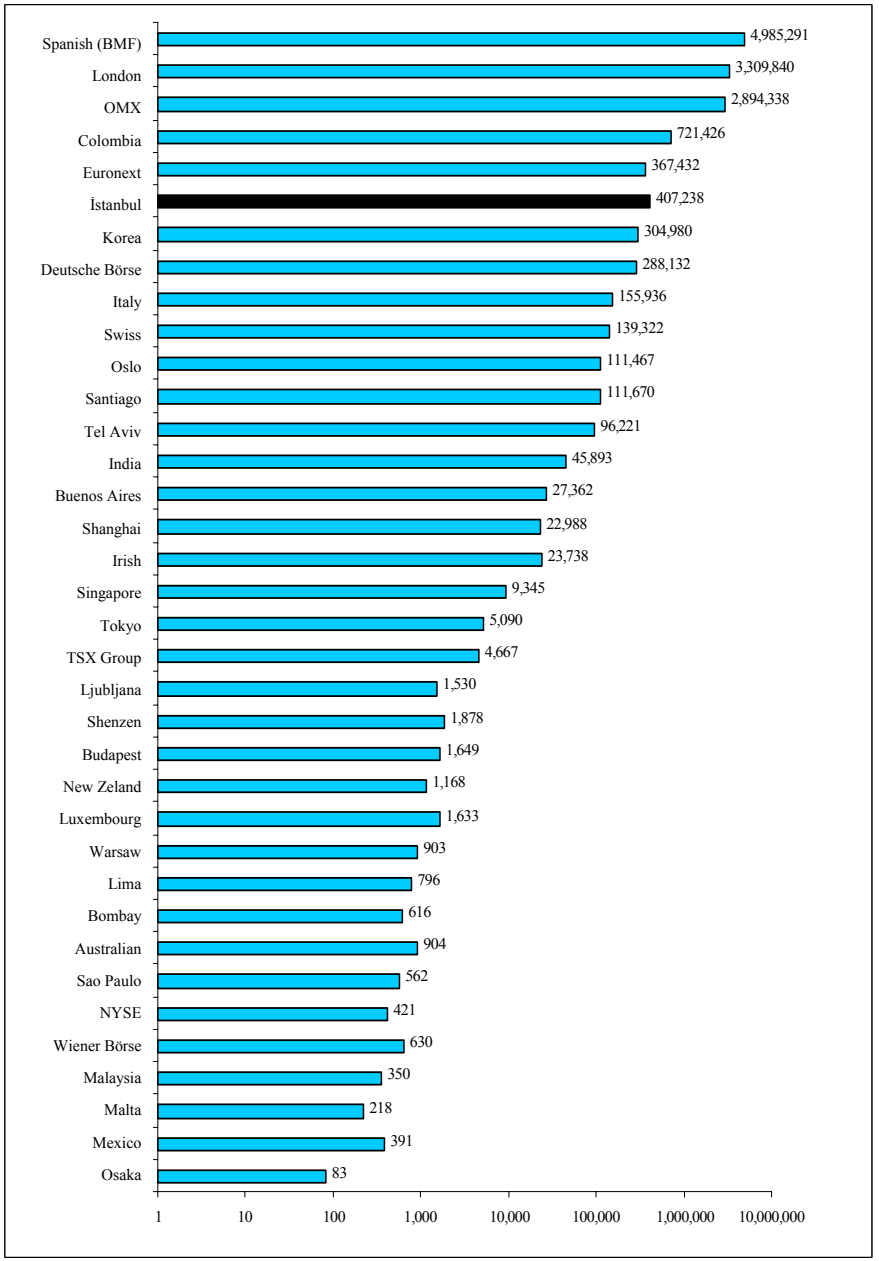
Source: The Economist, Jan 3rd 2007.

Market Value/Book Value Ratios

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Argentina	1.8	1.3	1.5	0.9	0.6	0.8	2.0	2.2	2.5	4.1
Brazil	1.0	0.6	1.6	1.4	1.2	1.3	1.8	1.9	2.2	2.7
Chile	1.6	1.1	1.7	1.4	1.4	1.3	1.9	0.6	1.9	2.4
China	3.9	2.1	3.0	3.6	2.3	1.9	2.6	2.0	1.8	3.1
Czech Rep.	0.8	0.7	0.9	1.0	0.8	0.8	1.0	1.6	2.4	2.4
Hungary	4.2	3.2	3.6	2.4	1.8	1.8	2.0	2.8	3.1	3.1
India	2.3	1.8	3.3	2.6	1.9	2.0	3.5	3.3	5.2	4.9
Indonesia	1.4	1.5	3.0	1.7	1.7	1.0	1.6	2.8	2.5	3.4
Jordan	1.8	1.8	1.5	1.2	1.5	1.3	2.1	3.0	2.2	3.3
Korea	0.5	0.9	2.0	0.8	1.2	1.1	1.6	1.3	2.0	1.7
Malaysia	1.4	1.3	1.9	1.5	1.2	1.3	1.7	1.9	1.7	2.1
Mexico	2.3	1.4	2.2	1.7	1.7	1.5	2.0	2.5	2.9	3.8
Pakistan	2.3	0.9	1.4	1.4	0.9	1.9	2.3	2.6	3.5	3.2
Peru	2.0	1.6	1.5	1.1	1.4	1.2	1.8	1.6	2.2	3.5
Philippines	1.3	1.3	1.4	1.0	0.9	0.8	1.1	1.4	1.7	1.9
Poland	1.7	1.5	2.0	2.2	1.4	1.3	1.8	2.0	2.5	2.5
Russia	0.5	0.3	1.2	0.6	1.1	0.9	1.2	1.2	2.2	2.5
S.Africa	1.6	1.5	2.7	2.1	2.1	1.9	2.1	2.5	3.0	3.8
Taiwan	3.1	2.6	3.4	1.7	2.1	1.6	2.2	1.9	1.9	2.4
Thailand	0.8	1.2	2.1	1.3	1.3	1.5	2.8	2.0	2.1	1.9
Turkey	6.8	2.7	8.9	3.1	3.8	2.8	2.6	1.7	2.1	2.0
Venezuela	1.2	0.5	0.4	0.6	0.5	0.5	1.1	1.2	0.7	2.6

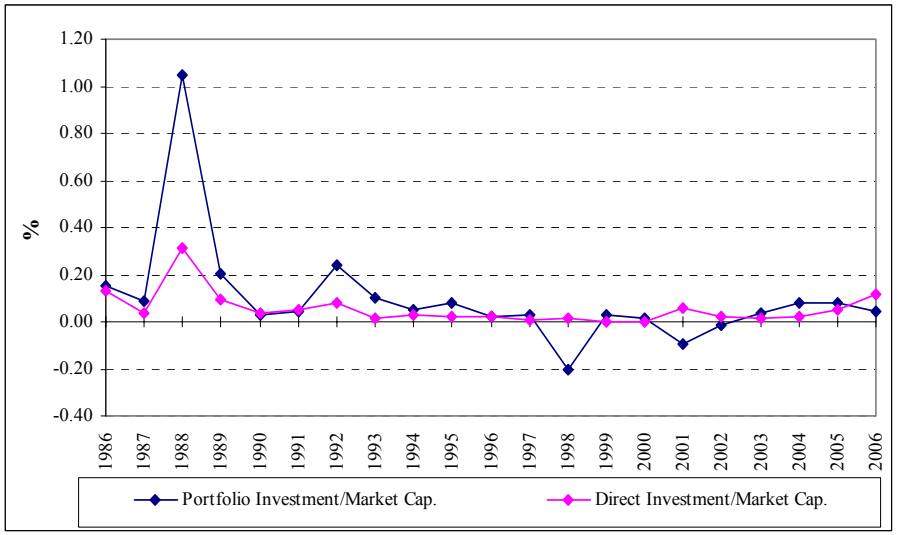
Source: IFC Factbook, 2004; Standard & Poor's, Emerging Stock Markets Review, December 2006.
Note: Figures are taken from S&P/IFCG Index Profile.

Value of Bond Trading (Million USD Jan. 2006-Dec. 2006)



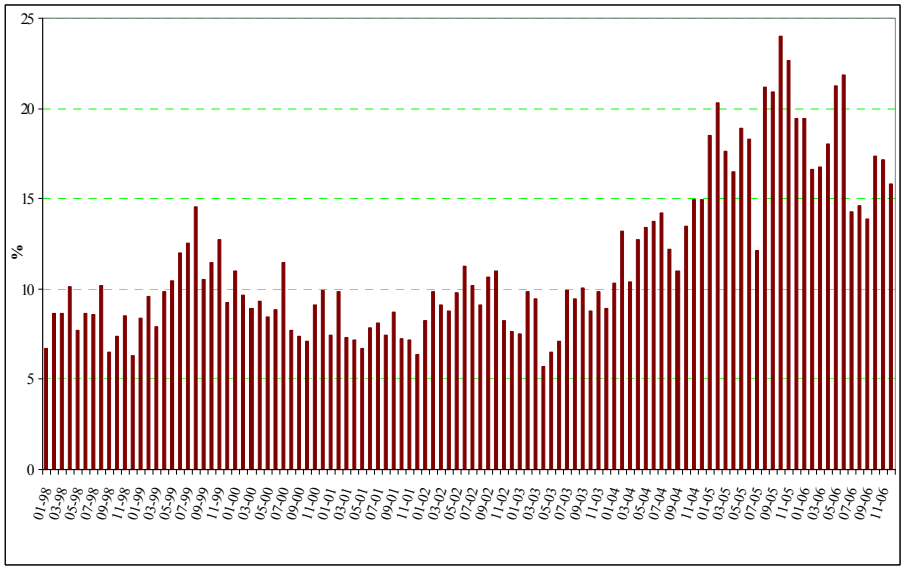
Source: FIBV, Monthly Statistics, December 2006.

Foreign Investments as a Percentage of Market Capitalization in Turkey (1986-2006)



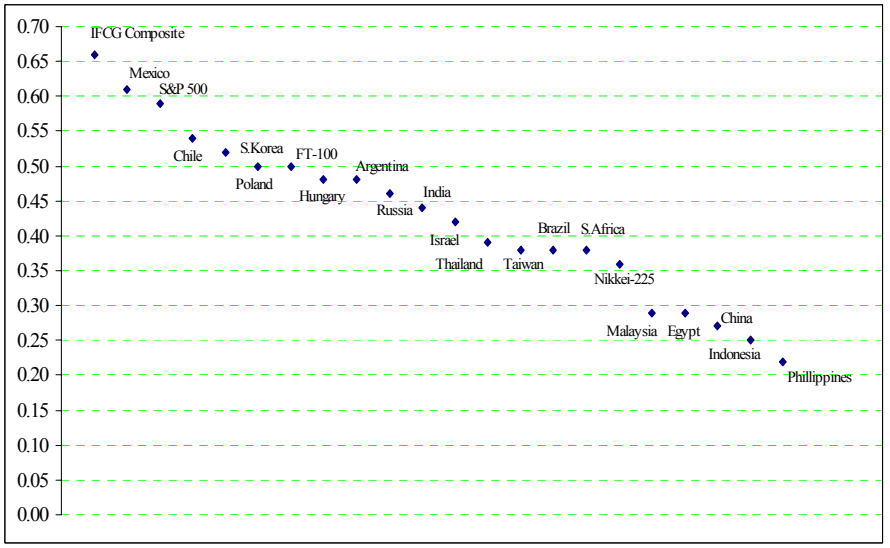
Source: ISE Data. CBTR Databank.

Foreigners' Share in the Trading Volume of the ISE (Jan. 1998-Dec. 2006)



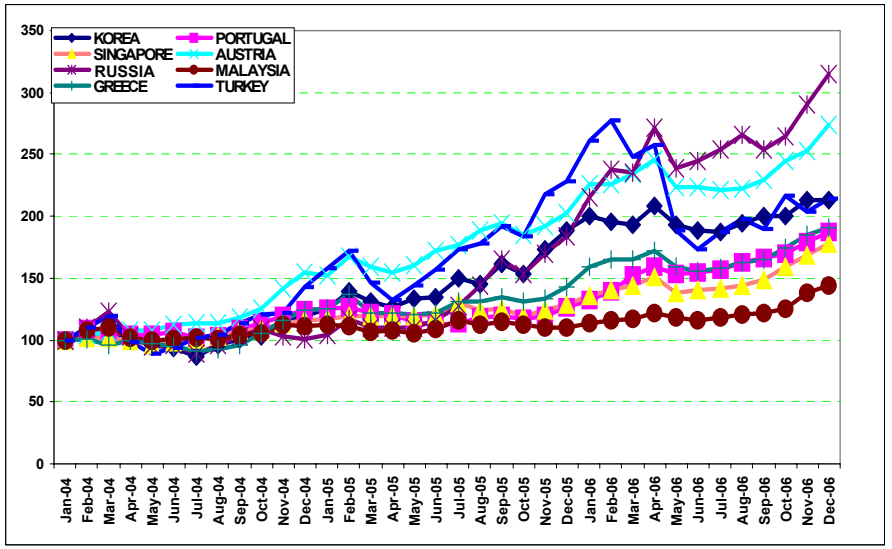
Source: ISE Data.

Price Correlations of the ISE (Dec. 2001- Dec. 2006)



Source: Standard & Poor's, Emerging Stock Markets Review, December 2006.
Notes: The correlation coefficient is between -1 and +1. If it is zero. for the given period. it is implied that there is no relation between two serious of returns.

Comparison of Market Indices (31 Jan. 2004=100)



Source: Bloomberg
Note: Comparisons are in US$.

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ISE
Market Indicators

STOCK MARKET

	Number of Companies	Traded Value				Market Value		Dividend Yield	P/E Ratios		
		Total		Daily Average							
		(YTL Million)	(US$ Million)	(YTL Million)	(US$ Million)	(YTL Million)	(US$ Million)	(%)	YTL (1)	YTL (2)	US$
1986	80	0,01	13	---	---	0,71	938	9,15	5,07	---	---
1987	82	0,10	118	---	---	3	3.125	2,82	15,86	---	---
1988	79	0,15	115	---	---	2	1.128	10,48	4,97	---	---
1989	76	2	773	0,01	3	16	6.756	3,44	15,74	---	---
1990	110	15	5.854	0,06	24	55	18.737	2,62	23,97	---	---
1991	134	35	8.502	0,14	34	79	15.564	3,95	15,88	---	---
1992	145	56	8.567	0,22	34	85	9.922	6,43	11,39	---	---
1993	160	255	21.770	1	88	546	37.824	1,65	25,75	20,72	14,86
1994	176	651	23.203	3	92	836	21.785	2,78	24,83	16,70	10,97
1995	205	2.374	52.357	9	209	1.265	20.782	3,56	9,23	7,67	5,48
1996	228	3.031	37.737	12	153	3.275	30.797	2,87	12,15	10,86	7,72
1997	258	9.049	58.104	36	231	12.654	61.879	1,56	24,39	19,45	13,28
1998	277	18.030	70.396	73	284	10.612	33.975	3,37	8,84	8,11	6,36
1999	285	36.877	84.034	156	356	61.137	114.271	0,72	37,52	34,08	24,95
2000	315	111.165	181.934	452	740	46.692	69.507	1,29	16,82	16,11	14,05
2001	310	93.119	80.400	375	324	68.603	47.689	0,95	108,33	824,42	411,64
2002	288	106.302	70.756	422	281	56.370	34.402	1,20	195,92	26,98	23,78
2003	285	146.645	100.165	596	407	96.073	69.003	0,94	14,54	12,29	13,19
2004	297	208.423	147.755	837	593	132.556	98.073	1,37	14,18	13,27	13,96
2005	304	269.931	201.763	1.063	794	218.318	162.814	1,71	17,19	19,38	19,33
2006	316	325.131	229.642	1.301	919	230.038	163.775	2,10	22,02	14,86	15,32
2006/Q1	306	98.235	74.208	1.637	1.237	237.563	177.180	1,81	23,27	21,63	21,59
2006/Q2	316	92.212	63.707	1.441	995	201.202	128.268	2,23	19,33	17,68	15,09
2006/Q3	316	66.524	44.656	1.039	698	213.525	142.721	2,25	20,42	20,55	19,11
2006/Q4	316	68.160	47.071	1.099	759	230.038	163.775	2,10	22,02	14,86	15,32

Q: Quarter

Note:

* Between 1986-1992, the price earnings ratios were calculated on the basis of the companies' previous year-end net profits. As from 1993,
TL(1) = Total Market Capitalization / Sum of Last two six-month profits
T(2) = Total Market Capitalization / Sum of Last four three-month profits.
US$ = US$ based Total Market Capitilization / Sum of Last four US$ based three-month profits.

* Companies which are temporarily de-listed and will be traded off the Exchange under the decison of ISE's Executive Council are not included in the calculations.

* ETF's data are taken into account only in the calculation of Traded Value.

Closing Values of the ISE Price Indices

YTL Based

	NATIONAL -100 (Jan. 1986=1)	NATIONAL - INDUSTRIALS (Dec. 31.90=33)	NATIONAL - SERVICES (Dec. 27,96=1046)	NATIONAL - FINANCIALS (Dec.31.90=33)	NATIONAL - TECHNOLOGY (Jun.30.2000=14.466,12)	'INVESTMENT TRUSTS (Dec 27,1996=976)	'SECOND NATIONAL (Dec.27,1996=976)	'NEW ECONOMY (Sept. 02, 2004 =20525,92)
1986	1,71	---	---	---	---	---	---	---
1987	6,73	---	---	---	---	---	---	---
1988	3,74	---	---	---	---	---	---	---
1989	22,18	---	---	---	---	---	---	---
1990	32,56	---	---	---	---	---	---	---
1991	43,69	49,63	---	33,55	---	---	---	---
1992	40,04	49,15	---	24,34	---	---	---	---
1993	206,83	222,88	---	191,90	---	---	---	---
1994	272,57	304,74	---	229,64	---	---	---	---
1995	400,25	462,47	---	300,04	---	---	---	---
1996	975,89	1.045,91	---	914,47	---	---	---	---
1997	3.451,--	2.660,--	3.593,--	4.522,--	---	2.934,--	2.761,--	---
1998	2.597,91	1.943,67	3.697,10	3.269,58	---	1.579,24	5.390,43	---
1999	15.208,78	9.945,75	13.194,40	21.180,77	---	6.812,65	13.450,36	---
2000	9.437,21	6.954,99	7.224,01	12.837,92	10.586,58	6.219,00	15.718,65	---
2001	13.782,76	11.413,44	9.261,82	18.234,65	9.236,16	7.943,60	20.664,11	---
2002	10.369,92	9.888,71	6.897,30	12.902,34	7.260,84	5.452,10	28.305,78	---
2003	18.625,02	16.299,23	9.923,02	25.594,77	8.368,72	10.897,76	32.521,26	---
2004	24.971,68	20.885,47	13.914,12	35.487,77	7.539,16	17.114,91	23.415,86	39.240,73
2005	39.777,70	31.140,59	18.085,71	62.800,64	13.669,97	23.037,86	28.474,96	29.820,90
2006	39.117,46	30.896,67	22.211,77	60.168,41	10.341,85	16.910,76	23.969,99	20.395,84
2006/Q1	42.911,32	32.961,91	20.018,86	68.636,50	15.558,11	22.089,86	30.205,93	31.556,79
2006/Q2	35.453,31	28.324,23	19.476,35	54.247,09	9.984,53	16.836,37	21.867,26	19.632,59
2006/Q3	36.924,86	28.165,89	21.477,35	57.874,65	10.252,64	16.731,61	22.749,24	17.403,11
2006/Q4	39.117,46	30.896,67	22.211,77	60.168,41	10.341,85	16.910,76	23.969,99	20.395,84

US $ Based

	NATIONAL - 100 (Jan. 1986=100)	NATIONAL - INDUSTRIALS (Dec. 31, 90=643)	NATIONAL - SERVICES (Dec. 27, 96=572)	NATIONAL - FINANCIALS (Dec.31, 90=643)	NATIONAL - TECHNOLOGY (Jun. 30,2000=1.360.92)	'INVESTMENT TRUSTS (Dec. 27, 96=534)	'SECOND NATIONAL (Dec. 27, 96=534)	'NEW ECONOMY (Sept. 02, 2004 =796,46)	EURO Based NATIONAL - 100 (Dec. 31, 98=484)
1986	131,53	---	---	---	---	---	---	---	---
1987	384,57	---	---	---	---	---	---	---	---
1988	119,82	---	---	---	---	---	---	---	---
1989	560,57	---	---	---	---	---	---	---	---
1990	642,63	---	---	---	---	---	---	---	---
1991	501,50	569,63	---	385,14	---	---	---	---	---
1992	272,61	334,59	---	165,68	---	---	---	---	---
1993	833,28	897,96	---	773,13	---	---	---	---	---
1994	413,27	462,03	---	348,18	---	---	---	---	---
1995	382,62	442,11	---	286,83	---	---	---	---	---
1996	534,01	572,33	---	500,40	---	---	---	---	---
1997	981,99	756,91	1.022,40	1.286,75	---	834,88	785,65	---	---
1998	484,01	362,12	688,79	609,14	---	294,22	1.004,27	---	---
1999	1.654,17	1.081,74	1.435,08	2.303,71	---	740,97	1.462,92	---	1.912,46
2000	817,49	602,47	625,78	1.112,08	917,06	538,72	1.361,62	---	1.045,57
2001	557,52	461,68	374,65	737,61	373,61	321,33	835,88	---	741,24
2002	368,26	351,17	244,94	458,20	257,85	193,62	1.005,21	---	411,72
2003	778,43	681,22	414,73	1.069,73	349,77	455,47	1.359,22	---	723,25
2004	1.075,12	899,19	599,05	1.527,87	324,59	736,86	1.008,13	1.689,45	924,87
2005	1.726,23	1.351,41	784,87	2.725,36	593,24	999,77	1.235,73	1.294,14	1.710,04
2006	1.620,59	1.280,01	920,21	2.492,71	428,45	700,59	993,05	844,98	1.441,89
2006/Q1	1.862,36	1.430,55	868,82	2.978,84	675,23	958,70	1.310,94	1.369,57	1.801,72
2006/Q2	1.315,23	1.050,76	722,52	2.012,43	370,40	624,59	811,22	728,32	1.212,04
2006/Q3	1.436,20	1.095,52	835,36	2.251,04	398,78	650,78	884,83	676,90	1.328,82
2006/Q4	1.620,59	1.280,01	920,21	2.492,71	428,45	700,59	993,05	844,98	1.441,89

Q: Quarter

BONDS AND BILLS MARKET

Traded Value

Outright Purchases and Sales Market

	Total		Daily Average	
	(YTL Million)	(US$ Million)	(YTL Million)	(US$ Million)
1991	1	312	0,01	2
1992	18	2.406	0,07	10
1993	123	10.728	0,50	44
1994	270	8.832	1	35
1995	740	16.509	3	66
1996	2.711	32.737	11	130
1997	5.504	35.472	22	141
1998	17.996	68.399	72	274
1999	35.430	83.842	143	338
2000	166.336	262.941	663	1.048
2001	39.777	37.297	158	149
2002	102.095	67.256	404	266
2003	213.098	144.422	852	578
2004	372.670	262.596	1.479	1.042
2005	480.723	359.371	1.893	1.415
2006	381.772	270.183	1.521	1.076
2006/Q1	113.677	85.883	1.864	1.408
2006/Q2	98.588	68.967	1.540	1.078
2006/Q3	80.435	54.011	1.257	844
2006/Q4	89.072	61.322	1.437	989

Repo-Reverse Repo Market

Repo-Reverse Repo Market

	Total		Daily Average	
	(Y TL Million)	(US$ Million)	(Y TL Million)	(US$ Million)
1993	59	4.794	0	22
1994	757	23.704	3	94
1995	5.782	123.254	23	489
1905	18.340	221.405	73	879
1997	58.192	374.384	231	1.486
1998	97.278	372.201	389	1.489
1999	250.724	589.267	1.011	2.376
2000	554.121	886.732	2.208	3.533
2001	696.339	627.244	2.774	2.499
2002	736.426	480.725	2.911	1.900
2003	1.040.533	701.545	4.162	2.806
2004	1.551.410	1.090.477	6.156	4.327
2005	1.859.714	1.387.221	7.322	5.461
2006	2.538.802	1.770.337	10.115	7.053
2006/Q1	509.928	384.999	8.359	6.311
2006/Q2	725.652	500.229	11.338	7.816
2006/Q3	685.964	459.332	10.718	7.177
2006/Q4	617.258	425.777	9.956	6.867

Q: Quarter

ISE GDS Price Indices (January 02, 2001 = 100)

YTL Based

	3 Months (91 Days)	6 Months (182 Days)	9 Months (273 Days)	12 Months (365 Days)	15 Months (456 Days)	General
2001	102,87	101,49	97,37	91,61	85,16	101,49
2002	105,69	106,91	104,87	100,57	95,00	104,62
2003	110,42	118,04	123,22	126,33	127,63	121,77
2004	112,03	121,24	127,86	132,22	134,48	122,70
2005	113,14	123,96	132,67	139,50	144,47	129,14
2006	111,97	121,14	127,77	132,16	134,48	121,17
2006/Q1	113,29	124,28	133,14	140,12	145,22	127,71
2006/Q2	111,79	120,63	126,80	130,61	132,30	123,75
2006/Q3	112,20	121,39	127,81	131,76	133,47	122,67
2006/Q4	111,97	121,14	127,77	132,16	134,48	121,17

ISE GDS Performance Indices (January 02, 2001 = 100)

YTL Based

	3 Months (91 Days)	6 Months (182 Days)	9 Months (273 Days)	12 Months (365 Days)	15 Months (456 Days)
2001	195,18	179,24	190,48	159,05	150,00
2002	314,24	305,57	347,66	276,59	255,90
2003	450,50	457,60	558,19	438,13	464,98
2004	555,45	574,60	712,26	552,85	610,42
2005	644,37	670,54	839,82	665,76	735,10
2006	751,03	771,08	956,21	760,07	829,61
2006/Q1	666,36	693,42	868,48	690,34	762,65
2006/Q2	688,16	706,53	870,37	691,84	749,80
2006/Q3	720,22	739,45	916,99	728,90	793,98
2006/Q4	751,03	771,08	956,21	760,07	829,61

ISE GDS Portfolio Performance Indices (December 31, 2003 = 100)

YTL Based

	Equal Weighted Indices (YTL Based)			Market Value Weighted Indices			
	EA180-	EA180-	EA GENERAL	PDA180-	PDA180+	PDA GENERAL	REPO
2004	125,81	130,40	128,11	125,91	130,25	128,09	118,86
2005	147,29	160,29	153,55	147,51	160,36	154,25	133,63
2006	171,02	180,05	175,39	170,84	179,00	174,82	152,90
2006/Q1	152,41	166,19	159,05	152,67	166,25	159,80	137,51
2006/Q2	155,83	161,55	158,30	156,03	161,00	158,04	141,65
2006/Q3	163,90	170,54	166,86	164,03	169,74	166,48	147,09
2006/Q4	171,02	180,05	175,39	170,84	179,00	174,82	152,90

Q: Quarter