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HOW TO MANAGE THE MORTGAGE CREDIT RISK IN TURKEY? CAN DUAL-INDEXED MORTGAGES BE A REMEDY?

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Abstract

A market-oriented housing finance system has been under discussion in Turkey recently. In this article we analyze different types of mortgages that have been used in developed and developing countries to select the one that is most appropriate for Turkey-one which minimizes risks for both lenders and borrowers. Each type of mortgage presents different risks to borrowers and lenders. After taking into consideration the economic history of Turkey, we conclude that the most appropriate mortgage for Turkey that minimizes risk is the dual-indexed mortgage model. We test this model by using data from the most volatile period of the Turkish economy, applying historical simulation and Monte-Carlo simulation. We find that, using this model; the total loan is paid off in a reasonable period without causing substantial difficulty for lenders and borrowers. Analyses confirm that borrowers and lenders are exposed to minimum risk if this type of mortgage is originated in Turkey.

I. Introduction

Recently, "housing finance" is one of the core issues of academic and political debates due to the enduring problem of housing in developing countries. In many developing countries, institutionalized solutions for housing finance have not been successful. Contemporary housing policies require institutional solutions. As a developing country, Turkey still has a housing problem in terms of both supply and finance. Households mostly rely on traditional ways to finance housing since institutional housing finance has not been established properly. Recently, government has drafted a law proposal to find an institutional solution to this problem. This law introduces housing mortgage system similar to the systems in developed countries. When this law goes into effect financial institutions will provide long-term mortgage loans to households who can use the proceeds to finance their housing.

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There are various types of mortgage loans. Financial institutions, which provide mortgage loans, have created different types of loans in order to attract more customers, but at the same time not to endanger their financial positions. Types of mortgage loans offered differ substantially among the countries depending on the needs and preferences of both the financial institutions and the households in each country. Economic conditions of different countries also play an important role in determining the types of mortgage loans. In this paper we will try to find a suitable type of mortgage model for Turkey-one that minimizes risks for both lenders and borrowers.

II. Types of Mortgage Loans

Mortgage loans can be classified as classical mortgages (fixed-rate mortgages), adjustable (variable) rate mortgages and indexed mortgages. The classical mortgages have fixed interest rates and the amount of periodic payments that the borrowers pay throughout the life of the loan remains constant. They can be offered without major problems in the countries, where there is a history of low inflation rates and economic stability. Classical mortgages have two significant problems with high and fluctuating inflation (Fabozzi and Modigliani, 1992). The first problem is the mismatch problem of rates on the source and the use of the funds. Mortgages are long-term loans whose maturities are usually over 20 years. On the other hand, lenders generally have to finance the loans with shorter-term funds. As explained above, interest on classical mortgages does not change throughout the life of the loans. Since the funds to finance these loans have shorter maturities (mismatch problem), the financial institutions have to refinance the funds with higher interest rates during a high inflation period. The second problem is the diminishing economic value of payments due to the inflation (tilt problem). If inflation increases, financial institutions cannot profit from these loans and there is a high risk of loss.

Adjustable (variable) rate mortgages were introduced to alleviate this problem (Brueckner, 1993; Sprecher and William, 1993). In this type of mortgages, interest rate is adjusted periodically according to the loan agreement signed by the lender and the borrower. The amount of the loan balance does not change but the amount of the periodic payments is computed based on the new interest rate. Adjustment periods depend on the economic situations of the countries involved. Interest rates can be adjusted every 2-3 years if the inflation is low and stable. On the other hand, if the inflation is high and fluctuating, interest rates can be adjusted every 3-6 months. Interest rates must be tied to a carefully selected index so that the adjustment can be acceptable to both the lender and the borrower. On the adjustment date, the interest charged is calculated by adding a certain amount (margin) to the value of the index. The margin stays constant over the life of the loan. Financial institutions in developed countries use different incentives to make adjustable rate mortgages more attractive to the borrowers (Lino, 1992). The widely used incentive is to charge lower than market interest rates initially.

Another type of mortgage loan is price-level adjusted mortgages (Peek and Wilcox, 1991). In this type of mortgages, both the outstanding debt balance and the amount

of the periodic payments are increased according to a predetermined (inflation) index. Price-level adjusted mortgages resemble adjustable rate mortgages because the amount of the payments is adjusted periodically. Price-level adjusted mortgages also resemble classical mortgages because the periodic payments and the interest rate are fixed in real terms. Although the nominal value of the periodic payments changes in accordance with the inflation, the real value of the payments remains constant. Like periodic payments, interest rate is not nominal in this type of mortgages but it is also real. Although price-level adjusted mortgages protect the lenders, they present a problem to the borrowers. The amount of periodic payments is increased in accordance with the rate of inflation, but the income of the borrowers may not increase at that rate. If the income of the borrowers does not increase as much as the inflation rate then the borrowers may experience financial difficulties and may default which creates a problem to the lenders. Dual-indexed mortgages were introduced to solve this problem.

Dual-indexed mortgage is a loan where the outstanding debt balance is adjusted according to the inflation rate and the periodic payments are adjusted according to the income increase rate (Lipscomb and Hunt, 1999). If the inflation rate is 30% and the income increase rate is 20%, periodic payments are increased by 20% and the loan balance is increased by 30%. Like price-level adjusted mortgage loans Interest charged is based on the real interest rate. In another version of dual-indexed mortgages, the periodic payments are adjusted according to the income increase rate and the interest rate is tied to the inflation. Here, the interest is the nominal interest rate and if the interest computed is greater than the periodic payment the difference is added to the loan balance (negative amortization).

The classical mortgages, which were used before the 1970s in the developed countries, were transformed into adjustable-rate mortgages after the 1970s as a result of high inflation. Adjustable-rate mortgages originated in the 1970s helped saving institutions in the United States perform better. Adjustable-rate mortgages constituted more than 60% of single-family conventional mortgages in the United States by 1984 (Madura, 1989). Some developed countries introduced price-level adjusted mortgages to eliminate inflation risk. Also, studies were conducted in the US to introduce price-level adjusted mortgages (Sloan Management School, 1974). So far, classical mortgages and adjustable-rate mortgages have been the main types of mortgage loans in developed countries. Preferences for these loans have varied in accordance with the prevailing economic conditions in countries involved.

But the situation is different for developing countries. High (even hyper) and fluctuating rates of inflation have prevailed in most of the developing countries. Because of this economic instability, the financial institutions in these countries have not preferred classical mortgages. Another problem in developing countries is to make housing affordable to low and especially moderate-income households. As explained above adjustable-rate mortgages and price-level adjusted mortgages have some pitfalls in inflationary periods. Low and moderate-income households who take out these types of mortgages may experience payment difficulties in such periods. Dual-indexed mortgages have been originated to make housing more affordable for lower and

moderate-income households. This type of mortgage loan was first introduced in Mexico in 1984 and became the major type of mortgage in Mexico by 1993 (Lipscomb and Hunt, 1999). Other than Mexico, dual-index mortgages were successfully used in Poland and Colombia.

III. An Appropriate Mortgage Model for Turkey

Since the beginning of rapid urbanization in the 1950s, a housing problem has persisted in Turkey and this problem is still continuing. The most important part of this problem is related to finance. Housing finance is mostly based on traditional means such as self-finance and uninstitutionalized borrowing. This situation makes it hard for the low and the moderate-income households to find necessary funds to buy a house. Establishment of the Housing Development Administration (HDA) was the first step towards institutionalizing of housing finance. This was a government-subsidized agency. HDA provided loans to the housing cooperatives and charged lower than market interest rates (Alp, 2000). Due to financial constraints level of support through HDA was low and the institution could not meet increased loan demand. Interest charged was low, but the inflation rate was very high. There was a mismatch between rate of interest and inflation. As a result, Housing Development Fund became insolvent. Emlak Bank and Vakıf Bank that were state-owned banks provided price-adjusted mortgages to the households in the late 1980s. This was followed by foreign exchange denominated housing loans originated by state and privately owned banks. During the early 1990s some banks also originated adjustable-rate mortgages. But during the economic crisis of 1994, inflation and the foreign exchange rates increased drastically which caused severe payment problems for the borrowers. After the crisis, housing loans provided by the banks reduced. Government took another step and Emlak Bank (a state-owned bank) began originating Civil Servants' Wage Indexed (CSW) housing loans. This loan was designed basically for the civil servants (Erol and Patel, 1995).

But none of these attempts produced the desired results. The need to introduce market-oriented housing finance system has urged the government to draft a law aiming at establishing efficient and market-oriented housing finance system. The economic stability and reducing rate of inflation also convinced the government for this action. Now the question is "which type of mortgage loan is most suitable for Turkey?" Classical mortgages are risky for the financial institutions.

Table 3.1: Monthly Average Income of a Civil Servant, Yearly Average Income Increase and the Consumer Price Index

Year	Monthly Average Income of a Civil Servant[1]	Yearly Average Income Increase (%)	Consumer Price Index[2] (%)
1984	40.090		49,7
1985	57.754	44,1	44,2
1986	78.986	36,8	30,7
1987	113.984	44,3	55,1
1988	182.307	59,9	75,2
1989	378.090	107,4	68,8
1990	697.227	84,4	60,4
1991	1.240.704	77,9	71,1
1992	2.400.300	93,5	66,0
1993	4.072.052	69,6	71,1
1994	6.556.503	61,0	125,5
1995	12.091.709	84,4	78,9
1996	23.463.672	94,0	79,8
1997	50.759.457	116,3	99,1
1998	92.481.635	82,2	69,7
1999	159.429.000	72,4	68,8
2000	218.520.153	37,1	39,0
2001	324.738.063	48,6	68,5
2002	497.849.199	53,3	29,7
2003	618.320.348	24,2	18,4
2004	701.482.053	13,4	9,3

As can be seen from Table 3.1, inflation rates are historically volatile in Turkey. Although current inflation is relatively low, an increase in the rate of inflation endangers the financial positions of institutions, which originate this type of mortgages. For example, turbulence in emerging markets in May and June 2006 also affected the Turkish Economy where, as a result, interest rates and inflation increased. Financial institutions prefer originating adjustable-rate or price-level adjusted mortgages to alleviate the problem that stems from a possible increase in interest rate. But, adjustable-rate mortgages and price-level adjusted mortgages are risky for the borrowers. If the income of the borrowers does not increase as much as the index or the inflation rate they may not be able to make the periodic payments. When we examine the average income increases in the past we see that the average income increases sometimes lagged behind the inflation rate. Table 3.1 shows that especially during the crisis years of 1994 and 2001 inflation rate outpaced the average income increase substantially. So, dual-indexed mortgages seem to be a compromise. But dual-indexed mortgages are not risk free. The main risk of the dual-indexed mortgages for the lenders is the liquidity risk. If the inflation outpaces the income increase rate consistently the lender receives less payment that increases the liquidity risk (Lea and Bernstein, 1996). Another risk is the prolonged term of the loan. We will test whether these risks would have materialized if dual-indexed mortgages had been used in Turkey.

[1] Source: The Ministry of Finance
[2] Source: Turkish Statistical Institute.

IV. Testing Dual-Indexed Mortgages in Turkey

Historical simulation and Monte-Carlo simulation are used to test dual-indexed mortgages. First, historical simulation is applied. We have chosen the most volatile period of the Turkish economy to apply historical simulation. We applied historical simulation in three different scenarios. Down payment and percentage of income for periodic payments differ in scenarios. In historical simulation, the actual inflation and income increase rates are used, seeking an answer to the question, "when the loan would have been paid off if it had been taken out in 1984?" Basic assumptions of the model are as follows:

- mortgage loan was taken out in 1984.
- cost of dwelling unit for 75 m^2 housing is calculated as 3,165,750 TL in 1984.[3] 75 m^2 housing is the most suitable one for a low income household.
- the borrower earns the average income of a civil servant.
- the borrower spends certain amount of his/her income for payments
- real interest rate is 0.078[4].

a. Scenario-1

In this scenario the borrower makes 25% down payment (amount of loan is 2,374,312 TL) and allocates 42% of his/her income for periodic payments.

Table 4.1: Amortization Table for Scenario-1

Year	Loan Balance Before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	2.374.312	481.080	0,42	202.054	0,078	185.196	2.357.455
1985	3.399.450	693.048	0,42	291.080	0,078	265.157	3.373.527
1986	4.409.199	947.832	0,42	398.089	0,078	343.918	4.355.027
1987	6.754.648	1.367.808	0,42	574.479	0,078	526.863	6.707.031
1988	11.750.718	2.187.684	0,42	918.827	0,078	916.556	11.748.447
1989	19.831.378	4.537.080	0,42	1.905.574	0,078	1.546.847	19.472.652
1990	31.234.133	8.366.724	0,42	3.514.024	0,078	2.436.262	30.156.371
1991	51.597.551	14.488.448	0,42	6.085.148	0,078	4.024.609	49.537.012
1992	82.231.440	28.803.600	0,42	12.097.512	0,078	6.414.052	76.547.981
1993	130.973.595	48.864.624	0,42	20.523.142	0,078	10.215.940	120.666.393
1994	256.536.752	78.678.036	0,42	33.044.775	0,078	20.009.867	243.501.844
1995	435.624.799	145.100.508	0,42	60.942.213	0,078	33.978.734	408.661.320
1996	734.773.053	281.564.064	0,42	118.256.907	0,078	57.312.298	673.828.445
1997	1.341.592.433	609.113.484	0,42	255.827.663	0,078	104.644.210	1.190.408.980
1998	2.020.124.039	1.109.815.620	0,42	466.122.560	0,078	157.569.675	1.711.571.153
1999	2.889.132.107	1.913.148.000	0,42	803.522.160	0,078	225.352.304	2.310.962.251
2000	3.212.237.529	2.622.241.836	0,42	1.101.341.571	0,078	250.554.527	2.361.450.486
2001	3.979.044.068	3.896.856.756	0,42	1.636.679.838	0,078	310.365.437	2.652.729.668
2002	3.440.590.379	5.974.190.388	0,42	2.509.159.963	0,078	268.366.050	1.199.796.466
2003	1.420.559.016	7.419.844.176	0,42	3.116.334.554	0,078	110.803.603	-1.584.971.935

[3] Unit m^2 cost of dwelling unit was 28,140 TL in 1984 (Turkish Statistical Institute). 25 % land share and 20 % interest rate of entrepreneurship were added to dwelling cost.

[4] This figure was calculated according to nominal interest and inflation rates of 2004. Since 1984 real interest rates were about 0.08, 0.078 is a good approximation.

In this scenario, the loan balance is adjusted according to the inflation rate each year. Borrower spends 42% of his/her income for periodic payments each year. So the periodic payments are adjusted according to the income increase. As can be seen from Table 4.1 the loan is paid off in 20 years, which is quite reasonable.

b. Scenario-2

In this scenario the borrower makes 40% down payment (amount of loan is 1,899,450 TL) and allocates 33% of his/her income for periodic payments.

Table 4.2: Amortization Table for Scenario-2

Year	Loan Balance Before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	1.899.450	481.080	0,33	158.756	0,078	148.157	1.888.851
1985	2.723.723	693.048	0,33	228.706	0,078	212.450	2.707.467
1986	3.538.660	947.832	0,33	312.785	0,078	276.015	3.501.891
1987	5.431.432	1.367.808	0,33	451.377	0,078	423.652	5.403.707
1988	9.467.295	2.187.684	0,33	721.936	0,078	738.449	9.483.809
1989	16.008.669	4.537.080	0,33	1.497.236	0,078	1.248.676	15.760.109
1990	25.279.214	8.366.724	0,33	2.761.019	0,078	1.971.779	24.489.974
1991	41.902.346	14.488.448	0,33	4.781.188	0,078	3.268.383	40.389.541
1992	67.046.638	28.803.600	0,33	9.505.188	0,078	5.229.638	62.771.088
1993	107.401.331	48.864.624	0,33	16.125.326	0,078	8.377.304	99.653.309
1994	211.862.935	78.678.036	0,33	25.963.752	0,078	16.525.309	202.424.492
1995	362.137.417	145.100.508	0,33	47.883.168	0,078	28.246.719	342.500.968
1996	615.816.740	281.564.064	0,33	92.916.141	0,078	48.033.706	570.934.305
1997	1.136.730.201	609.113.484	0,33	201.007.450	0,078	88.664.956	1.024.387.707
1998	1.738.385.938	1.109.815.620	0,33	366.239.155	0,078	135.594.103	1.507.740.887
1999	2.545.066.617	1.913.148.000	0,33	631.338.840	0,078	198.515.196	2.112.242.973
2000	2.936.017.733	2.622.241.836	0,33	865.339.806	0,078	229.009.383	2.299.687.310
2001	3.874.973.117	3.896.856.756	0,33	1.285.962.729	0,078	302.247.903	2.891.258.291
2002	3.749.962.004	5.974.190.388	0,33	1.971.482.828	0,078	292.497.036	2.070.976.212
2003	2.452.035.835	7.419.844.176	0,33	2.448.548.578	0,078	191.258.795	194.746.052
2004	375.859.880	8.417.784.636	0,33	2.777.868.930	0,078	29.317.071	-2.372.691.979

In the second scenario above, when 40% down payment is made and the borrower spends 33% of his/her income for periodic payments the loan is paid off in 21 years, which is also reasonable.

c. Scenario-3

In this scenario the borrower makes 50% down payment (amount of loan is 1,582,875 TL) and allocates 33% of his/her income for periodic payments.

Table 4.3: Amortization Table for Scenario-3

Year	Loan Balance before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	1.582.875	481.080	0,33	158.756	0,078	123.464	1.547.583
1985	2.231.614	693.048	0,33	228.706	0,078	174.066	2.176.975
1986	2.845.306	947.832	0,33	312.785	0,078	221.934	2.754.455
1987	4.272.160	1.367.808	0,33	451.377	0,078	333.228	4.154.012
1988	7.277.828	2.187.684	0,33	721.936	0,078	567.671	7.123.563
1989	12.024.575	4.537.080	0,33	1.497.236	0,078	937.917	11.465.255
1990	18.390.269	8.366.724	0,33	2.761.019	0,078	1.434.441	17.063.691
1991	29.195.976	14.488.448	0,33	4.781.188	0,078	2.277.286	26.692.074
1992	44.308.843	28.803.600	0,33	9.505.188	0,078	3.456.090	38.259.744
1993	65.462.423	48.864.624	0,33	16.125.326	0,078	5.106.069	54.443.166
1994	115.746.170	78.678.036	0,33	25.963.752	0,078	9.028.201	98.810.620
1995	176.772.199	145.100.508	0,33	47.883.168	0,078	13.788.232	142.677.263
1996	256.533.718	281.564.064	0,33	92.916.141	0,078	20.009.630	183.627.207
1997	365.601.769	609.113.484	0,33	201.007.450	0,078	28.516.938	193.111.258
1998	327.709.804	1.109.815.620	0,33	366.239.155	0,078	25.561.365	-12.967.985

In the third scenario, when 50% down payment is made, total loan is paid off within 15 years with a payment rate of 33% of income.

More scenarios may be developed for this model; however, since our purpose is to test the appropriateness of the dual-indexed mortgage model for Turkey, these three scenarios seem to be sufficient. These scenarios show that if a borrower had taken out a dual-indexed mortgage in 1984, he/she could have paid it off in at most 21 years, which is a reasonable period, without constraining his/her income. Also, the lender would not have faced any difficulty because the loan balance would have been adjusted according to the inflation rate and the lender would have been repaid within a reasonable period of time.

d. Monte-Carlo Simulation

Next we used Monte-Carlo simulation. Monte-Carlo simulation differs slightly from historical simulation. In historical simulation the actual inflation and income increase rates are used. In Monte-Carlo simulation inflation and income increase rates are represented by probability distributions and values for these variables are created randomly from the distributions in each year. Values of the variables in Table 3.1 are used to fit a distribution for each variable. The most appropriate distribution to represent inflation rate is found to be Logistics (0.65, 0.14), the most appropriate distribution to represent income increase rate is found to be Normal (0.65, 0.28). We also take the correlation between these variables into account. If the correlation is not incorporated into the model, a very high inflation rate may coincide with a very low income increase rate that is unrealistic. We also take into account the autocorrelation in inflation series. If this is not done, a very high inflation in one year my follow a very low inflation in the preceding year that is also unrealistic. The correlation between inflation and income increase rate is 0.693. One lagged autocorrelation in inflation series is 0.506. Random values for the variables in each year are created from the probability distributions by paying attention to this relationship. In each iteration a value is created randomly for the variables and the year when the loan is paid off is calculated. So, different

combinations of inflation and income increase rate (of course paying attention to the relationships) are considered and a loan pay-off year is calculated for each combination. After a certain number of iterations the mean of the loan pay-off year is calculated.

We run Monte-Carlo simulation for all three scenarios discussed above. In the first scenario the number of iterations is 1500 and 1500 pay-off years are calculated. When the mean pay-off year does not change considerably, the iterations end. The minimum of these years is 2000, the maximum is 2010. The minimum is the best case; the maximum is the worst case. The mean pay-off year is 2005. So, on average this loan is paid off in 22 years. If the worst case occurs the loan is paid off in 27 years, which is less than 30 years that is a common maturity for a mortgage loan in most of the developed countries. Simulation model reveals that the probability of a pay-off year over 2008 is 5%. So, it is a remote probability that the worst case occurs. Even if it occurs the loan is still paid off in a reasonable period.

In the second scenario the minimum pay-off year is 2000, maximum pay-off year is 2010, and mean pay-off year is 2005. The probability that pay-off year exceeds 2009 is 5%. The loan is also paid off in a reasonable period in this scenario.

In the third scenario the minimum pay-off year is 1995, maximum pay-off year is 2005, and mean pay-off year is 2000. The probability that pay-off year exceeds 2004 is 5%. On average the loan is paid off in 17 years. If the worst case occurs, the loan is paid off in 22 years, which is reasonable.

V. Conclusion

In Turkey, all concerned parties have been trying to find an institutionalized and market-oriented solution to the housing finance problem. The government has drafted a new law and submitted to the parliament, which introduces the issuance of mortgage loans by the financial institutions. There are different types of mortgage loans. So, it is important to choose the one, which is suitable for both the lenders and the borrowers, taking into consideration the economic conditions and the economic history of the country. If this is not done, the borrowers and the lenders may experience difficulties. Classical mortgages may cause mismatch and tilt problems for the lenders. Adjustable-rate and price-level adjusted mortgages may cause payment problems for borrowers which then also creates a problem for the lenders. If the borrowers default, lenders have to initiate legal procedures to foreclose the mortgage to get their money. Turkey has experienced high and fluctuating inflation in the past and household income increases have sometimes lagged behind the inflation rate substantially. Although the current inflation rate is low, there is no guarantee that it will not rise in the future because there are some uncertainties stemming from domestic politics, foreign affairs, and international economics, which have an impact on inflation. Mortgage loans are long-term in their nature. So no one can give assurance that there won't be any increase in the level of inflation throughout the life of the loan. Taking all of these facts into consideration, it seems that the most suitable mortgage loan for Turkey is dual-indexed mortgage, which minimizes risk taken by borrowers and lenders. We tested the appropriateness of this mortgage for Turkey by using historical simulation and Monte-Carlo simulation. We found that the loan is totally paid off in a reasonable period without causing any trouble for borrowers and lenders.

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FORECASTING FINANCIAL VARIABLES BY THE GREY THEORY

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Abstract

Forecasting financial and economic variables is one of the most attracted subjects in finance and many models and studies are devoted for predicting future. This study is one of them and uses relatively new prediction model, Grey Theory. This theory is suitable for forecasting competitive environment where the model uncertainty is present and decision makers have insufficient information. We use this model for one-step-ahead prediction of daily and monthly Turkish Lira/US Dollar exchange rate and Istanbul Stock Exchange Market Composite Index (ISEM-100). The results indicate a moderate success for a highly volatile environment comparing to the previous studies and models.

I. Introduction

There are many studies in Finance area about the predictability of future outcomes of Stock Market and Exchange Rates. The highly volatile characteristics of these markets have led practitioners and researchers attempt to develop models that can forecast these variables for the sake of hedge and/or make a profit.

However, forecasting is not an easy task and is inconsistent with the two key theories in finance. The first one is the random walk hypothesis, which states that security price changes can not be forecasted since they follow a random walk. The later one is the efficient market hypothesis (EMT) which asserts that all relevant information about security pricing are already incorporated into the stock prices and hence nobody can make an extra profit by having special information.

The dilemma between theories and forecasting do not end empirical studies about the predictability of future values. Several models are developed and used for the prediction and the results of these studies are mixed. There has been no model that tends to outperform other methods. Madura, Martin, and Wiley (1999) compared three different forecasting methods for predicting and concluded that the performance of different models differs for currencies and for forecast horizons. Grey model (GM) are introduced to the literature recently and had great attention especially for non-financial applications. This study aims to apply this relatively new method to highly volatile Turkish financial markets.

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The outline of this paper is as follows: We give a review of relevant literature in section II, which is followed by a summary of the Grey Prediction Model in section III. The data set used in the current study is explained in the last part of section III. Section IV presents the results and relevant discussions while section V ends the paper with conclusions and suggestions for future research.

II. Literature Survey

Forecasting fundamental economical indicators has been very active research area for a long time. Various forecasting models can be classified as time-series, regression analysis and artificial intelligence based models. Time-series methodologies assume that historical data is steady and uses random statistics analysis to predict future. The main criticism of these methodologies focuses on the steady-state assumption of the historical data and need for long-time series that are mutually incompatible. On the other hand, regression analysis based approaches try to figure out the fundamental relations between the variables of the system and tries to find these connection parameters by simple linear regression. Artificial intelligence based forecasting systems, especially Neural-Networks and Expert Systems are becoming widely used prediction models that are nonlinear models. Hsu, Tse, and Wu (2003) explain the popularity of these methods as the complicated phenomenon of humanities and society is hard to be fully explained by traditional models. The track-record of these models are mixed, at best. We report the results of some studies below.

Diler (2003) analyses daily changes of the Istanbul Stock Exchange Market Index (ISE-100) by using Artificial Neural Network (ANN) approach. He uses 7 inputs, most of them are a part of technical analyses, and 1 output, daily changes of the ISE-100 Index. This study does not aim to forecast the exact change of the ISE-100 Index but the direction of change. Results indicate that direction of ISEM can be forecasted 60.81% of the time.

Yao and Tan (2000) try to predict the exchange rates between American Dollar and five other major currencies. Their model is also neural network model and results indicate that useful prediction can be made and significant paper profits can be obtained for out-of-sample data with simple technical indicators.

Kanas and Yannopoulos (2001) investigate the return predictability of monthly returns for Dow Jones and Financial Times indices by using Artificial Neural Network model. Dividends and trading volume are considered as fundamental explanatory variables. They report that ANN results are more accurate than linear models.

Yu, Wang, and Lai (2004) try to forecast foreign exchange rates by using ANN and Generalized Linear Autoregression (GLAR) models. They compare many models and conclude that the nonlinear ensemble model can be used as an alternative forecasting tool for foreign exchange rates to achieve greater forecasting accuracy and improve prediction quality for further.

Lisi and Schiavo (1999) compare ANN and Chaotic models for exchange rate prediction from 1973 to 1995. They report that the statistical significance of two models is equivalent but better than simple random walk model.

All of these studies use explanatory variables in order to forecast for financial variables. Some models propose no explanatory variable for prediction. Tseng, Tzeng, Yu, and Yuan (2001) try to forecast foreign exchange rates by using Fuzzy ARIMA model. They advocate that this model is very useful for decision makers in terms of

seeing the best- and worst- situations. They reach to this conclusion by using single time series data unlike the works reported above.

Wang (2004) analyses tourism demand for Taiwan by using three prediction models: Fuzzy time series, Markov model, and GM. The results indicate no unique prediction model. This is because Fuzzy time series is suitable for the tourism demand forecasting of Hong Kong arrival to Taiwan, the GM appropriate the tourism demand forecasting for Hong Kong and United States arrival figure for Taiwan, and Markov-improved model is the best for German tourism demand estimation.

Lin, Su, and Hsu (2001) apply GM to predict future outcome of Stock Exchange market index by using 1000 daily close values of stock market. They also use other prediction models such as Neural Network, Wang-Mendel, and Fourier. They combine short-term predicted value by a Fourier series and a long-term estimated error by the Markov forecasting method and assert that the combined approach can predict the future more accurately.

Lin, Wang and Pai (2004) use the Taiwan Stock Exchange Index to verify multifactor GM. Their model can be thought as a different version of Arbitrage Pricing Theory since the forecasting is done by using quantitative and qualitative factors. Factor weights are computed by Fuzzy analytical hierarchy process (AHP). Then, weights of Fuzzy AHP are transformed into the grey relational grade and finally grey prediction procedure is applied. They also apply different models such as linear regression and Neural Networks to the same data. Empirical results show that the multifactor grey model outperforms the other approaches.

Hsu (2003) tests the Grey-forecasting model. This method along with other models such as time-series and exponential smoothing is applied to predict demand and sales in the global integrated circuit industry. The results show that GM is very useful for short-term predictions. Mid- and long-term forecasting are not that successful. Another assertion comes from this study is that modification of the GM could reduce overall predicted error apparently. The final remark of this study is that GM is suitable for making forecasts about the integrated circuit industry.

Tseng, Yu and Tzeng (2001) assert that GM forecasting is insufficient for forecasting time series with seasonality. They propose a hybrid forecasting model that combined the GM and the ratio-to-moving-average deseasonalization method to remove the seasonality characteristics from a seasonal time series. They apply this version of GM as well as other methods in forecasting the Taiwan's machinery industry output and the sales volume of soft drinks. The results indicate that GM with deseasonalized data outperformed than the others.

III. The Model and data

Grey Theory[1], which was proposed by Deng (1982, 1989), has been used widely in many different areas such as geology, agriculture, earthquakes, stock markets and many different areas. Grey prediction model is designed to focus on model uncertainty and information insufficiency in analyzing and understanding systems via research on conditional analysis, prediction, and decision-making. The name of the model originates from the colors of information where black denotes no knowledge while white represents completely clear information about the system. Grey colors represent systems such as

[1] For a detailed discussion of the philosophy of this method see Lin, Chen and Liu (2004)

social, economic, or weather systems, which are characterized by incomplete information.

A Grey approach resorts to accumulated generating operations (AGOs) to preprocess the raw data. An AGO is an accumulation of the data from the first datum up to the considered step. The Grey forecasting model uses AGO to build differential equations. Lin, Su and Hsu (2001) say that the data obtained by the AGO is always monotonically increasing, if all the raw data are non-negative. A reasonable curve for the accumulated data has an exponential form. The most commonly used Grey models called GM (1,1), which indicates that the GM is constructed for a single variable and a first order differential equation is used in matching the data generated by the AGO. One of the main advantages of this method is that it requires less data compared to other methods.

The procedure of this method can be described as follows:

Step 1. Form the row matrix $X^{(0)}$ for the historical time data as

$$X^{(0)} = \left\{ X^{(0)}_{(1)}, X^{(0)}_{(2)}, ..., X^{(0)}_{(n)} \right\} \tag{1}$$

Step 2. Form a row matrix of $X^{(1)}$ by Accumulated Generating Operation (AGO) as

$$X^{(1)} = \left\{ X^{(1)}_{(1)}, X^{(1)}_{(2)}, ..., X^{(1)}_{(n)} \right\} \tag{2}$$

where

$$X^{(0)}_{(k)} = \left\{ \sum_{i=1}^{k} X^{(0)}_{(i)}, k = 1,2,.....,n \right\}^{2} \tag{3}$$

Step 3. Form the Grey differential equation

$$X^{(0)}_{(k)} + a.Z^{(1)}_{(k)} = b \qquad \text{k} = 1,2,3,.....,\text{n} \tag{4}$$

where

$$Z^{(1)}_{(k)} = \alpha .X^{(1)}_{(k)} + (1-\alpha).X^{(1)}_{(k-1)}{}^{3} \tag{5}$$

---

[2] k can be chosen as 4 or more. k values affect the prediction quality.
[3] σ value is very important for predicted values. These values are reported in Table 1.

which can be written as

$$Y_n = B.a \quad \text{where}$$

$$B = \begin{Bmatrix} -Z^{(1)}_{(2)} & 1 \\ -Z^{(1)}_{(3)} & 1 \\ & \\ -Z^{(1)}_{(n)} & 1 \\ & \end{Bmatrix} \tag{6}$$

$$Y_n = \begin{Bmatrix} X_1^{(0)}{}_{(2)} \\ X_1^{(0)}{}_{(3)} \\ \\ X_1^{(0)}{}_{(n)} \\ \end{Bmatrix} \; ; \; \bar{a} = \begin{Bmatrix} a \\ b \end{Bmatrix}$$

Step 4. By using the least-squares error method, a and b coefficients are found by solving

$$\bar{a} = \begin{Bmatrix} a \\ b \end{Bmatrix} = (B^T B)^{-1} B^T Y_N \tag{7}$$

Step 5. From the Grey differential Equation

$$\frac{\partial X^{(1)}}{\partial t} + a.X^{(1)} = b \tag{8}$$

is solved by using the initial condition $X^{(1)}_{(1)} = X^{(1)}_{(0)}$

The parameter a is called the developing coefficient and b is the grey input.

The AGO Grey prediction equation can be obtained as

$$\hat{X}^{(1)}_{(k+1)} = \left(X^{(0)}_{(1)} - \frac{b}{a} \right) e^{a.(k)} + \frac{b}{a} \tag{9}$$

where ^ denotes Grey prediction value.

Step 6. The prediction value is obtained by

$$X^{(0)}_{(k+1)} = X^{(1)}_{(k+1)} - X^{(1)}_{(k)} \tag{10}$$

The prediction value is

$$\hat{X}^{(0)}_{(k+1)} = (1 - e^{a})\left(X^{(0)}_{(1)} . \frac{b}{a} \right) e^{a.(k)} \tag{11}$$

There are many quantities that are used to judge the quality of the predictions a particular model produces. Among them are root mean square error, mean absolute error, Pearson correlation, direction accuracy, and sign prediction. Directional statistics D_{stat} measures the fraction of times the change in actual data and the predicted series agrees as:

$$D_{stat} = \frac{1}{N} \sum_{i=1}^{N} a_i \tag{12}$$

where $a_k = 1$ if $\left(x_{t+1} - x \right)\left(\hat{x}_{t+1} - \hat{x}_t \right) \geq 0$, and a_k otherwise.

Normalized root mean square error is defined as:

$$NMSE = \frac{\sum_{t=1}^{N} (y_t - \hat{y}_t)^2}{\sum_{t=1}^{N} (y_t - \bar{y}_t)^2} = \frac{1}{\sigma^2} . \frac{1}{N} . \sum_{t=1}^{N} (y_t - \hat{y}_t)^2 \tag{13}$$

Where σ^2 is the estimated variance of the data and y_t is the mean of data. NMSE is closely related to well-known criteria, R^2, since it is equal to $1\text{-}R^2$.

The data used in this work for the Stock Exchange Market (ISEM) Index and US$ buying rate were obtained from the Web site of the Central Bank of Turkey (CBT). The data for both are as daily and monthly values. The ISEM index is the ISE-100 index. Both data sets cover the period 1990.01:2004.12.

These series were analyzed by using GM and predictions as well as the statistical properties of the predictions were calculated.

IV. Results and Discussion

The predicted series as well as the actual data are displayed in Figure 1[4] for the ISEM data as daily and Figure 2 as monthly. As can be seen from the Figure, the predicted value and actual value are quite close. The directional statistics for daily prediction

[4] We only show the most recent values. If we use the whole time period, the graph will be meaningless in terms of seeing the difference between actual and predicted value.

is 0.5372, which shows that the model and the actual data have same directions for the 53, 72% of the time that is moderately successful.

Figure 3 and figure 4 shows the predicted and actual values of US$ as daily and monthly.

Visual examinations of figures show that actual and predicted values are quite close. However, the prediction quality is measured by statistical approaches defined in the previous section of this study. We report two basic evaluation criteria: NMSE and Dstat. They are reported in Table 1.

Figure 1: Actual and Predicted Values of the ISE-100 Daily Closing Prices

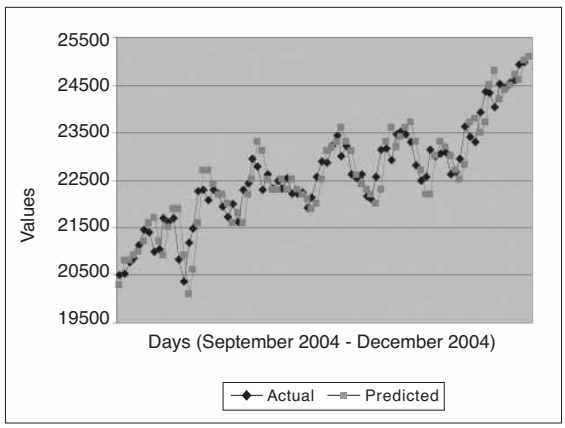
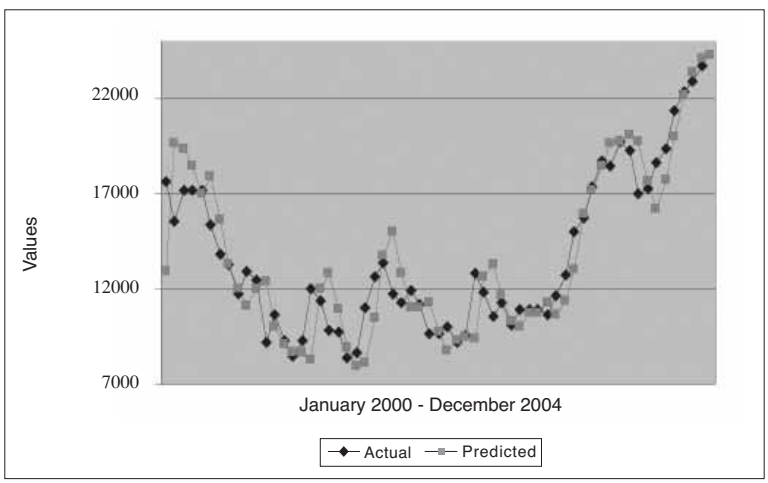


Figure 2: Actual and Predicted Values of the ISE-100 Monthly Closing Prices



As it can be seen clearly, NMSE is very low which is good for the daily results. NMSE tends to increase for ISEM but not US$ when we decrease data frequency from day to month. Yao and Tan (2000) report a NMSE value of 0,0543 for weekly exchange rate data and Yu, Wang, and Lai (2005) report 0,0143 value for monthly foreign exchange rates. Diler (2003) reports different criteria, Root Mean Square Error, which is very close to 0 for the daily ISE-100 Index. Our results compare well to the results of the previous works even though we use simpler method.

Figure 3: Central Bank Buying Rate and Predicted Values of the Daily US$

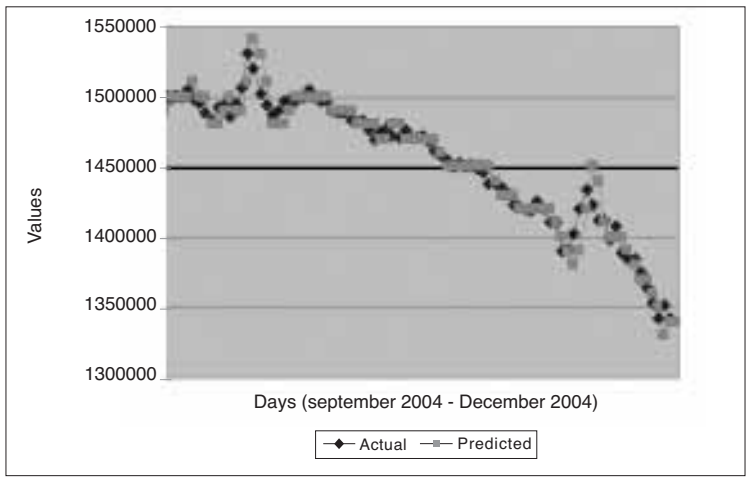


Figure 4: Central Bank Buying Rate and Predicted Values of Monthly US$

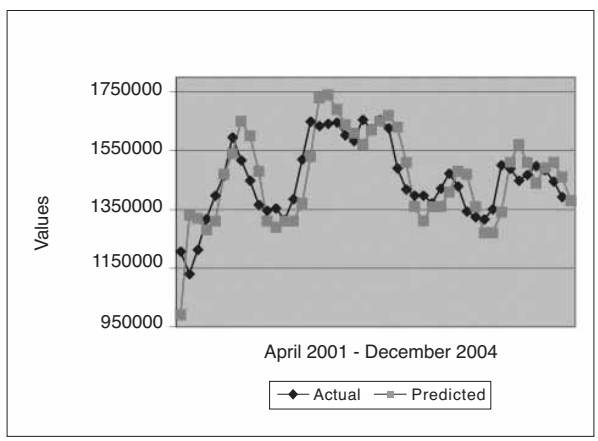


Table 1: Diagnostic Tests of the Prediction

		ISEM (Daily)		US$ (Daily)		ISEM (Monthly)		US$ (Monthly)	
k		**NMSE**	**$D_{stat.}$**	**NMSE**	**$D_{stat.}$**	**NMSE**	**$D_{stat.}$**	**NMSE**	**$D_{stat.}$**
4	0,10	0,0016	0,5202	0,0003	0,5603	0,0245	0,5455	0,0053	0,8182
4	0,25	0,0017	0,5205	0,0004	0,5571	0,0264	0,5341	0,0058	0,8182
4	0,50	0,0020	0,5162	0,0005	0,5534	0,0381	0,5341	0,0078	0,8239
4	0,75	0,0025	0,5154	0,0007	0,5460	0,0719	0,5284	0,0118	0,8125
5	0,10	0,0017	0,5253	0,0004	0,5654	0,0253	0,5714	0,0063	0,8514
5	0,25	0,0018	0,5240	0,0004	0,5636	0,0270	0,5600	0,0068	0,8457
5	0,50	0,0020	0,5237	0,0005	0,5556	0,0382	0,5657	0,0086	0,8343
5	0,75	0,0023	0,5248	0,0006	0,5503	0,0709	0,5486	0,0120	0,8229
6	0,10	0,0018	0,5372	0,0004	0,5743	0,0287	0,6207	0,0075	0,8563
6	0,25	0,0019	0,5348	0,0004	0,5733	0,0303	0,6149	0,0080	0,8621
6	0,50	0,0021	0,5329	0,0005	0,5653	0,0401	0,5977	0,0096	0,8448
6	0,75	0,0023	0,5286	0,0006	0,5608	0,0662	0,6034	0,0123	0,8276

NMSE is not the only criteria to evaluate prediction performance. D_{stat} measures the direction of movements. The results of D_{stat} statistics is more than 50 % for all cases and extremely high for monthly US$ prediction. Kim (2003) reports the range of prediction performance between 50,0861% and 57,8313% for the daily Korea Composite stock price index predictions. However, he uses 12 technical indicators for prediction. Our results seem to be moderately successfull. Diler (2003) reports a 60,81% success of prediction in terms of the movement direction. Yao and Tan (2000) document D_{stat} results between 51% and 55% for weekly exchange rate series. Panda and Narasimhan (2003) report D_{stat} statistics around 72 %. Our monthly result seems to be high when we compare to the previous works. However, these results should be evaluated carefully. They might exist because of the market characteristics. Turkey changed its exchange rate regime to freely floating regime at the beginning of 2001. Exchange rates tended to be upward until this date. The daily results indicate a moderate success in terms of D_{stat}.

V. Conclusions

We employ GM to forecast the selected financial variables of the Turkish Economy. The selected variables are monthly and daily US$ exchange rate and ISE-100 index. The results indicate that the movement of variables can be forecasted by more than 50 % of the time. This result is higher for exchange rates than Stock market. Prediction quality measured by NMSE is quite good when we compare our results with the previous model studies. We also may notice that decreasing the frequency of data improves D_{stat} but also increases NMSE.

The modification of model may improve the prediction and lead to more precise results may be obtained. Future studies should also test the profitability of these predictions, which may show somehow efficiency, or inefficiency of the ISE Market.

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OVERREACTION HYPOTHESIS AND AN EMPIRICAL WORK ON THE ISTANBUL STOCK EXCHANGE

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Abstract
In this study, the weak form efficiency of the ISE is tested with the operational strategy which the overreaction hypothesis projects. The period between January 1, 1988 and December 31, 2002 is examined. The total number of 4 periods consisted of 36 months, were examined. According to the results of the empirical study show that the Winner portfolio provides lower yield with a ratio of 50,57 %, which is below the market whereas the Loser portfolio produces higher yield with a ratio of 66,11 %, above the market. The findings gathered by under the operational strategy which overreaction hypothesis foresees have shown that the ISE is not a weak form of efficient market. The side effect is seen to become more evident in the fourth period including financial crisis that prevailed in Turkey between November 2000 and February 2001.

I. Introduction

One of the most researched matters in the field of finance in the last three decade is the "Market Efficiency Hypothesis" (Fama, 1970). The price of a stock in the capital markets reflects the agreement among the market players who purchases or sells this stock according to the information in the market. When there is new information coming into the market, market players analyze and interpret this data and apply it into the new price of the stock. The price of that stock does not change until new information comes to the market. According to Fama, (Fama, 1970) "Market in which prices reflect current information 'accurately' is defined as 'efficient market'." In other words, it is impossible for any investors to get abnormal returns by applying all information available in the market, is already reflected to stock prices.

Fama (1970) has subdivided the market efficiency into three categories according to the type of information that the investors use. The first form of market efficiency is Weak-Form Efficiency, that it is not possible to get abnormal returns by using historical price movements in a weak form of efficient market. If a market is a weak form of efficient market, then there is no use of technical analysis, time series and similar analysis depending on past data. The second form of market efficiency is Semi - Strong Form Efficiency. It is not possible to gain abnormal returns by using publicly shared information in a semi - strong efficient market. The third form of market efficiency is Strong Form Efficiency. In a strong form efficient market, all information - whether it is public or private - also with historical price data is fully reflected in the

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prices. A market in the strong form efficiency is in the top rank. In a strong form of efficient market, no one, including the insider traders, could gain abnormal returns because all information is reflected to the prices of the stocks.

The Efficient Market Hypothesis assumes that the price of shares follows a random walk; it should be impossible to predict the price of stocks depending on current data in the public. Especially, it is required that the price of shares should not be predicted depending on past price movements. (Thaler1987 a).

After the efficient market hypothesis is implemented, numerous studies testing the market efficiency were done. The results of many studies were contradictory to the efficient market hypothesis have been obtained and the hypothesis is rejected according to the empirical findings. These contradictory findings are called "anomalies" (Thaler, 1987a, 1987b).

In the second part of the study, anomalies known as deviations from the hypothesis are examined while one of the anomalies-Overreaction Hypothesis-is discussed in the third part. The fourth and fifth section discusses the data belonging to empirical study and the research method respectively. The sixth part consisting of findings is followed by seventh part where the results and suggestions are found.

II. Anomalies Observed in the Capital Market

In the literature, many studies done on the test efficient market hypothesis resulted with conflicts between with its assumption. In other words, the findings do not hold the hypothesis. Many empirical studies show that returns can be predictable to a certain extent. The shares may yield a higher or lower return according to some of their features. For instance, empirical studies prove that certain time periods bring a continuously negative or positive return compared to others and state that there are seasonal trends in returns of shares (Ariel, 1987, 1990, Agrawal & Tandon, 1994, Bildik, 2000, Corhay, Hawawini & Michel, 1987, Dal, 2003, Gu, 2003, Gultekin & Gultekin, 1983, Jaffe Westerfield & Ma, 1989, Kato, 1990, Lakonishok & Smidth, 1984, Muradoglu & Oktay, 1993, Ozmen, 1997, Rogalski, 1984, Thaler, 1987a, 1987b). Besides, the stock exchanging in the stock market yield much more returns than the stocks of other companies, due to the fact that only their price is lower (Pinches and Simon, 1972). The stocks having a low-price/return ratio may yield much more return (Basu, 1977, Bartholdy, 1998). Also, it is possible that the stocks having low price/sales ratio may provide abnormal return to their investors (Barbee, Mukherji & Raines 1996, Senchack & Martin, 1987). Stocks having a low ratio of Market Value and Book value may also provide abnormal return (Ali, Hwang & Trobley, 2003, Kothari & Shengen, 1997, Lewellen, 1999, Park & Lee, 2003, Rosenberg, Reid & Lanstein, 1985). The secluded stocks may provide an abnormal return for the investors in the stock markets (Bauman, 1964). Also, firms having low market value may earn excessive return (Reinganum, 1982). This effect is called "small firm effect" or "size effect".

III. Overreaction Hypothesis

One of the important studies bringing up contrary findings with efficient market hypothesis is done by De Bondt and Thaler (1985, 1987). They indicated that they found contrary findings with the efficient market hypothesis in their study comprising the period between January 1933 and December 1980 on New York Stock Exchange. Their study brings up existence of a new anomaly.

Investors overreact (overvalued or undervalued) to unanticipated news (especially to profit declaration) which causes great changes in the expectations of investors about firms gaining power and take 3 to 5 years to adjust this overreaction in the long-term. De Bondt and Thaler (1985, 1987) called this effect as Overreaction Hypothesis. It is accepted that the starting point or the origin of overreaction hypothesis is the studies of De Bondt and Thaler (1985, 1987).

De Bondt and Thaler (1985, 1987) state that while examining the new coming information, investors give excessive reactions (evaluating lower or higher than expected) to very good/bad news (especially the ones about benefit news) which causes big changes in their expectations concerning the capability of gaining of firms and that they fix this overreaction in a long time period (3 or 5 years). De Bondt and Thaler (1985, 1987) named this effect as "Overreaction Hypothesis". Starting point of this overreaction hypothesis is accepted as the researches made by De Bondt and Thaler (1985, 1987).

The operational strategy that is brought up by overreaction hypothesis is to buy the Loser stocks over the previous period and sell Winner stocks. By this way one can earn more than the market does. Overreaction hypothesis states that excessive earnings by using past price movements which can be defined as a deviation from the efficient market hypothesis. It is impossible to earn abnormal returns by using past price movements in the weak form of efficient market.

> *"If the stocks become overvalued systematically, the returns should be predicted by historical return behaviors, even without using account data like earnings / yields. At this point two hypotheses are suggested: (1) Extreme movements in stock prices will be followed by price movements in the opposite direction. (2) The more extreme the initial price movement, the more extreme reaction in the opposite direction. These two hypotheses indicate the opposite of weak form efficiency (De Bondt and Thaler, 1985, 795)."*

In De Bondt and Thaler's (1985, 1987) operational strategy, first of all they sorted the stocks according to their returns and determined portfolios of the best 35 performing stocks as a Winner and the worst 35 performing stocks as a Loser. Then, the behavior of the portfolios formed according to their recent earnings is examined over the next period. The process of forming and holding a portfolio take 3 years. The date of formation of the portfolio is fixed as December. In other words the behavior of Winner and Loser - according to their returns over the previous three years - over the next three years is examined. De Bondt and Thaler (1985, 1987) state that when compared to the previous period the worst performing 35 stocks earn more than the market in comparison with the market in general, and the best performing 35 stocks show lower performance.

According to De Bondt and Thaler (1985, 1987) investors pay attention to new information instead of past information because of their inexperience. To pay too much attention to new data leads to deviation from real value of stock prices. According to the researchers, investors overprice or underprice the unexpected profit changes. After extreme price increase or decrease, investors attempt to correct these overreactions. They tend to decrease the price of overvalued stocks and increase the price of undervalued

stocks. The first act is how extreme the correction becomes that much bigger. Abnormal return (by purchasing Losers stocks and selling Winners stocks) may be obtained in this operational period which usually comprises of a long term such as 3 to 5 years. This situation points us an absolute contradiction according to the signs of earnings. De Bondt and Thaler (1985, 1987) states that investors overreact over the first period and then they try to correct their mistakes by revaluing the wrongly priced stocks over a long period of time.

According to De Bondt and Thaler (1985, 1987), the reason for overreaction is the behavior of the inexperienced investors who does not assess the information rationally. Just as investors trading on the stock exchange markets can not assess the information correctly with the financial declarations. Inexperienced investors who do not assess the information correctly may cause inefficiency in the market. De Bondt and Thaler (1990) states that not only inexperienced investors but also the professionals value the new information more than they value the old information and overreact to the new information.

According to the researchers, Loser portfolios over the previous period earn more returns relatively to Winner portfolios. In the studies of De Bondt and Thaler (1985) over periods of three years, past Loser portfolio was up 19,6 % relative to the market in average. On the other hand, the past Winner portfolio was down 5 % percent relative to the market in average. The difference between the two portfolios is 24,6 % if the past Loser is purchased and the past Winner is sold. The difference between the two portfolios after formation of portfolio according to the previous period of three years is 5,4 %. This shows that the difference between the Loser and Winner is formed over the second and third years after formation of portfolio.

Figure 3.1: Average of 16 Three-Year Test Period between January 1933 and December 1980 Length of Formation period: Three Years

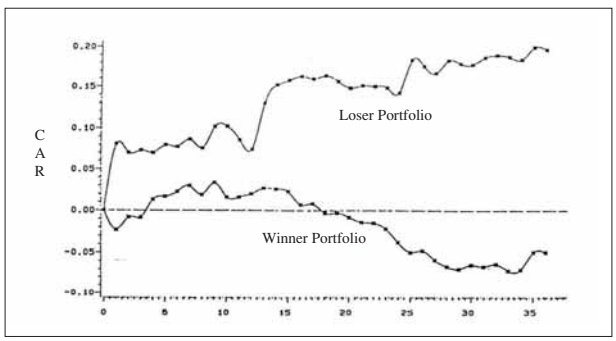


Figure 1. Cumulative Avarage Residuals for Winner and Loser Portfolios of 35 Stocks (1-36 months into the test period)

Reference: De Bondt and Thaler 1985, p.800.

De Bondt and Thaler (1985, 1987) calculated the abnormal returns by adjusting them according to the market. Researchers state that when they calculate the abnormal returns according to Capital Asset Pricing Model, they get the very similar results. At the same time the Loser portfolio has less risk than the Winner portfolio .

There are many studies testing the overreaction hypothesis in the international

markets. But we cannot say that there is an agreement on overreaction hypothesis in the literature. In some of these studies it is stated that this effect can be seen and this could be accepted as a deviation from efficient market hypothesis but on the other hand this effect cannot be seen in other studies. Some researchers test this hypothesis for the long term but some of them test it for the short term. This effect can be explained by the January anomaly, size effect and risk according to some of these studies in the literature. There are also some studies in which it is stated that this effect cannot be explained by the January anomaly, size effect and risk.

Abarbanell and Bernard (1992) had found results which are contradictory with De Bondt's and Thaler's (1990). In their study how professional investors response to the profit declarations is searched. The result is professional investors do not overreact and behaviors of professional investors may not be related with overreaction.

In other studies, De Bondt and Thaler (1987) searched for the possible relationship between overreaction hypothesis and January effect, risk and size effect. In this study, it is stated that as the overreaction hypothesis does not have a size effect and this also can not be explained with risk, on the other hand, there is no satisfying explanation about January effect.

Overreaction hypothesis consists of two proposes. Investors react to the new information which arises great attention or fear by making extreme changes for stock price and try to correct this by moving the stock price in the opposite direction after assessing this new information carefully (Ferri and Min 1996).

It is possible that investors may overprice or underprice the stocks by overreacting to the new information. But the process of revaluing the stock by moving the stock prices in opposite direction over a long term for three years is still discussed.

Another criticism for the Overreaction Hypothesis is that the Winner and the Loser portfolios are not identified. De Bondt and Thaler examined the first 35 and the last 35 stocks for defining the Winner and the Loser stocks. While determining portfolios, some of the researchers determined these extreme points as percentage.

Jegadeesh (1990) formed ten different portfolios according to the return of stock over the previous month. The return difference between the extreme portfolios over the period 1934 - 1987 is 2,49 %. The findings of this study strongly show that the stocks follow a significant trend and they also do not follow a random walk.

Brown and Harlow (1988) state that the investors do not behave rationally and overreact to bad information. The findings in this study support overreaction hypothesis.

Domian, Louton and Mossman (1998) have found similar results with the overreaction hypothesis in their study on American Stock Exchange. The two periods between 1964-1986 and 1964-1997 are examined and similar findings have been found. The existence of overreaction hypothesis on American Stock Exchange is confirmed once again.

Nam, Pyun and Avard (2001) have tested the overreaction hypothesis on American Stock Exchange. In this study using the data from 1926 to 1997, results supporting the overreaction hypothesis have been found. According to the researchers, these findings reinforce the overreaction hypothesis. This occurs due to overreaction of investors to new information and wrong price estimation for the stocks.

Girard, Rahman and Zaher (2001) have searched for the relationship between risk and return according to Capital Assets Pricing Model on 9 Asian stock market and American stock market during and after the financial crisis. They state that investors overreact to pricing the stocks over this period.

Kato (1990) has found supporting results for the overreaction hypothesis in his study on Japan stock market. The formation of a portfolio is considered as 3 years in this study. Kato, using the returns over 1973-1987, states that the past Winner portfolio has a poor performance over the next period. The Loser portfolio could not provide a return more than the market. In other words there is a return difference between the Winner and Loser portfolio; this is just because the Winner portfolio has a poor performance over the next period. When Kato subdivided his study into two periods as before 1980 and after 1980, for the period before 1980 it can be said that this period supports the overreaction hypothesis. We can not say about this effect for about the other period.

Another study testing the overreaction hypothesis on American stock market was carried out by Chen and Sauer (1997). In this study 20 different portfolios have been formed by ranking for their returns comprising the period 1926-1992. First portfolio represent the 'Losers' and the 20th portfolio represents 'Winners'. The yearly average return of Losers is 23,74 % whereas the yearly average return of Winners is 12,43%. The return difference between the Winners and Losers is 11%. In other words the Losers earn 11% more than the Winners over the next period of time.

Chen and Sauer deepened their study by subdividing it into four periods. These periods are as follows: period before the war, period between 1940-1950, period before the energy crisis and period after the energy crisis. Whereas the Loser portfolio earns more than the market over the periods before the war and before the energy crisis, it is not the same in the periods between1940-1950 and after the energy crisis. Chen and Sauer state that it is not possible to say about the existence of overreaction hypothesis every time. According to researchers, if we need steady returns of the stocks to prove the existence of this effect, it seems impossible to say about existence of this effect.

We can summarize the findings of other researchers who test this effect on national and international markets. The studies testing the overreaction hypothesis over long-term and having findings for the existence of this effect is as follows;

Howe (1986) states that his findings support the overreaction hypothesis and it is independent from the January effect. Alonso and Robio (1990) have tested this effect on Spanish Stock Exchange and found supporting results for this hypothesis. At the same time it is said that this effect is independent from size effect. Gunaratne and Yonesawa (1997) searched for this effect on Tokyo Stock Exchange. By this study it is determined that Japan Stock Exchange has this effect. Also it is stated that this effect is free from monthly seasonal returns. Domian, Louton and Mossman (1998) found supporting results for this overreacting hypothesis on American Stock Exchange. Baytaş and Çakıcı (1999) examined the America, Canada, England, Japan, Germany, France and Italy Stock Exchange and found this effect in all countries except America. Mun, Vascocellos and Kish (1999) have found this effect on France and Germany Stock Exchange. Researchers state that January effect does not have an effect on the returns at a meaningful level. Nam, Pyun and Avard (2001), Nam, Pyun and Arize (2002) have determined this effect over the period 1926-1997 on American Stock Exchange.

The studies testing the overreaction hypothesis over the long-term and having contradictory findings are as follows;

When Zarowin (1989 b) tested overreaction hypothesis over the long-term and he did not find this effect. According to Zarowin, the reason for the difference between returns is due to the January effect and the size effect. Pettengill and Jordan (1990)

state that the reason for this effect on the American Stock Exchange is the January effect. Kryzanowski and Zhang (1992) did not come across with this effect on Toronto, Canada Stock Exchange. At the same time, the winners have less systematic risk than the losers. Conrad and Kaul (1993) did not find this effect and they state that De Dondt and Thaler (1985 -1987) made a measurement error and the return over January is significantly high. Ball, Kothari and Shanken (1995) state that the reason for the return difference between the winners and losers that De Bondt and Thaler (1985-1987) found is the micro structure and the problems in the measurement of portfolios performance.

The studies testing the overreaction hypothesis over the short-term and having findings for the existence of this effect are as follows;

Rosenberg, Reid and Lasntein (1985) point out that buying the past losers and selling the past winners bring a great amount of profit. In this study, it is stated that it is possible to earn an abnormal return by doing this operational strategy over a short period. Another study for a period of month was carried out by Zarowin (1989a). According to Zaworin, short term overreaction hypothesis can be added to the growing anomaly list including size effect, January effect and price/earn effect. Jegadessh (1990) tested this overreaction hypothesis monthly. The findings of this study strongly show that the stocks do not follow a random walk and have a traceable trend. Another study testing the overreaction hypothesis over a short period was carried out by Atkins and Dyl (1990). This effect is tested daily and the return behavior of the portfolios has been examined the day after formation and found supporting evidences. Jegadeesh and Titman (1993) proved that doing an operational strategy by buying the past losers and selling the past winners can bring an abnormal return. Jegadeesh and Titman (1993) examined the period of 1965-1989 and considered the period of formation of portfolios as 6 months. The return difference between the winner and the loser is 12,01 %. Bowman and Iverson (1998) examined the New Zeeland Stock Exchange for overreaction hypothesis. In this study the return behavior of portfolios, formed over the previous week, is examined for the next week. Bowman and Iverson (1998) state that risk, size effect and seasonal effects can affect these results but the overreaction hypothesis is dominant. In other words, these results can not be explained with risk, small firm effect and January effect. Fung, Mok and Lam (2000) have tested this overreaction hypothesis on American Stock Exchange and Hong Kong Stock Exchange daily. According to findings the price changes are related with previous period and findings support this hypothesis. In this study, it is clarified that the overreaction hypothesis is an international fact and the investors do not behave in a rational manner. Huang, Fu and Ke (2001) have tested this hypothesis on the Taiwan Stock Exchange daily. The data of period 1990-1996 has been used and similar supporting results have been found. Kang, Liu and Ni (2002) have proved the existence of overreaction hypothesis on Chinese Stock Exchange market by using the data of period 1993-2000. This study shows that there is an effect which is stronger than the market risk and firm size effect.

The other studies testing the overreaction hypothesis over short-term and having contrary findings for the existence of this effect are as follows;

Gaunt (2000) searched for the overreaction hypothesis on Australian Stock Exchange. In this study, on the contrary to American Stock Exchange, there is not any evidence for this effect. This effect, which is examined without considering risk, size effect and other factors, has not been seen on Australian Stock Exchange on the contrary to the study carried out by De Bondt and Thaler (1985) on American market. The monthly

data of period 1794-1997 has been used in this study. The reason for this situation on the Australian market can be due to the use of different periods.

IV. Data

In this study, the monthly returns of the listed stocks traded on the Istanbul Stock Exchange has been used to test overreaction hypothesis. These returns of the ISE are adjusted according to the non-paid-up-share and paid dividends

The period examined in this study is between January 29, 1988 and December 31, 2002. In this period, there is a formation and tracking of the portfolio terms comprising 36 months. Data included in the first period comprises the period between January 29, 1988 and December 31, 1993; data included in the second period comprises the period between January 31, 1991 and December 27, 1996; data included in the third period comprises the period between January 31, 1994 and December 28, 1999 and data included in the fourth period comprises the period between January 31, 1997 and December 31, 2002.

V. Method

In this study it is examined whether there are significant differences existing between average cumulative abnormal return (ACAR) of Winner and Loser portfolios. Accordingly:

H_0 hypothesis ; $[ACAR_{L,t} - ACAR_{W,t}] = 0$
H_1 hypothesis ; $[ACAR_{L,t} - ACAR_{W,t}] > 0$

In the first step, the listed stocks on the ISE are sorted according to their returns monthly. New portfolios are formed according to the operational strategy of overreaction hypothesis. The first criterion is the return of the stock over the months before the formation. The first formation date is considered as December 31, 1990 as parallel to the De Bondt and Thaler's (1985, 1987). The returns of stock over the period of 36 months (January1988,....., December 1990) before this date has been taken into consideration.

The abnormal return of each stock is calculated by subtracting market return from stock return in October 1988. Abnormal return is the excess return which is above the normal return. In this study, the return of market portfolio represents the normal return parallel to De Bondt and Thaler's (1985) study. Market return is calculated by dividing the total number of stocks traded in that month to the number of stocks. This operation is repeated from January 1988 to December 1990. This way, abnormal return of each stock is calculated over the 36 months. The abnormal return (ar_{it}) of the stock (i) relative to market portfolio (m) over the period (t) is the difference between the stock return (r_{it}) and market portfolio's return (r_{mt}).

$$ar_{it} = r_{it} - r_{mt} \quad (1)$$

The abnormal return of stocks is calculated over the period up to December 2002. In the second step, cumulative abnormal return (CAR) of stocks over the three years is found.

$$CAR_{i,t} = \sum_{t=1}^{t=-36} ar_i \qquad [2]$$

In this way, cumulative abnormal return of each stock over the 36 months is calculated. Then, these stocks are ranked according to their return and this point (December 1990) is considered as "t" period.

In the third step, portfolios are formed according to their cumulative abnormal returns. At the date of first formation (December 1990) over "t" period, portfolios are ranked according to their cumulative abnormal returns and the first 10 is called as a Winner, and the last 10 is called as a Loser. It can be said that Winner portfolios are the ones which earn the most cumulative abnormal return, and the Loser are the ones which earn the least cumulative abnormal return.

Then the cumulative abnormal return of Winner and Loser of the latter periods (t+1,.....t+36) of stocks are examined including portfolios formed within the past 36-month-return of "t" period. In this way, as the overreaction hypothesis projects, it is tried to find out whether the Loser portfolio earns more than the market over the last period and the winner earns less than the market over the last period. For this, the abnormal return (AR) of the winner and loser portfolio formed by ten stocks is calculated. Abnormal return of Winner and Loser portfolios is the equally-weighted arithmetical mean of sock over (t + 1) period of the stocks included to these portfolios.

$$AR_{W,t+1} = 1/10 \sum_{i=1}^{10} ar_{i,t+1} \quad ; \quad AR_{L,t+1} = 1/10 \sum_{i=1}^{10} ar_{i,t+1} \qquad [3]$$

This operation is repeated for 36 times (t+1.....t+36) and 36 ARW and ARL are calculated for both the winner and loser portfolio. After calculation of abnormal return of both portfolios over the period of 36 months, cumulative abnormal return of portfolios is calculated.

$$CAR_W = \sum_{t=1}^{t=36} AR_W \quad ; \quad CAR_L = \sum_{t=1}^{t=36} AR_L \qquad [4]$$

In the fourth step, we try to find out how much cumulative abnormal return at the end of 36 months, an investor can earn on the ISE by doing the operational strategy that overreaction hypothesis projected.

The test procedure mentioned above is repeated 4 times between the period January 1988 and December 2002 so that 4 periods were obtained examining 36 months' performance of winner and loser portfolios based on their past CARs. After all ACAR is calculated.

$$ACAR_W = 1/4 \sum_{i=1}^{i=4} CAR_W \qquad ACAR_L = 1/4 \sum_{i=1}^{i=4} CAR_L \qquad [5]$$

In this study "a period" consists of a cumulative abnormal return of stocks over the 36 months trading on the ISE. A newly trading stock on the ISE in the middle of a period is not included in this period. This stock has been included in the calculations over the next period. A stock which is delisted in the middle of the period is not included in the calculations in this period. Therefore, it is required for every stock to have return of 72 months.

New stocks that will be traded for the first time on the market will be overvalued because it was undervalued at the beginning. This situation may reduce the effect of overvaluing and also make calculations easier.

VI. Findings

In this study, we have reached similar results with the overreaction hypothesis in general. The Winner portfolio have a poor performance relative to the market and the Loser portfolio have a good performance relative to the market over the period January 1988-December 2002 (36 months consisting of 4 periods) in this study.

Table 6.1 shows the average cumulative abnormal return (ACAR) of the Winner portfolio. It is seen that cumulative abnormal return of the Winner portfolio over all the periods are negative. In other words the Winner portfolio keeps on earning less than the market. Cumulative abnormal return becomes negative after the three periods.

Table 6.1: Average Cumulative Abnormal Return of the Winner Portfolio

Periods After Formation	Average Cumulative Abnormal Return (ACAR)	PAF.	ACAR	PAF.	ACAR	PAF.	ACAR
1	-0,15	**10**	-0,27	**19**	-0,34	**28**	-0,44
2	-0,11	**11**	-0,25	**20**	-0,33	**29**	-0,48
3	-0,17	**12**	-0,26	**21**	-0,35	**30**	-0,47
4	-0,18	**13**	-0,24	**22**	-0,36	**31**	-0,46
5	-0,21	**14**	-0,25	**23**	-0,35	**32**	-0,48
6	-0,25	**15**	-0,28	**24**	-0,36	**33**	-0,45
7	-0,22	**16**	-0,29	**25**	-0,39	**34**	-0,44
8	-0,23	**17**	-0,33	**26**	-0,41	**35**	-0,45
9	-0,26	**18**	-0,31	**27**	-0,41	**36**	-0,51

The Winner portfolio has a poor performance relative to the market over the months after formation and this value at the end of 36 months is 51 %. In other words, the Winner portfolio earns 51 % less than the market average. According to this result, we can say that investors reduce the overvalued stock price over the next period. Table 6.1 shows the cumulative abnormal return of the Winner portfolio. This means that this portfolio earns the highest return over the previous period. The overvalued stocks over the previous period make their investors to lose in the next period relative to the market.

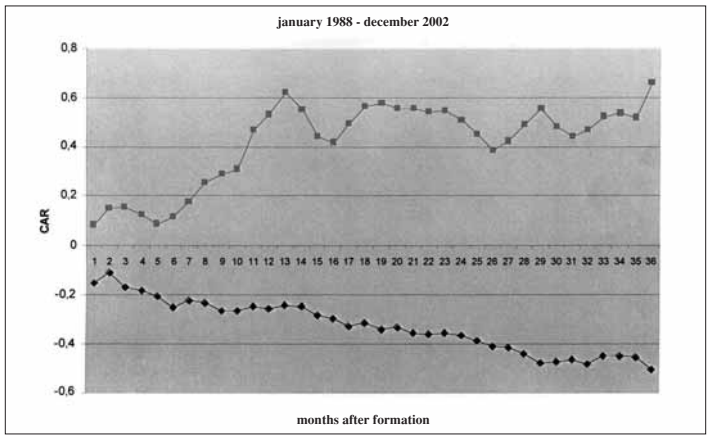
Table 6.2: Average Cumulative Abnormal Return of the Loser Portfolio

PAF	(ACAR)	PAF.	ACAR	PAF.	ACAR	PAF.	ACAR
1	0,08	**10**	0,31	**19**	0,58	**28**	0,49
2	0,15	**11**	0,47	**20**	0,55	**29**	0,55
3	0,16	**12**	0,53	**21**	0,55	**30**	0,48
4	0,13	**13**	0,62	**22**	0,54	**31**	0,44
5	0,09	**14**	0,55	**23**	0,54	**32**	0,47
6	0,12	**15**	0,44	**24**	0,51	**33**	0,52
7	0,18	**16**	0,42	**25**	0,45	**34**	0,54
8	0,26	**17**	0,50	**26**	0,39	**35**	0,52
9	0,29	**18**	0,56	**27**	0,42	**36**	0,66

Table 6.2 shows the average cumulative abnormal return of the Loser portfolio. As it is seen, the loser portfolio earns more than the market average over the next period. The average cumulative abnormal return of the Loser portfolio at the end of 36 months is 66 %. In other words, the Loser portfolio provides more returns for its investor than the market at the ratio of 66 %. Returns of the Loser portfolio are positive in all months after formation. In other words, this loser portfolio earns more than the market. Average cumulative abnormal return of month 13 is 62%, of month 19 is 58%, and of month 29 is 55%. But the highest cumulative abnormal return, 66%, is obtained in period 36 after the formation of the portfolio. Finally, it is possible to earn 66% more than the market with an operational strategy by buying the Losers over the last period of 36 months.

Figure 6.1 shows the average cumulative abnormal return of the Winner and the Loser portfolio over the 36 months comprised of 4 periods between January 1988 and December 2002. It is clear that the Winner portfolio have a poor performance relative to the market over the next period. The Loser portfolio earns more than the market as confirming overreaction hypothesis. The Loser portfolio earns 66% more than the market at the end of month 36. The Winner portfolio earns 51% less than the market average. The return difference between the Winner and the Loser is 117%. Finally, an investor may earn 117% more than the market with an operational strategy (buying the past Losers and selling the past Winners). The return difference between the Winner and the Loser reaches 103% at the end of period 29. Figure 6.1 clearly shows that the overreaction hypothesis is confirmed and applying such an operational strategy produces more return than the market earns.

Figure 6.1: Average Cumulative Abnormal Return of Winner and Loser Portfolios



Overreaction hypothesis on the ISE has an asymmetric feature, parallel to the study that De Bondt and Thaler (1985) made on the American Stock Exchange. Loser portfolio is larger than the winner. In other words, most of return difference between the loser and winner portfolio have been obtained from the loser portfolio. Although the cumulative abnormal return of the loser portfolio after the thirteenth month was lessened, in the following months it increased and the average cumulative abnormal return of the loser portfolio at the end of 36 months is 66 %. At the same time, this effect is seen in the second and third years of the portfolio period parallel to the international studies.

Meaningful results were gained when the values of average cumulative abnormal return (ACAR) of the Winner and Loser Portfolios tested statistically. Results of the "t" test are 95 % dependable. T-Statistic of the month 12 is found -3,09; month 24 is found -3,371; and month 36 is found -4,677. The highest values of "t" are as follows: month 36 (t-statistics: -4,677), month 35 (t-statistics: -4,607), month 3 (t-statistics: -4,597), month 10 (t-statistics: -4,181), month 16 (t-statistics: -4,166), month 27 (t-statistics: -4,045). So the hypothesis "H0", which assumed that ACAR difference of winner and loser portfolios is equal to zero, is rejected.

It is seen that the loser portfolio has a higher standard deviation than the winner portfolio. We can say that the loser portfolio is more risky relative to the winner in relation to measuring volatility in the market. The excess return of the Loser portfolio relative to the Winner portfolio and the market average is parallel to the Capital Asset Pricing Model (CAPM). That is to say the more return a portfolio has, the more risky it is.

This empirical study reinforces the overreaction hypothesis on the Istanbul Stock Exchange. The findings of our study show that if researchers invest by taking the risk of this effect, then they can earn excess return.

It is not possible to test this effect over a long term of 3 to 4 years. Since the ISE is a newly established stock exchange, the formation of a portfolio begins in October

1988 and ends in December 1999. The period of holding a portfolio begins in January 1991 and ends in December 2002. The ISE is a newly established stock Exchange (1986) and for this reason there are very few stocks traded on stock exchange in the beginning years. For this reason the best time to start this study is January 1988.

In the fourth period comprising the dates between January 1997 and December 2002 the overreacting hypothesis has its effect at the highest level. The difference between the winner and loser portfolios of the first period (January 1998 - December 1993) is 61 %. The difference in the second period (1991 January -1996 December) is 68 %. This difference in the third period (1994 January-1999 December) is 151 %. And in the last fourth period (January 1997- December 2002) the difference reaches 184 %. The return difference between the winner and loser portfolios is seen in every period but is at its highest level in third and fourth periods.

We do not have a certain explanation why this effect is strongly seen during the period after 1997. At this period Turkey has had serious developments. The Asian crisis has led to many problems in our country. The government which came into power after the election on April 18, 1999 made an agreement with the IMF. Together with the Copenhagen summit Turkey has advanced through the EU legislation and these developments has affected the economy positively. So, the Istanbul Stock Exchange National 100- Index has reached the level of 19,000s and tested the level of 20,000s. In November 2000 and February 2001 Turkey faced an appalling crisis.

In this period, Turkey has faced both positive and negative (especially) developments in political and economical arena. Finally, due to these problems in the country the Istanbul Stock Exchange has also been affected adversely. The listed stocks on the ISE have lost a great value during these two crises. The developments mentioned above may result in empowering of this effect on the ISE.

VII. Results

In this study, the weak form of market efficiency is tested with operational strategy in overreaction hypothesis. There are important results of this study carried out by using historical price movements in the direction of overreaction hypothesis. By doing an operational strategy of selling past winners and buying past losers, the earning an abnormal return is contradictory with weak form market efficiency and reinforces the result of the ISE not being a weak form efficient market. Therefore, it is not possible to earn abnormal return by using historical price movements in a weak form efficient market. The suggested operational strategy is to sell past winners and to buy past losers stocks.

Because the ISE is a newly established stock Exchange (1986) it provides the opportunity to test this effect in the long-term of 3 years in the form of 4 periods. This effect is tested by forming periods of three years considering that there should be at least 36 periods to measure the portfolio performance. There are studies in the international markets that test this effect in the short and long term. We suggest that the researchers should test this effect over periods of 1 to 3 months. Also, this effect can be tested daily, weekly and every ten days on the ISE as in parallel with the studies carried out in the international markets.

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PURCHASING POWER PARITY AND ARIMA MODELS IN FORECASTING EXCHANGE RATES: THE CASE OF TURKEY

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Abstract
This study aims to forecast the exchange rates of Turkey by using the Purchasing Power Parity theory (PPP) and its competitor the ARIMA models and compare their forecasting powers. In doing so, the models are estimated using the monthly real exchange rate data between Turkish Lira and Turkey's five biggest trading partners (The USA, Germany, England, France and Italy) for the period 1980-2003 and using the monthly real exchange rate data between Turkish Lira and European Union for the period 1999-2005. The conclusions based on the error terms statistics and the regression coefficients suggest that, compared to the PPP models, the ARIMA models have better forecasting powers.

I. Introduction

The modeling and forecasting of exchange rates have been one of the most important topics in international finance since the beginning of the flexible exchange rate system (Diamandis et.al., 1998). The successful forecast of exchange rates and having minimum forecast errors are very important especially for the economic actors in developing countries. The reason of this is that, together with other structural problems, compared to the developed countries, exchange rates are generally either fixed or under the strict control of government in developing countries. In addition, financial markets and credit providing institutions are weak and the laws for financial subjects are insufficient. In addition to generally having typical characteristics of developing countries, Turkey experienced many economic crises in the last decade which made her economy very unstable. Because of these reasons, the successful forecast of exchange rates for Turkey has been very important.

Even though there exists a few studies for the determination of exchange rates, the interest has risen lately for this topic. The structural models in determination of exchange rates for Turkey have been estimated using different approaches for different periods. Salehizadeh and Taylor (1999), tested the PPP theory using the cointegration approach

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for Turkey including the USA and 27 developing countries for the period 1951- 1994 and could not reach any supportive finding for the PPP theory. Seyrek (2003) tested the PPP theory for the determination of exchange rate between Turkish Lira and USA Dollar employing annual data for the period 1972-2001 and concluded that PPP theory does not hold both in the short and long run. Using Turkey's and her important trading partners' monthly data for the period 1973-1980, Temurlenk (1999)'s study included both fixed and flexible exchange rate systems and found that even though PPP hypothesis is valid for the fixed exchange rate period, it is not valid for the flexible exchange rate period after 1980. Telatar and Kazdağlı (1998) investigated 1980:10-1993:10 period and tested the PPP hypothesis between Turkey and Germany, France, England and the US. The findings from their study do not show that there exists a relationship between exchange rate and price in the long run between Turkey and her trading partners.

Although the studies on Turkey conclude that generally the PPP hypothesis does not hold Turkey, these studies have not forecasted Turkey's exchange rates using alternative forecasting approaches in the determination of exchange rates. This study aims to fill this gap in the literature by doing an exchange rate forecast for Turkey using two competitive forecasting approaches (a causal forecasting approach whose variables are determined by economic theory and a time series approach which uses only its past values and is based on its stochastic economic time series properties) and makes a comparison of the forecasting powers of two approaches. In doing this, using data from Turkey's five biggest trading partners for the period 1980-2003 and using data from European Union for the period 1999-2005, the PPP and ARIMA models are constructed. If PPP model shows a poor forecasting performance compared to ARIMA models, these conclusions will be evidence that economic actors in Turkey should take decisions and develop policies basing upon the conclusions of ARIMA models.

Section 2 explains theoretically the PPP theory and ARIMA models and gives information on evaluating a forecast. Section 3 presents econometric approaches used in forecasts and conclusions from these approaches and the last section provide a brief conclusion.

II. Purchasing Power Theory and ARIMA Model

After the collapse of the Bretton Woods system in early 1970's and currencies of some industrialized countries are allowed to fluctuate independently, theories to explain exchange rate changes have been developed. The oldest theory in explaining exchange rate changes is PPP approach. Having monetary policies gained importance in 1970's, economists such as Mussa (1976), Frenkel (1981 and 1976), and Kouri (1976) developed monetary approach in exchange rate determination. In order to add portfolio choices of economic actors in monetary models, Tobin (1980) developed a portfolio equilibrium model for a closed economy and later economists such as Kouri and Branson developed an open economy version portfolio model (Kouri, 1976). Generally, these three structural models are used in empirical exchange rate determination models. Since these models have been developed under different economic environments, some doubts have arisen about the success of these theories to explain exchange rate determination under changing economic conditions. Among these theories, the PPP theory, which is based on the assumption that an exchange rate is determined according to foreign and domestic price indices, is the basis of exchange rate forecasting models.

2.1. Purchasing Power Parity Model

The oldest and simplest model developed on exchange rate is the PPP theory. This theory has been developed and empirically tested firstly by Gustav Cassel (Officer, 1976). The theory is based on the idea that currencies of different countries should have same or similar purchasing powers. PPP is defined as the value of currency for goods and services. According to PPP theory, changes in the prices of goods and services lead to change in the value of a currency. Therefore, an exchange rate is defined as a relative price of currencies of two countries (Hallwood and McDonald, 1986).

In PPP theory, the relationship between exchange rates and price level is explained in two different ways as absolute and relative PPP. While the absolute PPP states that the equilibrium exchange rates between two currencies is equal to the ratio of the general price levels of two nations, the relative PPP postulates that the change in exchange rates is proportional to the relative price changes in the two nations. (Frenkel, 1982). In estimations of the PPP theory, since there is no common index having the same weight for the same goods in all countries, generally the consumer price index (CPI) is used to indicate foreign and domestic price levels. Since it is impossible to give same weights to same goods in two nations, absolute PPP does not lead to the exchange rate that equilibrates trade (Officier, 1976). However, the relative PPP can largely explain exchange rate changes even under the conditions of high inflation, high monetary emissions and supply shocks because the relationship between an exchange rate and price level is modeled using relative prices (inflation rates) of two nations. (Enders, 1989). Thus, instead of the absolute PPP, the relative PPP theory is estimated in this study.

The relative PPP theory is modeled in many studies as shown below: (Officer, 1980; Enders and Diboğlu, 2004; Xu, 2003; Fritsche and Wallece, 1996, Chen and Wu, 2000)

$$e = b_o + b_1 p + b_2 p^* + u \quad (1)$$

where e is an exchange rate refers to a domestic price of foreign currency; p is a domestic inflation rate; p* is a foreign inflation rate and u is a stationary error term. The coefficients of the model are expected to be: $b_1=1$ and $b_2= -1$. It is expected that while an increase in the value of the domestic currency leads to a positive effect on exchange rate, an increase in the value of the foreign currency leads to a negative effect on exchange rate.

2.2. ARIMA Models

Box and Jenkins (1970) developed a new method known as the ARIMA methodology through the publication of Time Series Analysis book. The methodology is known as Box-Jenkins (BJ) methodology, but it is technically known as ARIMA methodology. Unlike the regression models in the form that Yt is explained by k regressor X_1, X_2,...X_k, in the BJ type models Y_t is explained by past values of Y itself and stochastic error terms. Thus, ARIMA models are sometimes called a-theoretic models since they are not developed from any other economic theory (Gujarati, 1999). The ARIMA model

can generally be shown as below:

$$e_t = a_o + a_1 e_{t-1} + a_2 e_{t-2} + \ ...+ a_n\, e_{t-n} + u_t + b_1 u_{t-1} + ... + b_p u_{t-p} \qquad (2)$$

where e is an exchange rate refers to a domestic price of foreign currency and u is an error term.

Economists have frequently started to prefer using ARIMA models in their forecasts. The main reason of that, the models based on theories generally does not produce consistent outcomes in different economic conditions.

III. Econometric Methodology

In this study, monthly data of Turkey for her five biggest trading partners (the USA, Germany, the UK, France and Italy) for the period 1980:01-2003:07 and for the European Union for the period 1999:01-2005:01. In testing the PPP theory, the most preferred index, namely Consumer Price Index (CPI), is used. Since exchange rates for five countries and the European Union are in the form of the USA Dollar, they are converted to a Turkish Lira's value in terms of foreign currencies and real exchange rates were calculated by dividing price indices. Data of variables are obtained from International Financial Statistics (IFS) internet database. The time periods of the study is mainly determined by reaching the data. Since the series are monthly series, they are seasonally adjusted and then, used in logarithmic forms.

Before any regression analysis of the PPP theory and ARIMA models is performed, the stationary properties of series have to be investigated. In time series analyses, having a stationary series is very important in order to eliminate the effects of shocks from the series. In non-stationary series, in order to get a stationary series, procedures such as taking the differences of the series, taking their logarithms, taking the differences of logarithms, and de-trending are applied on series. While the series in the ARIMA model has to be stationary before the forecast, if the series in the PPP model is integrated of the same degree and they are co-integrated, the series can be estimated without transforming them into stationary series. In this study, the stationary properties of series of both models are determined by Augmented Dickey-Fuller unit root test. The lags in ADF tests are determined by the Schwarz information criterion. If the absolute values of ADF values are higher than MacKinnon critical values in different significance levels, it is concluded that the series is stationary. In determining the co-integration among the series integrated of the same order, Engle-Granger co-integration test is used. The Engle-Granger methodology requires that having estimated the regression with the series in levels, the ADF tests are performed on the residuals obtained from the regression. If the absolute value of the ADF statistics is higher than MacKinnon critical values, it is concluded that the series are co-integrated (Engle and Granger, 1987).

3.1. Evaluating Forecasts of Models

In order to determine the forecasting powers of different models, statistics of the residuals of regressions are used. The comparison of forecasting powers of different models with the same dependent variable is made by investigating the error term

statistics. The comparisons of forecasting powers are made using the error term statistics below:

- Root Mean Squared Error
- Mean Absolute Error
- Theil Inequality Coefficient
- Bias Proportion
- Variance Proportion
- Covariance Proportion

The first two statistics above depends on the dependent variable's measurement unit and since all models have the same dependent variable, these two statistics can be used to compare the forecasts of different models. The zero value of the Theil Inequality Coefficient indicates the perfect forecasting power of the model. This statistics should be as small as possible. In addition, the statistics of Bias, Variance and Covariance Proportions obtained through the decomposition of the Theil Inequality Coefficient also yield important information about forecasting powers. The bias proportion of the estimation is an indication of systematic error in the model, the variance proportion indicates how different the deviation of forecasted series from the deviation of actual series and the covariance proportion represents the remaining unsystematic errors. The ideal distribution of inequality over the three statistics is; Bias=Variance= 0 and Covariance=1 (Pindyck and Rubinfeld, 1991).

Second method in evaluating forecasting powers of the models includes an examination of figures of the forecasts over the period. The width between confidence intervals of the figures is taken as a guide to choose the model such a way that the model with the smallest confidence interval is the model which has better forecasting performance.

The other methodology in testing forecasting performances is an examination of the regression coefficients between actual and forecasted values. If actual values (e) are taken as a dependent variable, and forecasted values are taken as an independent variable (e_f), the model will be;

$$e = b_o + b_1 e_f + u \tag{3}$$

b_o=0 and b_1=1 corresponds to a good forecast. In order to select the model with the best forecast performance, the null hypothesis of b_o=0 and b_1=1 could not be rejected for each model. Then, the model with the smallest residual variance should be selected as the model which has the best forecasting power (Enders, 2004).

3.2. Empirical Results

The PPP and ARIMA models are estimated to forecast exchange rates between the Turkish Lira and the currencies of Turkey's five largest trading partners (the USA, Germany, the UK, France and Italy) for the period 1980:01-2003:07 and the Euro over the period 1999:01-2005:01. Before the estimation, the stationary properties of the series are examined. Table 1 shows the ADF test results to determine the integration degrees of the series.

Tablo 1: ADF Test Results

Countries	USA	Germany	England	France	Italy	Turkey
Lne	-2,51(2)	-1,50(2)	-2,71(1)	-0,80(0)	-0,39(0)	-
lnP	-2,70(5)	-2,28(1)	-2,65(6)	-2,79(12)	-1,43(12)	3,44(2)
Tlne	-4,06*(2)	-5,64*(1)	-4,32*(1)	-3,78*(0)	-4,19*(0)	-
tlnP	-6,68*(1)	-4,87*(1)	-3,08*(1)	-6,44*(1)	-6,29*(2)	-4,67*(2)

Countries	UE	Turkey
lne	-1,86(2)	-
lnP	-3,22*(0)	-0,39(1)
tlne	-4,74*(0)	-
tlnP	-	4,67*(0)

Notes: "*" shows that the series is stationary at the 5% significance level, t indicates that the series are eliminated from trends. The values in parentheses indicate the lags determined by the Schwarz Criterion. In ADF tests, the regression includes a constant. The MacKinnon critical values for the five countries: -3,4588 for 1%; -2,8735 for 5%; -2,5731for 10%. The MacKinnon critical values for the EU: -3,52 for 1%; -2,90 for 5%; %-2.58 for 10%.

In ADF tests, Schwarz criterion is used up to 12 lags because of the monthly data. The results in Table 1 show that, except the price index series of the EU, all series are not stationary at the level and they have become stationary after the elimination of trend.

In the ARIMA model, the exchange rate series is integrated of order one, thus it has to be made stationary. However, in the PPP model, if there exists a co-integration among the series integrated of the same order, series can be used without transforming them into stationary series. Since, except the domestic inflation rate series of the EU, all series are integrated of order 1, (I(1)), the co-integration test was done for the series of e, p and p*. For the series of the EU, the non-stationary series were transformed to stationary series by removing trend. Table 2 shows the results of the co-integration tests.

Table 2: The Results of the Co-integration Tests

Models	ADF
USA	-2,49(2)
Germany	-3.81*(0)
England	-1,95(1)
France	-3,94*(0)
Italy	-3,78*(0)

Notes: "*" shows that the series is stationary at the 5% significance level. Values in parentheses indicate the lags determined by the Schwarz Criterion. The MacKinnon critical values: -4.29 for 1%; -3.74 for 5%; -3.45 for 10%.

The results of Table 3 indicate that there is no co-integration among the series of England and the USA. Therefore, the series of England and the USA were used after transforming them into stationary series by removing trend and since there exists a co-integration relationship among the series of Germany, France and Italy, they were used in regressions at their levels. Table 3 shows the regression results of the PPP model from equation 1.

Table 3: Regression Results of PPP Model

Countries	USA	Germany	England	France	Italy	UE
b_o	-0,02	5,062	-0,002	6,170**	11,43	0,015
	(0,8)	(0,02)	(0,82)	(0,08)	(0,35)	(0,19)
b_1	-0,401*	0,090**	-0,335	0,226*	1,138*	-0,81*
	(0,0001)	(0,09)	(0,39)	(0,03)	(0,04)	(0,00004)
b_2	0,196	-0,308*	0,746	-1,191	-5,62	-0,014
	(0,84)	(0,04)	(0,12)	(0,527)	(0,4)	(0,69)
Summary Statistics						
R^2	0,8	0,95	0,76	0,94	0,94	0,72
DW	2,06	2,03	2,02	1,86	1,95	1,85
F	253,54	1439,7	197,9	1351,2	1334,02	58,63

Notes: Values in parentheses are the probability values of the t statistics. "*" and "**" show the significant coefficients at the 5% and 10% levels, respectively. "_" indicates that the heteroscedasticity problem in the regression is corrected using the "White's heteroscedasticity correction procedure". The autocorrelation problem in all models is corrected by the AR procedure.

According to the PPP theory, while the coefficient of the price index of domestic country is expected to be 1 and the coefficient of the price index of foreign country is expected to be -1, the results of the regressions reveal that only the coefficient of p variable (b_1) in the model of Italy and the coefficient of p* variable (b_2) in the model of France produce values close to the expected values. However, in empirical studies, having expected values and being significant of coefficients are also deemed that the model is successful.* Thus, obtaining the expected coefficients of the models in Germany, France and Italy models can be regarded as a successful result. In addition, it is observed that the model of Italy has the biggest coefficients for price indices, b1 and b2 coefficients and thus, has the largest effect of price indices on an exchange rate. But in all models except the model of Germany, the coefficients of price indices could not be found simultaneously significant. It is also seen that in the model of EU, the b_1 coefficient is significant even though not theoretically expected and the b_2 coefficients has an expected sign even though not significant.

In the selection of ARIMA models, the "general to specific" approach and the Schwarz Criterion are used. Table 4 shows the ARIMA models chosen for each country and the regression results:

* In studies which the PPP model is used, it is not possible to have an exact expected values of coefficients (b_1=1; b_2=-1). Therefore, the decision of whether the test results are in compliance with the theory are made according to the realizations of expected signs of the coefficients (Cheung, Y.W., 2004; Chen, S.L. and J.L. Wu, 2000).

Table 4: Regression Results of ARIMA Models

Countries	USA	Germany	England	France	Italy	UE
b_0	-0,0003	-0,0009	-0,0003	-0,04	0,0036	1,19
	(0,77)	(0,96)	(0,77)	(0,88)	(0,35)	(0,84)
AR(1)	1,079*	0,905*	1,905*	0,883*	1,838*	1,49*
	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)	(0,00)
MA(1)	-0,089	0,175*	-0,988*	_	-1,027*	_
	(0,17)	(0,01)	(0,00)	_	(0,00)	_
AR(2)	-0,657*	_	-0,924*	_	-0,870*	-0,50*
	(0,00)		(0,00)		(0,00)	(0,00)
MA(2)	-0880*	_	_	_	_	_
	(0,00)					
AR(3)	-0,773*	_	_	_	_	_
	(0,00)					
Summary Statistics						
R^2	0,73	0,86	0,86	0,84	0,77	0,99
DW	2,04	1,88	2	1,79	1,85	2,00
F	225,8	303,8	778,4	433,1	819,3	744,9

Notes: Values in parentheses are the probability values of the t statistics. "*" sign shows the significant coefficients at the 5% level.

Although estimations depend on all past observations, an immediate past is more important than the less recent. Thus, simpler ARIMA models yield better results. Table 4 reveals that coefficients are generally significant, they are jointly significant and have high R2's reflecting the very well goodness of fit of the regression line to data. Generally, it can be said that the ARIMA model is very successful in determining exchange rates. According to these results, for all countries, although they are in different degrees, an increase in exchange rates (devaluation) in the last period leads to an increase in exchange rate in the current period.

After the estimations of the models, in order to determine which model has the best forecasting performance, the evaluations of forecasts are given in Table 5.

Table 5: Error Terms Statistics

Countries	USA		Germany		England	
	PPP	ARIMA	PPP	ARIMA	PPP	ARIMA
Root Mean Squared Error	0,032	0,014	0,082	0,025	0,037	0,017
Mean Absolute Error	0,022	0,007	0,066	0,013	0,026	0,011
Theil Inequality Coefficient	0,785	0,19	0,009	0,19	0,839	0,209
Bias Proportion	0,004	0,003	0,003	0	0,002	0,001
Variance Proportion	0,495	0,035	0,139	0,036	0,418	0,04
Covariance Proportion	0,501	0,962	0,856	0,964	0,578	0,959
Countries	**France**		**Italy**		**UE**	
	PPP	ARIMA	PPP	ARIMA	PPP	ARIMA
Root Mean Squared Error	0,163	0,053	0,716	0,189	0,022	0,034
Mean Absolute Error	0,116	0,019	0,527	0,059	0,017	0,024
Theil Inequality Coefficient	0,02	0,255	0,174	0,274	0,007	0,010
Bias Proportion	0,001	0	0,059	0,001	0,0002	0,00
Variance Proportion	0,004	0,065	0,062	0,07	0,005	0,001
Covariance Proportion	0,953	0,935	0,877	0,929	0,994	0,998

The Root Mean Squared Error and Mean Absolute Error statistics which are both depends on the scale of the dependent variable are smaller in ARIMA models compared to PPP models in five countries. In the model of EU, although those statistics are close to each other, the statistics of the PPP model is a little bit smaller. The statistics of Bias Proportion, Variance Proportion and Covariance Proportion both of which are obtained from the decomposition of the Theil Inequality Coefficient are smaller the in ARIMA models compared to the PPP models. Since the systematic error for both models are not higher than 0.2, it can be concluded that there is no systematic error in the models thus no need to revise the models. An examination of the Variance Proportion reveals that compared to the PPP models, the change in forecasted values obtained from ARIMA models are smaller than the change in real series. Lastly, the covariance proportion which shows the remaining unsystematic forecasting errors is highest in all ARIMA models except the model of France. The statistics from these results indicate that, except the Root Mean Squared Error and Mean Absolute Error statistics for the model of the EU, the statistics for all other models show that the ARIMA models are more successful than the PPP models. Since for the model of EU, the statistics are very close to each other, it can be concluded that the ARIMA models have better performance of forecasting than the PPP models in all models.

The figures of forecasts computed from the PPP and ARIMA models for the exchange rates between Turkish Lira and the currencies of five countries are presented in Figure 1-6 below.

Figure 1: Forecasted Series of the PPP and ARIMA Models for the USA

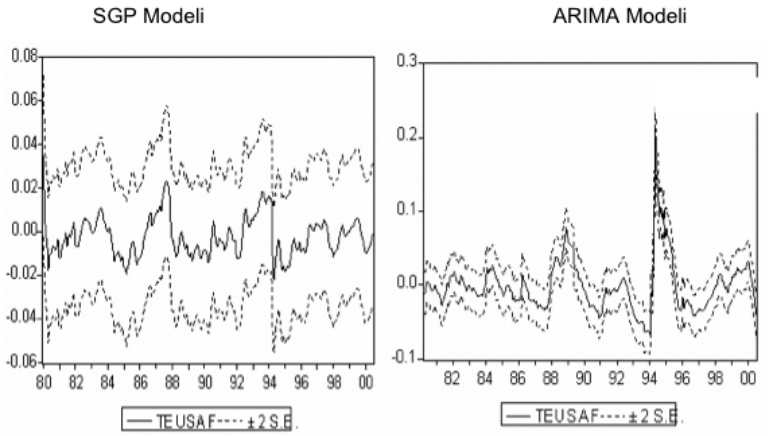


Figure 2: Forecasted Series of the PPP and ARIMA Models for Germany

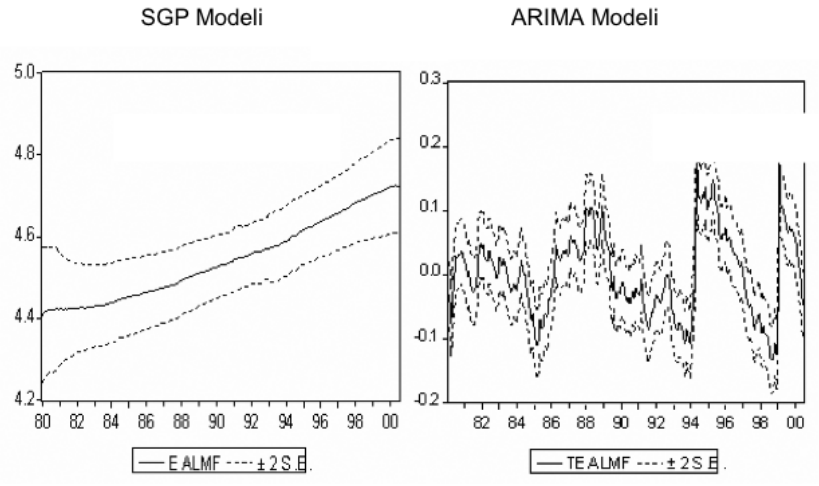


Figure 3: Forecasted Series of the PPP and ARIMA Models for England

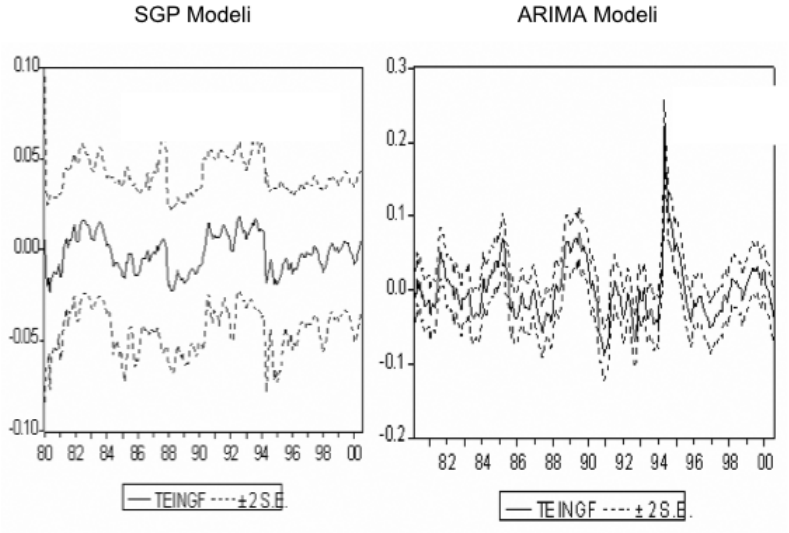


Figure 4: Forecasted Series of the PPP and ARIMA Models for France

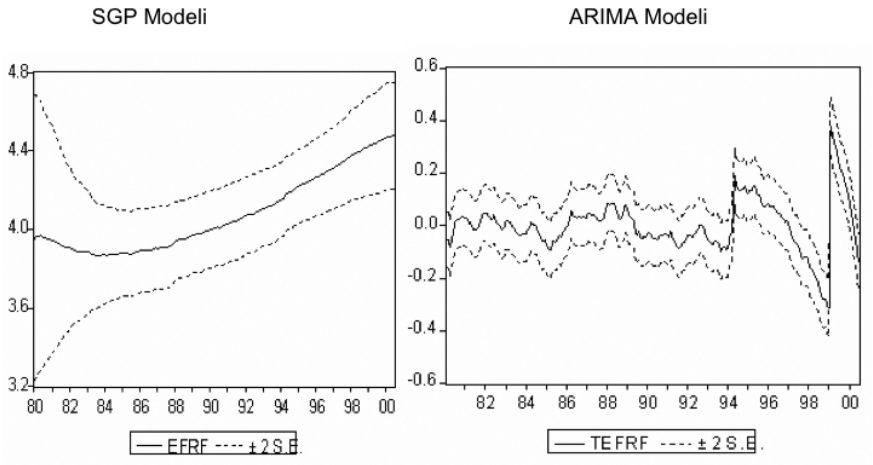


Figure 5: Forecasted Series of the PPP and ARIMA Models for Italy

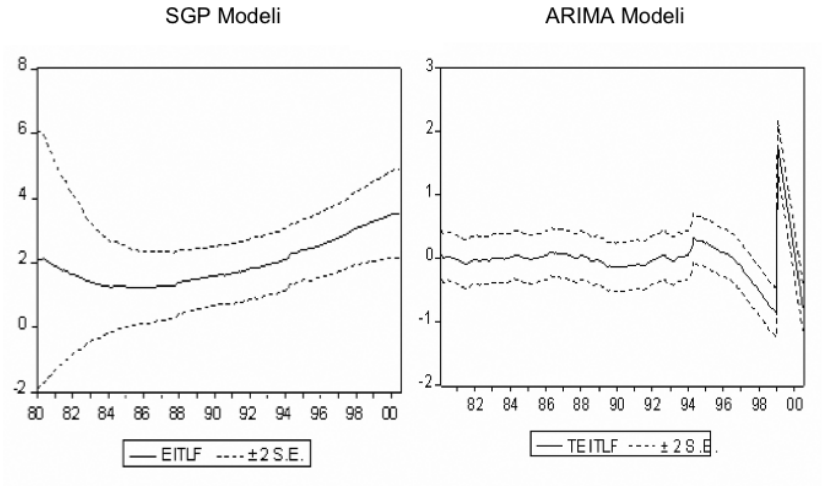
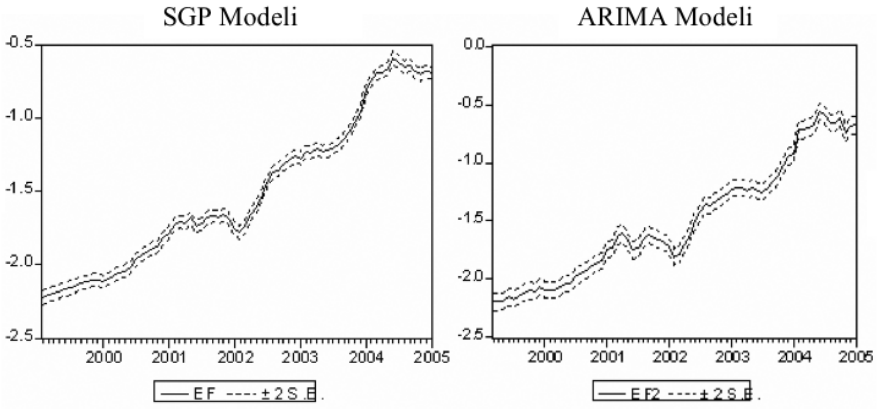


Figure 6: Forecasted Series of the PPP and ARIMA Models for the EU



Except the ARIMA model of the EU in which confidence intervals are almost same in both models, the width of the confidence intervals of the forecasts are smaller in the all ARIMA models compared to the PPP models (the real series are very close to forecasted series) and the width of the bands of the forecasts of the PPP model is larger than those of the ARIMA models for the case of five countries. Thus, it can be concluded that the ARIMA model has higher forecasting performance compared to the PPP model.

In order to compare forecasting powers of the two models, the equation 3 is estimated using the real and forecasted exchange rates between Turkish Lira and currencies of the five countries and the EU and the null hypothesis of $b_o=0$ and $b_1=1$ is tested. The F statistics, the $F_{probability}$ values which indicate the lowest significance level at which a null hypothesis can be rejected and a variance of an error term "u" are shown in Table 6.

Table 6: Test Results of b_o and b_1 Coefficients

Countries	**USA**		**Germany**		**England**	
	PPP	**ARIMA**	**PPP**	**ARIMA**	**PPP**	**ARIMA**
F Sta.	4,89	0,0015	0,505	0,0001	27,87	0,0006
$F_{probabiliy}$	0,008	0,998*	0,604*	0,999*	0	0,999*
Variance	0,00098	0,0174	0,0067	0,00058	0,0011	3,40E-07
Countries	**UE**		**France**		**Italy**	
	PPP	**ARIMA**	**PPP**	**ARIMA**	**PPP**	**ARIMA**
F Sta.	0,312	6.97E-22	4,87	7,90E-23	13,81	0,106
$F_{probabiliy}$	0,732*	1,00*	0,008	1*	0	0,899 *
Variance	0,0224	0,0343	0,025792	0,00283	0,4624	0,037636

Notes: "*" shows the model in which the null hypothesis can not be rejected.

Table 6 shows that the null hypothesis cannot be rejected in the all ARIMA models and it cannot be rejected only in the PPP models of Germany and the EU. These analyses also show that the ARIMA models have better forecasting performance than the PPP models which are in conformity with the previous results. However, in the model of the EU, although it is concluded that the ARIMA models have better forecasting performance, the PPP model also has very close forecasting performances to that of the ARIMA model. However, since the time span for the EU model is very short, it should be considered that the results might not reflect the true price movements.

IV. Conclusions

The estimations of exchange rate movements both in the short and long run have been one of the most important topics in international finance since the breakdown of the Bretton-Woods system. Compared to developed countries, together with having other structural problems, Turkey experienced many economic and financial crises in the last decade which made the forecast of Turkey's exchange rate both very difficult and very important. Nevertheless, there is no adequate study which aims to examine the determination of exchange rates in Turkey. Aiming to fill this gap in the literature, this study develops the Purchasing Power Parity (PPP) and ARIMA model using data of Turkey with her five biggest trading partners for the period 1980-2001 and the EU for the period 1999-2005. Using these models, the validity of both the PPP model and ARIMA models in explaining the exchange rate movements of Turkey and forecasting powers of these models are tested.

The results obtained from the statistics of forecasting performances of the models, figures and estimations from the regressions show that in explaining exchange rate movements of Turkey and exchange rate forecasts, the ARIMA models have better forecasting performances than the PPP models. Thus, the ARIMA models are better models to explain the exchange rate determination in Turkey. Monetary and fiscal policy makers as well as financial speculators, corporation managers and risk managers should take decisions and adopt policies basing on forecasts of the ARIMA models.

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GLOBAL CAPITAL MARKETS

World output increased in the first half of 2006. Growth was particularly strong in the United States in the first quarter, although it slowed in the second quarter due to the slowdown in the housing market and rising fuel costs. In the Euro area stronger corporate balance sheets have paved the way for higher investment, rising employment and a better balanced expansion. The Japanese economy continued to expand based on solid domestic demand and growth in China has accelerated even further, emerging Asia and Europe have continued to grow rapidly, and the pace of activity has picked up in Latin America. World output growth had been marked up to 5.1 percent in 2006 and 4.9 percent in 2007.

The U.S. Federal Reserve continued to raise interest rates further in recent months and the Bank of Japan ended its zero interest rate policy in July. Rising inflation concerns and tighter monetary conditions led to some weakness in advanced-economy equity markets and a series of larger moves in some emerging market asset prices in May-June, although markets have been more stable since July. These moves appear to largely represent corrections after major price run-up's, rather than a fundamental reassessment of economic risks.

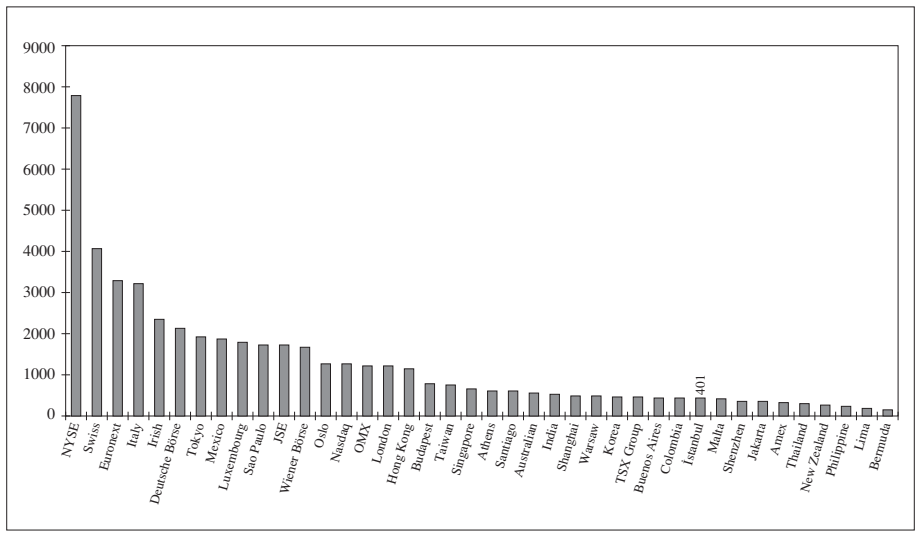
The performances of some developed stock markets with respect to indices indicated that DJIA, FTSE-100, Nikkei-225 and DAX changed by 4.1%, 10.8%, -1.7% and 12.1% respectively at July 5th, 2006 in comparison with the December 30, 2005. When US $ based returns of some emerging markets are compared in the same period, the best performer markets were: Peru (85.5 %), Venezuela (56.4 %), China (49.4 %), Russia (33.4 %), Indonesia (24.2 %) and Brazil (15.7 %). In the same period, the lowest return markets were: Colombia (-26.0 %), Turkey (-24,9 %) and Saudi Arabia (-21.9 %). The performances of emerging markets with respect to P/E ratios as of end-June 2006 indicated that the highest rates were obtained in Jordan (24.4), Taiwan (22.2), Russia (21.9), Turkey (18.3) and India (17.8) and the lowest rates in Venezuela (7.0), Thailand (9.1), Brazil (9.9) and Pakistan (10.9).

Market Capitalization (USD Million, 1986-2005)

	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	47.689
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

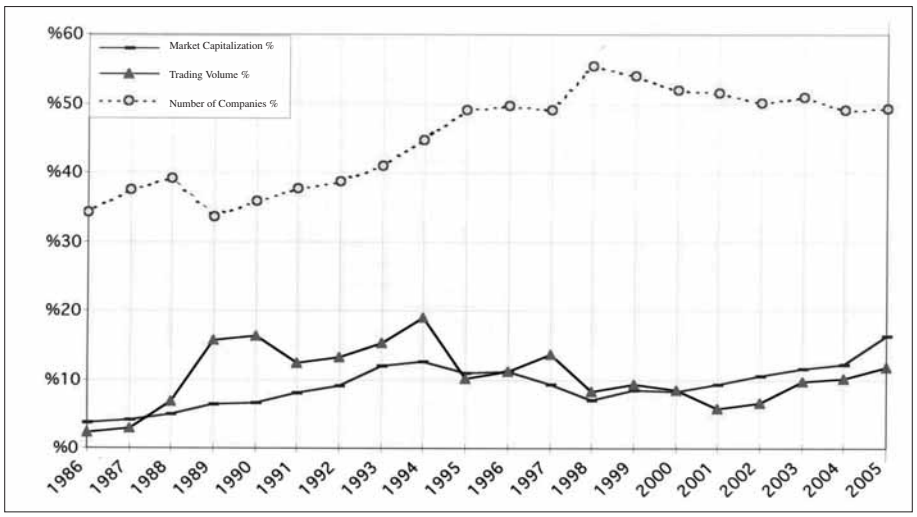
Source: Standard & Poor's Global Stock Markets Factbook, 2006.

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



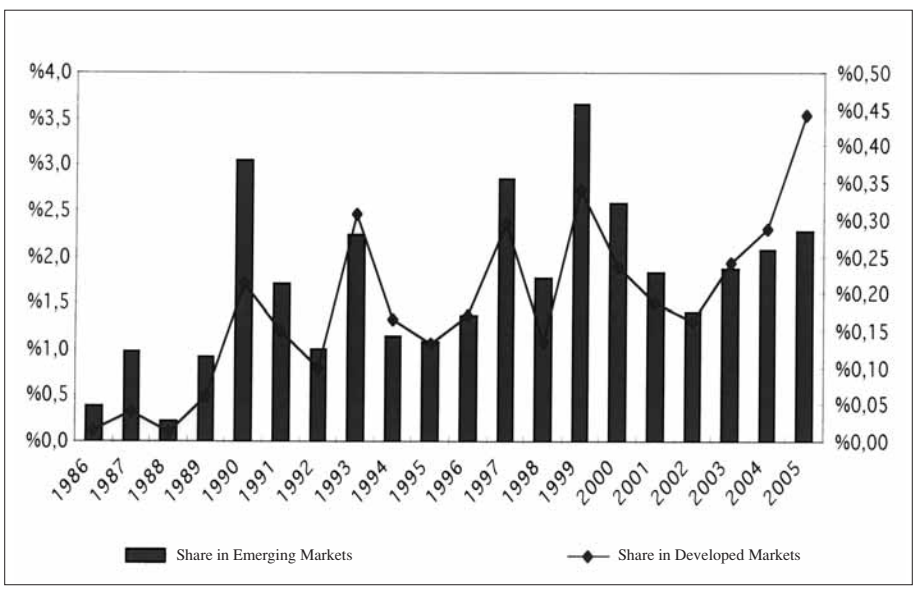
Source: FIBV, Monthly Statistics, June 2006.

Worldwide Share of Emerging Capital Markets (1986- 2005)



Source: Standard & Poor's Global Stock Markets Factbook, 2006.

Share of ISE's Market Capitalization in World Markets (1986-2005)



Source: Standard & Poor's Global Stock Markets Factbook, 2006

Main Indicators of Capital Markets (June 2006)

	Market	Monthly Turnover Velocity (June 2006) (%)	Market	Value of Share Trading (Mil. US$) (2006/1-2006/6)	Market	Market Cap. of Share of Domestic Companies (Mil. US$) June 2006
1	Nasdaq	262,28	NYSE	11.217.083	NYSE	13.939.777
2	Korea	220,36	Nasdaq	6.188.040	Tokyo	4.523.202
3	Shenzhen	198,53	Londra	3.749.281	Nasdaq	3.540.765
4	Deutsche Börse	171,97	Tokyo	3.197.408	London	3.347.429
5	Italy	167,38	Euronext	2.057.986	Osaka	2.990.866
6	Istanbul	164,26	Deutsche Börse	1.446.153	Euronext	3.175.063
7	Spanish (BME)	155,79	Spanish (BME)	894.555	TSX Group	1.633.233
8	Taiwan	150,86	Italy	835.274	Deutsche Börse	1.371.722
9	Oslo	139,22	Swiss	808.552	Hong Kong	1.266.950
10	Tokyo	135,25	Korea	776.532	Spanish (BME)	1.111.182
11	OMX	132,39	OMX	690.667	Swiss	1.042.130
12	Swiss	130,67	TSX Group	644.781	OMX	877.707
13	Shanghai	129,73	Australian	409.370	Italy	896.952
14	London	120,49	Hong Kong	403.629	Australian	896.975
15	Euronext	120,18	Taiwan	400.714	Korea	732.095
16	NYSE	116,70	Amex	348.549	Bombay	591.155
17	Australian	86,28	Shanghai	298.157	JSE	599.748
18	Budapest	84,67	India	227.535	India	548.362
19	India	77,34	Oslo	212.309	Sao Paulo	584.216
20	Thailand	75,18	Shenzhen	184.095	Taiwan	506.198
21	TSX Group	73,97	JSE	174.516	Shanghai	388.985
22	Athens	59,58	Osaka	151.632	Singapore	294.771
23	Irish	58,96	Sao Paulo	138.891	Mexico	244.754
24	Hong Kong	58,18	Istanbul	134.441	Oslo	243.246
25	Singapore	57,24	Bombay	116.477	Malaysia	192.829
26	JSE	50,37	Singapore	91.908	Istanbul	126.662
27	New Zealand	49,21	Athens	59.767	Athens	170.203
28	Wiener Börse	48,00	Thailand	54.254	Wiener Börse	156.160
29	Tel-Aviv	46,07	Mexico	47.377	Santiago	137.797
30	Jakarta	45,28	Wiener Börse	43.374	Thailand	129.191
31	Sao Paulo	44,64	Irish	40.792	Tel Aviv	130.219
32	Warsaw	44,12	Malaysia	35.232	Irish	125.990
33	Bombay	36,79	Tel-Aviv	31.720	Shenzhen	163.919
34	Colombia	31,09	Warsaw	27.288	Amex	139.571
35	Malaysia	30,27	Jakarta	23.838	Warsaw	106.430
36	Mexico	28,74	Budapest	16.466	Jakarta	97.271
37	Philippine	18,94	Santiago	12.888	Luxembourg	65.506
38	Ljubljana	17,71	New Zealand	11.137	Colombia	39.625
39	Santiago	16,57	Colombia	7.663	Buenos Aires	41.824
40	Colombo	15,87	Philippine	4.945	Philippine	44.369
41	Lima	15,34	Buenos Aires	3.153	New Zealand	34.933
42	Tehran	14,15	Lima	2.628	Budapest	31.729
43	Buenos Aires	9,38	Tehran	1.967	Tehran	34.160
44	Osaka	8,67	Ljubljana	927	Lima	30.891
45	Malta	6,84	Colombo	430	Ljubljana	9.694

Source: FIBV, Monthly Statistics, June 2006.

Trading Volume (USD millions, 1986-2005)

	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

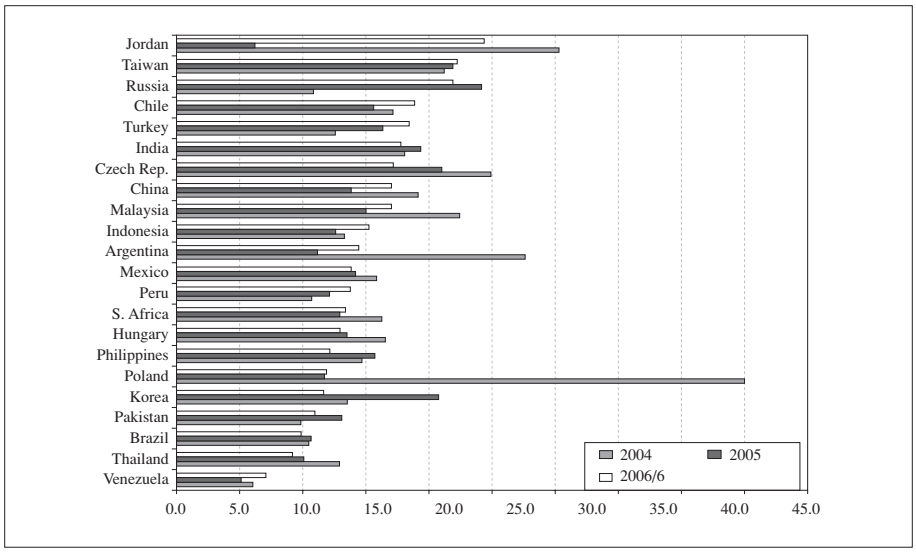
Source: Standard & Poor's Global Stock Markets Factbook, 2006.

Number of Trading Companies (1986-2005)

	Global	Developed	Emerging	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

Source: Standard & Poor's Global Stock Markets Factbook, 2006.

Comparison of P/E Ratios Performances



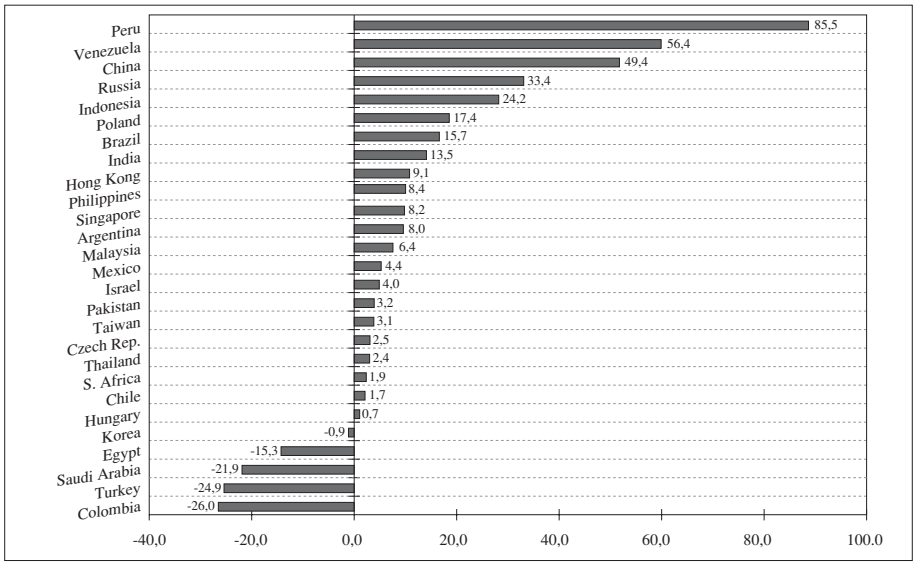
Source: IFC Factbook 2001. Standard & Poor's, Emerging Stock Markets Review, June 2006.

Comparison of P/E Ratios Performances

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006/6
Argentina	16,3	13,4	39,4	-889,9	32,6	-1,4	21,1	27,7	11,1	14,5
Brazil	12,4	7,0	23,5	11,5	8,8	13,5	10,0	10,6	10,7	9,9
Chile	14,7	15,1	35,0	24,9	16,2	16,3	24,8	17,2	15,7	18,9
China	34,5	23,8	47,8	50,0	22,2	21,6	28,6	19,1	13,9	17,1
Czech Rep.	37,1	-11,3	-14,9	-16,4	5,8	11,2	10,8	25,0	21,1	17,2
Hungary	27,4	17,0	18,1	14,3	13,4	14,6	12,3	16,6	13,5	13,0
India	15,2	13,5	25,5	16,8	12,8	15,0	20,9	18,1	19,4	17,8
Indonesia	10,5	-106,2	-7,4	-5,4	-7,7	22,0	39,5	13,3	12,6	15,2
Jordan	14,4	15,9	14,1	13,9	18,8	11,4	20,7	30,4	6,2	24,4
Korea	17,9	-47,1	-33,5	17,7	28,7	21,6	30,2	13,5	20,8	11,6
Malaysia	9,5	21,1	-18,0	91,5	50,6	21,3	30,1	22,4	15	17,0
Mexico	19,2	23,9	14,1	13,0	13,7	15,4	17,6	15,9	14,2	13,9
Pakistan	14,8	7,6	13,2	-117,4	7,5	10,0	9,5	9,9	13,1	10,9
Peru	14,0	21,1	25,7	11,6	21,3	12,8	13,7	10,7	12,0	13,7
Philippines	10,9	15,0	22,2	26,2	45,9	21,8	21,1	14,6	15,7	12,1
Poland	11,4	10,7	22,0	19,4	6,1	88,6	-353,0	39,9	11,7	11,8
Russia	8,1	3,7	-71,2	3,8	5,6	12,4	19,9	10,8	24,1	21,9
S. Africa	10,8	10,1	17,4	10,7	11,7	10,1	11,5	16,2	12,8	13,3
Taiwan	28,9	21,7	52,5	13,9	29,4	20,0	55,7	21,2	21,9	22,2
Thailand	-32,8	-3,6	-12,2	-6,9	163,8	16,4	16,6	12,8	10,0	9,1
Turkey	20,1	7,8	34,6	15,4	72,5	37,9	14,9	12,5	16,2	18,3
Venezuela	12,8	5,6	10,8	30,5	-347,6	-11,9	14,4	6,0	5,1	7,0

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

Comparison of Market Returns in USD (30/12/2005-05/07/2006)



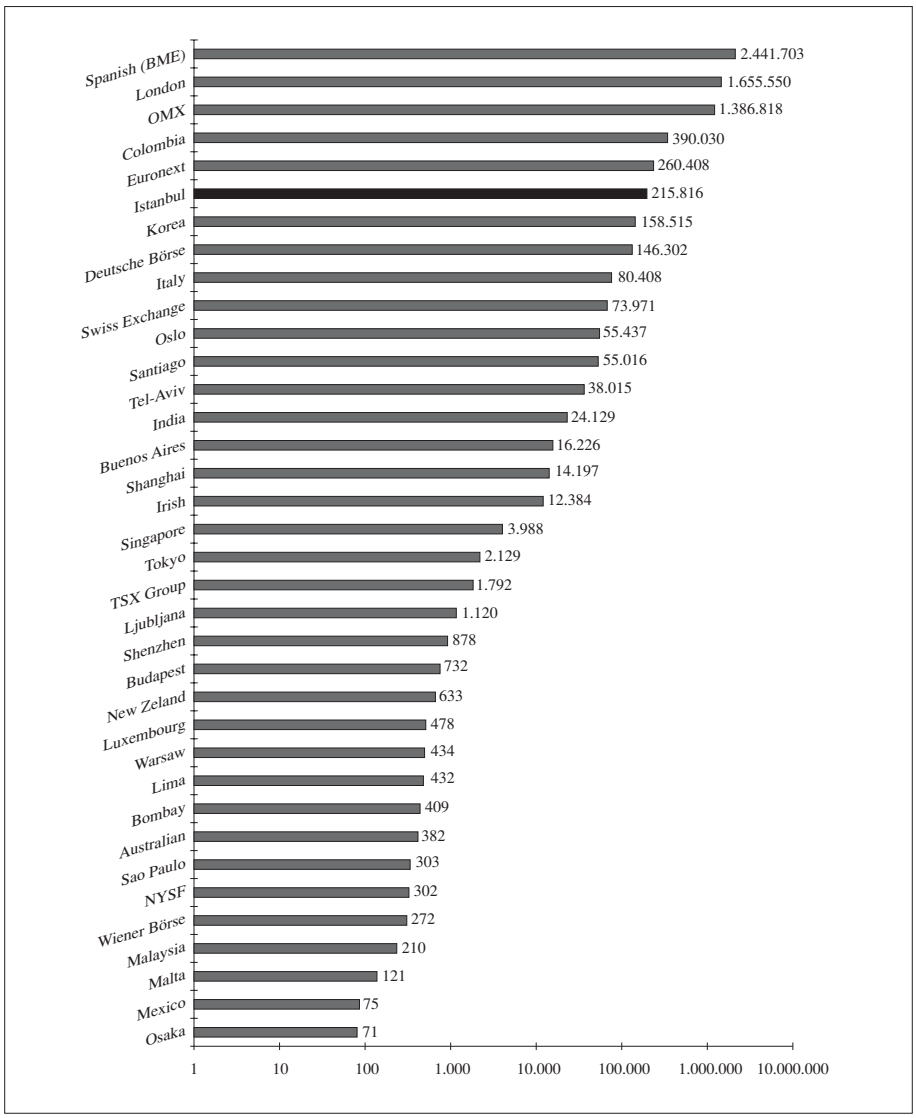
Source: The Economist, July 6th 2006.

Market Value/Book Value Ratios

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006/6
Argentina	1,8	1,3	1,5	0,9	0,6	0,8	2,0	2,2	2,5	3,3
Brazil	1,0	0,6	1,6	1,4	1,2	1,3	1,8	1,9	2,2	2,1
Chile	1,6	1,1	1,7	1,4	1,4	1,3	1,9	0,6	1,9	1,9
China	3,9	2,1	3,0	3,6	2,3	1,9	2,6	2,0	1,8	2,1
Czech Rep.	0,8	0,7	0,9	1,0	0,8	0,8	1,0	1,6	2,4	2,1
Hungary	4,2	3,2	3,6	2,4	1,8	1,8	2,0	2,8	3,1	3,0
India	2,3	1,8	3,3	2,6	1,9	2,0	3,5	3,3	5,2	4,0
Indonesia	1,4	1,5	3,0	1,7	1,7	1,0	1,6	2,8	2,5	2,4
Jordan	1,8	1,8	1,5	1,2	1,5	1,3	2,1	3,0	2,2	3,7
Korea	0,5	0,9	2,0	0,8	1,2	1,1	1,6	1,3	2,0	1,6
Maleysia	1,4	1,3	1,9	1,5	1,2	1,3	1,7	1,9	1,7	1,7
Mexico	2,3	1,4	2,2	1,7	1,7	1,5	2,0	2,5	2,9	2,9
Pakistan	2,3	0,9	1,4	1,4	0,9	1,9	2,3	2,6	3,5	3,1
Peru	2,0	1,6	1,5	1,1	1,4	1,2	1,8	1,6	2,2	3,0
Philippines	1,3	1,3	1,4	1,0	0,9	0,8	1,1	1,4	1,7	1,5
Poland	1,7	1,5	2,0	2,2	1,4	1,3	1,8	2,0	2,5	2,1
Russia	0,5	0,3	1,2	0,6	1,1	0,9	1,2	1,2	2,2	2,6
S. Africa	1,6	1,5	2,7	2,1	2,1	1,9	2,1	2,5	3,0	3,1
Taiwan	3,1	2,6	3,4	1,7	2,1	1,6	2,2	1,9	1,9	2,0
Thailand	0,8	1,2	2,1	1,3	1,3	1,5	2,8	2,0	2,1	1,8
Turkey	6,8	2,7	8,9	3,1	3,8	2,8	2,6	1,7	2,1	1,8
Venezuela	1,2	0,5	0,4	0,6	0,5	0,5	1,1	1,2	0,7	1,0

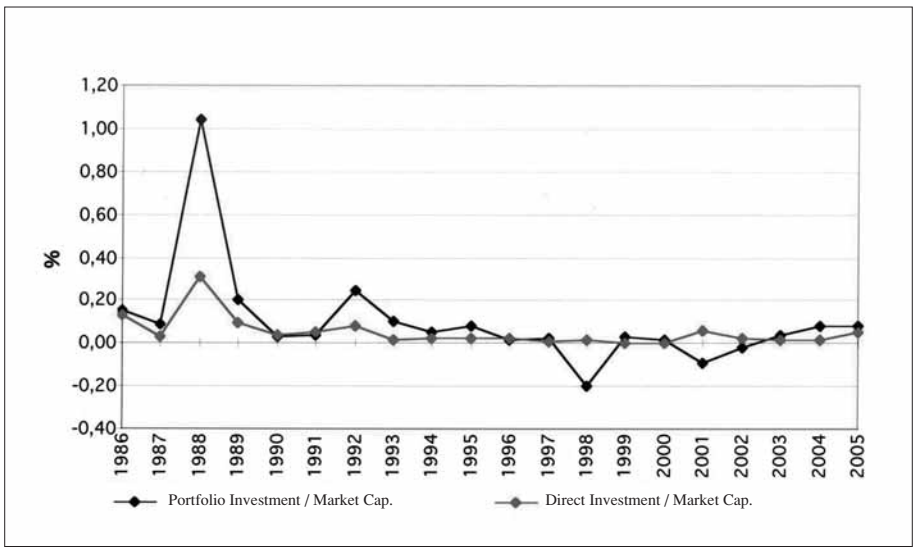
Source: IFC Factbook, 2004; Standard & Poor's, Emerging Stock Markets Review, June 2006.
Note: Figures are taken from S&P/IFCG Index Profile.

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



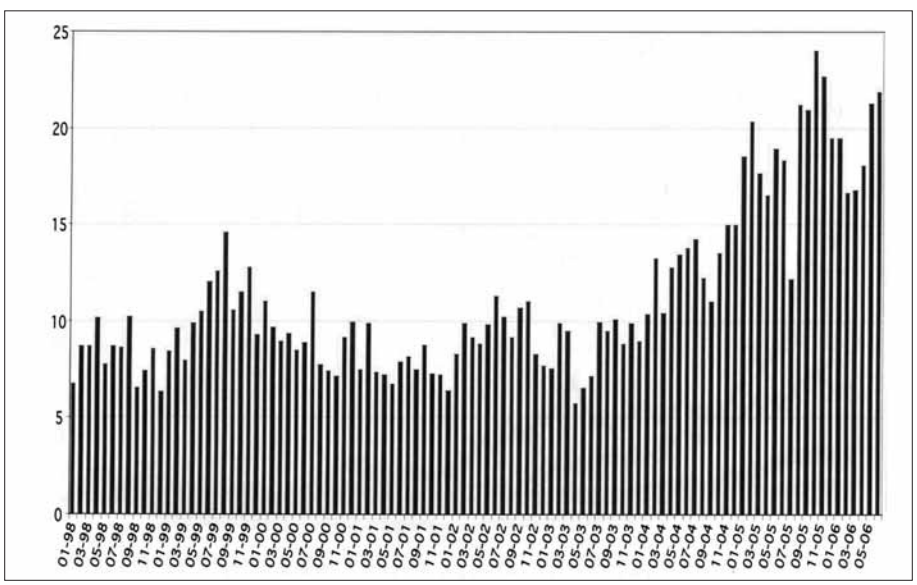
Source: FIBV, Monthly Statistics, June 2006.

Foreign Investments as a Percentage of Market Capitalization in Turkey (1986-2005)



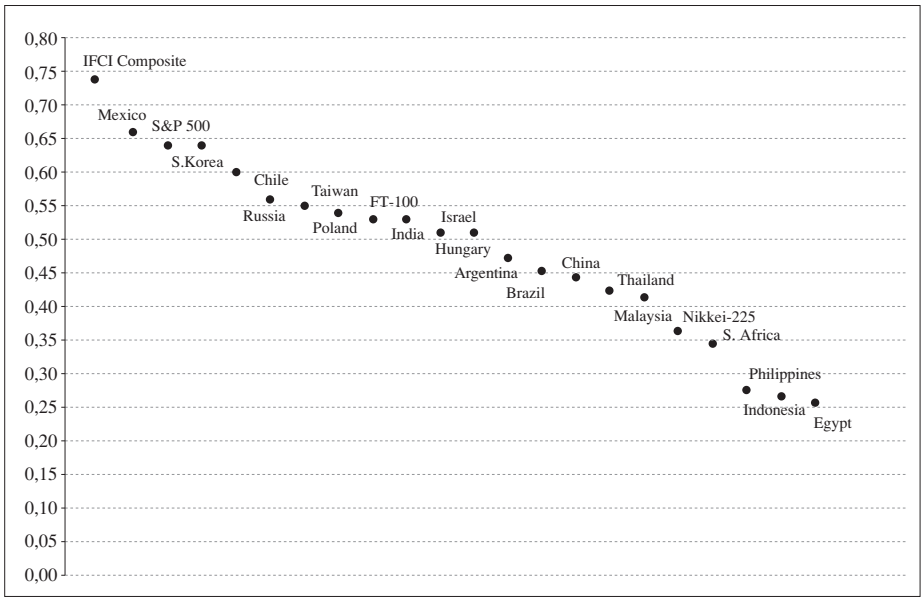
Source: ISE Data. CBTR Databank

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



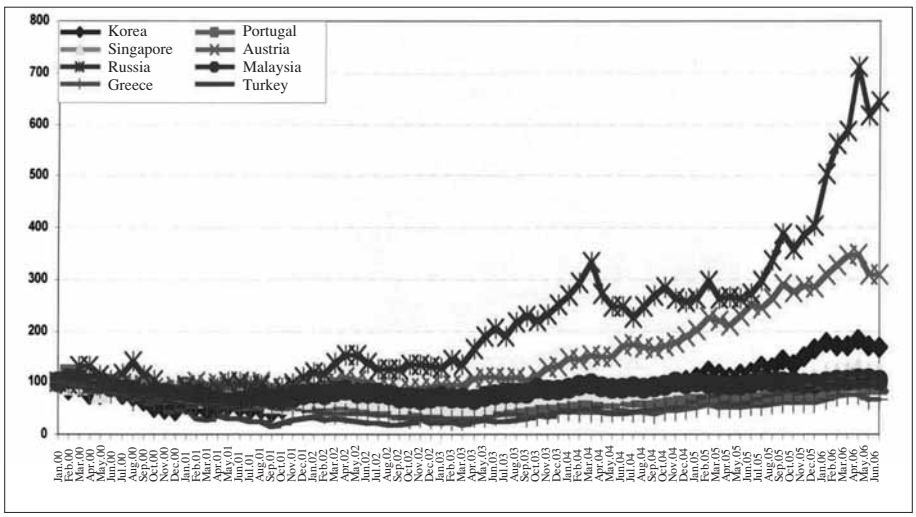
Source: ISE Data

Price Correlations of the ISE (July 2001- July 2006)



Source:Standard & Poor's, Emerging Stock Markets Review, July 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 series of returns.

Comparison of Market Indices (31 Jan. 2000=100)



Source: Reuters.
Note: Comparisons are in US$.

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ISE
Market Indicators

		STOCK MARKET									
		Traded Value				Market Value		Dividend Yield	P/E Ratios		
	Number of Companies	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	190,447	137,915	1,536	1,112	201,202	128,268	2.23	19.33	17.68	15.09
2006/Ç1	306	98,235	74,208	1,637	1,237	237,563	177,180	1.81	23.27	21.63	21.59
2006/Ç2	316	92,212	63,707	1,441	995	201,202	128,268	2.23	19.33	17.68	15.09

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,
  YTL(1) = Total Market Capitalization / Sum of Last two six-month profits
  YTL(2) = Total Market Capitalization / Sum of Last four three-month profits.
  US$ = US$ based Total Market Capitalization / Sum of Last four US$ based three-month profits.
- Companies which are temporarily de-listed and will be traded off the Exchange under the decision of ISE's Board of Directors 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 (June, 30, 2000=14.466,12)	INVESTMENT TRUSTS (Dec, 27, 96=976)	SECOND NATIONAL (Dec, 27, 96=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	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/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

US$ 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 (June, 30, 2000=14.466,12)	INVESTMENT TRUSTS (Dec, 27, 96=976)	SECOND NATIONAL (Dec, 27, 96=976)	NEW ECONOMY (Sept. 02, 2004=20525,92)	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	982.--	757.--	1,022.--	1,287.--	---	835.--	786.--	---	---
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	1,315.23	1,050.76	722.52	2,012.43	370.40	624.59	811.22	728.32	1,212.04
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

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	212,265	154,849	1,698	1,239
2006/Q1	113,677	85,883	1,864	1,408
2006/Q2	98,588	68,967	1,540	1,078

REPO-RESERVE REPO MARKET

Outright Purchases and Sales Market

	Total		Daily Average	
	(YTL Million)	(US$ Million)	(YTL Million)	(US$ Million)
1993	59	4,794	0.28	22
1994	757	23,704	3	94
1995	5,782	123,254	23	489
1996	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	1,235,580	885,229	9,885	7,082
2006/Ç1	509,928	384,999	8,359	6,311
2006/Ç2	725,652	500,229	11,338	7,816

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	111.79	120.63	126.80	130.61	132.30	123.75
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

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	688.16	706.53	870.37	691.84	749.80
2006/Q1	666.36	693.42	868.48	690.34	762.65
2006/Q2	688.16	706.53	870.37	691.84	749.80

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

YTL Based

	Equal Weighted Indices (YTL Based)			Market Value Weighted Indices (YTL Based)			
	EQ180-	EQ180-	EQComposite	MV180-	MV180+	MVComposite	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	155.83	161.55	158.30	156.03	161.00	158.04	141.65
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

Q: Quarter