# ISE REVIEW

Istanbul Stock Exchange

ISSN 1301-1642

Volume: 2 No: 6 April/May/June 1998

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# The ISE Review

Quarterly Economics and Finance Review



**Editorial Production & Printing**
Mart Matbaacılık
Sanatları Tic. Ltd. Şti.



This review is published quarterly. Due to its legal status, the Istanbul Stock Exchange is exempt from corporate tax.

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The ISE Review

Volume 2 No 6 April/May/June 1998

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The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 © ISE 1997

# RELATIVE PRICE VARIABILITY and INFLATION: EMPIRICAL EVIDENCE FROM TURKEY**

Meral KARASULU*

**Abstract**

This paper presents empirical evidence on the relationship between inflation and relative price variability (RPV) using disaggregated store level price data for Istanbul, Izmir and Ankara for the 1991-1996 period. Both intermarket and intramarket dimensions of relative price variability are analyzed. Up to 95% of total variation in inflation rates is due to the within market variation of inflation. I find robust evidence for a positive correlation between inflation and relative price variability. For intermarket variation this relationship is strengthened by the skewness of relative price changes.

## 1. Introduction

Although causes of the inflationary process in Turkey have been studied intensively (see Onis and Ozmucur [1987], Ozdemir [1995], and Akcay et al. [1996] among others), the discussion about the cost of inflation received no attention. This intellectual indifference towards the cost of inflation is not unique to Turkey. Almost every macroeconomist would agree that the major determinant of inflation in the long run is the money growth. Adherents to this view focus on different sources of money growth such as financing of budget deficit, exchange rate and/or interest rate policy, and other aggregate demand policies. However, the short-run determinants of inflation and the short-run implications of inflation are not understood very well. The role of supply shocks, organization of markets, and existence of nominal rigidities in understanding the short-run dynamics of inflation received almost no attention. In contrast to above mentioned research the discussion in this paper will take a

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** I thank for the invaluable efforts by the two most able research assistants I had the privilage to work with: Kemal Badur, Yusufcan Masatlioğlu and Cenk Tarhan. As usual, the remaining errors are mine.

different route and try to shed some light on the cost of inflation using micro-level price data from the largest three cities in Turkey. The findings of this study may help identify some of the microeconomic sources and consequences of the inflationary process in Turkey.

As it is well known, inflation rate in Turkey has stabilized around a 60-80% plateau since the late 80's. The macroeconomic explanation provided for this outcome usually rests with the high borrowing requirements of successive governments. In order to finance ever increasing debt stock, the authorities either reverted to monetization of deficit and when this became unsustainable, they relied on non-bank financing of the deficit. This latter course led to artificially high interest rates which resulted in a typical text-book version of crowding out of private investments. Although several other aspects of this process await thorough research, one outcome; inflation, occupied the forefront. Inflation became such a common concept of daily life that there seems to be a tacit belief that "people are used to inflation". Although getting used to inflation may mean several different things, one important implication of this statement is that it tends to underestimate the cost of inflation on the workings of the economy. This, in turn, has important implications for the political economy of inflation and/or policies designed to reduce inflation. Although it has been clear to a handful of scolars from the beginning, only recently, did the dividing nature of inflation within the society became more apparent. Inflation creates winners and losers. In the case of Turkey, the structurally skewed income distribution became even more so, due to lucrative returns on government debt which has mostly attracted non-wage income whereas the immediate burden of inflation fell on fixed income groups representing a much larger percentage of the population than the former. With this perspective in mind, the phrase 'getting used to inflation' bears a heavy political clout within the discussions of macroeconomic policy making. Firstly, it wronlgy implies that inflation is fully anticipated and hence both consumers and producers can figure its effects in their consumption and production decisions. The findings of this paper will try to convince the reader otherwise. The uncertainity of inflation in Turkey led to almost nonforecastable prices, which in simple terms means that all the information usually expected to be embedded in prices, concerning cost, quality, etc of a product have eroded.

Secondly, 'getting used to inflation' has implications for the desired course of macroeconomic policy for the governments. A widely discussed, but rarely publicized scenario, for solving the problem of high government debt, involves some drastic measures for debt consolidation. The immediate problem with these measures is the credibility of government policies. With an inflationary policy that has been in place for over a decade and an economic structure that 'got used to inflation' the choice of government policies is very restrictive. These restrictions, partly self-inflected due past policies, partly conceptualized due to the assumed acquaintance by the public to inflation (as reflected in the phrase 'getting used to inflation'), are used to discourage drastic economic measures. In this paper, I attempt to empirically question these assumptions.

Identifying and quantifying the cost of inflation are not trivial tasks. We are all aware of decreasing purchasing power due to rising prices. When we refer to costs of inflation we don't refer to erosion of real wages and hence the decline in the purchasing power of the consumer. Instead the cost of inflation in this paper refers to the informational and allocational costs of inflation. Prices in market economies fulfill the role of carrying information and guiding allocation of resources. If due to high inflation these functions of the price mechanism are distorted allocational inefficiency results. The sources of these allocational costs can be studied both from the perspective of the consumer or the producer. The existing literature provides some theoretical models, which try to identify the sources of this cost. Menu-cost modelş focus on nominal rigidities in price setting behavior of the seller, which under some stylized assumptions lead to efficiency loss. Search models look at search costs of the consumer when trying to find the most favorable price in the market and show that these search costs increase in inflation since prices loose their information content faster with inflation. Conceptual common denominator of these models is distortions in relative prices. From both perspectives, high inflation is associated with relative price changes, which form the basis of allocational costs.

In the next section we summarize some of the theoretical work in this area. Section 3 describes the data and the definitions used throughout the paper. Section 4 presents empirical results and Section 5 concludes.

## 2. Theories

There is ample time series evidence for the positive correlation between inflation and relative price changes. Various theories have been advanced that try to explain this behavior. An all-encompassing study that tries to test numerous implications of these theories is beyond the scope of this paper. Instead I will focus on two approaches and try to provide empirical evidence for these.

Following Fischer [1981] theoretical work positing a positive relationship between inflation and relative price changes can be summarized in two broad categories. The first group tries to explain this relationship with reference to market-clearing behavior under rational expectations and misperceptions about aggregate price movements. Lucas [1973] and Barro [1976] are examples of this approach. In this approach the deriving force both behind inflation and relative price variability is unanticipated changes in money stock. In that sense these studies do not provide a direct causal relationship between inflation and RPV. However, in logical sense RPV follows misperceived inflation in individual markets. Misperceived changes in the aggregate money stock lead to price changes in individual markets, which are considered by individual suppliers as relative price changes. If demand and supply elasticises are different across markets then these perceived changes lead to actual changes in relative prices. Under the assumption of an efficient allocation of resources under full-information initially, these relative rice changes cause a distortion in the allocation of resources. The relevant dimension of analysis in these models is the product dimension, since these models are cast in terms of misperceptions of aggregate changes in individual markets. Accordingly, our analysis will consider the relationship between intermarket RPV and inflation and test whether such a positive association is present in the data.

A second approach builds on fixed costs of adjustment in nominal prices (see Sheshinski and Weiss [1977], and Rotemberg [1980] among others). These menu cost models take inflation as exogenous. Under some assumptions, the optimal price setting behavior for sellers of a single product is to increase the nominal price only when the real price hits a lower threshold, s, so that the new real price is set at a higher level, S. With positive inflation this S, s band widens, which increases the RPV. The relevant dimension of analysis for these models is the store dimension, since they are based on the price setting behavior of sellers of an individual product. The implications of this price setting behavior are numerous. First by generating nominal rigidities they constrain the scope of an active monetary policy. If there is such staggering in price setting behavior can the monetary policy affect output? Secondly, since the S, s band widens with inflation; the variance of store prices may increase, increasing the search costs of the consumer. This latter implication will be tested here using intramarket RPV.

Ball and Mankiw [1994] develop a menu-cost model, which takes relative price variability as exogenous. Their framework generates asymmetric response of prices to disturbances with positive trend inflation. Specifically, firms regularly change their prices. However, they can also make special adjustments to accommodate shocks by incurring a menu-cost. With trend inflation, negative shocks to desired prices are partially taken care of by the inflation itself. The firm does not need a large reduction in its price since inflation will erode it shortly. However, a positive shock to desired prices leads to larger adjustments to save on future menu-costs of frequent adjustments. Hence, shocks that raise firms' desired prices lead to larger price changes than shocks that lower firms' desired prices. This setup has implications for the intermarket relationship of inflation and relative price variability. In an environment where there are sectoral shocks, the model predicts that shifts in relative prices across markets are inflationary. If shocks increase desired prices of some producers and lower some others, that is there is high RPV across markets, then the asymmetric response of sellers towards desired price changes will lead those with positive shocks to increase their prices more than those with desired decreases. The causal link in this model is from RPV towards inflation.

### 3. Description of the Data and Relative Price Variability

As discussed in the previous section, the market dimension of the analysis is crucial in understanding various implications of inflation on the price mechanism. Hence a description of the terms employed in the literature and adopted in this paper follows.

Relative price variability refers to the change of relative prices over time. It is proxied by the cross-sectional variance of the rate of change of a price. The cross-sectional dimension can be either across goods or, across stores with the product held fixed. The former describes intermarket relative price variability (INTER-RPV) where the dispersion of a good's own inflation rate around an aggregate inflation rate is the unit of analysis. The latter refers to intramarket relative price variability (INTRA-RPV). In this case the relevant measure of RVP is the dispersion of relative prices of a given good across stores. The analysis in this paper is carried out both for intra- and intermarket relative price variability.

The data consists of monthly price quotations of 575 items reported by a sample of stores in Istanbul, Izmir and Ankara for the period 1991:1-1996:12. The data has been collected by the State Statistical Institute of Turkey (SSI) in order to construct the Consumer Price Index (1987=100) for these cities. 575 items included in the data cover a variety of food items and consumption durables. Each good is homogenous across stores. Utmost care is given to this property of the data. Consequently there are two prices reported for some food items for which the quality and the selling point may destroy the homogeneity of the items. For instance SSI collects two sets of prices for rice of different quality. Similarly, prices of seasonal food items have been collected separately both from grocery stores and open markets. When these quality and selling point differences are excluded there are 347 items in the data set.

Table 3.1. reports basic statistics for the data set. I have filtered the data for missing observations and for items whose prices are controlled by the government. Stores which report for less than 30 months have been eliminated from the sample. If there are less than 5 stores with adequate number of observations for an item that item is excluded from the analysis. The maximum number of stores reporting a price is 30. The thresholds used for filtering the data are invariably ad hoc. However, I believe that 30, which corresponds roughly to half of the sample (72 observations in total) is an adequate threshold. Similarly, since the intramarket price variability is calculated using store dimension, 5 stores per item is a reasonable cut-off point. Even after this filtering of the data there are a total of 16150 series with 360 items for Istanbul, 373 for Ankara and 354 items for Izmir. In the case of Istanbul these 360 goods are represented by a total of 6029 stores. The same numbers for Ankara and Izmir are 5898 and 4223, respectively. The richness of the data is balanced by it relative short time span. Since the inflation rate in the sample, remained in the same plateau with a 12-month average of 0.04, except for 1994, when it reached a 0.06 average, the implications of a higher level of inflation (as compared to the lower plateau of early 1980's for instance) can not be fully studied.

**Table 3.1.: Summary Statistics of the Data**

| Averages across Commodities | | | | | |
|---|---|---|---|---|---|
| | Number of Reporting Stores [1] | Median Number of Stores Per Month [2] | Median Store Coverage Ratio [3] = [2]/[1] | Median Number of Months Per Store [4] | Median Monthly Ratio [4]/72 |
| Istanbul | 16.75 | 15.67 | 0.93 | 65.84 | 0.91 |
| Ankara | 15.81 | 15.03 | 0.94 | 64.23 | 0.89 |
| Izmir | 11.93 | 11.61 | 0.97 | 66.38 | 0.92 |

## 4. Empirical Evidence

In order to define INTRA-RPV and INTER-RPV used in the empirical analysis let Pijt be the price of good $i$ in store $j$ in time period $t$. $I$ denotes the total number of goods, and $N_{it}$ is the total number of stores reporting a price for good $i$ in time period $t$. The average price of good i across the $N_{it}$ stores is denoted by:

$$P_{it} = \frac{1}{N_{it}} \sum_{j=1}^{N_{it}} P_{ijt} \qquad (1)$$

Let Pt be the price index. In this study only an unweighted measure of the price index is used since SSI expenditure shares used in calculating the CPI's for these cities is not available. However, Tommasi [1993] and Vining and Elwertowski [1976], among others, report no significant changes in findings when weighted price indices are used:

$$P_t = \frac{1}{\sum_{i=1}^{I} N_{it}} \sum_{i=1}^{I} \sum_{j=1}^{N_{it}} P_{ijt} \qquad (2)$$

D$P_{ijt}$ is the logarithmic rate of change of the price level:

$$DP_{ijt} = \ln(P_{ijt}) - \ln(P_{ijt-1}) \qquad (3)$$

D$P_{it}$ is the rate of growth of price for product i at time t:

$$DP_{it} = \frac{1}{N_{it}} \sum_{j} DP_{ijt} \qquad (4)$$

The overall inflation rate across products is given by:

$$DP_t = \frac{1}{I}\sum_i DP_{it} \qquad (5)$$

Then intramarket relative price variability for the $i$th good can be defined as:

$$INTRA\text{-}RPV_{it} = \left[\frac{1}{N_{it}-1}\left(DP_{ijt} - DP_{it}\right)^2\right]^{1/2} \qquad (6)$$

Similarly, intermarket relative price variability is calculated using

$$INTER\text{-}RPV_t = \left[\frac{1}{I-1}\sum_i\left(DP_{it} - DP_t\right)^2\right]^{1/2} \qquad (7)$$

### 4.1. Variance Decomposition

I start with documenting the importance of the within market dimension of the price mechanism in understanding the inflationary process.

The price index, $P_t$, is obtained by aggregating both over stores and goods. In order to assess the importance of store-level variation in the overall variation of inflation the variance decomposition of inflation is calculated:

$$\sum_i^I\sum_j^{N_{it}}(DP_{ijt} - DP_t)^2 = \sum_i^I\sum_j^{N_{it}}(DP_{ijt} - DP_{it})^2 + \sum_i^I N_{it}(DP_{it} - DP_t)^2 \qquad (8)$$

The first term on the right captures the variance within good; the variation in individual stores' price changes around the product average. The second term denotes the variation between goods; the deviation of individual goods' price changes around the overall mean, DPt.

Table 4.1. presents the monthly shares of each component averaged over 12 months in each year. For Istanbul between 64% and 80.53% of the variability of inflation rates is due to the variability in inflation rates within markets. A similar result applies to Ankara. Izmir has the largest variability within markets; between 92% and 95%. The common finding across these cities is the very high share of within market variability in explaining inflation variability. This result is only mildly consistent with earlier findings in the literature, which explain the high share of intramarket RPV with reference to menu cost models. An interesting

feature of these models is the positive effect of expected inflation on intramarket dispersion of prices. One should note at this point the distinction between dispersion of prices, RPV and the within market variability of inflation reported in Table 4.1.I. Dispersion of prices refers to cross-sectional variance of *price levels* and RPV is that of the *inflation rates*. The within market inflation variability at best is a summary statistic of the RPV and should be interpreted cautiously. In fact Danziger [1987] shows in the context of a stylized model that there is a positive relationship between RVP and inflation at low levels of inflation and the sign of this relationship reverses at very high levels of inflation. The dispersion of prices is, on the other hand, always positively related to the inflation rate. Although there is no theoretical relationship posited for the relationship between inflation and within market variability of inflation the common empirical finding is that it increases with inflation rate. Ideally, a detailed analysis that looks at the effect of expected inflation for a good on its intramarket price dispersion is called for, but such an analysis is beyond the scope of this study since there are a total of 1087 goods in the data set. Nevertheless, I experimented with some simple forecast rules for the inflation rates of some selected goods. These forecast rules included simple first order autoregressive schemes, monthly dummy variables, the aggregate price index calculated above and the depreciation rate of the TL/USD exchange rate. In none of the cases were any of these forecast rules statistically acceptable. Unit root tests, partial autocorrelation and autocorrelation functions have been used to analyze time series properties of individual inflation rates. The results suggest that individual inflation series are close to a random error process with a constant mean. The short size of the sample coupled with the fact that the variance of inflation (both at the national and city level[1]) in the sample is very low makes the results harder to interpret along these lines. The safest interpretation that can be derived from this table is the importance of micro-dimension in understanding the dynamics of inflation in the short run. The price setting behavior of individual sellers contributes significantly to the total variability in inflation.

1 The variance of CPI inflation for the sample is 0.000861, for the price indices calculated for Istanbul, Ankara and Izmir, respectively, the numbers are 0.00190, 0.00189, and 0.00180.

**Table 4.1: Variability Decomposition of Inflation**

| | Total Sum of Squares | %Share of Within Sum of Squares | %Share of Between Sum of Squares | Inflation (12 Month Averages) |
|---|---|---|---|---|
| | Istanbul | | | |
| 1991 | 443.61342 (68.90663) | 80.53631 (5.32639) | 19.46369 (5.32639) | 0.03446 |
| 1992 | 207.01387 (123.95661) | 69.36161 (10.87850) | 30.63839 (10.87850) | 0.03456 |
| 1993 | 92.94097 (27.78382) | 64.00662 (14.36299) | 35.99338 (14.36299) | 0.03861 |
| 1994 | 122.57497 (60.78654) | 66.00105 (8.71051) | 33.99895 (8.71051) | 0.07434 |
| 1995 | 117.88824 (55.72895) | 65.71257 (7.09852) | 34.28743 (7.09852) | 0.04323 |
| 1996 | 103.84547 (43.41541) | 70.91451 (11.53071) | 29.08549 (11.53071) | 0.03797 |
| | Ankara | | | |
| 1991 | 114.23594 (31.58298) | 65.33027 (11.20174) | 34.66973 (11.20174) | 0.03658 |
| 1992 | 129.89846 (45.11912) | 57.65782 (13.29313) | 42.34218 (13.29313) | 0.03816 |
| 1993 | 123.40587 (33.29258) | 63.90530 (10.33425) | 36.09470 (10.33425) | 0.03860 |
| 1994 | 152.71648 (95.95777) | 67.15219 (6.26429) | 32.84781 (6.26429) | 0.07271 |
| 1995 | 125.50879 (54.70443) | 64.80154 (6.08425) | 35.19846 (6.08425) | 0.03994 |
| 1996 | 108.74086 (50.20671) | 70.74862 (11.78297) | 29.25138 (11.78297) | 0.03812 |
| | Izmir | | | |
| 1991 | 239.48809 (29.54270) | 95.65836 (3.60506) | 4.34164 (3.60506) | 0.03652 |
| 1992 | 106.66421 (79.54070) | 92.82164 (2.98706) | 7.17836 (2.98706) | 0.03895 |
| 1993 | 63.19517 (26.17096) | 92.20940 (8.59615) | 7.79060 (8.59615) | 0.04085 |
| 1994 | 74.03642 (36.98238) | 92.80612 (2.70212) | 7.19388 (2.70212) | 0.07347 |
| 1995 | 72.64975 (36.05034) | 93.21038 (1.65197) | 6.78962 (1.65197) | 0.04526 |
| 1996 | 50.65572 (17.43041) | 94.87493 (2.05964) | 5.12507 (2.05964) | 0.03616 |

Standard deviations of monthly shares around the annual averages are in parentheses.

### 4.2. Information Content and Excess Variability of Relative Prices

According to Ball and Romer [1992] prices fulfill two important functions in market economies; they carry information and guide allocation of resources. If the information content of prices erodes this will affect the latter role adversely. It has been pointed out in the literature that one of the implications of high inflation is to reduce information content of real prices.

This sub-section provides empirical evidence for the information content and excess variability of relative prices. The positive association of RPV and inflation does not necessarily imply a welfare cost, except under the case where the distribution of relative price changes is skewed and leads to higher inflation levels as in Ball and Mankiw [1995]. From the consumer's point of view the cost of inflation can be considered as an information cost. Even if RPV across stores is very high, if this pattern were fully known to the consumer then there wouldn't be any informational problem in forecasting the real price of an item in a given store in the future and the consumer would avoid substantial search costs once this pattern of RPV is observed. Following the example in Tommasi [1992] consider a case where half of the stores in Istanbul increase their nominal prices by 30% every even month and the other half did so in odd months. Assume further that this pattern has been continuing for a long time and is perfectly known to consumers. In this case RPV will be 15% but prices today will be fully informative about prices in the future and the consumer can avoid substantial search costs. However, if the stores decided randomly whether or to raise their nominal prices by 15%, then RPV will be only 7.5% but the prices will not give any information about the future prices.

In order to assess the role of inflation in erosion of information embedded in prices, I calculated the relative price for each store as:

$$R_{ijt} = P_{ijt} / P_t \qquad (9)$$

Different forecast rules can be assumed at this stage. However, the large number of stores makes the choice of different forecast rules problematic. Instead I used a simple first order autoregressive scheme to forecast real prices:

$$R_{ijt} = \alpha + \rho R_{ijt-1} + \varepsilon_{ijt} \qquad (10)$$

The regressions are run for three sub-periods with 24 observations each.

If a store in any sub-sample had less than 17 observations it was excluded from this part of the analysis. The choice of 17 for the total number of non-missing observations was induced by a consideration of the degrees of freedom in the resulting two-parameter regression. The results averaged over stores in each city are given in Table 4.2. Correlation coefficient, r, tends to be lower in high inflation period of 93:1-94:12 only for Ankara indicating that past real prices are less correlated with future ones. For Istanbul and Izmir a reverse finding applies. This finding is inconsistent with earlier results obtained using data from other countries. In order to check whether a longer memory exists in the data or not, I also present average Q-statistics[2] for 6 lags in each sub-period. Although not presented here Q statistics for the residuals obtained from these first-order autoregressions reveal no further information for an unexploited structure in the error process. A low/high correlation coefficient might not necessarily indicate less/more information since it merely reflects a smaller/larger slope in the above regression. If it is known for sure that the slope have decreased/increased this would still constitute perfect information regarding future real prices. What really matters is not necessarily the size of the correlation coefficient but how informative past prices are in forecasting future ones-at least with this simple forecasting rule-. Hence as a measure of the forecasting power Table 4.2 also reports average mean squared forecast errors (MSE). MSE is increasing in inflation slightly for Ankara only and decreasing in inflation rate for Istanbul and Izmir. This result implies that the information content of real prices is actually increasing in inflation rate, i.e. people are more informed about future real prices as inflation gets higher. This rather counter-intuitive result calls for further analysis. The second part of Table 4.2 tries to qualify this finding. It includes the same statistics as in the first part of the table but only for cases where the correlation coefficient is significant at 5% significance level. It is likely that insignificant but large correlation coefficients may be driving the results in the first part of Table 4.2. Although there is no change in the direction of the correlation coefficient, the MSE is increasing slightly in inflation for Istanbul and Ankara implying a decrease in the information content of real prices. These results

2 The Ljung-Box Q statistics is used to test for higher order autocorrelation.

$$T(T+2)\left(\sum_{j=1}^{M}\frac{r_j^2}{T-j}\right)$$

where rj is the j th lag autocorrelation of the residuals. M is the number of autocorrelations and T is the number of observations. Thu null hypypothesis is no autocorrelation.

should be interpreted at best as mixed evidence for the erosion of information embedded in real prices due to inflation. The small variance of inflation in the sample and the relatively short sample size masks the differences between these sub-periods. Furthermore, the forecast rule is open to debate. If the pricing behavior is consistent with S, s rules as described in Section 2; a simple autoregressive structure would be insufficient to describe the behavior of real prices over time. An extension of this paper will compare different forecast rules and their performance in predicting future real prices.

**Table 4.2: Information Content of Real Prices**

| | Sample Range | Number of Stores | MSE | $\rho$ | Inflation n | Significance of t-statiscs± | Significance of Q-statistics± |
|---|---|---|---|---|---|---|---|
| Istanbul | 91:01-92:12 | 5073 | 0.19 | 0.21 | 0.034 | 0.35 (24.04) | 0.30 (25.78) |
| | 93:01-94:12 | 4911 | 0.11 | 0.68 | 0.056 | 0.31 (88.72) | 0.09 (71.06) |
| | 95:01-96:12 | 5266 | 0.12 | 0.66 | 0.040 | 0.34 (88.32) | 0.08 (74.80) |
| Ankara | 91:01-92:12 | 4149 | 0.17 | 0.62 | 0.037 | 0.03 (87.05) | 0.09 (67.92) |
| | 93:01-94:12 | 5164 | 0.18 | 0.59 | 0.055 | 0.05 (80.32) | 0.11 (63.42) |
| | 95:01-96:12 | 5306 | 0.16 | 0.64 | 0.039 | 0.03 (87.28) | 0.08 (72.48) |
| Izmir | 91:01-92:12 | 3363 | 0.22 | 0.44 | 0.037 | 0.14 (60.10) | 0.20 (55.49) |
| | 93:01-94:12 | 3768 | 0.14 | 0.55 | 0.057 | 0.06 (79.33) | 0.14 (57.40) |
| | 95:01-96:12 | 3830 | 0.11 | 0.61 | 0.040 | 0.04 (84.96) | 0.09 (72.40) |

The statistics are averaged over the number of stores in each sub-period. Significance level is 5%. ‡ Percentage of cases t (or Q) statistics are significant are given in parentheses.

(i)Statistics for three sub-periods in three cities

| | Sample Range | Number of Stores | MSE | $\rho$ | Inflation n | Significance of t-statiscs± | Significance of Q-statistics± |
|---|---|---|---|---|---|---|---|
| Istanbul | 91:01 -92:12 | 1220 | 0.10 | 0.55 | 0.034 | 0.013 | 0.071 |
| | 93:01-94:12 | 4357 | 0.12 | 0.73 | 0.056 | 0.004 | 0.050 |
| | 95:01-96:12 | 4651 | 0.11 | 0.71 | 0.040 | 0.004 | 0.032 |
| Ankara | 91:01-92:12 | 3612 | 0.15 | 0.67 | 0.037 | 0.006 | 0.050 |
| | 93:01-94:12 | 4148 | 0.18 | 0.66 | 0.055 | 0.006 | 0.055 |
| | 95:01-96:12 | 4631 | 0.15 | 0.69 | 0.039 | 0.004 | 0.035 |
| Izmir | 91:01-92:12 | 2021 | 0.17 | 0.59 | 0.037 | 0.010 | 0.037 |
| | 93:01-94:12 | 2989 | 0.15 | 0.62 | 0.057 | 0.006 | 0.066 |
| | 95:01-96:12 | 3254 | 0.10 | 0.68 | 0.040 | 0.005 | 0.032 |

(ii)Statistics for three sub-periods in three cities only for stores with significant t-statistics

Tommasi [1992] notes that the allocational role of prices will be adversely affected if prices are away from fundamentals, or from their 'correct' levels. In order to analyze the divergence of prices from their 'correct' levels induced by high-inflation I follow Tommasi [1992] and assume that the 'correct' level of real prices for each period is given by:

$$R_{ij} = \frac{1}{T}\sum_{t}^{T} R_{ijt} \tag{11}$$

For this analysis the length of each time period is taken as 12 months. The coefficient of variation of the real price for each store around the 'correct' price level is calculated using

$$CV_{ij} = \left[\sum_{t}^{T}\left(R_{ijt} - R_{ij}\right)^2\right]^{1/2} \Big/ R_{ij} \tag{12}$$

Table 4.3. reports the results averaged over stores for 6 years. There is a positive relationship between inflation and excess variability of real prices for Ankara and Istanbul indicating an allocation cost of inflation on the workings of the price system. However, as noted earlier caution should be employed in interpreting these results, since the relatively short span of the data and the low variation in inflation rates in the sample render these results less convincing.

**Table 4.3: Coefficients of Variation**

| | Istanbul | | | Ankara | | | Izmir | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | $CV_{ij}$ | Inflation | Number of Stores | $CV_{ij}$ | Inflation | Number of Stores | $CV_{ij}$ | Inflation | Number of Stores |
| 1991 | 0.6287 | 0.03446 | 5326 | 0.5991 | 0.03658 | 4241 | 0.8150 | 0.03652 | 3948 |
| 1992 | 0.6662 | 0.03456 | 5144 | 0.5431 | 0.03816 | 4457 | 0.6769 | 0.03895 | 3334 |
| 1993 | 0.4540 | 0.03861 | 5103 | 0.5287 | 0.03860 | 5242 | 0.7049 | 0.04085 | 3791 |
| 1994 | 0.5509 | 0.07434 | 4977 | 0.5708 | 0.07271 | 5400 | 0.6154 | 0.07347 | 3874 |
| 1995 | 0.5323 | 0.04323 | 5364 | 0.5192 | 0.03994 | 5496 | 0.5258 | 0.04526 | 3899 |
| 1996 | 0.4993 | 0.03797 | 5349 | 0.5647 | 0.03812 | 5389 | 0.4818 | 0.03616 | 4007 |

## 4.3 Regression Analysis

### 4.3.1 Intramarket RPV vs. Inflation

This section presents evidence for a positive relationship between RPV and the inflation rate using various regression strategies. Figures I-III present examples of scatter plots for intramarket RPV versus city level inflation rate, DPit. For intramarket analysis our goal is to test whether there is a positive slope in these figures. In these representative figures some represent a monotonic relationship between a good's inflation rate and the intramarket RPV whereas for some others a V-shaped pattern is more apparent. Furthermore, the dispersion of RPV at high inflation rates is also suggestive of some concavity. Tommasi [1993] has documented a V-shaped pattern for Argentine data as well. Such a V-shaped relationship in intramarket RPV is possible if for products for which some sellers raise their prices faster or slower that the product's average inflation rate exhibit higher RPV. It is consistent with two hypotheses, which are observationally equivalent for the data set at hand. First, when a seller receives a positive/negative demand shock, compared to the city average for that product, the existence of less-tradeable[3] items may lead to a larger dispersion of relative prices following both a positive and a negative shock. Secondly, the assertion that inflation erodes information for the producer may lead to a similar observation. Specifically, the fact that we observe high RPV in deflationary periods may be resulting from misperceptions about demand and the subsequent downward adjustment in prices to increase sales. At this point I use the large panel dimension of the data and ran a fixed-effects regression including dummies for each month. Three columns of Table 4.4 report the results for different specification previously used in the literature.

The first column of Table 4.4 presents a quadratic specification. The last column includes the absolute value of product inflation as a control variable to test for the significance of a significant positive correlation between product inflation and intramarket RPV. The best fitting relationship is given in column (2) indicating a V-shaped pattern. The negative sign on squared inflation term has been documented for Argentina as well. Tommasi [1993] provides two interpretations for this finding. The first explanation is technical; the frequency of the data is too low to capture frequent price changes in high inflationary periods and hence hides intraperiod price variability. Secondly, there might be some unifying forces at very high inflation levels. Namely, when inflation is very high, forward looking sellers will place more emphasis on frequently

3 I use the term less-tradable to describe services or goods for which it is costly or undesirable for the consumer to search for another provider. A close by barbershop or tea in the local coffee shop are likely examples..

**Table 4.4: Fixed Effects Regressions for Intramarket RPV**

| ISTANBUL | | | |
|---|---|---|---|
| Sample Range: 91:01 -96:12 Usable Observations : 22661 | | | |
| Dependent variable: INTRA- RPV | | | |
| | (1) | (2) | (3) |
| DPit | 0.099 (0.005) ‡ | | 0.006 (0.005) |
| DPit 2 | 0.314 (0.011) | -0.570 (0.017) | |
| Abs(DPit) | | 0.673 (0.01) | 0.397 (0.006) |
| R2 | 0.280 | 0.383 | 0.355 |

| ANKARA | | | |
|---|---|---|---|
| Sample Range: 91:01 -96:12 Usable Observations : 23753 | | | |
| Dependent variable: INTRA- RPV | | | |
| | (1) | (2) | (3) |
| DPit | 0.216 (0.004) Å | | 0.110 (0.004) |
| DPit 2 | 0.205 (0.007) | -0.493 (0.009) | |
| Abs(DPit) | | 0.712 (0.007) | 0.383 (0.005) |
| R2 | 0.152 | 0.339 | 0.288 |

| IZMIR | | | |
|---|---|---|---|
| Sample Range: 91:01 -96:12 Usable Observations : 22680 | | | |
| Dependent variable: INTRA- RPV | | | |
| | (1) | (2) | (3) |
| DPit | 0.134 (0.005) | | 0.035 (0.005) |
| DPit 2 | 0.405 (0.012) | -0.822 (0.020) | |
| Abs(DPit) | | 0.858 (0.011) | 0.450 (0.006) |
| R2 | 0.251 | 0.388 | 0.343 |

‡ Standard errors are given in parentheses.

observable aggregate information, such as exchange rate movements, macroeconomic policy announcements, and political developments in order to forecast future inflation than the emphasis they place on past idiosyncratic cost shocks in their pricing decisions. This aggregate information acts as a unifying source among different sellers and hence decreases RPV at very high inflation levels.

### 4.3.2 Intermarket RPV vs. Inflation

Figure IV presents the frequency distribution of product level inflation rates, DPit, over 6 years. As discussed in Section 2, Ball and Mankiw [1994] 's model implies a right skewed distribution for product level inflation rates if sectoral shocks increase desired prices for some goods and lower some for others. In other words if there is high RPV across markets, then the asymmetric response of sellers will lead those with positive shocks to increase their prices more than those with desired decreases. Hence a large number of products will exhibit low inflation rates whereas for a few products large inflation will result, leading to a right skewed distribution with a larger upper tail than the lower one. Since the tails of this distribution are not symmetric the net effect will be an increase in the overall inflation level. This hypothesis suggests that the inflation-skewness relationship is strengthened with high intermarket RPV. Figure IV confirms this hypothesis for all 6 years. The skewness of the distribution is positive in each case. Furthermore, it is increasing in high inflation years. To investigate this hypothesis overall skewness is calculated as follows:

$$Sk_t = \frac{I^2}{(I-1)(I-2)} \frac{\frac{1}{I}\sum_i^I (DP_{it} - DP_t)^3}{(INTER-RPV_t)^3} \quad (13)$$

Figure V shows the behavior of INTER-RPV and overall inflation, DPt. The beginning of the sample covering 1991-1992 period exhibits an interesting pattern. Following the Gulf War, there are episodes of deflationary periods that are also associated with high intermarket relative price variability. This is consistent with the hypothesis of sectoral shocks and asymmetric adjustment of sellers. The observation for 1995:3 in the inflation series is treated as an outlier since this is the only data point where there is an unexplainable discrepancy between DPt and the inflation rate calculated using the Consumer Price Index published by the SSI.

In order to test for a positive relationship between intermarket relative price variability and overall inflation, I, again use different specifications. The results are reported in Table 4.5. In these regressions the overall inflation rate for each city is taken as the independent variable in accordance with the Ball and Mankiw [1994] specification. In each case intermarket price variability has a robust positive effect on overall city level inflation. As hypothesized the independent effect of skewness is positive as well.

**Table 4.5: Time Series Regressions for Intermarket RPV**

| ISTANBUL | | | | |
|---|---|---|---|---|
| Sample Range: 91:01-96:12 Usable Observations: 70 | | | | |
| Dependent variable: DPt | | | | |
| | (1) | (2) | (3) | (4) |
| INTER- RPV | 0.643 (0.148) ‡ | | 0.617 (0.150) | |
| Sk | | 0.004 (0.003) | 0.002 (0.002) | |
| Sk* INTER- RPV | | | | 0.073 (0.031) |
| Constant | 0.012 (0.021) | 0.047 (0.017) | 0.015 (0.021) | 0.045 (0.006) |
| R-bar2 [4] | 0.215 | 0.131 | 0.213 | 0.141 |

| ANKARA | | | | |
|---|---|---|---|---|
| Sample Range: 91:01-96:12 Usable Observations: 70 | | | | |
| Dependent variable: DPt | | | | |
| | (1) | (2) | (3) | (4) |
| INTER- RPV | 0.537 (0.165) | | 0.645 (0.148) | |
| Sk | | 0.006 (0.002) | 0.005 (0.001) | |
| Sk* INTER- RPV | | | | 0.047 (0.019) |
| Constant | -0.009 (0.021) | 0.034 (0.002) | -0.021 (0.019) | 0.035 (0.002) |
| R-bar2 | 0.336 | 0.323 | 0.457 | 0.329 |

| IZMIR | | | | |
|---|---|---|---|---|
| Sample Range: 91:01-96:12 Usable Observations: 70 | | | | |
| Dependent variable: DPt | | | | |
| | (1) | (2) | (3) | (4) |
| INTER- RPV | 0.575 (0.148) | | 0.541 (0.159) | |
| Sk | | 0.004 (0.002) | 0.001 (0.002) | |
| Sk* INTER- RPV | | | | 0.058 (0.024) |
| Constant | -0.004 (0.021) | 0.039 (0.016) | -0.003 (0.021) | 0.036 (0.009) |
| R-bar2 | 0.230 | 0.161 | 0.220 | 0.147 |

‡ Standard errors are given in parentheses.

4 The adjusted $Rbar^2$ statistic is: $1 - \left( \frac{e'e}{(T-K)} \Big/ \frac{\hat{y}'\hat{y}}{(T-1)} \right)$

where e is the vector of residuals, $\hat{y}$ is the vector of deviation from the mean of the dependent variable. T and K are the number of observations and regressors respectively. $Rbar^2$ shows the percentage of total variation explained by the independent variables, adjusted for the degrees of freedom.

## 5. Conclusion

This paper provides an initial attempt in analyzing the micro-dynamics of inflation in the short run. The focus in the analysis has been to test the implications of inflation on its relationship with inter-and intramarket relative price variability. The evidence suggests that the within market price setting behavior is an important component of the total variability of inflation in the three largest cities studied. With homogenous product prices used for this analysis, the implication of this study is twofold. On the consumer side, the search costs are increasing in inflation. On the producer side, the cost structure looses its importance in price setting behavior hence the workings of the market economy on both sides of the market are negatively affected. This finding does not necessarily contribute to the explanation of high level inflation, rather it implies that at given inflation rates the price setting behavior of individual sellers becomes asynchronized. The products studied here are homogenous consumer goods, for which a competitive market structure should be a fair approximation. This high within-market variation in inflation then implies that pricing behaviour deviates from competitive price setting behavior devoit of cost considerations. Even in these highly unspecialized consumer goods markets inflation varries greatly among sellers impliyng dispersed profit margins. Furthermore, there is a robust positive association between RPV and inflation both at the store and product level. At the product level we observe a V-shaped pattern between intramarket RPV and inflation rate suggesting that both periods of relative deflation and inflation are equally likely to increase the variability of relative prices.

Interestingly, the intramarket RPV is decreasing in squared inflation implying some unifying forces among sellers at very high inflation levels. As inflationincreases to higher levels producers are more likely to follow aggregate macroeconomic observables than relevant market parameters such as competitors' prices or costs. This finding is consistent with the conclusion that cost considerations replace a rule of tumb in price setting behavior when inflation reaches very high levels. The self-feeding effects of this process on inflation have not been studied in detail. However, one can conjecture that with increased variability of inflation within a market, policies designed to decrease inflation will be harder to deliver results. However, once implemented, the expected gain from such policies in the form of reduced search costs for the consumer and better cost accounting and longer planning horizion for the producer are likely to overcome the initial costs of setbacks due to hysterisis.

The intermarket analysis reveals a similarly robust positive association between inflation and RPV. As suggested by some menu cost models the skewness of relative price changes across markets in the existence of high intermarket RPV explains a significant portion of overall city level inflation. The erosion of information embedded in real prices is not a robust finding and calls for further analysis. This is one of the several dimensions this study will be extended in the future. Different forecast rules can be used to test the claim that inflation reduces information content of prices. Furthermore, the duration of price quotations and the synchronization of price changes across sellers are other important aspects of price setting behavior in inflationary environments that have significant implications for an active monetary policy. These topics are left for future research.

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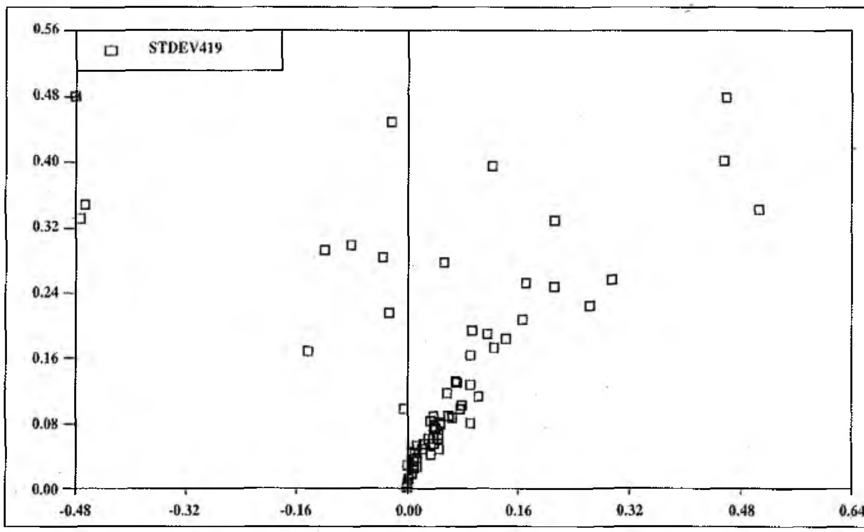
**Figure I : Selected Scatter Plots of Intramarket RPV vs. Inflation : Istanbul**



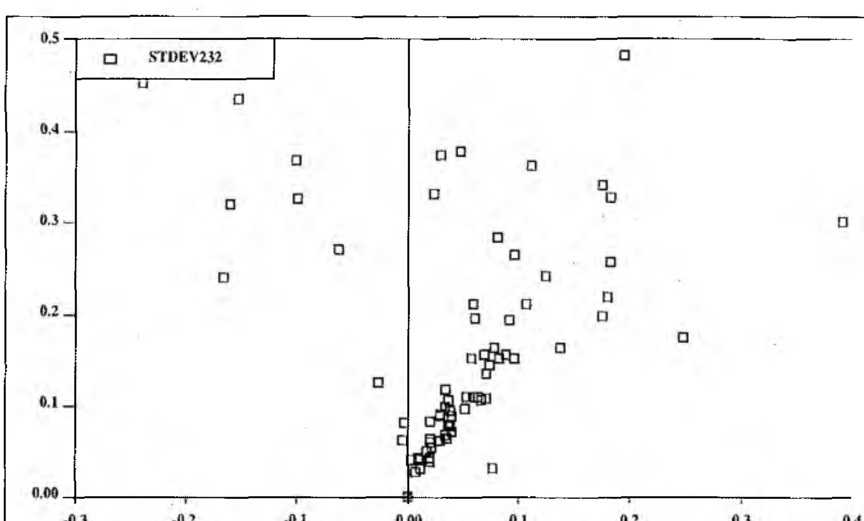
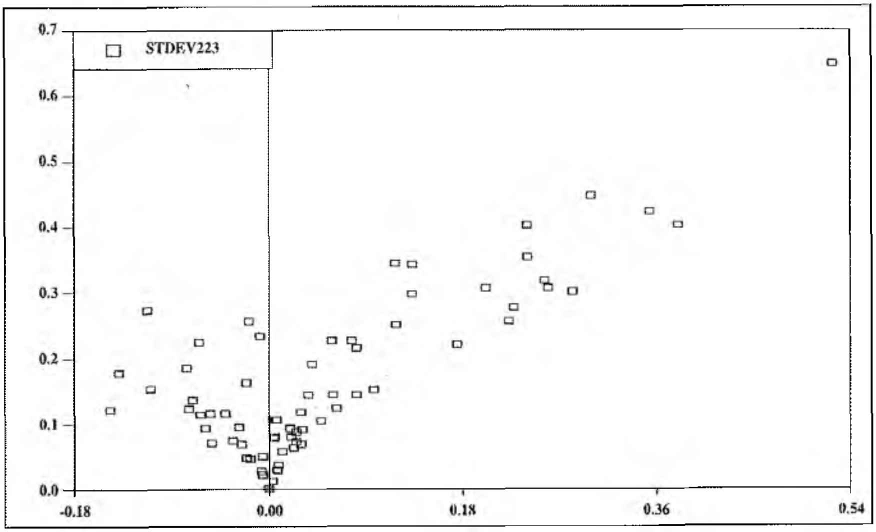



**Figure II : Selected Scatter Plots of Intramarket RPV vs. Inflation : Ankara**



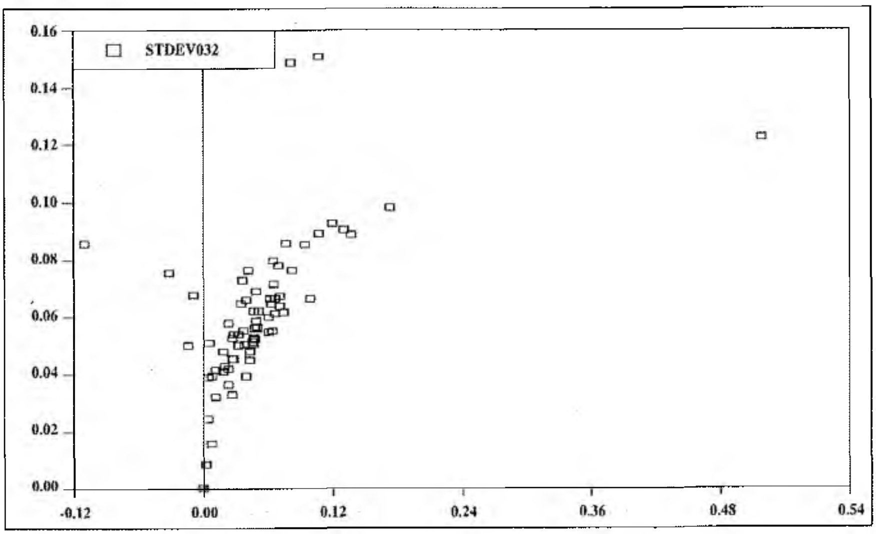
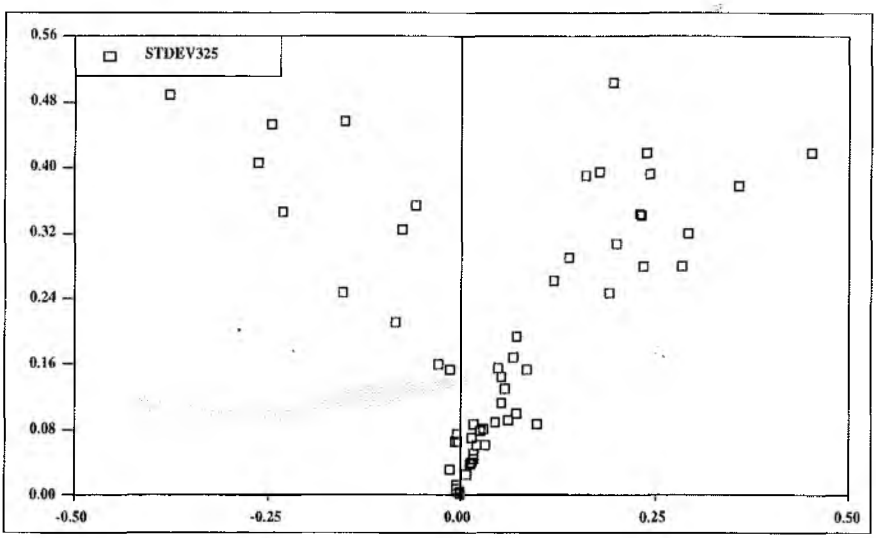



**Figure III : Selected Scatter Plots of Intramarket RPV vs. Inflation : Izmir**



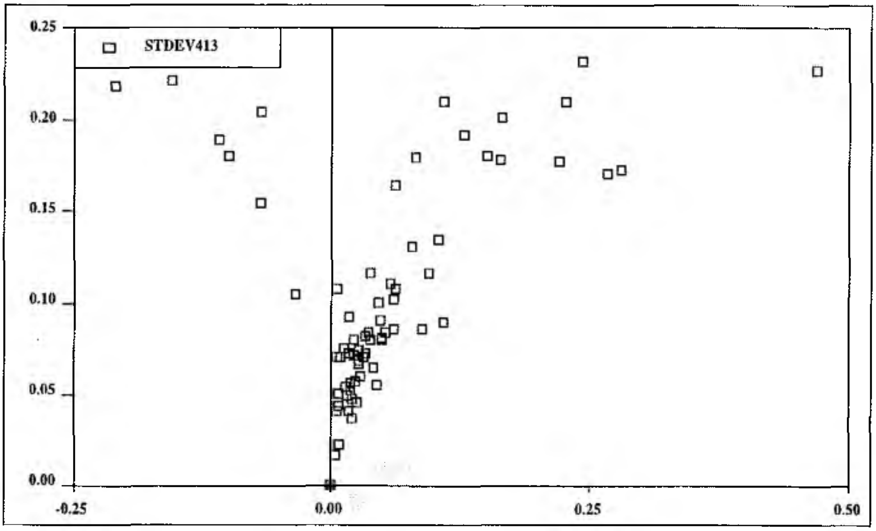
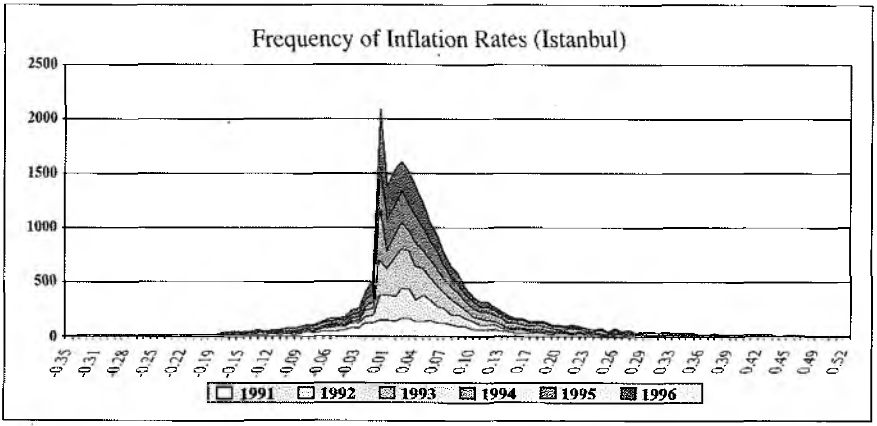
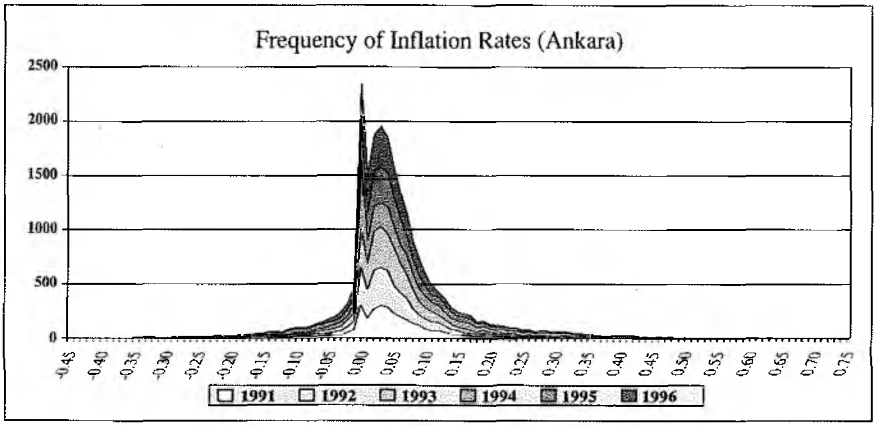
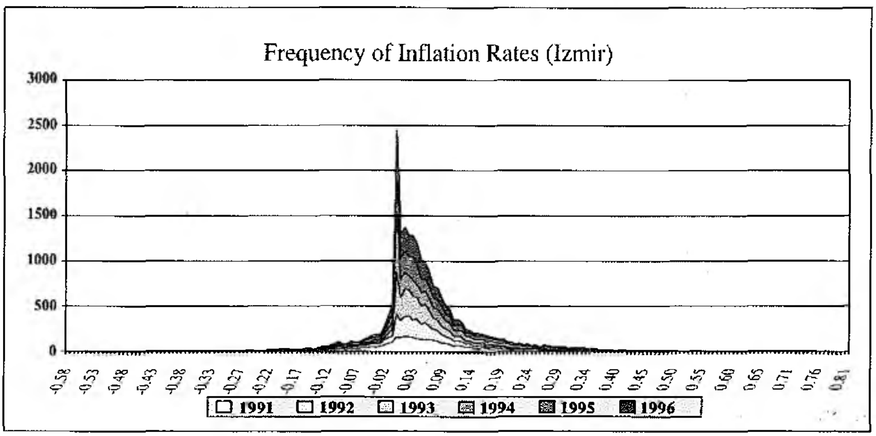



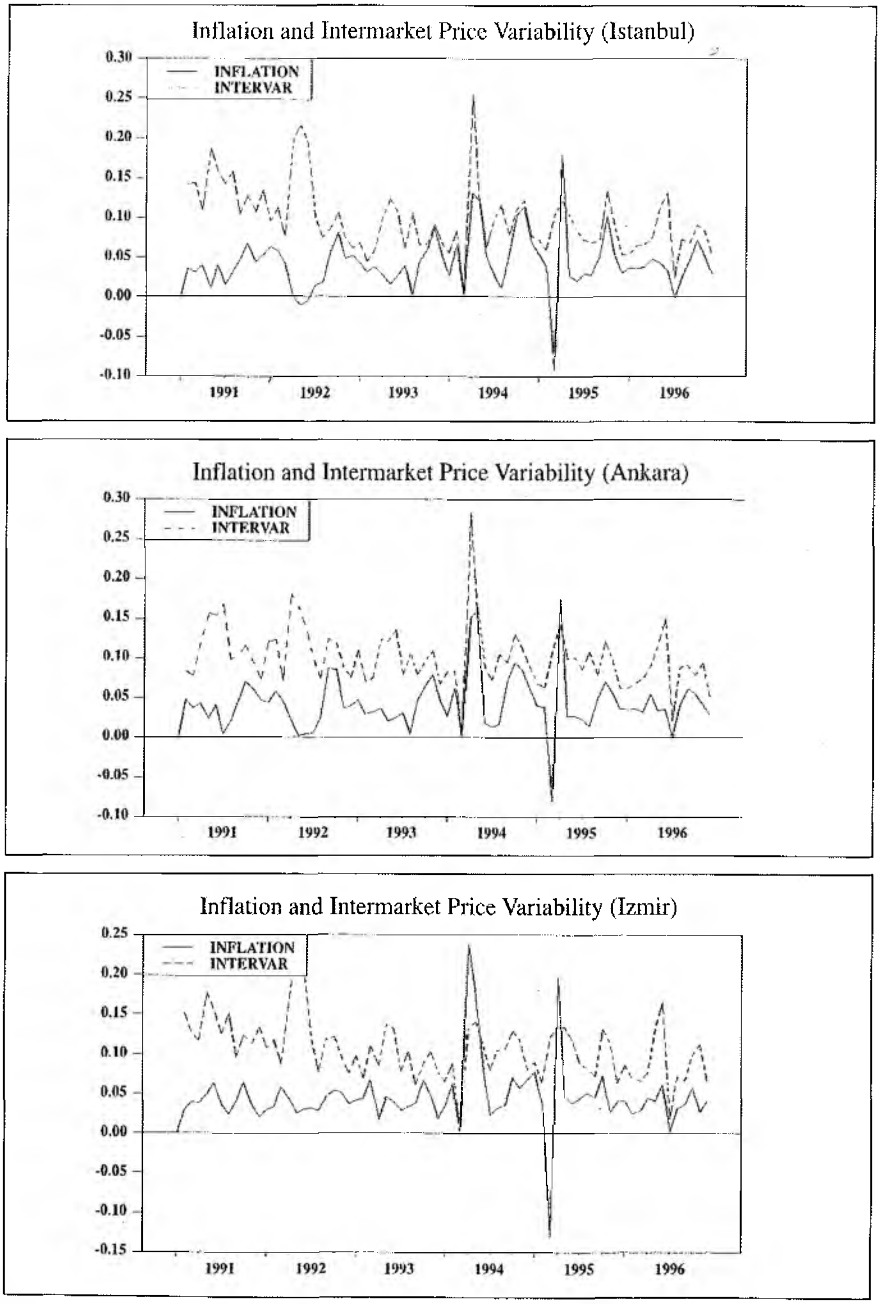
**Figure IV : Frequency Distribution of Product Level Inflation Rates**



## Figure V: Overall Inflation and Intermarket Price Variability



The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 

# AN ANALYSIS OF THE ISTANBUL STOCK EXCHANGE (ISE) NATIONAL-100 INDEX: A STATISTICAL APPROACH

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**Abstract**

In this paper, the series of two National-100 indices of Istanbul Stock Exchange (ISE) based on TL (Turkish Lira) and US$ (US Dollars) were statistically analyzed, and modelled using time series methods. For this aim, first, linearity and normality of each series were tested by using the likelihood ratio and goodness of fit tests. Then, after necessary transformations were made on the data, the nonseasonal IMA (2,1) model based on TL and the seasonal ARIMA (0,1,0)(0,1,1) model based on Dollar were obtained for the series of National-100 of ISE.

## I. Introduction

In developed markets, the possible economical indicators, which show the course of the economical development, have been the subject of various academic studies. Indices are one of them. They are useful to measure the changes of one or more variables throughout time. Moreover, indices are tools giving approximate knowledge about the disordered events by reducing them to a number.

Today, savings are invested mostly in stocks and bonds. An analysis of stock exchange of a country is so extensive that a researcher can use all his capacity for that. For this reason, the subject of this paper focuses on the Istanbul Stock Exchange, an important financial centre, (Balaban et al., 1996; Yılmaz, 1997; Metin *et al.*, 1997). Similar studies on the world exchanges are also carried out (Hinich and Patterson, 1985; Gooijer, 1989).

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As known, statistical estimation is a process to gain information from a sample of a population under study by help of some methods. As a statistical technique, time series methods use the idea of effectiveness of the past observations for the observations to be made in the future. Then, in time series analysis, the observations that effect each other in a definite time interval are considered dependent. This situation exhibits some differences from the classical statistics theory which accepts the independency assumption of observations (Mills, 1992).

One of the indices that enlighten ISE's development is the National-100 index, which is calculated by using TL closing prices of stocks that are included in the index. Moreover, the US Dollar based index series can also be examined. The US dollar based index series allow comparisons among different nations' stock exchange markets to be made. For this reason, it's important to analyse the structure of ISE's National-100 index in TL and US dollars in statistical manner.

Stationarity of time series which is used in econometrical analyses is important for researchers. But, the time series which is used in applications and especially in studies regarding Turkey is not usually stationary . In other words, averages of given time series depend on time. It might be necessary to take first degree of difference or higher degrees of differences along with some necessary transformations in order to make the time series a stationary one.

In this paper, the monthly average values of ISE National-100 indices (in TL and US dollars) between January 1986 and December 1996 based on the closing data has been tested for linearity and normality and modelled by using time series models. In Section II, the methodology is summarised. In Section III, results of the analysis are given.

## II. Methodology

The methodology of this study consists of two parts. The first part focuses on the study of the linearity and normality of the index series. These tests are *likelihood ratio* and *goodness of fit tests* which are approximately distributed as a $\chi^2$ and they are compared with the table of $\chi^2$ values in certain significant level (Tong, 1990).

In the second part, the time series modelling process begins with the necessary transformations of each index series which were made. In this manner, $Z_t$ is a series of random variables which is changing by the time. *Seasonal autoregressive integrated moving average* (SARIMA), the time series model can be written in a general form:

$$\theta(B^S)\ \phi(B)\ (1-B^S)^D\ (1-B)^d\ Zt = \Theta(Bs)\ \theta(B)\ A_t\ .$$

Where $BZ_t=Z_{t-1}$ and the nonseasonal parameters

$$\phi(B) = 1 - \phi_1 B - \ldots - \phi_p B^p$$
$$\theta(B) = 1 - \theta_1 B - \ldots - \theta_q B^q$$

and seasonal parameters are,

$$\Phi(B^S) = 1 - \Phi_1\ B - \ldots - \Phi_P\ B^P$$
$$\Theta(B^S) = 1 - \Theta_1\ B - \ldots - \Theta_Q\ B^Q$$

(Kendall and Ord, 1990). Above, "s" is the period of seasonality. "d" and "D" are order of nonseasonal and seasonal differences, respectively. "p" and "P", are order of nonseasonal and seasonal autoregressive (AR) model. "q" and "Q" are order of nonseasonal and seasonal moving average (MA) model. Also, $A_t$ is a series of residuals which is white noise process.

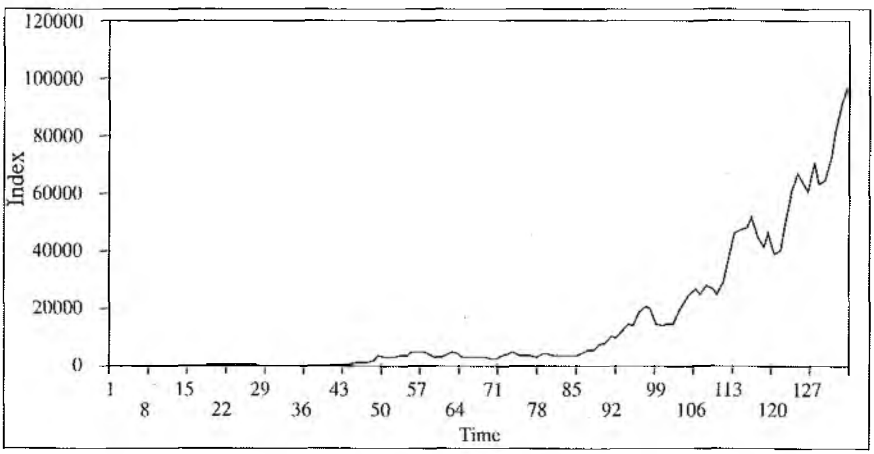
The general model is often denoted by SARIMA (p,d,q)(P,D,Q). Here (p,d,q) is the order of nonseasonality and (P,D,Q) is the order of seasonality. Before we start analysing the time series we have to give a reason why we choose the SARIMA model. Because we study ISE National-100 index series defined in terms of TL and US dollars separately. Our most important aim is not to analyse the series together with the other series which effect them. Besides, the analysis of co-movement of two series is not the aim of this study. The main issue here is to analyse each individual series in terms of its own index values and to model its past values. For all of these reason, the above mentioned methodology is used.

In general, the modelling process of time series analysis can be realised in four stages. These are, identification of models, estimation of the parameters, diagnosing and selecting the best model, respectively. There will not be any other explanations for these stages in this study. However, in the analysis, these stages will be applied and the results will be reported to the reader.

## III. Analysis

In this Section, we give the results of analysis by using the aforementioned methodology in previous section. First, we report the two series of TL and US dollar based National-100 index of ISE in Figure 1 and Figure 2, respectively. They clearly show that neither of the series is stationary. This result has been detected by the other time series methods too. For the detailed analysis we need some statistical inferences about the linearity and normality structures of these series, which constitutes an important part of this work.

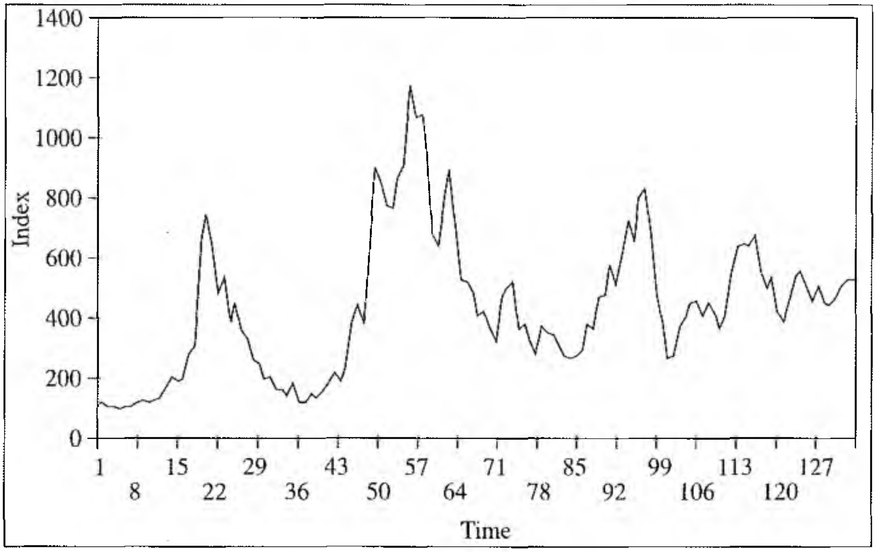
**Figure 1: The plot for ISE National-100 index on TL basis**




According to goodness of fit test, raw data, $Z_t$ series and log transformation of $Z_t$, log $Z_t$ series are not normal for monthly average values of ISE's National-100 indices on TL and US dollar basis. The results of the analysis are:

| | Index | Chi-Square | p-value |
|---|---|---|---|
| $Z_t$ | TL | 262.461 | 0.000 |
| | Dollar | 39.661 | 1.944E-5 |
| log $Z_t$ | TL | 49.585 | 3.512E-6 |
| | Dollar | 29.804 | 0.005 |

**Figure 2: The plot of ISE National-100 index on US dollar basis**




The results of linearity structures of the raw data are found by likelihood ratio test as the following;

| Index | test statistic |
|---|---|
| TL | 8.40 |
| Dollar | 5.57 |

When the values found are, compared with the critical value which 15.16 for the 0.01 significant level, it is seen that the linearity is not rejected. When the significant level is taken as 0.05, the linearity is rejected.

Now, we will give SARIMA models which are found appropriate for the ISE's National-100 index on TL and US dollar basis. According to the transformation of the indices two different groups of models are found. The first group model SARIMA (0,2,1)(0,0,0), for the National-100 index based on TL is,

$$(1-B)^2 \log(Z_t) = (1-0.922B)\, A_t \,,\ \hat{\sigma}_A=0.1791,\ \chi^2 = 17.4$$
$$(\hat{\sigma}_A = 0.036)$$

The model is obtained for the index based on US dollar is,

$$(1\text{-}B)^2 \log(Z_t) = (1\text{-}0.916B)\, A_t\,,\quad A=0.1968,\ (2 = 20.5$$
$$(\hat{\sigma} = 0.037)$$

Based on the second group models SARIMA (0,1,0)(0,1,1) for TL based index is,

$$(1\text{-}B)(1\text{-}B)^{12} \log(Z_t) = (1\text{-}0.953B^{12})\, A_t\,, \hat{\sigma}_A=0.1862,\ \chi^2 = 19.1$$
$$(\hat{\sigma} = 0.047)$$

and for US dollar based index is,

$$(1\text{-}B)(1\text{-}B)^{12} \log(Z_t) = (1\text{-}0.926B^{12})\, A_t\,, \hat{\sigma}_A=0.2065,\ \chi^2 = 24.3$$
$$(\hat{\sigma} = 0.054)$$

It is seen that the residuals obtained from every model were estimated, were found normally distributed. As a result, the most appropriate equations for the ISE indices for two model groups corresponding to two different transformations are found to use various aims. Some of possible applications of the obtained models are the control of the system in which the data gathered and the forecasting of the index values.

**IV. Conclusion**

The results of this study can be summarised as the following:

a) Although, the distributions of each raw and logged series of ISE National-100 are not normal, the series of index based on TL is closer to normality than the the US dollar based series.

b) In spite of the fact that linearity was not rejected for both index series, the index based on US dollars has a more linear structure than the TL index series due to the small test statistic value.

c) By employing two different transformations on the time series of ISE National-100 indices on TL and US dollar basis which were brought to be suitable for the modelling, SARIMA(0,2,1)(0,0,0) or IMA(2,1) and seasonal ARIMA(0,1,0)(0,1,1) models are obtained. More clearly, if the models are defined in terms of sentences; the most appropriate model for the TL based National-100 index series is the first order moving average model which is based on the original data after the second differences are taken. The most appropriate model for the US dollar based National-100 index series is the first order seasonal moving average model which is based on the original data after the first difference is taken.

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The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 

# VOLATILITY IN ISTANBUL STOCK EXCHANGE

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## 1-Introduction

Since economic agents make decisions based on the perceived distribution of the random, variables in the future, assessment and measurement of the variance has a significant impact on their course of action. Therefore, market participants' ability to accurately measure and predict the stock market volatility has wide spread implications. This capability has particular importance in an environment, where the perception of high levels of volatility has the potential to erode the investor confidence and divert the capital inflows from equity markets. This is a particular concern for the emerging equity markets that lack the advanced institutional and informational infrastructures and very vulnerable to domestic and foreign capital flows.

Early studies of the stock return behavior based on the constant variance assumption, traditionally has neglected the time varying nature of stock return variability. However, recent investigations of time-series properties of stock returns relaxed the implausible assumption of constant variance, and concentrated in models describing time-varying variance. These models, based on Autoregressive Conditional Heteroscedastic (ARCH) model of Engel (1982), have been popular in a wide range of financial applications and continuously improved with new generations of models. ARCH modeling can account for volatility clustering, that is the tendency of large stock price changes to be followed by large stock price changes. Empirical evidence suggests that variance does not only change

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Prepared for presentation in Global Finance Conference 1997, Montreal, Canada. Preliminary version. Please do not cite or quote without permission of the authors.

over time, but it also evolves in a predictable pattern that is detectable in the immediate history of the process. Generalized ARCH models (GARCH) introduced by Bollersev (1986) attempts to formulate these patterns in stock return data. From a theoretical point of view these models present linearity which is a crucial property since they imply an ARMA equation for the squared innovation process, which allows for a complete study of the distributional properties of the innovation process. It also simplifies the statistical inference. In addition to an adequate model of dependence of volatility , GARCH models take into account fat-tailed distribution of the stock returns. On the other hand, GARCH models contain several limitations. GARCH models imply that past values of the innovation on the current volatility is only a function of their magnitude. However, it is argued that this feature is generally not true in the financial context (Nelson, 1990). Typically, volatility tends to be higher after a decrease than after an equal increase (Campbell and Hentshcel, 1990; Christie 1982; Nelson 1990b, 1991; Schwert 1989). Naturally the symmetric conditional variance can not capture such phenomena. A new generation of models EGRACH (Nelson 1991), TGARCH (Rabemananjara and Zakoian, 1993), C-ARCH, CA-ARCH, are used to formulate negative asymmetry in volatility.

The GARCH model proposed by Engle (1982) also contributed to the study of the relationship between market risk and expected returns. The GARCH-M model introduced by Engle, Lilien and Robins (1987) explicitly links the conditional variance to the conditional mean of returns. The conditional mean of returns are specified as a function of past returns and a function that links the conditional variance to the conditional mean. Typically functional forms of conditional variance include linear, square-root and logarithmic. In the context of this study, we tested the relationship between the conditional variance and the conditional mean by using alternative functional forms.

The purpose of this study is to determine the time-varying characteristics of volatility in an emerging stock market by utilizing rich family of ARCH models. The primary focus of the study is to explore the nature of volatility in ISE. More specifically the study is designed to answer following questions:

* *Does volatility change in ISE over time ? If it does change, is there a predictable pattern in this change (Is conditional heteroskedasticity significant or is volatility clustering present?)*
* *What are the relative impact of positive and negative shocks in the market on the volatility (Is there any evidence of negative asymmetry observed in developed stock markets?) .*
* *What are the relative impact of transitory and permanent components on the volatility?*
* *Is there a positive risk-return trade-off in ISE returns?(Do estimated conditional variances contribute to the mean model estimation?)*

The study will progress in the following format: Section two will introduce and review the basic features of the ARCH models used in this study. Section three will briefly discuss the data and volatility in Istanbul Stock Exchange. Section four will present the empirical results, and finally section five will present the concluding remarks.

## 2- Review of GARCH Models

Empirical studies in 1960 and 1970s identified a number of characteristics commonly observed in stock returns. Included in these are serial correlation in successive returns and squared returns, distinct periods of volatility and stability, negative asymmetry and clustered observations around the mean and the tails (leptokurtic). These peculiarities at the time were dealt with ARIMA modeling. The ARIMA models are based on the assumption that the disturbance terms have constant variance. However, time varying nature of the variance of the disturbance term had severe practical implications and undermined the value of forecasts generated by the ARIMA models.

### 2.1. ARCH Model

Since effective modeling of stock return demands accurate representation of the variance component, a new generation of models that account for empirical peculiarities of data were needed. ARCH models developed by Engels (1982) served this purpose. They allowed volatility clustering or distinct periods of high volatility and stability in successive periods.

ARCH models essentially consists of two linked equations: the mean equation and the variance equation: The mean equation can be a standard

ARIMA $(m,d,n)$ process. In its simplest form ARCH(1) the mean and the variance equations can be expressed as

$$Y_t = \phi Y_{t-1} + \varepsilon_t$$
$$h_t = \omega + \alpha \varepsilon_{t-1}^2$$

The variance equation expresses how the variance changes over time and includes squared lagged disturbances. The generic ARCH($q$) process with $q$ lags can be expressed as:

$$h_t = \omega + \sum_{i=1}^{q} \alpha \varepsilon_{t-i}^2$$

### 2.2. GARCH(p,q) Model

Some restrictive attributes of ARCH models such as imposing a fixed lag structure to avoid negative parameter estimates, led to search for a new and general class of processes. Bollersev (1986) introduced the Generalized AutoRegressive Heteroscedastic (GARCH) model. This model was more flexible in its lag structure and integrated past conditional variances as well as past squared disturbances of ARCH processes. The GARCH($p,q$) model with conditional variance function is commonly expressed as

$$h_t = \omega + \sum_{i=1}^{q} \alpha \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i}, \alpha_i \geq 0; \beta_i \geq 0$$

This extension of ARCH model is very much like the extension of AR models to ARMA models (Bollersev, 1986), and it is argued that it allows a more parsimonious description of time series. In the ARCH($q$) process, the conditional variance is specified as a linear function of only past sample variances, whereas the GARCH ($p,q$) process allows lagged conditional variances to enter the model. Bollersev (1986) argues that incorporation of past conditional variances correspond to some sort of an adaptive learning process. Another important attribute of GARCH($p,q$) processes is their leptokurtic distribution, which concurs with the empirical characteristics of stock return data.

### 2.3. Exponential GARCH(p,q) (EGARCH) Model

Although GARCH models satisfactorily accounted for most of the empirical features of the financial time series, a commonly observed characteristic, negative asymmetry was not successfully captured by GARCH models. The Exponential GARCH (EGARCH) model proposed by Pagan and Schwert (1990) and Nelson (1991) incorporated the observed asymmetry in stock return data. EGARCH($p,q$) process specified as

$$\log h_t = \omega + \sum_{i=1}^{q} \alpha_i f(z_{t-i}) + \sum_{i=1}^{p} \beta_i \log h_{t-i}$$

$$f(z_t) = \phi z_t + \gamma\left[\left|z_t\right| - E\left(\left|z_t\right|\right)\right] \qquad z_t = \frac{\varepsilon_t}{h_t^{1/2}}$$

The advantage of using an exponential form for the conditional variance function ht is that the variance is positive for all choices of the parameters of the EGARCH process. The EGARCH model replaces lagged squared residuals in the GARCH model with a function which allows the model to account for asymmetry.

$$f(zt) = \phi zt + \gamma\left[\left|zt\right| - E\left(\left|zt\right|\right)\right]$$

For $\phi<0$, the term (zt induces asymmetry in the model. The second term in the function $\gamma[|z_t| - E(|zt|)]$ accounts for the magnitude. Residuals that are greater in magnitude than expected have a positive effect on the conditional variance. The residuals enter the model as standardized residuals with respect to current volatility. This allows the model to take into account of extreme residuals rather than the relatively moderate residuals that occur during a period of high volatility.

### 2.4. Threshold GARCH (TGARCH) Model

TGARCH Model is the product of another attempt to account for asymmetry in volatility (Engels and Bollersev, 1986; Zakoian, 1990). In this model, conditional variance is a piecewise function, thereby allowing different reactions of volatility to different signs and magnitudes of shock. The model is built by including a new term as a dummy variable which takes the value 1, when the news is bad., i.e. when $\varepsilon_t<0$, and zero otherwise. If the coefficient of the new term is significant, the ARCH effect on the conditional variance is augmented. This is consistent with the higher volatility associated with a bad news. The model is specified as follows:

$$ht = \omega + \sum_{i=1}^{q} \alpha\, \varepsilon_{t-i}^{2} + \sum \gamma\, e_{t-1}^{2} d_{t-1} + \sum_{i=1}^{p} \beta i h t - i$$

$d_{t-1}=1$ if $\varepsilon_t<0$ , and $d_{t-1}=0$ otherwise

**2.5. Component ARCH (C-ARCH) Model**

The component ARCH model modifies the constant (long term) component of the conditional variance into a time-varying component. This modification allows us to measure the rate at which short term variance converges to long term variance as well as the significance of transitory and permanent ARCH and GARCH effects in the conditional variance. The C-ARCH(1,1) model can be derived by substituting ω with $qt$ in the original GARCH(1,1) model, where $q_t$ is time-varying permanent component of conditional variance .

$$h_t = q_t + \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \beta(h_{t-1} - q_{t-1})$$

$$q_t = w + \rho(q_{t-1} - w) + \phi(\varepsilon_{t-1}^2 - h_{t-1})$$

This substitution yields the following model:

$$h_t = w + \rho(q_{t-1} - w) + \phi(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) + \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \beta(\sigma_{t-1}^2 - q_{t-1})$$

The coefficient $\rho$ measures the rate at which $q_t$ converges to $w$. The coefficient $\phi$ measures the permanent combined ARCH-GARCH effect. While $\beta$ measures the transitory GARCH effect, $\alpha$ measures the transitory ARCH effect.

**2.6. Asymmetric Component ARCH Model (AC-ARCH)**

A simple extension of C-ARCH model generated the AC-ARCH which interjects a dummy variable to account for asymmetry in the C-ARCH model. This simple modification decomposes the transitory ARCH effect, and allows us to detect leverage effect in the transitory component of conditional variance. The model can be specified as follows:

$$h_t = w + \rho(q_{t-1} - w) + \phi(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) + \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \gamma(\varepsilon_{t-1}^2 - q_{t-1})d_{t-1} + \beta(\sigma_{t-1}^2 - q_{t-1})$$

$d_{t-1}=1$ if $e_t<0$; 0 otherwise

### 3. Data and Study

The objective of this study was set to explore the nature of volatility in ISE returns. Data used in this study consists of the daily value of ISE Index from January 1986 to December 1996. The index is a weighted average based on individual stock closing prices for a select group of stocks quoted at the Istanbul Stock Exchange. The analysis here focused on the return series defined as the first difference of natural logarithm of the price. Due to unavailability of the information for the entire period that the study covers, the returns used in this study do not include dividends and returns refer only capital gains.

The first step of the study was to estimate a mean model for ISE returns. The error terms of the mean model was used to analyze the ARCH and GARCH effects. The relationship between conditional variance and the conditional mean (the contribution of the conditional variance to the mean model) was tested for GARCH, TGARCH, EGARCH, C-ARCH and CA-ARCH models was tested for each conditional volatility model. The mean models are referred as GARCH-M, TGARCH-M, EGARCH-M etc. The coefficients of the conditional variance functions (linear and squared functions only since coefficients of the logarithmic functions proved to be insignificant in all variance models) were reported in respective tables.

### 4. Empirical Results

The level ISE returns was modeled as ARIMA(0,1,1) (R) (or ARMA(0,1)D(R)). In other words the difference of the return series Rt is modeled as a drift coupled with the first moving average term. The residuals of the mean model

$$Rt=\alpha+\phi\varepsilon_{t-1}+\varepsilon_t$$

was used to model conditional variance of ISE returns.

The first model is GARCH(1,1). The following model was estimated and the contribution of estimated conditional variance and standard deviation to the mean model was tested.

$$h_t = w+\alpha\varepsilon_{t-1}^2+\beta\sigma_{t-1}^2$$

**Table-1: GARCH Model**

| | *Variance Model* | | *Mean Model* | |
|---|---|---|---|---|
| | $\alpha$ | $\beta$ | $ht$ | $ht^{1/2}$ |
| ***GARCH(1,1)*** | 0.24<br>(8.34) | 0.70<br>(20.80) | | |
| ***GARCH(1,1)-M-S*** | 0.24<br>(8.34) | 0.70<br>(20.80) | 0.14<br>(2.33) | |
| ***GARCH(1,1)-M-V*** | 0.24<br>(8.34) | 0.70<br>(20.80) | | 2.11<br>(2.22) |

The analysis of GARCH(1,1) model indicates that lagged conditional variance and lagged squared disturbance has an impact on the conditional variance. Including distant lags did not improve the model. The coefficients of the conditional variance or standard deviation in the mean model proved to be significant. In other words, incorporating volatility estimates into the mean model, improves the estimation of the mean returns.

In order to test for the asymmetry in the volatility of ISE returns, two alternative models were used: TGARCH and EGARCH. In the TGARCH model, the impact of the bad news was designed to be quadratic. The model was specified as:

$h_t = w + \alpha\varepsilon^2_{t-1} d_{t-1} + \gamma\varepsilon^2_{t-1} + \beta h_{t-1}$, $d_{t-1} = 1$ *eğer* $_{\varepsilon t} < 0$; $0$ otherwise

The significance of $\gamma$ indicates that the effect of bad news is larger on the volatility than the good news. In other words, the significance of the dummy coefficient implies the leverage effect in ISE returns.

**Table-2: TARCH Model**

| | *Variance Model* | | | *Mean Model* | |
|---|---|---|---|---|---|
| | $\alpha$ | $\beta$ | $\gamma$ | $ht$ | $ht^{1/2}$ |
| **TARCH(1,1)** | 0.24<br>(6.49) | 0.70<br>(20.90) | 0.00<br>(0.10) | | |
| **TARCH(1,1)-M-S** | 0.25<br>(6.55) | 0.70<br>(20.90) | -0.03<br>(-0.60) | 0.16<br>(2.55) | |
| **TARCH(1,1)-M-V** | 0.25<br>(6.57) | 0.70<br>(21.06) | -0.02<br>(-0.53) | | 2.40<br>(2.37) |

The model verifies the significance of ARCH and GARCH effects in the conditional variance of ISE returns. However, the asymmetry is not verified in ISE returns. Namely, the model does not provide any support the proposition that the bad news increases the volatility more than the good news. Incorporation of the TARCH estimation of conditional variance and standard deviation improved the mean model as in the GARCH model.

An alternative model that accounts for asymmetry is the EGARCH model of Bollersev. In this model the impact of the variance is exponential and residuals are standardized with respect to current volatility to account for relatively large unexpected changes in returns over a volatility cycle. The EGRACH(1,1) model used in this study is specified as follows:

$$\log(h_t) = w + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \beta \log(h_{t-1})$$

**Table-3: EGARCH Model**

| | *Variance Model* | | | *Mean Model* | |
|---|---|---|---|---|---|
| | $\alpha$ | $\beta$ | $\gamma$ | *ht* | $ht^{1/2}$ |
| ***EGARCH(1,1)*** | 0.42<br>(9.50) | 0.91<br>(46.50) | 0.00<br>(0.11) | | |
| ***EGARCH(1,1)-M-S*** | 0.42<br>(9.61) | 0.91<br>(47.10) | 0.01<br>(0.42) | 0.16<br>(2.55) | |
| ***EGARCH(1,1)-M-V*** | 0.42<br>(9.72) | 0.91<br>(46.55) | 0.01<br>(0.43) | | 2.40<br>(2.37) |

The results of the EGARCH analysis concur with the TARCH results. While the ARCH and GARCH effects are significant, asymmetry can not be confirmed. This result implies that bad news have no larger impact on the volatility than the good news. Incorporation of the conditional variance and the deviation improved the mean model performance in this particular case as well.

Although the results of TARCH and EGARCH analysis provide no evidence of leverage effect in ISE returns, a decomposition of permanent and transitory components of volatility may provide further insight on the nature of volatility in ISE returns. We used Component ARCH (C-ARCH)model to decompose permanent and transitory volatility. The model used in this analysis was specified as

$$h_t = w + \rho(q_{t-1} - w) + \phi(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) + \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \beta(\sigma_{t-1}^2 - q_{t-1})$$

**Table-4: C-ARCH Model**

| | *Variance Model* | | | | | *Mean Model* | |
|---|---|---|---|---|---|---|---|
| | *W* | *p* | $\phi$ | $\alpha$ | $\beta$ | *ht* | $ht^{1/2}$ |
| ***C-ARCH(1,1)*** | 0.00 | 0.99 | 0.07 | 0.18 | 0.65 | | |
| | (2.06) | (9.50) | (2.44) | (4.83) | (8.87) | | |
| ***C-ARCH(1,1)-M-S*** | 0.00 | 0.94 | 0.24 | 0.00 | 0.65 | 0.13 | |
| | (4.99) | (9.61) | (8.34) | (0.42) | (8.81) | (2.23) | |
| ***C-ARCH(1,1)-M-V*** | 0.00 | 0.99 | 0.07 | 0.19 | 0.64 | | 1.92 |
| | (2.25) | (9.72) | (2.41) | (4.91) | (8.96) | | (2.02) |

The results of the analysis indicate that transitory ARCH-GARCH effect is significantly larger than permanent ARCH-GARCH effect. While the coefficients of the transitory components sum up to 0.83, the coefficient of the permanent component is 0.07. In other words, short term dynamics dominate the conditional variance. The coefficient $\rho$ measures the rate at which $q_t$ (time varying component) reverts to w (permanent component). The estimated value of $\rho$ is 0.99 which implies that the reversion is very slow in ISE case.

Finally, we searched for a possible asymmetric effect on the conditional variance by decomposing the transitory component into two parts as in the TARCH model. A dummy variable was incorporated into the C-ARCH model. The dummy variable dt-1 is 1 if $\varepsilon<0$ and, 0 otherwise. If a decline in the index tend to increase the volatility, the coefficient of the transitory component with a dummy variable is expected to be significantly different than 0, if not it is expected to be insignificant.

$$\sigma_t^2 = w + \rho(q_{t-1} - w) + \phi(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) + \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \gamma(\varepsilon_{t-1}^2 - q_{t-1})d_{t-1} + \beta(\sigma_{t-1}^2 - q_{t-1})$$

**Table-5: AC-ARCH Model**

| | *Variance Model* | | | | | | *Mean Model* | |
|---|---|---|---|---|---|---|---|---|
| | $W$ | $p$ | $\phi$ | $\alpha$ | $\gamma$ | $\beta$ | $ht$ | $ht^{1/2}$ |
| *AC-ARCH(1,1)* | 0.00 | 0.99 | 0.062 | 0.17 | 0.04 | 0.63 | | |
| | (1.86) | (163) | (2.14) | (4.38) | (0.91) | (8.80) | | |
| *AC-ARCH(1,1)-M-S* | 0.00 | 0.94 | 0.07 | 0.18 | 0.03 | 0.63 | 0.09 | |
| | (1.82) | (160) | (2.18) | (4.44) | (0.61) | (8.87) | (1.59) | |
| *AC-ARCH(1,1)-M-V* | 0.00 | 0.99 | 0.07 | 0.18 | 0.03 | 0.63 | | 1.73 |
| | (2.00) | (155) | (2.15) | (4.46) | (0.52) | (8.83) | | (1.77) |

Our findings indicate that transitory component of the conditional variance does not submit any evidence of an asymmetric response to bad news relative to good news. Although this result does not collaborate with the empirical finding reported in the literature, it is consistent in the context of this study, where we could not find any evidence of asymmetric effect in volatility.

## 5-Concluding Remarks

The analysis of Istanbul Stock Exchange Index returns confirms time variation in stock market volatility. Our findings indicate that conditional variance of ISE returns are significantly affected by lagged shocks and the lagged variance contains information about the current volatility. In other words our findings confirm the well documented volatility clustering in stock returns. Another widely discussed empirical characteristic of the stock returns is the negative asymmetry in volatility. There is ample empirical evidence that a shock associated with a bad news tend to trigger a higher increase in volatility than the good news. However, our findings did not confirm this widely observed empirical characteristic for ISE returns. News impact curve for ISE remains to be symmetric, and GARCH(1,1) adequately models the volatility in ISE. This result concurs the findings of Koutmos (1992) which reported lack of asymmetry in

Canadian, French, Japanese and Dutch stock returns, and positive asymmetry for Australian stock returns. Our findings support the argument that the negative asymmetry is not a universal phenomena. The non-homogenous response to volatility shocks can be interpreted as a factor contributing to the stability of the international financial markets. Since our data set includes only one emerging stock market, it is impossible to argue that symmetric news impact is an emerging market peculiarity. However, this finding motivates us to extend the context of the study to other emerging markets to explore the extent that this is an emerging market peculiarity. A confirmation of our result for other emerging markets has the potential to further justify the diversification benefits of investing in emerging markets.

Our analysis of short term and long term components of the ISE volatility indicates that the short term component in ISE volatility is significantly larger than the permanent component (long term) and the reversion to permanent volatility is very slow. The implication of this finding is that volatility in ISE is governed by short term volatility shocks, and the convergence of current volatility level to average volatility takes long time. This finding implies that the pricing inefficiencies are rather large to the extent that market participants use constant measures of volatility to price Turkish equities. This result has a particular importance in the context of this study, since our mean model estimates confirmed the positive relationship between conditional variance and the conditional mean. Incorporation of the linear (square root of conditional variance) and squared functions yields positive and significant coefficients, which implies positive risk premiums on the conditional volatility.

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The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 

# DAY-OF-THE-WEEK EFFECTS in OVERNIGHT INTEREST RATES: EVIDENCE FROM TURKISH MONEY MARKETS

RECEP BILDIK*

**ABSTRACT**

This study examines the daily seasonalities in Turkish Money Markets. Day-of-the week effects in overnight interest rates in the Central Bank Interbank Money and Istanbul Stock Exchange Repo Markets are investigated. Results show that overnight interest rates significantly fall on Wednesdays and increase on Mondays relative the previous days which indicated the existence of significant day-of-the-week-effect in overnight interest rates. There are also two other strong trends in interest rates indicate the decrease on Tuesdays and increase on Fridays. Some evidences are documented for the relationship between the existence of day effect in overnight interest rates and Treasury Public Borrowing Auctions, institutional practices, strategies of market participants and the other factors which effect the liquidity conditions of the market and create the seasonality in liquidity. Findings are consistent with the liquidity conditions of the market, the liquidity ans so money policy of the Central Bank and Treasury Auction-related practices for the day-of-the-week effect in overnight interest rates which shows that regulatory bodies of the markets and public authorities have an important creative impact on the seasonalities in interest rates.

## I. Introduction

The evidence of a growing number of "Anomalies" both in the US and other countries' stock markets have led to doubts on "Efficient Markets Hypothesis". Of the calendar or seasonal anomalies, one of the most unusual empirical results indicates that the distribution of common stock

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Helpful comments contributed by the experts from Undersecreteriat of Treasury, Istanbul Stock Exchange Bonds and Bills Market and editors of this journal are greatefully acknowledged.

returns is not identical for all days of the week.

Since Cross (1973) and French (1980) observed that, stock returns are negative on Mondays and positive on Fridays, a number of studies have documented the same results and not only supported the existence of an anomaly that was named as "Day-of-the-Week Effect", but also found other magnitudes and versions.[1] According to this phenomenon, on average, return of the last trading day is the highest, and return of the first trading day is the lowest across the days of the week. Several studies[2] have shown that day-of-the-week effect exists not only in the US markets, but are also observed in the international markets. In addition to the extensive research into weekly seasonalities in stock returns, there is a growing literature that investigates seasonal patterns in other financial markets.

For example, Gibbons and Hess (1981) report that returns on an index of Treasury-bills (T-Bill) with constant maturity are lower on Monday than on other days of the week. Flannery and Protopapadakis (1988) documented a Monday seasonal in a variety of US Treasury securities that is more negative for securities with longer maturities. Significant day-of-the-week effects are also documented in the federal funds market by Cornell (1983) and Eisemann and Timme (1984) and in markets for foreign exchange by McFarland, Pettit and Sung (1982). Additionally, there are other studies that investigate the daily patterns in returns on financial futures contracts.

Chiang and Tapley (1983) and Johnston et. al. (1991) for financial future markets, Ball, Torous and Tschoegl (1982) for gold markets find weekly

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1 Gibbons and Hess (1981), Lakonishok and Levi (1982), Keim and Stambaugh (1984), Rogalski (1984), Jaffe and Westerfield (1985) are some of them.

2 For example, Solnik and Bousquet (1990) for Paris Bourse, Agrawal and Tandon (1994) for eight countries, Alexakis and Xanthakis (1995) for Athens Stock Exchange, Lee et. al. (1990) for Japan, Korea and Singapore Stock Markets.
However, this effect displays different patterns from one country to the other. Although numerous studies indicated that average return in the US markets is significantly negative on Mondays and abnormally large on Fridays, Jaffe and Westerfield (1985) have found this effect also in Canada and the UK, but found Tuesday returns to be negative and the lowest for the week in Australia and Japan. Strong negative Tuesday effect was found in several countries particularly in Europe and Asia. Besides Fridays' highest returns, Wednesday returns are also high in some countries.

seasonals-including a Monday effect-in daily returns on a variety of futures contracts. Cornell (1985) and Dyl and Maberly (1986) find that returns on the S&P 500 stock index future exhibit a closed-market weekend effect similar to that previously found in stock returns. More recently, Paterson (1990) reported day effect in CBOE options market, Phillips-Patrick and Schneeweis (1988) provided evidences on US stock index futures markets, Yadav and Pope (1992) on UK stock index futures markets. Martikainen and Puttonen (1996) investigated the day-of-the-week effect in Finnish Stock Market and verified the Monday effect (negative returns) in index futures and options markets, but Tuesday effect in cash market. Gay and Kim (1987) find a negative Monday seasonal in the commodities futures. In addition, Chang and Kim (1988) find evidence of a negative Monday in both the Dow Jones Commodity Price cash and futures indices.

Despite the efforts of academicians to explain the day-of-the-week effect, no theoretical explanation has satisfied researchers yet. Many explanations for the day-of-the-week effect in stock markets have been examined. These explanations[3] are; settlement procedures, institutional practices, econometric methods, risk level, ex-dividend days, behavior of individual investors, liquidity, systematic news releases, high closing prices, firm size, specialist-broker biased activities, time-zone theory, previous week's market performance, January effect. Only a very small part of the explanatory hypotheses were accepted, while each of them found only weak support in empirical tests.

The pattern of return seasonals across different securities can provide important insights into the causes of intra-week seasonality. If seasonality is generated by broad-based economic and other factors that influence all asset returns, securities should exhibit similar seasonal patterns regardless of the particular markets in which they are traded. On the other hand, if seasonality reflects specific payment, clearing, or other institutional arrangements in individual markets, seasonal patterns should be similar for securities traded in the same market but should be different across markets. In fact, determining whether seasonal patterns are similar for stocks and bonds aids in formulating the hypothesis concerning the origins of the effects. If two different asset classes exhibit the same

3 For detailed review of the previous results and explanations in the literature, see Bildik (1997).

seasonal pattern, then a viable explanation for one should apply also to the other.

The purpose of this paper is to investigate the existence of the day of the week effects in overnight interest rates determined in Turkish Interbank Money and Istanbul Stock Exchange Repo Markets. However there are some studies that seek the day-of-the week effects in equity returns in Istanbul Stock Exchange[4], this is the first empirical study that investigates the day of the week effects in interest rates in Turkish Money Markets, as we know. Besides the being the first study on this topic in Turkey, limited research on fixed-income securities and expectations for having important knowledge about the main reasons of "day-of-the-week effect" have encouraged us to realize this study.

In the analysis that follows, daily average changes in overnight interest rates both in Central Bank Interbank Money Market from 1990 to 1997 and ISE Repo Markets from 1993 to 1997 with different sub-periods are examined. We find significant day-of-the-week effects in overnight interest rates which shows that interest rates fall on Wednesdays and increase on Mondays.

The remainder of the paper is organized as follows;
The next section presents the previous findings and discusses the potential reasons and explanations for the day-of-the-week effect in the fixed income securities. Third section describes the data and empirical methodology employed in this study to investigate the existence of day-of-the-week effect in Turkish Money Markets. Empirical tests and results are then presented in this section. Fourth section explains the potential reasons for the existence of the seasonalities in interest rates based on different explanatory points of view. The last section, Section V, contains the summarized results and concluding remarks of the study.

4 Day of the week effect was found in stock returns of ISE in several studies. Bildik (1997), Özmen (1997), and Balaban (1995) are some of them. They show that Tuesday returns are significantly low and negative whereas Fridays' average return is abnormally large and positive relative to other days of the week, however that this pattern has changed after the rule for settlement procedure has been changed from one-day to two-days settlement period. Bildik and Özmen indicated that low returns on Tuesdays and high returns on Fridays reversed to low and negative returns on Mondays and high and positive returns on Thursdays after the settlement procedure change.

## II. Literature Review

In contrast to the extensive research on equity returns, few investigations examine seasonality in the instruments of fixed-income and money markets such as overnight repo, Government securities and corporate bonds.

Gibbons and Hess (1981) investigate daily patterns in T-bills and find that Monday's return is lower and Wednesday's return is higher than other days of the week.

Saunders and Urich (1984) and Eisemann and Timme (1984) examine day-of-the-week seasonality in the federal funds market and latter of them find that, rates peak on Thursday or Friday, and Wednesday is the lowest rate day.[5]

Flannery and Protopapadakis (1988) investigated that how uniform are intra-week and other seasonal patterns across common stocks and Treasury securities with a wide range of maturities. They documented intra-week seasonality for each of eleven assets (an overnight repo rate, seven Treasury securities of different maturities, and three stock market indices) between 1976 and 1984. They find that the lowest returns on all instruments occur on Mondays, with high returns on Thursday for Treasuries and Friday for equities. Flannery and Protopapadakis find substantial intra-week seasonality in all the assets studied, but after returns are adjusted for clearing conventions, seasonal patterns disappeared. For instance, high Treasury returns on Thursday and high stock returns on Friday seem to be due to clearing conventions. However the negative weekend return pattern persists, there is a linear negative relation between Monday Treasury returns and the underlying securities' maturity. The longer the maturity, the lower the mean Monday return. Finally, they reject the hypothesis that intra-week seasonality is the same across all securities for each day of the week.

Flannery and Protopapadakis concluded that day-of-the week seasonality is not uniform across assets. Even within similar securities, seasonals differ significantly. One viable explanation is that term premia contained in the interest rates tend to risk over the weekend because non-trading period are characterized by different risks and information flows.

5 Johnston et. al. (1991)

Term premia compensate the holders of longer term bonds for the risk of new information arriving in the market during the holding period. The fact that similar secuirities exhibit significantly different seasonal patterns suggests that market-specific, institutional features can not explain all seasonality. Negative Monday returns may be subject to a unified explanation across all securities. The particular pattern of Treasury securities' Monday returns is consistent with intra-week variations in the market discount rates' term premia.

Jordan and Jordan (1991) examined the five calendar effects in bond returns from 1963 to 1986: day-of-the-week, turn-of-the-year, January, turn-of-the-month and week-of-the-month. The bond index has its lowest mean return on Tuesday. Thursday has the highest average return and additionally is the only day with a positive mean return. The relatively high returns on Thursday are consistent with Flannery and Protopapdakis' (1988) findings. However that there is no evidence of a significant day-of-the-week effect in the corporate bond market. They also pointed out that corporate bond prices do display some degree of seasonal regularity, but the pattern is not the same as that observed for equities. Jordan and Jordan show that there is little evidence that Treasury securities display a day-of-the-week effect, but significant turn-of-the-year and week-of-the-month effects.

Johnston, Kracaw, and McConnell (1991) investigated the seasonal effects in financial futures markets. They identified two significant seasonal patterns in the data which covers a longer time period than previous studies. First for GNMA and T-Bond contracts, average returns on Mondays are found to be negative and statistically different from zero. Additionally, the negative Monday return observed for T-bond futures closely parallels that found by Flannery and Protopapadakis (1988) in the cash market for long term Treasuries.

Moreover, Johnston, Kracaw, and McConnell find that the Monday effect occurs during trading hours on Monday, as opposed to over the weekend for stocks and stock index futures. Previous research has demonstrated that the negative Monday seasonal associated with stock returns and with index futures actually occurs during non-trading hours over the weekend. The other significant pattern that they observed is a positive Tuesday effect on GNMA, T-bond, and T-note contracts. Average returns on

Tuesday for these contracts are positive and significantly different from zero. In addition, the Tuesday effect also appears during non-trading hours and only on contracts traded prior to a delivery month.

Finally, Johnston, Kracaw, and McConnell (1991) find no significant seasonal patterns in returns on T-bill contracts. This contracts with the finding of Gibbons and Hess (1981) of a Monday effect in the cash market for T-bills. Johnston, Kracaw, and McConnell show a significant negative effect on Wednesday for both GNMA and T-bond contracts in nonparametric tests.

Johnston, Kracaw, and McConnell (1991) note that seasonal patterns have already been established in the cash markets for both T-bonds and for T-bills, and, while they do not find similar patterns in T-bond futures, there is no corresponding seasonal pattern in T-bill futures. This evidence contradicts the notion that seasonal patterns in futures contracts are generally reflections of seasonal patterns in the underlying cash market. The negative Monday effects observed in both stock and futures markets might be due to some common characteristics of market organization.

On the other hand, Smirlock and Starks (1986) have reported that the negative Monday effect in stock returns has been "moving up" in time. Johnston, Kracaw, and McConnell find similar results (for GNMAs, this effect occurs after December 1984. For T-bonds, the negative Wednesday occurs before January 1981) of Gay and Kim (1987) and Chang and Kim (1988), who documented the disappearance of Monday effects in the commodities futures index.

## III. Empirical Tests and Results

### A. Data and Methodology

The primary data set used in this study consist of the daily average values of the Overnight Interest Rates determined in the "Interbank Money Market of Central Bank of Turkey" for the period of October 6, 1990 - April 4, 1997.[6]

6 Data that used in this study were provided by The Central Bank of Turkey and Istanbul Stock Exchange.

Using each day's average overnight interest rates occurred at Central Bank Interbank Money Market, the percentage changes in the interest rates relative to previous day's value are computed as follows;

$$r_t = \frac{v_t - v_{t-1}}{v_{t-1}} . 100 \qquad (1)$$

$r_t$ = Percentage change in overnight interest rate on day t.
$v_t$ = Overnight interest rate on day t
$v_{t-1}$ = Overnight interest rate on day t-1.

In order to test whether the seasonalities in daily interest rate changes exist or not, same method was applied on the period October 6, 1990 - April 4, 1997, as it was used by Gibbons and Hess (1981) who found that t-bills, like stocks, have strong day of the week effects. Similar to Gibbons and Hess we have tested whether interest rates exhibit the day of the week effects or not. We observed significant seasonalities in daily interest returns.

We also divided the whole period into two sub-periods to detect the movements in seasonalities and eliminate the possible distortion of Economic Crisis period which was realized between January and June 1994, on our data. In order to eliminate the negative impacts of the crisis period on interest rates, observations for interest rates which belong to the crisis period between January 1, 1994 and May 31, 1994 where the interest rates jumped to extraordinary levels as a result of the economic and financial crisis have been excluded from the full data set. Sub-periods are from October 6, 1990 to December 31, 1993 and from June 1, 1994 to April 4, 1997. Then we repeated the analysis for these periods and examined the existence of day effect in interest rates.

In order to test the differences in mean changes of overnight interest rates across the days of the week, besides the descriptive statistics, the following model is applied for overnight interest rates;

$$r_t = \gamma_1 D_{1t} + \gamma_2 D_{2t} + \gamma_3 D_{3t} + \gamma_4 D_{4t} + \gamma_5 D_{5t} + \varepsilon_t \qquad (2)$$

$r_t$ = Change in daily average overnight interest rate in period t.
$D_1, D_2, D_3, D_4, D_5$ = Dummy variables for Monday, Tuesday, Wednesday... respectively.

$D_{1t}$ = Dummy variable for Monday, if day t is a Monday, otherwise zero.
$\gamma_i$ = Coefficients are expected daily mean changes for Monday through Friday.

$\varepsilon_t$ = Error term and the vector of disturbances.
t = 1,.......,T

What is being tested here is the equality of mean changes in interest rates across all the days of the week. If the hypothesis is rejected, it means that strong seasonality in overnight interest rates (returns) across the days of the week has existed.

$\gamma_1 = \gamma_2 .... = .\gamma_5$

If the expected return is the same for each day of the week, the estimates of $\gamma_2$ .....$\gamma_5$ will be close to zero and F-statistic measuring the joint significance of the dummy variables should be insignificant.

Finally, the same analysis are repeated for the new data set which consists of the overnight interest rates determined at the Repo Market of Istanbul Stock Exchange.

## B. Empirical Findings

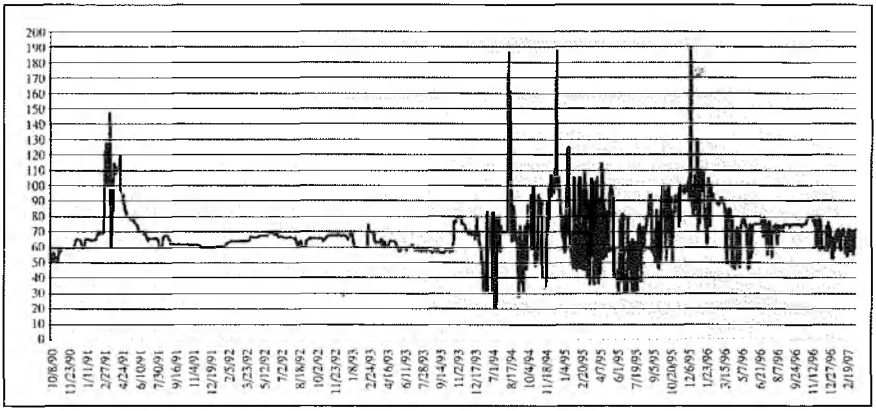
### B1. Overnight Interest Rates in Interbank Market

The summary statistics for the daily average interest rates in Interbank Market that consists of 1619 observations, from 6.10.1990 to 4.4.1997, and two different sub-periods are presented in Table 1.

However, that interest rates vary between 20.4% and 696.7%, 75% of the daily interest rates has changed within only 17 points, between 54% and 71% and the average and median overnight interest rates are 79.2% and 66.8%, respectively, in the last seven years. Figure 1. indicates the trend line of the overnight interest rates in Interbank market.

Average overnight interest rate determined in Interbank Market in the second sub-period (between 1.6.1994 and 4.4.1997) is 72.4% and approximately 10% higher than first sub-period (between 6.10.1990 and 31.12.1993) rate which is 66.1%.

**FIGURE 1: INTERBANK OVERNIGHT INTEREST RATES**
**(October 1990 - April 1997, Except Crisis Period)**



Mean overnight interest rates on Fridays in Interbank Market are the highest across the week with the rate of 81.0%, however the median rate of Mondays is higher than Fridays in all periods.

On the other hand, average risk-free interest rate in real term basis (adjusted to the inflation) is around 25% annually which is very high because of the high public borrowing requirement. By dividing each yearly basis overnight interest rates to 360, daily interest returns are also calculated. The daily average interest return is approximately 0.22% which is quite high across the week for the full observation period.

It seems that Central Bank of Turkey followed a stable and non-active money policy in Interbank Market between the years 1990 and 1994. In this period which is before the deep financial crisis, the daily mean change and standard deviation are 0.09% and 3.44%, respectively. Difficult conditions in financial markets after the 1994-financial crisis forced Central Bank to apply more active policy in the money markets. Mean daily change and standard deviation of overnight rates in Interbank are 2.61% and 25.18%. These numbers are quite high relative to those in pre-crisis period (6.10.1990 - 31.12.1993) and indicate that the volatility in terms of standart deviation in interest rates increased substantially after the crisis period.

Descriptive statistics for the percentage average changes in daily overnight interest rates in Interbank Market and the corresponding regression results are displayed in Table 2.

Table 2 gives evidences for the existence of seasonality in overnight interest rates both in full period and after-crisis period. These results show that changes in overnight interest rates are not identical across the week. For example, in full period, interest rates fall significantly on Wednesdays relative to the previous day. Changes in overnight interest rates are low and negative on Wednesdays whereas they are high and positive on Fridays. Overnight rates fall by 2.2% on Wednesdays and increase by 4.95% on Fridays relative to previous days.

The highest positive change in daily average overnight interest rates is received on Fridays and the change (4.95%) is almost triple of the average daily change (1.67%) in the same period. Similarly, the percentage change on Wednesdays (-2.2%) is quite lower than the average daily change in interest rates across the week.

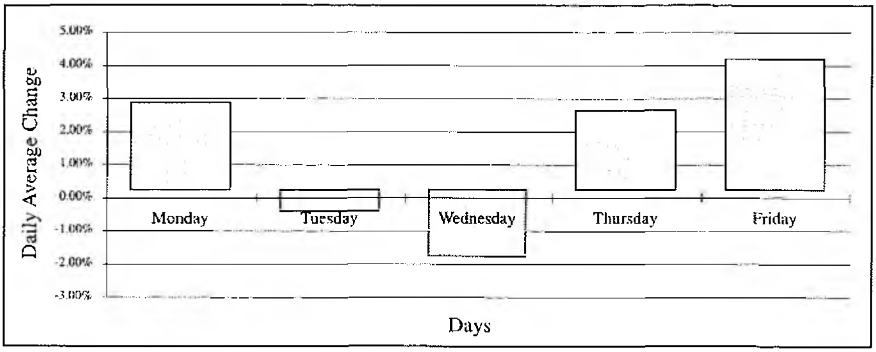
Equality tests for the mean changes in daily interest rates across the days have allowed us to reject the hypothesis that mean changes among the days of the week are equal. The fall in overnight interest rates on Wednesdays is found statistically significant at 1% level. On the other hand, overnight interest rates on Mondays tend to increase by 2.75% relative to the previous day that represents the second highest increase that has been faced across the week. Although Fridays face larger changes in interest rates compared to Mondays, due to volatility, changes in interest rates on Fridays is higher than it is on any other day of the week, t-statistic for Friday is not significant. Monday was found statistically significant at 5% level, with having the lowest volatility in interest rates across the days.

It is shown that there is no significant differences between the overnight interest rates across the days of the week in pre-crisis period. Wednesdays show the decreasing trend relative to previous day. Volatility in interest rates is higher in the second part of the week (from Wednesday to Friday) and reaches its highest level on Fridays whereas Tuesdays and Mondays are the lowest days almost in all periods.

However the regression results in the first sub-period which is pre-crisis period (6.10.1990 - 31.12.1993) are parallel to previous findings so that the overnight interest rates decrease on Wednesdays and increase on Mondays, those are weakened statistically. Only Wednesday was found significant at 10% level. In this period, the change on Thursdays reversed to negative. However the t-statistics for Monday, Friday and Thursday are not significant, these are very close to 10% significancy level. The highest variability on overnight interest rates in the first sub-period is seen on Mondays and then Wednesdays.

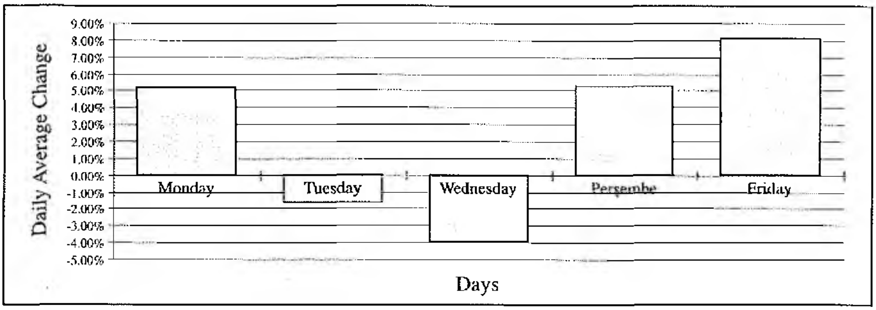
On the other hand, after 1994-crisis, mean changes are substantially larger across the days of the week. Daily average overnight interest rate of Wednesdays is lower than any other day of the week whereas the average rate of Mondays and Fridays is higher than the rates on rest of the week. Although it is not statistically significant, Fridays generate abnormal changes with the average of 8.1%. We found that daily average change in overnight interest rates on Wednesdays and Tuesdays are nearly -4% and -1.6%, and significant at 1% and 5%, respectively (see Figure 2). Furthermore, daily average change in overnight interest rates on Mondays is nearly 5.1% and significant at 1%. It is clear that the results strengthen in the after-crisis period, 1.6.1994 - 4.4.1997. F-value of regression is also significant at 1%.

**FIGURE 2: DAILY AVERAGE CHANGE IN INTERBANK OVERNIGHT INTEREST RATES**
**(6.10.1990 - 4.4.1997, Except 1994-Crisis Period)**




Similar results were found for the full period to which was held for the after-crisis period after excluding the Crisis-period (1.1.1994-31.05.1994) observations from the full data set. In the analysis on the full period, from 6.10.1990 to 4.4.1997 except (1.1.1994-31.05.1994) Crisis-period, we find that overnight interest rates on Mondays increase in average of 2.6% whereas rates on Wednesdays and Tuesdays decrease 2% and 0.64%, respectively (see Figure 3). Coefficients of Monday and Wednesday are significant 1% whereas Tuesday is at 5% level.

**FIGURE 3: DAILY AVERAGE CHANGE IN INTERBANK OVERNIGHT INTEREST RATES (1.6.1994 - 4.4.1997)**




Interestingly, the sign of Tuesdays changed to negative after the crisis period in Interbank Market which indicates the decrease in interest rates on Tuesdays relative to previous day, however there is no clear reverse in the interest rates determined in ISE Repo Market. We see that sign of Tuesday changes to negative when we delete Crisis-period data from the full period's data set. Thus, it shows that extraordinary levels of interest rates and volatility in overnight interest rates have important impact on our full data set. This opposite pattern may also be sourced from the change in Treasury Auction days after the crisis period.

## B2. Overnight Interest Rates in Repo Market in ISE

In order to confirm the existence of the day-of-the-week effect in interest rates, we repeated the same analysis above also for the interest rate data that occurred at the "Repo Market" of Istanbul Stock Exchange (ISE). Due to Repo Market within the premises of Bonds and Bills Market at ISE has just begun operations at the beginning of 1993, only the data (percentage changes in overnight interest rates across the days of the week relative to previous day's overnight rates) between March 30, 1993 and June 13, 1997 has been examined.

Summarized statistics are given on Table 3. Nominal annual-based overnight rates determined in ISE Repo Market reaches its highest level on Tuesdays and then Mondays with 85.1% and 83.0% respectively in whole period (between 30.3.1993 and 13.6.1997). The lowest average rate is faced on Wednesdays both in whole period and the period after the financial crisis. Overnight interest rates vary between 19.6% and 723.7% and daily average overnight rate is 82.1% in the same period. The daily average overnight interest rate has decreased significantly to 72.1% after the 1994-Crisis period.

Descriptive statistics for the daily average changes in overnight interest rates in ISE Repo Market are displayed on Table 4. We see that daily average changes in overnight interest rates are higher in ISE Repo Market than Interbank Market.[7] Mean interest rates decrease on Wednesdays in ISE Repo Market in all periods, whereas Thursdays shows decrease according to median value. On the other hand, average interest rate on Fridays and median rate on Mondays increase substantially similar to those in Interbank Market. Thus descriptive statistics clearly indicate that overnight interest rates are lower on Wednesdays and higher on Mondays and Fridays than any other day of the week in ISE Repo Market in all observation periods.

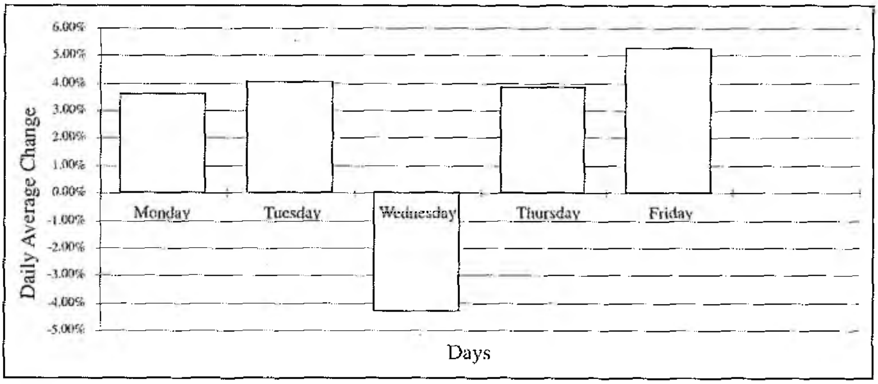
Similar to the findings in Interbank Market, we see that overnight interest rates determined at ISE Repo Market fall significantly on Wednesdays relative to previous day. Average daily change in overnight rates of Wednesdays is -4.58%. Fridays face the highest increase in interest rates which is 6.3%, across the weekdays. Although average percentage change in interest rates in ISE Repo increase on Thursdays (4.05%) is higher than the change in other days except Fridays, median percentage change on Thursdays is low and negative (-1.13%) and different than it is on other days. The highest increase in interest rates is generated on Mondays according to the median values in all periods.

Variability of overnight rates are increasing at the second part of the week, from Wednesdays to Fridays, and reaching its highest point on Fridays. When we check the "mean return per unit of risk" ratio, we find that investing on overnight Repo on Fridays generate higher risk-adjusted returns than doing it on other days. Second highest "mean return per unit of risk" ratio is generated on Mondays. On the other hand, the lowest risk-adjusted interest rate change is faced on Wednesdays across the week.

7 There are no significant differences between the repo rates occured in the ISE Repo Market and interest rates in Interbank Market. Variations between interest rates occured in two different market are around 4-5% due to some technical practices. Higher variations occured seldom based upon the daily changes in the monetary policy of Central Bank of Turkey.

Regression results indicated that the highest percentage increase in overnight interest rates relative to previous day occurred on Fridays, however its coefficient was not statistically important. The fall in overnight interest rates on Wednesdays is found statistically significant at 1% level and average increase in interest rates on Mondays is found statistically significant at 5% level in full period (30.3.1993 - 13.6.1997). Equality tests for the mean changes in daily interest rates across the days have allowed us to rejection of the hypothesis that mean changes among the days of the week are equal. As a result, overnight interest rates on Wednesdays are significantly lower than other days and significantly higher on Mondays relative to the rates of previous days.

**FIGURE 4: DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN ISE REPO MARKET**
**(30.3.1993 - 13.6.1997, Except 1994-Crisis Period)**




We also run the tests for the full period excluding the Crisis-period of ISE Repo Market. We found almost the same results and significance level with what we held in full period. Excluding the Crisis period accelarate the decline of the rates on Wednesdays (-4.33%) and increase of the rates on Mondays (3.58%), (see Figure 4).

Then the same analysis are repeated for the second sub-period: June 1, 1994 to June 13, 1997. Overnight interest rates vary between 19.6% and 186.1% and daily average overnight rate is 72.1% in this period. We found similar results that overnight rates drop on Wednesdays and soar on Mondays significantly relative to previous days. In this period, Monday's significancy dropped to 10% from previous 5%.

On the other hand, rates on Fridays show still the highest increase across the week, however it's not statistically significant.[8]

These results above provide strong evidences for the existence of the seasonal patterns observed in overnight interest rates determined in both Interbank Market and Repo Market of ISE. Interest rates significantly fall on Wednesdays and increase on Mondays relative the previous days, which confirmed the previous findings of Gibbons and Hess (1981).

Significant increase in overnight interest rates on Mondays theoretically demonstrates the negative return on fixed-income (interest rate-based) securities such as bonds or T-Bills whereas the strong drop in overnight interest rates on Wednesdays indicate positive return or profits for the same securities. There are also two other strong trends in interest rates that indicate the decrease on Tuesdays and increase on Fridays. Consistent with the findings of Johnston et.al. (1991) statistically significant decrease on Tuesdays in Interbank implies high positive return on Tuesdays.

## IV. Explanations of Seasonalities in Overnight Interest Rates

Possible explanations for the result of negative change in the interest rates on Wednesdays and Tuesdays, positive change on Mondays and Fridays would be as following;

Treasury used to open Public Borrowing Auctions on Wednesdays till 1994 regularly and announce the auction one day prior to the auction date. However, after the financial crisis in 1994, Treasury could not open auctions in regular basis due to difficult situations. Since the beginning of 1996, Treasury has been conducting auctions on Tuesdays, announcing it on Mondays. Although the regular auction day has been changed to Tuesdays in 1994, payments are still made on Wednesdays. High variability in daily overnight rates on the days of the second part of the week, particularly Fridays are likely to be related to traditional Public Borrowing Auctions that have been conducted by Treasury and paid mostly on Wednesdays and announced on Mondays.

8 We have also tried the same analysis for a new period, from January 1, 1996 to April 4, 1997 with the data of Interbank, we observe a opposite trend on the rate of Fridays which became negative. This finding indicates us that the study should be updated with more data based on longer period in the future to see the effects of time variation.

Market participants try to adjust and balance their positions from previous Friday and Monday for the Public Borrowing Auction which is conducted on Tuesdays or Wednesdays. Public announcements which usually released one day prior from auction date involve some specific information about the conditions or targets on auction and market to the market participants. Banks which balance their positions, expectations for the auction announcement, auction and so market conditions increase the volatility of market from Friday.

**a)** As mentioned above, Public Borrowing Auctions have been conducted by the Treasury on Wednesdays for a long time. Central Bank may change the Interbank overnight interest rates in order to help the Treasury in Public Borrowing Auction. One of the basic aims of the Central Bank and Treasury is to lower or balance the interest rates for reducing cost of borrowing and its burden on the state budget, based on its money policy. By decreasing the overnight rates on auction days, Central Bank gives a signal to the market that interest rates will be lower in auction than its previous level.

Besides the effect of this signal, Central Bank is likely to fund the market participants at lower costs in order to encourage them to join the Treasury auction and bid more because of the public borrowing requirement. Central Bank balance the necessity for liquidity in the market before and after the auction not only to help to Treasury for public borrowing but also to follow its monetary policy.

**b)** On the other hand, Redemptions and/or coupon payments of previously issued T-Bills and/or Government Bonds are executed usually on Wednesdays so that increasing liquidity let overnight interest rates drop. In fact, we have documented that most of the redemptions and/or coupon payments of previously issued T-Bills and/or Government Bonds were made usually on Wednesdays and sometimes on Thursdays.
Our colleagues from "Undersecreteriat of Treasury of Turkey" confirmed that all redemptions or repayments of borrowings are usually planned to be made on Wednesdays as shown in Table 5.

**Table 5. Distributions of Redemption Dates of Public Borrowing Assets (January 1, 1993 - October 30, 1997)**

| | Number of Observations | Share% |
|---|---|---|
| **Monday** | 29 | 10.0 |
| **Tuesday** | 15 | 5.2 |
| **Wednesday** | 167 | 57.6 |
| **Thursday** | 41 | 14.2 |
| **Friday** | 38 | 13.1 |
| **Total** | 290 | 100.0 |

As it is seen above, 167 of 290 or 58% of all redemption dates between January 1, 1993 and October 30, 1997, are Wednesdays, and 14.2% of the dates are Thursdays. Redemption dates of securities are usually set to be on mostly Wednesdays and sometimes on Thursdays. Treasury Public Borrowing Auctions were generally conducted regularly on Wednesdays since 1990.

**c)** Alternatively, banks who will join the public auction and expect the interest rates increase in auction may sell their lower faced-value T-Bills or foreign currency on days ahead of auction to participate to new issues of auction with better yields. It is expected that bidders for the Public Borrowing Auction may sell the T-bills that they own already from Friday or Monday in order to finance their new bids in Treasury auction that is usually conducted on Tuesdays or Wednesdays. In other words, institutional investors or banks who will bid for auction try to provide liquidity for possible executions of their orders in the new auction. Unclear market conditions before the auction announcement, force the banks to adjust their positions from previous Friday or Monday. Furthermore, it is also important that how the banks are financing their bond portfolios. Their continous financing behavior particularly in Public Auction periods by borrowing overnights from Interbank may create seasonalities in overnight interest rates.

**d)** Banks and other institutions who joined to auction but were not able to buy government securities, must evaluate their excess cash funds. Therefore, those banks usually try to sell their excess cash at lower rates in the afternoon of auction-day which really cause the interest rates drop after the results of auction announced. This pattern may also be effected by the auction results which is an important message for the market participants.

**e)** One other reason for the increase in interest rates on Mondays would be the investors' strategic behavior against the Treasury which aims at buying the T-bills at lower prices, i.e. higher interest rates, and to show the interest rates in upward trend before the Treasury auction. Thus, that behavior may effect the interest rates.

**f)** Selling pressure of T-bills on Fridays and Mondays causes increase in interest rates. The reason behind the selling pressure of the market on Fridays would be buying domestic and foreign currency in order to meet some banking-sector reserve requirements (such as dispo and foreign currency transfer) required by Central Bank and/or Treasury. Furthermore, due to stringent conditions in liquidity on Fridays and Thursdays banks may sell their securities one day earlier which may cause an increase on interest rates with a time lag.

**g)** We usually observe that companies generally make their regular payments on Fridays and people demand more cash for the weekends. Increasing number of ATMs force banks to keep more cash in these machines for the possible cash demand of people. Furthermore, banks generally do tax and dispo payments on Thursdays and Fridays so that they face need for liquidity on following Fridays and Mondays. Thus increasing money demand on Fridays and Mondays may be one reason of higher overnight interest rates observed on these days.

**h)** Negative macroeconomic or political information releases or statements which have been made by politicians or bureaucrats during the weekends may increase the concerns of investors about the economical and political stability and reverse the expectations to negative. However that we have no evidences to support that there is a regular negative information flow about macro economy or politics in Turkey.

**i)** Furthermore, investors may have negative psychology on the first trading day of the week, because of the unclear conditions and expectations for the current weeks market activity. Thus, investors may prefer to stay in cash by selling securities on Mondays till at least the expectations be defined.

Finally, factors that effect the liquidity level or money demand in the market determine the overnight interest rates.

Factors such as change in market's cash balance, market's daily reserve balance, public borrowing requirement, public cash flow, wage payments, T-bill or bond redemptions and coupon payments, conditions in foreign currency market, announcement and results of Treasury Auctions, Treasury Auction payments, tax payments, banking-sector reserve requirements, institutional practices, banks that balance the positions of the portfolios on certain days, money demand of people for weekends have an impact on the liquidity level of the market. Central Bank plays an active role both in the Interbank and ISE Repo Markets, particularly after 1994-Crisis and maintains the proper liquidity conditions to keep its money policy for the public benefit. Thus Central Bank and Treasury, two public institutions, determine the liquidity conditions and so that overnight interest rates in the money markets in Turkey.

## V. Summary and Conclusion

We found the existence of day-of-the-week-effect in overnight interest rates so that interest rates collapse on Wednesdays and soar on Mondays significantly relative the previous days. There are also two other strong trends in interest rates that indicate the decrease on Tuesdays and increase on Fridays. On the other hand, volatility of the interest rates is higher in the second part of the week (from Wednesday to Friday) and reaches its highest level on Fridays whereas Tuesdays and Mondays are the lowest days.

Significant increases in interest rates on Mondays and Fridays and decreases on Wednesdays and Tuesdays are likely to be related to Public Borrowing Auctions. Institutional practices such as regulations made by governmental agencies like Central Bank, Treasury, Tax Administration, and so forth, public borrowing requirement, market's daily reserve balance, public cash flow, wage payments, conditions in foreign currency market, settlement procedure of Treasury Auctions, tax payments, banking-sector reserve requirements, money demand of people for weekends, auction and redemption dates that are set to be on specific days of the week, public announcements and results of Treasury Auctions, coordinated market policy of the Central Bank and Treasury, strategies of market participants, banks who balance the positions of the portfolios on certain days, specific days across the week for payments, liquidity demand which may be sourced by institutional practices, excess cash flows of the market participants who joined the auction but were not able to buy government securities and expectations on liquidity level of the other day are the main factors that determine the liquidity conditions of the market. These factors may cause the seasonality in liquidity across the week which are possible explanations of the day-of-the-week effect in overnight repo interest rates observed in Turkey.

Finally, the existence of the day-of-the-week effect has implications regarding the regulations and public policy on markets. Our findings are consistent with the liquidity conditions of the market, the liquidity policy of the Central Bank and Treasury Auction-related issues for the day-of-the-week effect in overnight interest rates which shows that regulatory bodies of the markets have an important creative impact on the seasonalities in interest rates.

Assuming that the changes on overnight interest rates effect the discount rates of T-Bills or bonds in the same direction, theoretically, significant increase in overnight interest rates on Mondays may have the prices of T-Bills dropped relative to previous day by generating negative return on Treasury securities, whereas the strong drop in overnight interest rates on Wednesdays provide positive return or profits for the same securities. Therefore, buying the T-bills on Mondays and selling it on Wednesdays or Fridays, which is an active trading strategy based on seasonalities in overnight interest rates that we found may provide abnormally higher returns for the investors than basic "buy and hold" strategy.

Future analysis for the existence of seasonalities in the prices of Treasury securities will show us the power of relationship between overnight interest rates and Treasury securities prices and how the changes in overnight interest rates reflect to security prices. These tests will provide direct evidences whether an active trading strategy based on seasonalities in interest rates provides higher returns or not.

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## TABLE 1. SUMMARY STATISTICS OF OVERNIGHT INTEREST RATES (%) IN INTERBANK MARKET

### DAILY AVERAGE OVERNIGHT INTEREST RATES (%) IN INTERBANK MARKET (6.10.1990 - 13.6.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 79.81 | 79.74 | 78.10 | 77.21 | 80.95 | 79.15% |
| **Median** | 67.75 | 66.92 | 65.94 | 66.75 | 66.76 | 66.77% |
| **Minimum** | 24.66 | 30.21 | 20.89 | 20.43 | 20.76 | 20.43% |
| **Maximum** | 584.45 | 581.03 | 500.00 | 500.00 | 696.68 | 696.68% |
| **Count** | 320 | 321 | 326 | 329 | 323 | 1619 |

### DAILY AVERAGE OVERNIGHT INTEREST RATES (%) IN INTERBANK MARKET (6.10.1990 - 31.12.1993)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 65.96 | 66.02 | 66.15 | 66.09 | 66.25 | 66.09% |
| **Median** | 64.03 | 63.88 | 63.77 | 63.77 | 63.82 | 63.84% |
| **Minimum** | 50.20 | 50.07 | 50.08 | 50.14 | 50.19 | 50.07% |
| **Maximum** | 110.00 | 114.57 | 125.33 | 128.15 | 147.39 | 147.39% |
| **Count** | 160 | 161 | 161 | 162 | 159 | 803 |

### DAILY AVERAGE OVERNIGHT INTEREST RATES (%) IN INTERBANK MARKET (1.6.1994 - 4.4.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 75.12 | 72.69 | 69.45 | 71.29 | 73.71 | 72.43% |
| **Median** | 74.85 | 74.43 | 72.97 | 72.04 | 73.95 | 74.21% |
| **Minimum** | 24.66 | 30.21 | 20.89 | 20.43 | 20.76 | 20.43% |
| **Maximum** | 161.64 | 129.87 | 133.10 | 190.84 | 188.03 | 190.84% |
| **Count** | 140 | 140 | 144 | 147 | 144 | 715 |

## TABLE 2. DESCRIPTIVE STATISTICS OF DAILY AVERAGE CHANGES IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET (6.10.1990 - 4.4.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Mean | 2.75% | 0.63% | -2.20% | 2.25% | 4.95% | 1.67% |
| Median | 0.02% | 0.00% | -0.01% | 0.00% | 0.00% | 0.00% |
| Std. Dev. | 14.81% | 25.22% | 17.42% | 22.15% | 26.40% | 21.77% |
| Kurtosis | 8.77 | 201.14 | 13.82 | 21.64 | 25.61 | 88.22 |
| Skewness | 1.97 | 12.82 | 1.10 | 3.57 | 4.23 | 6.47 |
| Minimum | -43.34% | -44.87% | -72.62% | -59.90% | -51.91% | -72.62% |
| Maximum | 92.58% | 401.39% | 130.89% | 167.79% | 211.17% | 401.39% |
| Count | 320 | 321 | 326 | 329 | 323 | 1619 |

### INTERBANK / 6.10.1990 - 4.4.1997 Regression Results

| | Monday | Tuesday | Wednesday | Thursday | Friday | F-Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0275 | -0.0212 | -0.0495 | -0.0050 | 0.0220 | 4.90 |
| t-Statics | 2.27 | -1.24 | -2.90 | -0.29 | 1.29 | |
| P-Value | 0.0233 | 0.2150 | 0.0037 | 0.7701 | 0.1975 | 0.0006 |

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET (6.10.1990 - 31.12.1993)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Mean | 0.43% | 0.21% | -0.21% | -0.18% | 0.23% | 0.09% |
| Median | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Std. Dev. | 4.83% | 2.33% | 3.81% | 2.83% | 2.84% | 3.44% |
| Kurtosis | 51.43 | 28.36 | 31.17 | 30.12 | 27.03 | 55.50 |
| Skewness | 4.12 | 4.35 | -2.27 | 2.53 | 3.46 | 2.59 |
| Minimum | -27.12% | -7.20% | -29.68% | -14.41% | -12.29% | -29.68% |
| Maximum | 44.34% | 15.97% | 21.44% | 22.60% | 20.48% | 44.34% |
| Count | 160 | 161 | 161 | 162 | 159 | 803 |

INTERBANK / 6.10.1990-31.12.1993
Regression Results

| | Monday | Tuesday | Wednesday | Thursday | Friday | F- Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0043 | -0.0022 | -0.0064 | -0.0061 | -0.0020 | 1.05 |
| t-Statics | 1.58 | -0.57 | -1.66 | -1.58 | -0.52 | |
| P-Value | 0.1155 | 0.5665 | 0.0964 | 0.1144 | 0.6002 | 0.3806 |

## TABLE 2. DESCRIPTIVE STATISTICS OF DAILY AVERAGE CHANGES IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET

DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET
(6.10.1990 - 4.4.1997) (Except Crisis Period - 1.1.1994-30.5.1994)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Mean | 2.62% | -0.64% | -1.98% | 2.42% | 3.97% | 1.28% |
| Median | 0.02% | 0.00% | -0.02% | 0.00% | 0.00% | 0.00% |
| Std. Dev. | 14.12% | 10.97% | 16.80% | 20.54% | 21.96% | 17.50% |
| Kurtosis | 9.59 | 28.61 | 16.31 | 26.38 | 23.73 | 27.54 |
| Skewness | 1.91 | 2.57 | 1.57 | 4.04 | 3.78 | 3.50 |
| Minimum | -43.34% | -44.87% | -60.75% | -56.69% | -51.91% | -60.75% |
| Maximum | 92.58% | 99.43% | 130.89% | 167.79% | 196.61% | 196.61% |
| Gözl. sayısı | 300 | 301 | 305 | 309 | 303 | 1518 |

INTERBANK / (6.10.1990 - 4.4.1997) (Except Crisis Period - 1.1.1994-30.5.1994)
Regression Results

| | Monday | Tuesday | Wednesday | Thursday | Friday | F- Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0262 | -0.0327 | -0.0460 | -0.0020 | 0.0134 | 6.20 |
| t-Statics | 2.62 | -2.30 | -3.26 | -0.14 | 0.95 | |
| P-Value | 0.0090 | 0.0214 | 0.0011 | 0.8856 | 0.3423 | 0.0001 |

## TABLE 2. DESCRIPTIVE STATISTICS OF DAILY AVERAGE CHANGES IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN INTERBANK MARKET (1.6.1994 - 4.4.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 5.13% | -1.62% | -3.96% | 5.29% | 8.10% | 2.61% |
| **Median** | 0.20% | -0.12% | -0.99% | 0.03% | 0.06% | -0.01% |
| **Std. Dev.** | 19.76% | 15.87% | 24.01% | 29.42% | 31.26% | 25.18% |
| **Kurtosis** | 3.32 | 13.38 | 7.43 | 10.89 | 9.61 | 11.66 |
| **Skewness** | 1.08 | 2.01 | 1.41 | 2.63 | 2.39 | 2.33 |
| **Minimum** | -43.34% | -44.87% | -60.75% | -56.69% | -51.91% | -60.75% |
| **Maximum** | 92.58% | 99.43% | 130.89% | 167.79% | 196.61% | 196.61% |
| **Gözl. sayısı** | 140 | 140 | 144 | 147 | 144 | 715 |

### INTERBANK 1.6.1994-4.4.1997 Regression Results

| | Monday | Tuesday | Wednesday | Thursday | Friday | F-Value |
|---|---|---|---|---|---|---|
| **Coefficients** | 0.0513 | -0.0675 | -0.0909 | 0.0015 | 0.0297 | 6.08 |
| **t-Statics** | 2.45 | -2.27 | -3.09 | 0.05 | 1.01 | |
| **P-Value** | 0.0147 | 0.0232 | 0.0021 | 0.9584 | 0.3142 | 0.0001 |

## TABLE 3. SUMMARY STATISTICS OF OVERNIGHT INTEREST RATES (%) IN ISE REPO MARKET

### DAILY AVERAGE OVERNIGHT INTEREST RATES (%) IN ISE REPO MARKET (30.3.1993 - 13.6.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 83.03 | 85.05 | 80.16 | 80.21 | 81.90 | 82.07 |
| **Median** | 71.86 | 73.92 | 70.29 | 71.43 | 70.31 | 71.44 |
| **Minimum** | 19.64 | 23.40 | 24.03 | 21.12 | 20.06 | 19.64 |
| **Maximum** | 723.69 | 681.02 | 626.19 | 487.65 | 705.74 | 723.69 |
| **Count** | 206 | 203 | 204 | 204 | 200 | 1017 |

### DAILY AVERAGE OVERNIGHT INTEREST RATES (%) IN ISE REPO MARKET (1.6.1994 - 13.6.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| **Mean** | 72.37 | 74.19 | 69.83 | 71.71 | 72.58 | 72.12 |
| **Median** | 73.30 | 74.58 | 71.29 | 71.62 | 71.01 | 72.96 |
| **Minimum** | 19.64 | 23.40 | 24.03 | 21.12 | 20.06 | 19.64 |
| **Maximum** | 132.14 | 133.32 | 136.93 | 186.09 | 153.02 | 186.09 |
| **Gözl. sayısı** | 149 | 151 | 154 | 152 | 149 | 755 |

## TABLE 4. DESCRIPTIVE STATISTICS OF DAILY AVERAGE CHANGES IN OVERNIGHT INTEREST RATES (%) IN ISE REPO MARKET

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN ISE REPO MARKET (30.3.1993 - 13.6.1997

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Mean | 3.98% | 3.79% | -4.58% | 4.05% | 6.30% | 2.69% |
| Median | 1.55% | 0.86% | -3.67% | -1.13% | 0.53% | -0.07% |
| Std. Dev. | 22.41% | 21.94% | 25.14% | 28.31% | 29.08% | 25.76% |
| Kurtosis | 19.73 | 18.11 | 12.65 | 9.94 | 9.81 | 12.57 |
| Skewness | 2.79 | 3.03 | 2.12 | 2.58 | 2.55 | 2.54 |
| Minimum | -60.30% | -52.65% | -60.30% | -50.61% | -49.35% | -60.30% |
| Maximum | 180.18% | 160.69% | 167.61% | 159.96% | 170.26% | 180.18% |
| Count | 205 | 203 | 204 | 204 | 200 | 1016 |

| | Monday | Tuesday | Wednesday | Thursday | Friday | F-Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0398 | -0.0018 | -0.0856 | 0.0007 | 0.0233 | 5.51 |
| t-Statics | 2.23 | -0.07 | -3.39 | 0.03 | 0.92 | |
| P-Value | 0.0260 | 0.9424 | 0.0007 | 0.9766 | 0.3596 | 0.0002 |

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN ISE REPO MARKET (30.3.1993 - 13.6.1997) (Except Crisis Period - 1.1.1994-30.5.1994)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Mean | 3.58% | 4.03% | -4.33% | 3.85% | 5.27% | 2.47% |
| Median | 1.19% | 0.86% | -3.33% | -0.76% | 0.29% | -0.09% |
| Std. Dev. | 21.77% | 22.34% | 25.39% | 25.94% | 27.35% | 24.83% |
| Kurtosis | 23.69 | 18.53 | 13.47 | 11.39 | 12.44 | 14.31 |
| Skewness | 3.02 | 3.21 | 2.24 | 2.70 | 2.82 | 2.68 |
| Minimum | -60.30% | -52.65% | -60.30% | -50.61% | -49.35% | -60.30% |
| Maximum | 180.18% | 160.69% | 167.61% | 159.96% | 170.26% | 180.18% |
| Count | 185 | 183 | 184 | 184 | 181 | 917 |

| | Monday | Tuesday | Wednesday | Thursday | Friday | F-Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0358 | 0.0045 | -0.0791 | 0.0027 | 0.0169 | 4.51 |
| t-Statics | 1.97 | 0.18 | -3.08 | 0.11 | 0.66 | |
| P-Value | 0.0488 | 0.8598 | 0.0021 | 0.9155 | 0.5115 | 0.0013 |

## TABLE 4. DESCRIPTIVE STATISTICS OF DAILY AVERAGE CHANGES IN OVERNIGHT INTEREST RATES (%) IN ISE REPO MARKET

### DAILY AVERAGE CHANGE IN OVERNIGHT INTEREST RATES IN ISE REPO MARKET (1.6.1994 - 13.6.1997)

| | Monday | Tuesday | Wednesday | Thursday | Friday | All Days |
|---|---|---|---|---|---|---|
| Ortalama | 3.60% | 3.95% | -4.04% | 4.83% | 6.12% | 2.86% |
| Median | 0.65% | 0.20% | -3.30% | -0.43% | 0.40% | -0.15% |
| Std. Dev. | 23.65% | 24.29% | 27.23% | 27.88% | 29.65% | 26.81% |
| Kurtosis | 20.93 | 15.86 | 11.87 | 9.74 | 10.35 | 12.31 |
| Skewness | 2.96 | 3.05 | 2.16 | 2.55 | 2.62 | 2.55 |
| Minimum | -60.30% | -52.65% | -60.30% | -50.61% | -49.35% | -60.30% |
| Maximum | 180.18% | 160.69% | 167.61% | 159.96% | 170.26% | 180.18% |
| Count | 149 | 151 | 154 | 152 | 149 | 755 |

| | Monday | Tuesday | Wednesday | Thursday | Friday | F-Value |
|---|---|---|---|---|---|---|
| Coefficients | 0.0360 | 0.0035 | -0.0764 | 0.0123 | 0.0252 | 3.44 |
| t-Statics | 1.65 | 0.11 | -2.49 | 0.40 | 0.82 | |
| P-Value | 0.0996 | 0.9094 | 0.0128 | 0.6887 | 0.4144 | 0.0085 |

The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 

# GLOBAL CAPITAL MARKETS

Bursting out in South East Asia in June-July 1997, the economic and financial crisis did not remain there and extended through all other world economies especially from October 1997. In spite of the financial crisis caused the falls in the shares prices together with the high devaluation rate; financial activities increased by 12.6 % according to the previous year and reached to USD 1.77 trillion. Bond trading represented 47 % of this huge volume in international financial market (OECD Financial Market Trends, February 1998).

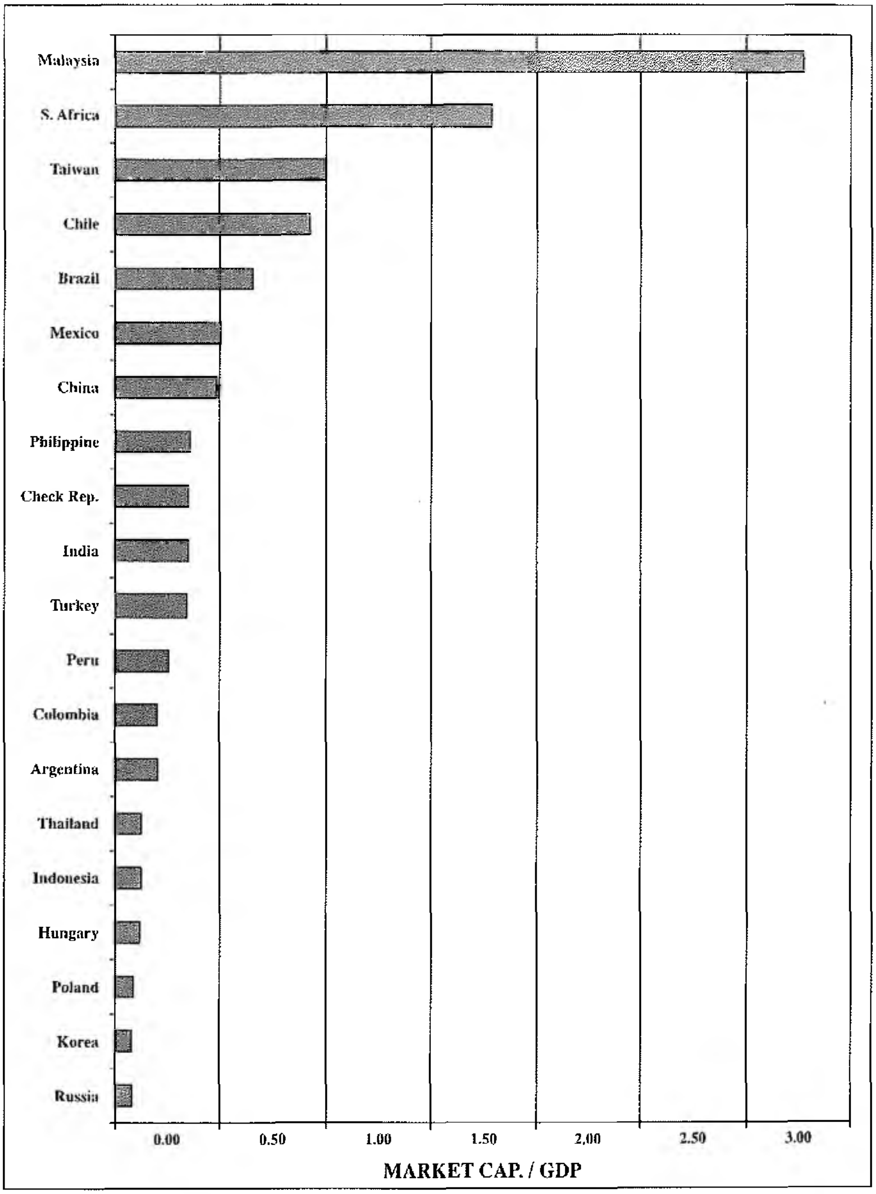
During the extension of the crisis in the last quarter of 1997, the bond offerings cramped about %40 with respect to the sharp decreases in the stock markets indices, and to the high volatilities. Another important development in financial markets in 1997 is the divergence of long term interest rates in EU's countries, and in Canada and the USA as well. The divergence of long-term interest rates is also a substantive factor in the establishment of the European Monetary Union (EMU) that is already agreed by 11 member countries. On the other hand, short term interest rates did not follow the same movement. The latter rates in England increased, depending upon high growth and satisfactory employment last year.

Dropping by 14.5 % in 1997, below its lowest in 1995, the IFCG Composite Index gradually increased in the first quarter of 1998. On the contrary, the S&P 500 raised 50.3% and reached a peak in 1997 which is a record of the last 13 years. The raising trend continued in the first quarter as well. The increase in the FT EuroPac Index was 8.8% in 1997 and 14% in the first quarter of 1998. Whilst developed markets seemed to be unaffected from the financial crisis, most Asian markets were pushed to very low levels. However, along with the recovery in the economies in early 1998, the stock markets' indices began slightly to raise.

Market capitalization over GDP, as an indicator of the importance of the capital markets in national economy, dropped dramatically in the developing markets except for Malaysia, S.Africa, Chile, and Taiwan. The ratio in Korea, Indonesia, and Thailand fell respectively to 0.08, 0.12 and 0.12 from the previous yaers' values of 0.31, 0.38, and 0.60. In general, despite 24% increase in the market capitalization of developed markets, there was a 31% decrease in emerging markets. As a result, the emerging markets' share in the global markets decreased. The market capitalization over GDP in Turkey, fascinatingly, jumped to 0.34 in 1997 from 0.18 in 1996.

The analysis of emerging markets' performances with respect to price/earnings ratio indicates that, except for Mexico, Taiwan, China, Turkey and Hungary, the ratio dropped considerably in other emerging markets. The most noteworthy decline is detected in Malaysia, Indonesia, Thailand, Chile, Argentina, and the Czech Republic. The price/earnings ratio of the ISE is up to 18.9 last year, as compared with 17.99 a year earlier.

**Emerging Stock Markets' Importance in the National Economy (1997)**




Source : Emerging Markets Investor, Vol.4, No.3, March 1997, 49, 56.

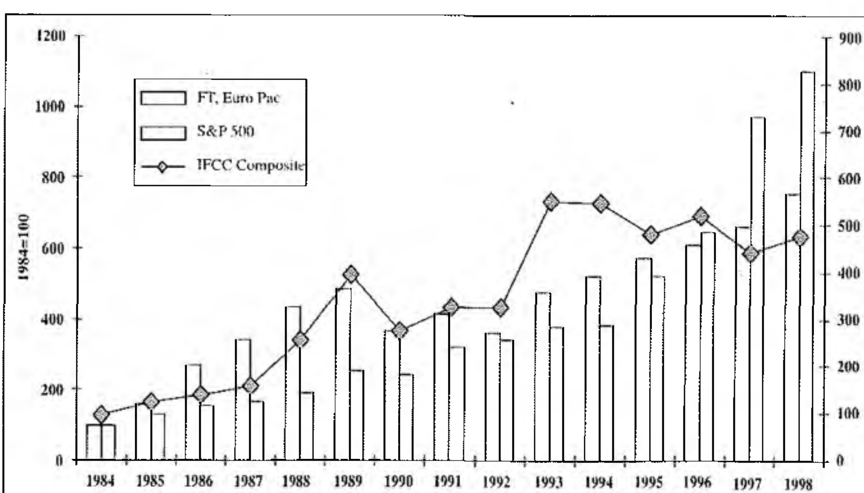
* : The capitalization of stock market as of December 1997 is the total market value of the listed and trading companies in the country's stock exchange or exchanges. GDP/GNP values are estimated by the adjustment of previous year GDP according to last years' growth rates.

**Market Capitalization (USD Million, 1986-1997)**

| | 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** | 11,713,683 | 10,975,622 | 738,061 | 6,756 |
| **1990** | 9,393,545 | 8,782,267 | 611,278 | 18,737 |
| **1991** | 11,290,494 | 10,435,686 | 854,808 | 15,564 |
| **1992** | 10,833,177 | 9,949,721 | 883,456 | 9,922 |
| **1993** | 13,963,831 | 12,377,034 | 1,586,797 | 37,824 |
| **1994** | 15,154,292 | 13,241,841 | 1,912,451 | 21,785 |
| **1995** | 17,787,883 | 15,892,174 | 1,895,709 | 20,782 |
| **1996** | 20,158,845 | 17,932,888 | 2,225,957 | 30,792 |
| **1997** | **23,541,385** | **21,311,877** | **2,229,508** | **61,095** |

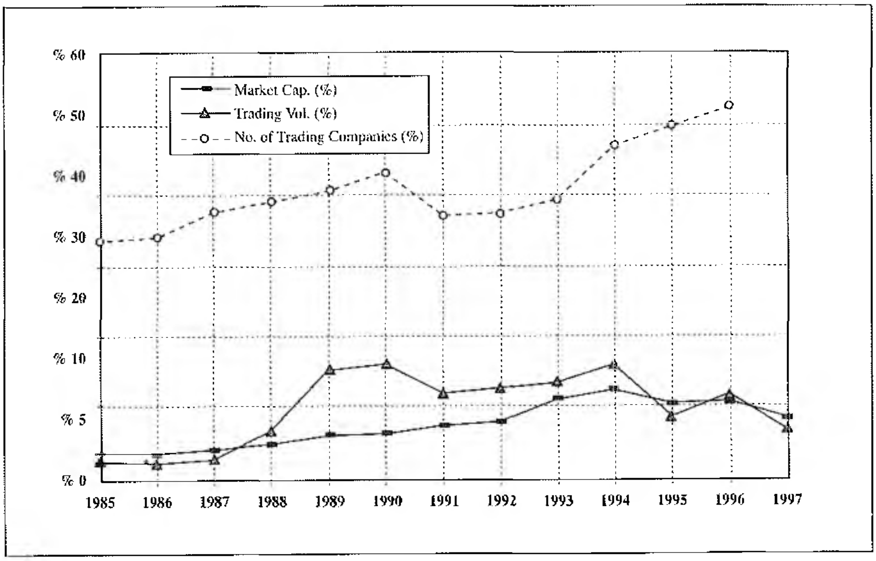
Source: IFC Factbook 1996,16-17; Emerging Markets Montly Review, December 1997, 8; ISE Monthly Bulletin, January 1998.

**Comparison of Markets' Indices (1984-97)**



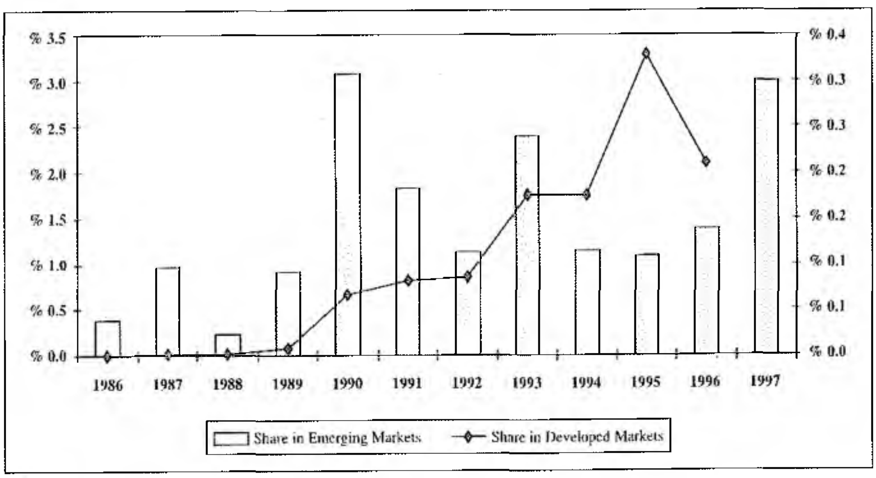

Source: IFC Factbook 1997; IFC Monthly Review, March 1998.

## Worldwide Share of Emerging Capital Markets (1985-1997)




Source : IFC Factbook 1996-1997, 16-23; IFC Database.
Not : Number of trading companies in emerging markets dramatically increased until 1996 and the worldwide share reached above 50 %. On the other hand, their share in global capitalization is relatively very low since the average sizes of the companies are significantly smaller.

## The ISE's Share in World Markets (1986-1997)




Source: IFC, 1996-1997; IFC Database.

## Main Indicators of Capital Markets (March 1998)

| | Market | Turnover Velocity (March) | Market | Value of Share Trading (millions, US$) Up to Year Total | Market | Market Cap. of Shares of Domestic Companies (millions, US$) (March) |
|---|---|---|---|---|---|---|
| 1 | Taiwan | 396.6% | NYSE | 1,681,481.5 | NYSE | 10,090,780.4 |
| 2 | NASDAQ | 259.7% | NASDAQ | 1,236,717.6 | London | 2,428,791.2 |
| 3 | Paris | 228.1% | London | 730,878.9 | Tokyo | 2,306,854.8 |
| 4 | Korea | 201.1% | Paris | 399,803.3 | NASDAQ | 2,009,939.8 |
| 5 | Germany | 189.0% | Germany | 344,930.6 | Osaka | 1,862,068.4 |
| 6 | Madrid | 185.2% | Taiwan | 297,781.5 | Germany | 979,051.6 |
| 7 | Italy | 150.7% | Tokyo | 206,113.5 | Paris | 843,697.7 |
| 8 | Istanbul | 126.8% | Switzerland | 188,119.3 | Switzerland | 673,570.6 |
| 9 | Switzerland | 122.4% | Madrid | 163,399.5 | Toronto | 643,837.8 |
| 10 | Lisbon | 105.8% | Italy | 137,369.3 | Amsterdam | 562,114.9 |
| 11 | Athens | 102.7% | Amsterdam | 93,090.0 | Italy | 497,104.3 |
| 12 | Thailand* | 84.9% | Toronto | 91,805.1 | Hong Kong | 416,194.8 |
| 13 | Oslo | 80.5% | Hong Kong | 68,859.2 | Madrid | 389,269.5 |
| 14 | Irish | 80.2% | Osaka | 68,166.9 | Taiwan | 338,398.8 |
| 15 | Amsterdam | 79.1% | Barcelona | 57,552.4 | Australian | 321,583.9 |
| 16 | Barcelona | 76.9% | Stokholm | 56,366.6 | Bilbao | 312,226.5 |
| 17 | Stockholm | 76.3% | Bilbao | 52,598.1 | Stokholm | 312,212.8 |
| 18 | Jakarta | 74.7% | Australian | 38,727.7 | Barcelona | 306,210.6 |
| 19 | Warsaw | 73.6% | Korea | 36,349.4 | Rio de Janerio | 277,055.5 |
| 20 | Copenhagen | 71.8% | Singapore | 20,005.2 | Johannesburg | 276,984.3 |
| 21 | NYSE | 67.9% | Istanbul | 16,548.0 | Brussels | 169,761.1 |
| 22 | Vancouver | 66.6% | Copenhagen | 16,054.3 | Mexico | 141,325.6 |
| 23 | Singapore | 63.1% | Johannesburg | 13,624.8 | K,Lumpur | 125,083.4 |
| 24 | Hong Kong | 62.5% | K,Lumpur | 12,498.9 | Singapore | 110,982.2 |
| 25 | Toronto | 61.5% | Oslo | 11,962.6 | Copenhagen | 106,474.4 |
| 26 | Bilbao | 60.8% | Lisbon | 11,830.6 | Helsinki | 95,912.4 |
| 27 | Helsinki | 55.6% | Brüksel | 11,475.9 | Santiago | 70,612.5 |
| 28 | B,Aires | 54.2% | Helsinki | 11,028.3 | Oslo | 69,924.9 |
| 29 | Australian | 52.9% | Irish | 10,931.2 | Korea | 68,047.0 |
| 30 | N,Zealand | 50.4% | Mexico | 10,598.6 | Irish | 61,734.2 |
| 31 | London | 49.9% | Athens | 9,687.0 | Buenos Aires | 60,280.2 |
| 32 | Vienna | 46.1% | Buenos Aires | 7,599.3 | Lisbon | 58,636.0 |
| 33 | Tokyo | 44.7% | Vienna | 4,491.6 | Istanbul | 51,436.7 |
| 34 | Philippine | 41.0% | Jakarta | 4,430.6 | Tel-Aviv | 47,620.3 |
| 35 | Tel-Aviv | 39.3% | Thailand | 4,041.2 | Vienna | 43,333.6 |
| 36 | Osaka | 37.1% | Tel-Aviv | 3,536.8 | Athens | 42,424.4 |
| 37 | Mexico | 32.5% | Phillippine | 3,302.3 | Phillippine | 40,501.4 |
| 38 | K,Lumpur | 29.7% | New Zealand | 2,652.7 | Thailand* | 38,142.7 |
| 39 | Brussels | 28.7% | Warsaw | 2,402.9 | Luxembourg | 32,583.4 |
| 40 | Johannesburg | 24.7% | Rio de Janerio | 1,858.6 | New Zealand | 28,341.2 |
| 41 | Lima | 18.0% | Santiago | 1,363.9 | Jakarta | 26,405.8 |
| 42 | Tehran | 8.5% | Vancouver | 894.8 | Warsaw | 15,588.4 |
| 43 | Santiago | 8.3% | Lima | 828.4 | Tehran | 15,127.7 |
| 44 | Rio de Janerio | 3.4% | Tehran | 258.8 | Lima | 14,329.5 |
| 45 | Luxembourg | 2.3% | Luxembourg | 174.1 | Vancouver | 6,479.1 |

Source: FIBV, Focus, March 1998,

**Trading Volume (USD bills, 1986-97)**

| | 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 | 0.02 |
| **1989** | 7,468,215 | 6,302,687 | 1,165,528 | 773 | 15.61 | 0.07 |
| **1990** | 5,512,129 | 4,617,688 | 894,441 | 5,854 | 16.23 | 0.65 |
| **1991** | 5,016,379 | 4,410,855 | 605,524 | 8,502 | 12.07 | 1.42 |
| **1992** | 4,778,429 | 4,165,501 | 612,928 | 8,567 | 12.83 | 1.34 |
| **1993** | 7,702,502 | 6,633,684 | 1,068,818 | 21,770 | 13.88 | 2.17 |
| **1994** | 10,085,703 | 8,445,585 | 1,640,118 | 23,203 | 16.26 | 1.32 |
| **1995** | 11,666,260 | 10,632,763 | 1,033,497 | 52,357 | 8.86 | 4.97 |
| **1996** | 13,580,050 | 11,993,232 | 1,586,818 | 37,737 | 11.7 | 2.38 |
| **1997** | 19,484,706 | 16,782,995 | 2,701,711 | 58,104 | 13.9 | 2.15 |

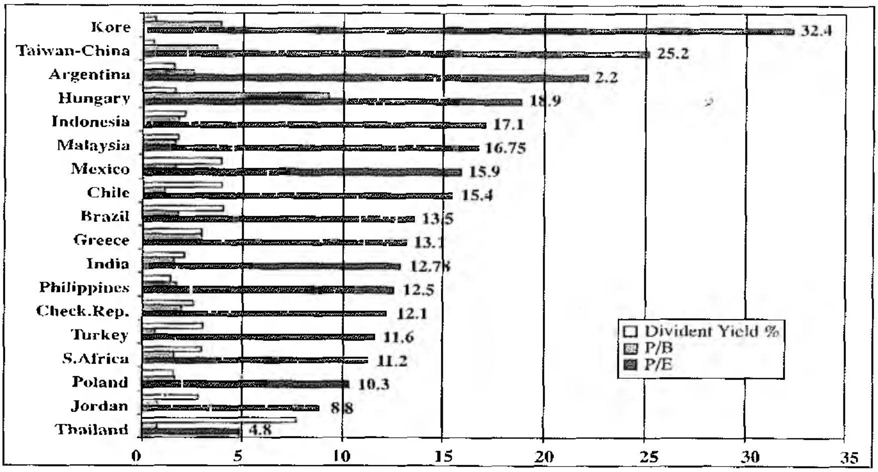
Source: IFC Factbook 1996-1997, pp.20-21; IFC Database.

**Number of Trading Companies (1986-97)**

| | Global | Developed | Emerging | ISE | Emerging/ Global (%) | ISE/ Emerging (%) |
|---|---|---|---|---|---|---|
| **1986** | 28,173 | 18,555 | 9,618 | 40 | 34.14 | 0.42 |
| **1987** | 29,278 | 18,265 | 11,013 | 50 | 37.62 | 0.45 |
| **1988** | 29,270 | 17,805 | 11,465 | 50 | 39.17 | 0.44 |
| **1989** | 29,486 | 17,478 | 12,008 | 50 | 40.72 | 0.42 |
| **1990** | 28,918 | 16,403 | 12,515 | 110 | 43.28 | 0.88 |
| **1991** | 25,951 | 16,315 | 9,636 | 134 | 37.13 | 1.39 |
| **1992** | 27,586 | 17,227 | 10,359 | 145 | 37.55 | 1.40 |
| **1993** | 28,768 | 17,431 | 11,337 | 152 | 39.41 | 1.34 |
| **1994** | 36,078 | 19,064 | 17,014 | 176 | 47.16 | 1.03 |
| **1995** | 38,864 | 19,467 | 19,397 | 205 | 49.91 | 1.06 |
| **1996** | 42,351 | 20,088 | 22,263 | 228 | 52.60 | 1.36 |
| **1997** | 40,593 | 20,656 | 19,937 | 258 | 49,1 | 1,29 |

Source: IFC Factbook 1996-1997, pp. 22, 23; IFC Database; Istanbul Stock Exchange.

**Comparison of Markets' Performances (Dec 1997)**



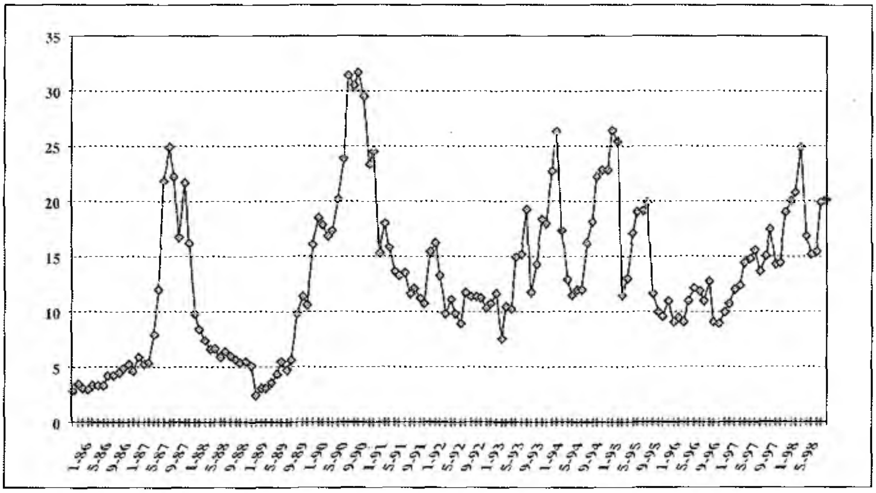

Source: IFC, Monthly Review, June 1997.
Notes: P/B= Market Value (price)/Book Value; P/E = Price/Earnings.

**Price-Earnings Ratios in Emerging Markets (1992-1997)**

| | 1993 | 1994 | 1995 | 1996 | 1997 January | 1997 |
|---|---|---|---|---|---|---|
| Taiwan-China | 34.7 | 36.8 | 21.4 | 28.16 | 29.45 | 32.4 |
| Hungary | 52.4 | -55.3 | 12.0 | 17.48 | 23.75 | 25.2 |
| Mexico | 19.4 | 17.1 | 28.4 | 16.79 | 16.73 | 22.2 |
| Turkey | 36.3 | 31.0 | 8.4 | 10.74 | 17.99 | 18.9 |
| Argentina | 41.9 | 17.7 | 15.0 | 38.21 | 39.81 | 17.1 |
| India | 39.7 | 26.7 | 14.2 | 12.32 | 13.76 | 16.8 |
| Chile | 20.0 | 21.4 | 17.1 | 27.76 | 15.85 | 15.9 |
| Brasil | 12.6 | 13.1 | 36.3 | 14.5 | 15.49 | 15.4 |
| Malaysia | 43.5 | 29.0 | 25.1 | 27.11 | 27.46 | 13.5 |
| Greece | 10.2 | 10.4 | 10.5 | 10.45 | 13.13 | 13.1 |
| Jordan | 17.9 | 20.8 | 18.2 | 16.89 | 14.93 | 12.8 |
| Philippine | 38.8 | 30.8 | 19.0 | 19.99 | 20.69 | 12.5 |
| S.Africa | 17.3 | 21.3 | 18.8 | 16.27 | 16.24 | 12.1 |
| Korea | 25.1 | 34.5 | 19.8 | 1.69 | 12.57 | 11.6 |
| Indonesia | 28.9 | 20.2 | 19.8 | 21.62 | 24.34 | 11.2 |
| Poland | 31.5 | 12.9 | 7.0 | 14.3 | 16.15 | 10.3 |
| Check.Rep. | 18.8 | 16.3 | 11.2 | 17.62 | 14.67 | 8.8 |
| Tailand | 27.5 | 21.2 | 21.7 | 13.06 | 13.84 | 4.8 |

Source: IFC Factbook 1996, 129-233; IFC, July 1997.

## ISE's Price-Earnings Ratio (1986-1998)



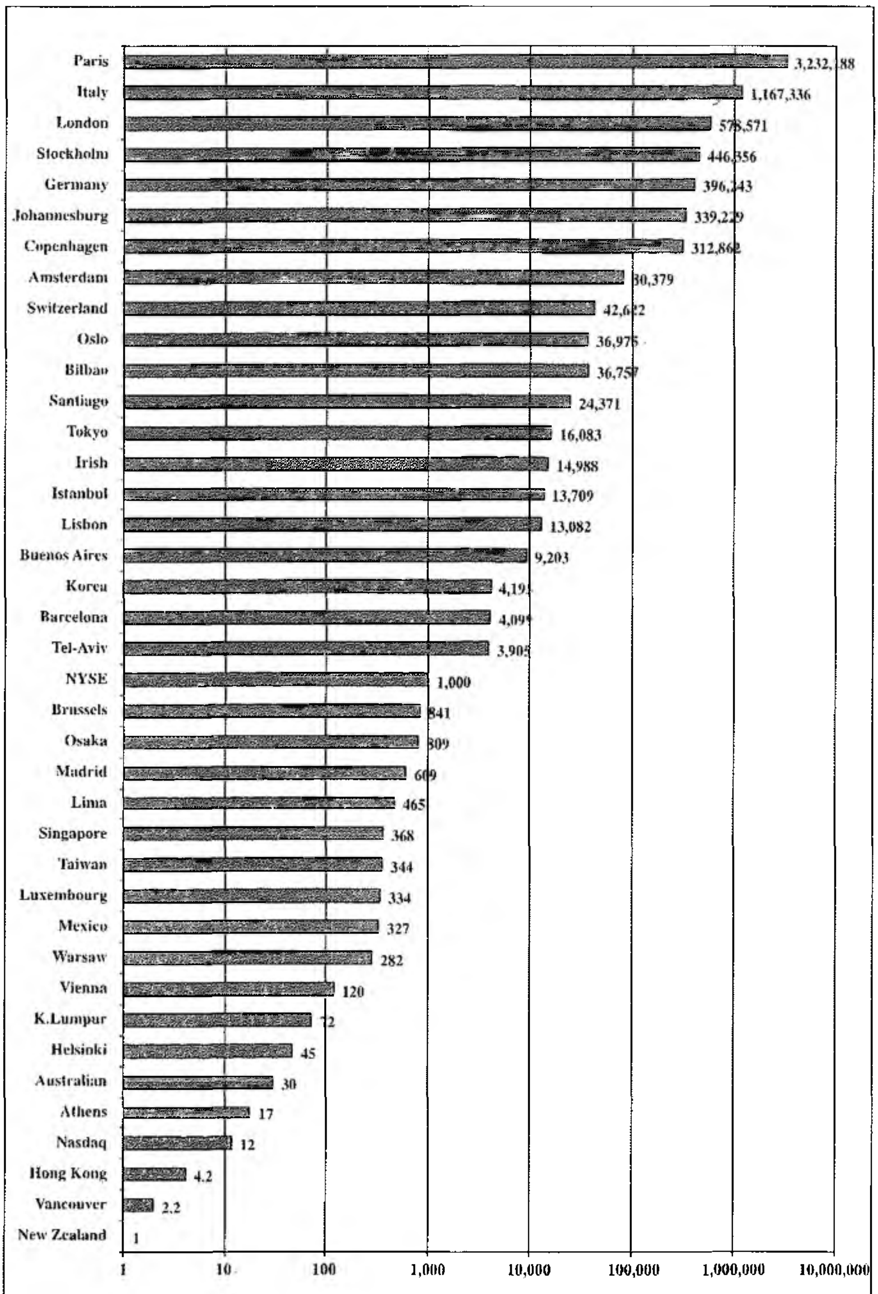
Source: ISE Monthly Bulletin, May 1998.

## Market Value/Book Value Ratios (1992-Jan 1997)

| | 1993 | 1994 | 1995 | 1996 | 1997 Jan. | 1997 |
|---|---|---|---|---|---|---|
| **Turkey** | 7.2 | 6.3 | 2.7 | 3.98 | 6.64 | 9.2 |
| **Taiwan.China** | 3.9 | 4.4 | 2.7 | 3.31 | 3.48 | 3.8 |
| **Hungary** | 1.6 | 1.7 | 1.2 | 1.97 | 2.33 | 3.7 |
| **Greece** | 1.9 | 1.9 | 1.8 | 2.01 | 2.45 | 2.9 |
| **India** | 4.9 | 4.2 | 2.3 | 2.07 | 2.58 | 2.7 |
| **Mexico** | 2.6 | 2.2 | 1.7 | 1.68 | 1.76 | 2.5 |
| **S.Africa** | 1.8 | 2.6 | 2.5 | 2.34 | 2.6 | 1.9 |
| **Malaysia** | 5.4 | 3.8 | 3.3 | 3.78 | 3.98 | 1.8 |
| **Argentina** | 1.9 | 1.4 | 1.3 | 1.62 | 1.73 | 1.8 |
| **Philippine** | 5.2 | 4.5 | 3.2 | 3.14 | 3.24 | 1.7 |
| **Poland** | 5.7 | 2.3 | 1.3 | 2.59 | 2.93 | 1.6 |
| **Chile** | 2.1 | 2.5 | 2.1 | 1.59 | 1.72 | 1.6 |
| **Jordan** | 2.0 | 1.7 | 1.9 | 1.71 | 1.88 | 1.6 |
| **Endonesia** | 3.1 | 2.4 | 2.3 | 2.66 | 3.01 | 1.5 |
| **Brazil** | 0.5 | 0.6 | 0.5 | 0.73 | 0.79 | 1.1 |
| **Tailand** | 4.7 | 3.7 | 3.3 | 1.78 | 1.9 | 0.8 |
| **Check** Rep. | 1.3 | 1 | 0.9 | 0.89 | 0.97 | 0.8 |
| **Korea** | 1.4 | 1.6 | 1.3 | 0.76 | 0.8 | 0.6 |

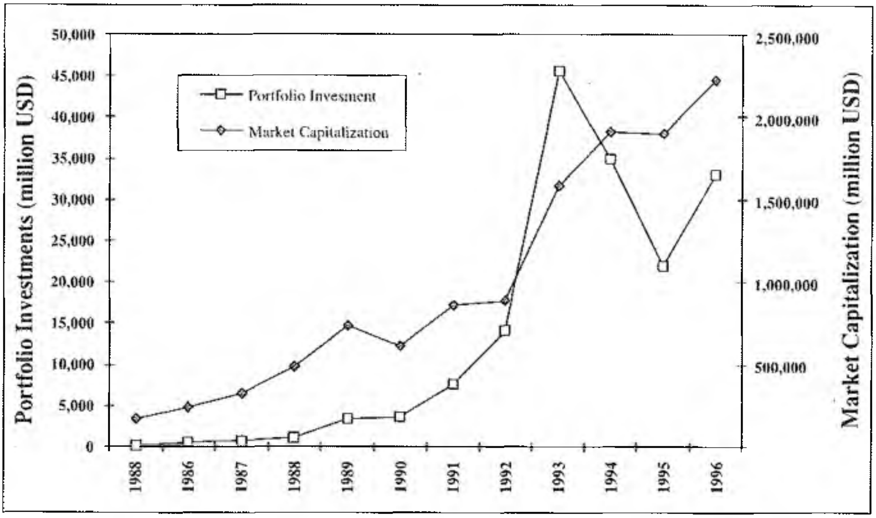
Source: IFC Factbook 1996-1997, pp.129-233; IFC Monthly Review, June 1997. World Equity, February 1998.

## Market Value of Bonds (Million USD, Jan-March 1998)



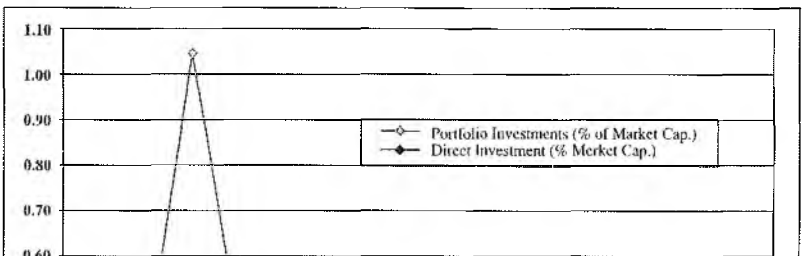

Source: FIBV, Focus, Monthly Statistics, July 1997.

**Foreign Investments and Market Capitalization in Emerging Markets (1985-1996)**



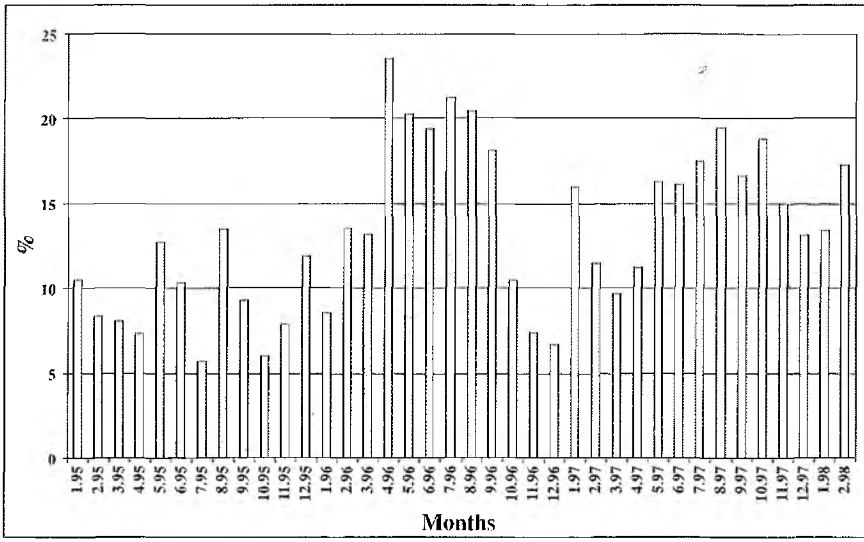

Source: IFC Factbook 1996, 6-23.
Notes: The portfolio investment as of 1996 was USD 45,7 billion.

**Foreign Investments as a Percentage of Market Capitalization in Turkey (1986-1997)**



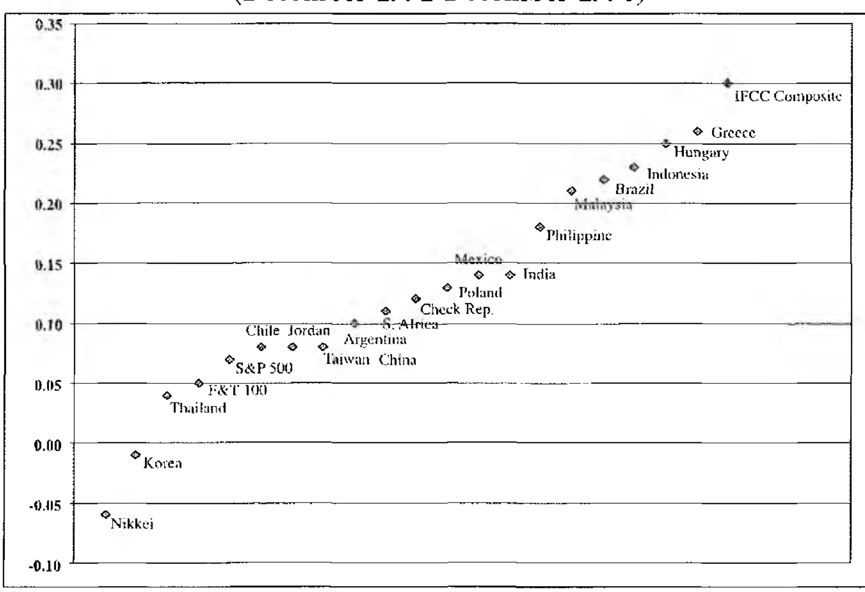

Source: SPO (DPT), Main Economic Indicators, July 1996, 47; January 1997; SPO, Economic and Social Indicators 1950-1995, 36; ISE's Monthly Bulletins.

## Foreigners Share in the Trading Volume of the ISE (Monthly, 1996-1997)




Source: ISE, Monthly Bulletin, May 1997.

## Return Index Correlations of the ISE (December 1991-December 1996)




Notes: The correlation coefficient is between -1 and +1. If it is zero, for the given period, it is implied that there is no linear relation between two serious of returns. For monthly return index correlations (IFCG) see. IFC, Monthly Review, Jan.1998.

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ISSN 1301-1642 © ISE 1997

# ISE
# Market Indicators

## STOCK MARKET

| | | Total Value | | | | Market Value | | Dividend Yield | P/E Ratios |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Companies | Total | | Daily Average | | | | | |
| | | (TL Billion) | (US$ Million) | (TL Billion) | (US$ Million) | (TL Billion) | (US$ Million) | (%) | |
| 1986 | 80 | 9 | 13 | — | — | 709 | 938 | 9.15 | 5.07 |
| 1987 | 82 | 105 | 118 | — | — | 3,182 | 3,125 | 2.82 | 15.86 |
| 1988 | 79 | 149 | 115 | 1 | — | 2,048 | 1,128 | 10.48 | 4.97 |
| 1989 | 76 | 1,736 | 773 | 7 | 3 | 15,553 | 6,756 | 3.44 | 15.74 |
| 1990 | 110 | 15,313 | 5,854 | 62 | 24 | 55.238 | 18,737 | 2.62 | 23.97 |
| 1991 | 134 | 35,487 | 8,502 | 144 | 34 | 78,907 | 15,564 | 3.95 | 15.88 |
| 1992 | 145 | 56,339 | 8,567 | 224 | 34 | 84,809 | 9,922 | 6.43 | 11.39 |
| 1993 | 160 | 255,222 | 21,770 | 1,037 | 89 | 546,316 | 37,824 | 1.65 | 25.75 |
| 1994 | 176 | 650,864 | 23,203 | 2,573 | 92 | 836,118 | 21,785 | 2.78 | 24.83 |
| 1995 | 205 | 2,374,055 | 52,357 | 9,458 | 209 | 1,264,998 | 20,782 | 3.56 | 9.23 |
| 1996 | 228 | 3,031,185 | 37,737 | 12,272 | 153 | 3,275,038 | 30,797 | 2.87 | 12.15 |
| 1997 | 258 | 9.048,721 | 58,104 | 35,908 | 231 | 12.654,308 | 61,879 | 1.56 | 24.39 |
| 1998 | 262 | 3,810,696 | 17,133 | 63,512 | 286 | 12,424,795 | 51,680 | 2.71 | 15.13 |
| 1998/Ç1 | 262 | 3,810,696 | 17,133 | 63,512 | 286 | 12,424,795 | 51,680 | 2.71 | 15.13 |

Q : Quarter

# Closing Values of the ISE Price Indices

## TL Based

| | NATIONAL-100 (Jan. 1986=1) | NATIONAL-INDUSTRIALS (Dec.31, 90=33) | "NATIONAL-SERVICES (Dec.27, 96=1046)" | "NATIONAL-FINANCIALS (Dec. 31, 90=33)" |
|---|---|---|---|---|
| 1986 | 1.71 | — | — | — |
| 1987 | 6.73 | — | — | — |
| 1988 | 3.74 | — | — | — |
| 1989 | 22.18 | — | — | — |
| 1990 | 32.56 | 32.56 | — | 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 | 1,045.91 | 914.47 |
| 1997 | 3,451 | 4,060 | 3,593 | 4,522 |
| 1998 | 3,181.15 | 2,746.90 | 3,892.74 | 4,024.12 |
| 1998/Q1 | 3,181.15 | 2,746.90 | 3,892.74 | 4,024.12 |

## US $ Based

| | NATIONAL-100 (Jan. 1986=100) | NATIONAL-INDUSTRIALS (Dec.31, 90=643) | "NATIONAL-SERVICES (Dec.27, 96=572)" | "NATIONAL-FINANCIALS (Dec. 31, 90=643)" |
|---|---|---|---|---|
| 1986 | 132 | — | — | — |
| 1987 | 385 | — | — | — |
| 1988 | 120 | — | — | — |
| 1989 | 561 | — | — | — |
| 1990 | 643 | 643 | — | 643 |
| 1991 | 501 | 570 | — | 385 |
| 1992 | 273 | 335 | — | 166 |
| 1993 | 833 | 898 | — | 773 |
| 1994 | 413 | 462 | — | 348 |
| 1995 | 383 | 442 | — | 287 |
| 1996 | 534 | 572 | 572 | 500 |
| 1997 | 982 | 757 | 1.022 | 1.287 |
| 1998 | 788.82 | 664.86 | 942.19 | 973.99 |
| 1998/Q1 | 788.82 | 664.86 | 942.19 | 973.99 |

# BONDS AND BILLS MARKET

## Traded Value

### Outright Purchases and Sales Market

| | Total | | Daily Average | |
|---|---|---|---|---|
| | TL Billion | US$ Million | TL Billion | US$ Million |
| 1991 | 1,476 | 312 | 11 | 2 |
| 1992 | 17,977 | 2,406 | 72 | 10 |
| 1993 | 122,858 | 10,728 | 499 | 44 |
| 1994 | 269,992 | 8,832 | 1,067 | 35 |
| 1995 | 739,942 | 16,509 | 2,936 | 66 |
| 1996 | 2,710,973 | 32,737 | 10,758 | 130 |
| 1997 | 5,503,632 | 35,472 | 252,761 | 1,626 |
| 1998 | 3,186,680 | 14,154 | 52,241 | 232 |
| 1998/Q1 | 3,186,680 | 14,154 | 52,241 | 232 |

### Repo-Reverse Repo Market

| | Total | | Daily Average | |
|---|---|---|---|---|
| | TL Billion | US $ Million | TL Billion | US $ Million |
| 1993 | 59,009 | 4,794 | 276 | 22 |
| 1994 | 756,683 | 23,704 | 2,991 | 94 |
| 1995 | 5,781,776 | 123,254 | 22,944 | 489 |
| 1996 | 18,340,459 | 221,405 | 72,780 | 879 |
| 1997 | 58,192,071 | 374,384 | 252,761 | 1,626 |
| 1998 | 19,320,590 | 86,636 | 316,731 | 1,420 |
| 1998/Q1 | 19,320,590 | 86,636 | 316,731 | 1,420 |

Q: Quarter

## ISE GDS Price Indices (December 25-29, 1995=100)

| | 30 Days | 91 Days | 182 Days | General |
|---|---|---|---|---|
| **TL Based** | | | | |
| 1996 | 103.41 | 110.73 | 121.71 | 110.52 |
| 1997 | 102.68 | 108.76 | 118.48 | 110.77 |
| 1998 | 103.53 | 111.16 | 122.77 | 112.03 |
| 1998/Q1 | 103.53 | 111.16 | 122.77 | 112.03 |
| **US $ Based** | | | | |
| 1996 | 57.09 | 61.13 | 67.19 | 61.01 |
| 1997 | 29.71 | 31.47 | 34.28 | 32.05 |
| 1998 | 25.48 | 27.36 | 30.21 | 27.57 |
| 1998/Q1 | 25.48 | 27.36 | 30.21 | 27.57 |

## ISE GDS Performans Indices (December 25-29, 1995=100)

| | 30 Days | 91 Days | 182 Days |
|---|---|---|---|
| **TL Based** | | | |
| 1996 | 222.52 | 240.92 | 262.20 |
| 1997 | 441.25 | 474.75 | 525.17 |
| 1998 | 523.70 | 571.24 | 646.15 |
| 1998/Q1 | 523.70 | 571.24 | 646.15 |
| **US $ Based** | | | |
| 1996 | 122.84 | 132.99 | 144.74 |
| 1997 | 127.67 | 137.36 | 151.95 |
| 1998 | 128.88 | 140.58 | 159.02 |
| 1998/Q1 | 128.88 | 140.58 | 159.02 |

Q : Quarter

The ISE Review Volume: 2 No: 6 April-June 1998
ISSN 1301-1642 

# Book Reviews

*The Handbook of Fixed Income Securities, Frank Fabozzi (Ed.), McGraw-Hill, 1997, pp. xxx + 1339.*

The fifth edition of "the Handbook of Fixed Income Securities" provides a comprehensive coverage on all groups of debt obligation instruments, markets and portfolio management strategies within seven parts which include 62 chapters.

The early chapters of the book equip the reader with a general knowledge of the fixed income security and provide a conceptual and terminological background such as nature of risk, future and present value and yield of an instrument, bond market indices. For instance, it is essential to start by explaining that the fixed income securities in different sectors of the market respond differently to environmental changes because of a combination of 12 major risks, which consists of market, reinvestment, timing, default, maturity, inflation, liquidity, exchange rate, volatility, political stability, sector and specific event risks.

After these fundamental chapters, the consequtive thirteen chapters explain specifications of various governmental and private fixed income securities, and bond market conditions. Treasury bills, bonds and notes, coupon stripping method of dealers in order to convert Treasury securities to synthetic zero-coupon instruments such like STRIPS, and municipal bonds constitute major groups of government debt obligations. On the other hand, MTNs (Medium-Term Notes), floating-rate and adjustable-rate debt instruments, convertible securities and non-convertible preferred stocks frame major corporate bond groups.

U.S.-pay international bonds like Eurodollar bonds, Yankee bonds, Bradys, Aztecs, FLIRBs, and foreign-pay international bonds like Bulldogs, Samurais all together represent a significant portion of the world's fixed-income markets. For this reason, a special importance is given to these instruments and to the markets in which these instruments are traded.

Chapters 20-25 are dedicated to credit analysis issues of corporate and municipal bonds, evaluating high-yield bonds and bankrupt securities. Country risk analysis and IEMs (international emerging markets) are also reviewed in the context of fundamental valuation. The following ten chapters discuss mortgage-backed securities due to the importance of innovations which have occurred in terms of the design of new mortgage instruments as fixed income securities. Structure of mortgage market, the risks associated with investing in mortgages and the different types of mortgage design such as mortgage pass-through securities, collateralized mortgage obligations, commercial mortgage-backed securities, auto-loan-backed, HEL (home equity loan)- backed, manufactured housing-backed and credit card-backed securities are the major topics of this section.

After all these basic information, time comes to the valuation of bonds with embedded options through binominal lattice model, Monte Carlo methods and the continuous-time diffusion model. Although these methods are applicable to all types of fixed income securities, considering that the most common type of option embedded in a bond is a call option, primary focus is on callable bonds in order to illustrate the valuation approach. Interest-rate risk models, new duration measures, fixed income risk modeling, analysis of convertible securities and the term structure of interest rates are all discussed under Part 5, named Fixed Income Analytics and Modeling.

The prospect of a new dimension of fixed income portfolio strategy that goes beyond the traditional notions of management enforces fund managers to learn more about benchmark portfolios, decision making in bond selection, asset/liability optimization strategy and international bond investments.

Meanwhile, it is now possible to alter the interest-rate sensitivity of a fixed income portfolio through options, futures and forwards on interest-rate instruments. Considering importance of derivative contracts in fixed-income markets, the last, 7th part of the book is allocated to the introduction of derivative products and markets, pricing futures contracts, the mechanics and valuation of Treasury bond futures, the basics of interest-rate options, interest-rate swaps and hedging possibilities via derivative products.

As it can be guessed from these intense trenches of subjects, The Handbook of Fixed Income Securities, edited by F.J. Fabozzi, does cover almost all aspects of fixed-income securities. This brick-size book, with its more than 1.300 text pages, is highly recommended to fixed-income securities' market professionals, as well as researchers, academicians and students, as a reference book.

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*"International Capital Markets: Developments, Prospects, and Key Policy Issues", IMF, World Economic and Financial Surveys, Washington, DC, pp. xiv+265.*

The structure and quality of information sources have been a considerable impact on the development of financial system since 1980. The players on the both sides of the financial game should observe not only the related region and the countries but also others. With respect to the swift changes in global markets, information quality and its accuracy become more striking.

The International Capital Markets report has been published annually by International Monetary Fund since 1980. This report of 1998 provides international update statistics information together with some discussions and comments.

This edition of IMF periodical includes eight chapters and annexes, reviewing the developments in world capital markets, and especially providing particular information about currency market until July 1997.

In the introduction, stressing the USA dollar appreciation and the problem that are faced in developing market, two international political developments are explained. The first is the establishment of the European Monetary Union which has ever been the most universal and lively financial arrangements since Bretton Wood's system so far. Second one is the politics that is exemplary with the emerging markets bound to put to use a risk management because of huge foreign debt obligation.

In the second chapter, the developments in emerging markets and trends are considered. Moreover, the foreign exchange market, the capital flows and appreciation of US dollar in currency market, the spread decrease in credit markets and the situation of increasing trade in bond markets are discussed. The operation of international banks in credit markets, the currency risks, the rise or decrease of shares prices in stock markets, and the tendency of growth of derivatives markets are also main issues.

Chapter three touches basic facts concerning the global developments of finance sector with respect to the EMU that is presented from the systemic risk point of view. In this situation, the new potentials forwarded by the EMU and restructuring the European sector market and construction of European Bank System and the systematic risk management in EMU.

Chapter four gives a brief summary about the events in the emerging markets within the framework of capital movements. Net private capital flows to emerging countries from developed economies during the 1990s, was an essential contributor to the economic development in especially Latin and Asian economies. Whereas African and the Middle Eastern countries are lack of chance to attract sufficient share from this inflow. The main reason for the record level inflows and sharp decreases of yield spreads are based on three factors: The first is the search for higher yields in mature markets, the second is the diversification of portfolios, and the last is the development and liberalization in emerging markets.

Chapter five focuses on the external liability management. Including the large foreign currency exposure of emerging markets, main developments related to the debt management of governments are explained. It is stressed that unlike Argentina, Mexico, South Africa, Turkey, most of the emerging market countries do not review their debt management practices since they are not running any separate debt management department.

Regarding to the comparative performances of international banks, chapter six discusses the differences in banking systems. The attention is drawn towards to the importance of the general principles of a sound financial system.

Chapter seven, following the last subject, addresses the turbulence in emerging foreign exchange markets during May, June and July in 1997 in Asia. Furthermore, the spillover effect from the Asian crisis is also considered

In chapter eight, conclusions with respect to the mature markets, emerging markets, the European Monetary Union, the external liability management, and international banking are summarized. It is worth writing here from this section that "In a world of increasingly mobile capital flows and integrated capital markets, large and unhedged external sovereign liabilities could expose countries to risks that some of them are not fully prepared to manage."

First of the two distinctive background materials as annexes that differs the book from others presents some detailed and useful data and statistics related to global financial markets. The second part review specifically the European Monetary Union and European capital markets, sovereign liability management, and capital flows to emerging markets.

"International Capital Markets: Developments, Prospects, and Key Policy Issues" seems to be an introductory book that is helpful to someone who demands fundamental information on international markets, and a statistical report, as well, that is very useful for someone who needs to research by using international data of global markets.

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*"Customized Derivatives", K. Ravindran, McGraw Hill, 1998, pp. xxx+418.*

In general the risk, inherent in any type of business, is analyzed by splitting into two components. The first component which is usually hedgeable by the appropriate financial instruments is named financial risk. However the second part of risk is considered to be unhedgeable and assumed to be a part of doing business and hence named nonfinancial or business risk. Due to the globalization and deregulation in financial markets, the market risk faced by firms and institutions have augmented. Besides the increasing risk, hedging instruments have also diversified with the increasing competition. As a result of these developments, new hedging instruments that allow very complicated strategies, named derivatives have begun to be widely used since 1970s. Though mainly used for hedging purposes, derivatives are also very suitable instruments for speculation, as they are highly leveraged. As the high leverage-effect can cause very huge loses derivatives should be implemented prudently.

There is quite a lot of materials in the literature about derivatives and the pricing models that are fairly complicated and difficult to understand. Most of these books and articles written by both theoreticians and practitioners focus on the pricing models of traditional derivatives or "vanilla derivatives". Many other books or articles concentrating on non-standard or exotic derivatives are not easy to understand as most of them require advanced mathematics. The book entitled "Customized Derivatives" written by Ravindran who is not only a theoretician but also a practitioner, by taking the subject from the beginning and following a building-block approach provides the key tools to understand exotic derivatives. Although the writer avoid using advanced quantitative technics, the reader is assumed to have a basic knowledge on derivatives as well as basic calculus.

The book consists of four main chapters including the introduction part. The second chapter which focuses on the vanilla derivatives is rather short as the main objective of the book is to concentrate on exotic derivatives. Futures, swaps and forward contracts on currency, interest rate or equity are examined briefly where the options are discussed in detail as they are the key step to understand the pricing of exotic options. Once the reader understands the European or American options, it is easy to implement them to exotic options. Therefore if the reader wants to go further on exotic derivatives he should understand the traditional ones and especially options, first. At the end of this chapter the writer gives the reasons why the traditional derivatives are not sufficient in risk management and why it is compulsory to use more complicated instruments namely exotics, for better and sophisticated strategies.

In the second chapter, vanilla options are categorized into European-style options, Mid-Atlantic-style options and American style-options. In the third chapter it is mentioned that the exotic options can be similarly categorized, however unlike vanilla options, for each exercise type in an exotic option there are an additional 11 building blocks namely "spread, average, basket, cash-or-nothing, choice, compound, deferred, strike, lookback, nonlinear payoff, product, sudden birth/death options. Each building-block is examined in detail. As the writer believes that it is more important to understand the logic behind exotics than memorizing formulations, he avoided using mathematical notations and formulations as far as possible.

The eleven building-blocks mentioned in chapter three can be briefly summarized as follows: A spread option is an option that allows the purchaser to exchange one asset for another asset plus cash. This type is also known as a dual option, spreadtion, or called an exchange option when the cash element is absent. An average option which is also known as average price option, averaging option or Asian option, pays the purchaser an in-the-money payoff that is the difference between the average value of the underlying variable that is calculated on predetermined dates and a prespecified strike value upon exercise, when the option finishes in-the-money. The third building block called basket option is known as portfolio option as the underlying asset is a basket. A cash-or-nothing option is an example of a binary option that pays out a fixed amount of money to the holder as long as the option finishes in-the-money. The fixed amount received by the investor would be independent of the in-the-moneyness of the option. A choice option's definition as given in the book is as follows: An option that has in-the-money payoff such that the holder gets to choose from a predefined range of payoffs/instruments, either the best or the worst (or some combination therof), at the time of choice. A compound option is an option that allows the holder to either buy or sell the underlying vanilla option for a prespecified price during some prespecified time in the future. The other names of this type of option are split-fee option, installment option, option-on-an-option or pay-as-you-go option. In the deferred-strike option there are typically two types of strikes such as a floating and a fixed one both attached to the payoff the option. The fixed component is set at the inception and the floating strike gets set some prespecified time in the future prior to the option maturity. A look-back option is a call (put) option that allows the purchaser the right to buy (sell) an asset at a prespecified time in the future for the lowest (highest) value the asset reaches during the option life. It is also called a hindsight, look-back strike, no-regret option. In the nonlinear payoff option, the payoff upon exercise is a nonlinear function of the in-the-moneyness of the option. Any option whose in-the-money payoff is calculated by multiplying the values of the least two different assets is called a product option. A sudden-birth option or an in-option can be defined as any option that begins to exist only if the price of an asset and/or the combination of assets satisfies a prespecified condition. Conversely any option that ceases to exist only if the price of an asset and/or combination of assets satisfies a prespecified condition, is called as sudden-death option.

The following chapter gives the reader intuitive methods for pricing options. The applications of binomial method and Monte Carlo method to the exotic option mentioned above, are illustrated by examples in chapter four.

At the end of the book the appendix that gives the mathematics for derivatives is useful for the readers who are interested in. There is also a brief dictionary which is very useful and helpful for the reader to understand the main concepts mentioned in the book. The book "Customized Derivatives" is an excellent tool for those who has a basic knowledge on vanilla derivatives and want to learn the exotics.

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