VOLATILITY OF THE TURKISH STOCK MARKET

By

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To my parents
Emine and Ali Kirbas

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The world financial market has experienced a rapid growth in emerging stock markets as the flow of capital across national borders has become less restricted. Developing countries that borrowed heavily from foreign banks during the 1970 have realized that the external capital markets are neither the only, nor necessarily the best, source of funds for development especially after the Latin American debt crisis.

In an effort to obtain capital from different sources, some developing countries have established their own stock market while others that already had a stock market have decreased restrictions on foreign investment. Investors have begun including assets of foreign countries into their portfolios to reduce risk and diversify effectively. As more and more investors exploit investment opportunities in emerging markets, the question of how volatile are these markets have become an important one. In this dissertation we attempt to answer this question for a particular emerging market namely Istanbul Stock Exchange (ISE).

The Istanbul Stock Exchange (ISE) in its current form was founded in 1986. Eighty years earlier, during the Ottoman Empire, so called "Imperial Securities Exchange" was created in Istanbul, largely to trade sovereign bonds issued by the Sultan to finance the Crimean War against Russia. Very little happened until the economy was opened to market players in 1980. From then on, liberalization move helped to create an emerging market in Turkey.

Today, ISE is the one of the fastest growing emerging stock markets. Market capitalization, volatility and foreign investment have dramatically increased in recent years. At the end of 1989, according to the International Finance Corporation (IFC), the market capitalization was US$ 6.756 billion and the number of listed company was 76. At the end of 1999, on the other hand, the market capitalization had increased to US$ 114,276 billion and the number of companies had increased to 285. The IFC data also indicate that by the end of 1999, the share of the market capitalization of ISE was 3.7% of all emerging stock market capitalization.

In this dissertation our objective is to characterize the volatility of stock returns in ISE not only at the level of the market as a whole but also at the level of industry and firm. All of the previous studies for the volatility of emerging stock markets have only focused on aggregate market volatility but the volatility of an individual stock depends on the volatility of industry-specific and firm-specific shocks as much as the volatility of aggregate market return. There are several reasons to study these disaggregated volatility measures. Three of these reasons can be summarized as following:

1) Many investors hold large amount of individual stocks. In other words, they do not diversify their portfolios in the manner recommended by financial theory. This is especially true for investors in emerging stock markets. These investors are affected by shifts in industry-level and idiosyncratic volatility, just as much as by shifts in market volatility.
2) Arbitrageurs who trade to exploit mispricing of individual stocks face risks that are related to idiosyncratic return volatility, not aggregate market volatility.

3) The price of an option on an individual stock depends on industry-level and idiosyncratic volatility as well as market volatility.

Despite the importance of these disaggregated volatility measures, there is surprisingly little empirical research on volatility at the level of the industry or firm. Especially, there is not an extensive study for an emerging stock market even though emerging stock markets have recently been of great importance to the worldwide investment community. Our goal is to fill this gap by characterizing the historical movements in aggregate as well as disaggregate volatility of ISE. The contribution of this research would be three-fold:

1) There has been little research on Turkish Stock Market relative to other emerging markets. Volatility of ISE has not been examined so far. Our goal is to fill this gap and add relatively small stock of evidence on these issues in the context of emerging stock markets.
2) This study will provide broad and rigorous analysis of the Turkish Stock Market with respect to volatility of stock returns. It is important to understand the volatility of emerging stock markets because risk premiums may be directly related to the volatility of stock returns in the particular market. Higher volatility implies higher capital cost. Higher volatility may also increase the value of the 'option to wait' hence delaying investments. We believe such an extensive study about market, industry and firm level volatility in the Turkish stock market would be beneficial to investors and regulators for determining the cost of capital, for evaluating direct investment and asset allocation decision and hopefully, would be relevant to other developing countries' stock markets.

3) While a few studies have evaluated the disaggregated volatility measures for developed stock markets, none has evaluated the emerging stock markets on the disaggregated level. It is also necessary to study these issues for an emerging markets since the importance of emerging markets have been increasing as more and more investors include the stocks of emerging markets into their portfolios.

The plan of this dissertation as follows: Chapter II gives brief information about Istanbul Stock Exchange. We analyze the volatility of aggregate market indices using daily data of the market and sectoral indices in Chapter III. We construct the monthly standard deviation of stock returns as a measure of volatility. Our first goal in this chapter is to see whether the volatility of the aggregate market indices increased over time. Our second goal is to examine global and local events during the periods of increased volatility. Chapter IV discusses the market, industry and firm level volatility of ISE. This section gives information about the literature, the methodology and the data of the study. Chapter V analyzes the behavior of market, industry and firm level volatility. We first examine our three volatility series graphically. Then we investigate whether they have stochastic or deterministic trend. Covariation and lead-lag relationship between the series are examined at last. Chapter VI discusses the relationship between our disaggregated volatility measures and Turkish business cycle. GDP growth, industrial production, inflation rate and exchange rate are chosen macroeconomic variables relevant to the characterization of the business cycle for the Turkish economy. We construct new volatility series in quarterly frequency to analyze the link between three volatility series and GDP growth. Chapter VII analyzes the behavior of industry level volatility. We construct new volatility measures to study 15 industries separately. We repeat all the previous analysis for each industry. Chapter VIII sums up the results of this dissertation.

CHAPTER II

THE ISTANBUL STOCK MARKET

Brief History

Security trading in Turkey has a long history, but the stock market in its present form, centered on the Istanbul Stock Exchange (ISE), is relatively young. The origin of an organized securities market in Turkey has its roots in the second half of the 19^{th} century. The first security market in the Ottoman Empire was established in 1866 under the name of "Dersaadet securities exchange" following the Crimean war (1853-1856) against Russia. The government borrowed heavily from foreign governments and the public by issuing domestic and foreign bonds. After the war, a group of minorities started buying and selling these bonds. At that time, railroad bonds were the main securities traded. The government decided to regulate these activities and issued a decree regarding the establishment of an exchange. After 1910, the list of securities was expanded to include the stock of the natural gas and coal mine companies.

The exchange of the 19^{th} century disseminated information; in the later 1800s Istanbul became connected to European Markets by telegraph. In the 1890s, Dersaadet Security Exchange was the second leading exchange in Europe after the London Stock Exchange in terms of transaction volume. Innovation such as joint-stock funding for urban amenities helped advance the Ottoman financial and economic development. The innovations also influenced new European techniques of financing.

The exchange was closed during the World War I. Following the proclamation of the Turkish Republic on the ruins of the Ottoman Empire, a new law was enacted in 1929 to reorganize the fledgling capital markets under the new name of "Istanbul Securities and Foreign Exchange Bourse."

The Bourse became very active and contributed substantially to the funding requirements of new enterprises across the country. However, its success was clouded by series of events. One of these events was the Second World War (SWW). During the SWW Turkey remained neutral but war had taken its toll in the embryonic business world of Turkey. During the subsequent decades banks dominated the financial sector and security markets were nearly nonexistent.

The early phase of 1980's saw a marked improvement in the Turkish capital markets, both in regard to the legislative framework and the institutions required to set the stage for sound capital movements. The government's desire to develop a deeper capital market stems partly from the need to privatize the large and very inefficient state economic enterprises (SEEs). In 1981, the "Capital Market Law" was enacted and one year later the main regulatory body responsible for the supervision and regulation of the Turkish security market, the Capital Markets Board based in Ankara, was established.

In 1983, a new decree concerning the operation of the security exchange was issued. Subsequently, the new Istanbul stock exchange (ISE) was established on January 1, 1986. The trading system in the Istanbul stock exchange was a call market until November 17, 1987. After that date, the Istanbul stock exchange adopted the continuous auction trading system. Under Turkish legislation, the ISE is responsible for developing and maintaining the central securities market of Turkey for the benefit of the national economy in general and the Turkish capital market in particular.

Structure and Operation

The Istanbul stock exchange (ISE) is governed by a council composed of five members. The government appoints the chairman of the Executive Council, representing the members and acting also as the chief executive officer.

Members

Members of the ISE are classified into three groups: the investment and development banks; the commercial banks; and brokerage houses. All members are incorporated and are under the comprehensive supervision and control of the Capital Markets Board (CMB) and of the ISE. All intermediary institutions including commercial banks engaging capital market operations are required to meet specific qualifications according to the Capital Market Law and regulations. Regulators restricted banks from engaging in any activities in the secondary markets in 1997. Banks must establish a new brokerage house for their capital market operations. Intermediary institutions engaged in trading in the market are required to place a deposit in either U.S. dollars or government bonds with the Central Bank or a bank designated by the Executive Council. Alternatively, they can submit a letter of guarantee on sight drafted by an international bank and affirmed irrevocably.

Trading System

The fully computerized trading system was established in 1994. Stock trading activities are carried out in two separate two-hour sessions, one in the morning and one in the afternoon. A lot, the standard unit of trading is 1,000 shares. Odd lot orders and orders for "right coupons" can also be executed on the ISE. Price determination follows the continuos auction method in which buyers and sellers enter bids and offers into the computer system through their workstations at the ISE. The system is a blind order system with counterparties identified on matching. The computer system enables members to execute several types of orders, including market orders, limit orders, limit value orders, fill or kill orders, and all or none orders. Unmatched orders without a specific validity period are canceled at the end of the trading session.

Settlement and Transfer

The ISE and its members own the Clearing and Custody Bank Inc. (Takasbank). Takasbank handles the settlement of transactions conducted on the ISE and also acts as central depositary and custodian. The settlement period of T+2 may be extended to facilitate access to investors. To ensure full compliance with international settlement norms and procedures, the Takasbank collaborate with international settlement companies such as Euroclear and Cedel with the aim of eventual full integration through the existing system.

Listing Requirements

In order for a security to be listed on the Exchange, the following conditions must be met:

1. The annual and quarterly financial reports of the previous year should have been independently audited and the group companies should have consolidated financial reports.
2. At least three calendar years must have elapsed since its incorporation. This obligation is reduced to two years if at least 25% of the capital is publicly held.
3. The company must have earned profits before taxes in the past two consecutive years.
4. The aggregate amount of the paid-in or issued capital must be at least TL1,250 billion.
5. The company's free float must be 15% if its capital does not exceed TL750 billion, 10% if the capital is between TL750 billion and TL1.5 trillion, and 5% if the capital is in excess of TL1.5 trillion.
6. The financial position of the corporation must be examined and approved by the Executive Council.

The free-zone status entitles the ISE to apply procedures of admittance to this market. A listing committee scans issues prior to trading. In general, to obtain trading approval, the security shall be listed on at least one exchange in the country of origin or should meet the ISE normal listing criteria. When the ISE Executive Council approves trading, securities will be deposited with the Clearing and Custody Bank (Takasbank) or with a bank or custody company in the country of origin that issues depository receipts and formally requests that these be circulated.

ISE's Stock Markets

The Turkish stock market is organized into five segments: the National Market, the Regional Market, the Wholesale Market, the New Companies Market and the Watch List Companies Market. The National Market includes companies with high capitalization and high daily average volumes. All companies included in this market fulfill the listing requirements. Currently 100 companies selected from among the listed companies in the National Market are included in the main index of the ISE.

The Regional Market promotes trading in stocks of small and medium-sized companies from all parts of the country. This market consist of companies delisted temporarily or permanently from the ISE's National Market as well as companies that fail to fulfill the listing requirements and lack necessary qualifications for trading on the ISE's National Market. Companies meeting the criteria for trading on the Regional Markets are admitted to this market by the decision of the Executive Council of the ISE.

The Wholesale Market provides the environment for trading in large quantities. The market permits the sale of stocks that are traded on the ISE's National and Regional Market. The New Companies Market enables young companies with growth potential to offer their stocks to the Public. It encourages newly-established companies while offering new alternatives to investors willing to increase their earnings by taking relatively higher risk. This market was established in 1995 but began to operate on July 6, 1996.

The Watch List Companies Market was established with an aim to provide an organized and liquid market for trading of stocks of companies under special surveillance and investigation due to extraordinary situations with respect to stock transactions. For example, disclosure of incomplete information to the public, failure to comply with the existing rules and regulations lead to delisting of stocks or dismissal from the related market temporarily or permanently in order to protect investors' rights and public interest. This market began to operate on December 4, 1996.

Investor Protection

Securities issued on the international market are subjected to the rules and regulations of the ISE concerning the public dissemination of information, documentation, and regular submission of information. A domestic intermediary may be assigned to take on joint responsibility for these obligations. All transactions are under the strict control of the Exchange management supported at times by the Disciplinary and Arbitration Committees. Floor experts supervise all stock market activities. Computerized surveillance system is also employed to detect any irregular or illegal activity. The Exchange also collects financial, legal and managerial information about listed companies from various news sources. This helps catch misleading information issued by companies. The Exchange holds an "Umbrella Insurance" policy which covers all securities traded and transacted on the Exchange and kept in custody at the ISE Settlement and Custody Company. Members firms are required to post security deposits with the Exchange to cover losses suffered by their clients due to stockbroker default or fraud. Insider trading is prohibited and punishable by fines and imprisonment.

Since 1989, when the required laws in Article 15 of Decree 32 were changed, Turkey has been on of the emerging markets that are very open and easily accessible to foreign investors. Direct purchasing and selling by foreign investors, as well as the repatriation of interest and dividend income and the originally invested capital, are free of restrictions. Capital movements, buying and selling, of more than $50,000, however, have to be registered with the central bank. For foreign investors, long-term capital gains, as well as interest and dividend income, are tax-free. As a result, foreign institutional investors now account for substantial proportion of daily trading and own over 48% of publicly held stocks. The net equity investment in Turkey by foreign portfolio managers has been estimated at US$3.7 billion.

Market Indices and their constituents

The ISE computes the National All Share Index, the ISE National 30, the ISE National 100, various sectorial indices, and the ISE Regional New Market Index. All the indices are composed of National Market (as opposed to Regional Market) companies, excluding investment trusts, and are weighted according to the publicly held portion of each constituent company. The stocks are ranked in ascending order according to market capitalization and turnover, and those stocks that have the highest values are included in the National 30 and National 100 Indices. The ISE National-100 is float capitalization-weighted price index.

Istanbul Stock Market as an Emerging Market

Emerging stock markets have recently been of great importance to the worldwide investment community. No universal definition of emerging market exists. An emerging stock market is defined by the International Finance Corporation (IFC), a subsidiary of the World Bank, as a low-income or middle-income economy. Low-income economies are those with a GNP per capita of $610 or less, while middle-income economies are those with a GNP per capita of more than $610 but less than $7,620 in 1990. Some other institutions, on the other hand, refer to an emerging stock market as one, which has begun a process of change and is growing in size and sophistication. In general emerging markets are referred to as "developing countries" or "third-world countries". The Istanbul Securities Exchange (ISE) qualifies as an emerging stock market according to above definitions.

The market capitalization, volatility, and returns have increased dramatically in these countries over the last several years. Many of these countries are now allowing foreign institutional investors to invest in their stock markets and repatriate profits. While emerging markets are more volatile than developed markets, they tend to be relatively uncorrelated with each other and with developed markets. This means that global investor can reduce portfolio risk by diversifying their funds across these markets.

The market capitalization in these countries is relatively low compare to developed countries. However, it is rising at a very fast pace. Market capitalization in the emerging markets increased from 3.7% in 1985 to 12.7% by the end of 1994. On the assumption that the emerging markets will grow at an annual rate of 15% while the developed countries will grow at an annual rate of only 8%, Keppler and Lechner (1997) project that the emerging market's share of total world stock market capitalization will increase to about 43% in the year 2025.

Table 2.1 reports the market capitalization, value of trade, turnover ratio, and number of listed companies in the 31 emerging markets. As seen in the table, the market capitalization, value of trade, and the number of listed companies in most of these countries increased dramatically from 1992 to 1999. The Istanbul stock market has a remarkable record relative to the 31 emerging markets included in the IFC Global index, the market capitalization rose from $9,931 million in 1992 to $112,716 million at the end of 1999. The listed companies increased from 145 in 1992 to 285 at the end of 1999. Table 2.1 also reports that the ISE ranked 14th for number of listed companies, 7th for trading value, 6th for turnover ratio, and 10th for market capitalization in 1999.

Table 2.1 Indicators of Stock Market Development for Selected Emerging Markets

	Market Capitalization (US$ Millions)			Value of Trade (US$ Millions)			Turnover Ratio (Percent)		Number of Listed Companies		
	1992	1999	Ranking by end-1999	1992	1999	Ranking by end-1999	1999	Ranking by end-1999	1992	1999	Ranking by end-1999
Latin America											
Argentina	18,633	83,887	11	15,679	7,781	20	12	24	175	129	27
Brazil	45,261	227,962	5	20,525	87,276	6	53	11	565	478	10
Chile	29,644	68,228	13	2,029	6,874	21	11.4	26	245	285	13
Colombia	5,681	11,590	24	554	704	26	5.8	30	80	145	26
Mexico	139,061	154,044	8	44,582	36,042	11	29	20	195	188	23
Peru	2,630	13,392	22	417	2,289	24	18.6	21	287	242	17
Venezuela	7,600	7,471	25	2,631	770	25	10.2	27	91	87	28
East Asia											
China	18,255	330,703	2	16,715	377,099	3	134.2	4	52	950	3
Korea	107,448	308,534	3	116,101	733,591	2	355.8	1	688	725	7
Philippines	13,794	48,105	17	3,104	19,673	14	46.5	13	170	226	19
Taiwan	101,124	375,991	1	240,667	910,016	1	290.5	3	256	462	11
South Asia											
India	65,119	184,605	7	20,597	122,247	5	84.4	9	2781	5,863	1
Indonesia	12,038	64,087	14	3,903	19,903	13	47	12	155	277	16
Malaysia	94,004	145,445	9	21,730	48,512	9	39.8	15	369	757	6
Pakistan	8,028	6,965	26	980	21,057	12	345.2	2	628	765	5
Sri Lanka	1,439	1,584	30	114	209	30	12.9	23	190	239	18
Thailand	58,259	58,365	16	72,060	41,604	10	90.6	8	305	392	12
Europe, Middle East, and Africa											
Czech Republic	-	11,796	23	-	9,038	18	36.7	16	-	164	24
Egypt	3,259	32,838	18	195	9,038	19	31.6	18	656	1,032	2
Greece	9,489	204,213	6	1,605	188,722	4	131.1	5	129	281	15
Hungary	562	16,317	20	38	14,395	16	95.8	7	23	66	30
Israel	29,634	63,820	15	14,694	15,463	15	29.8	19	377	644	9
Jordan	3,365	5,827	27	1,317	548	27	9.4	28	103	152	25
Morocco	1,909	13,695	22	70	2,530	23	17.6	22	62	55	31
Nigeria	1,221	2,940	28	14	145	31	5.1	31	153	194	22
Poland	222	29,577	19	167	11,149	17	45.8	14	16	221	20
Russia	218	72,205	12	-	2,839	22	5.9	29	26	207	21
Slovakia	-	723	31	-	474	28	59.7	10	-	845	4
South Africa	103,537	262,478	4	7,767	72,917	8	34.1	17	683	668	8
Turkey	**9,931**	**112,716**	**10**	**8,191**	**81,277**	**7**	**102.8**	**6**	**145**	**285**	**14**
Zimbabwe	628	2,514	29	20	227	29	12	25	62	70	29

Note: The Source of the table is IFC Factbook 1999.
Turnover ratio is calculated in dollar terms by dividing total value traded by average market capitalization.

Many mutual funds and other institutional investors across the world, especially developed countries, are increasing their investments in these markets. Most of these countries have a very low ratio market capitalization to their GNP, compare to the developed world.

Turkey has always been a strategically important country by virtue of its unique location straddling Europe, Asia, and Russia. Turkey continues in its traditional role as the crossroad of Europe and Asia and started to benefit from the economic development of the Balkans, the southern former Soviet republics, Russia, even Iran and Iraq and the rest of Middle East. Surrounded by such growth, the Turkish economy is bound to benefit. Today, Turkish stock market is one of the world's busiest.

As discussed in the previous section, the stock market activities date back to the Ottoman Empire, but the Modern Istanbul Stock Exchange was founded in 1986. The ISE has continued to operate continuously since January 1986. Number of companies whose stocks have been traded increased from 80 in 1986 to 285 by the end of 1999. Total market capitalization was US$ 938 million at the end of 1986. It increased to US$ 112,716 million by the end of 1999. Total trading volume was US$ 81,277 million in 1999. Price-Earning (P/E) was 37.52 and dividend yield was 0.72% in 1999. Following tables give further descriptive details concerning ISE for the period of 1986-1999.

Number of Listings and Market Capitalization

At the end of the 1999 there are 285 companies listed on the ISE while that number was 80 in 1986. The market capitalization has been increased between 1986 and 1999. In 1999, the market value of ISE shares totaled TL 61,137,073 billion (US$

114,271 million), which represents an increase of 476.1% (235.3% in US dollar terms) compared with end of the 1998. Table 2.2 reports the number of listed companies and the market value both in Turkish Liras and in US dollars between 1986 and 1999.

Table 2.2 Number of Listed Companies and Market Capitalization, ISE, 1986-1999

Year-end	No. Of companies listed	Market Value (TL billion)	Market Value (US$ million)
1986	80	709	938
1987	82	3,182	3,125
1988	79	2,048	1,128
1989	76	15,553	6,756
1990	110	55,238	18,737
1991	134	78,907	15,564
1992	145	84,809	9,922
1993	160	546,316	37,824
1994	176	836,118	21,785
1995	205	1,264,998	20,782
1996	228	3,275,038	30,797
1997	258	12,654,308	61,879
1998	227	10,611,820	33,646
1999	285	61,137,073	114,271

Trading Volume

Total traded value increased from TL 9 billion (US$ 13 million) in 1986 to TL 36,865,348 (US$ 84,034 million) by the end of 1999. The average daily value of stocks has also increased continuously. Table 2.3 reports the total and daily average value of stocks and the number of stocks traded. Table 2.4 shows the trading value of the stocks by sector for 1999.

Table 2.3 Traded Value and The Number of Stocks Traded

	Traded Value				Number of Stocks Traded (Million)	
	Daily Average		Total			
	TL Bill	US$ Mil.	TL Bill.	US$ Mil.	Daily Average	Total
1986	---	---	9	13	---	3
1987	---	---	105	118	---	15
1988	1	---	149	115	---	32
1989	7	3	1,736	773	1	238
1990	62	24	15,313	5,854	6	1,537
1991	144	34	35,487	8,502	18	4,531
1992	224	34	56,339	8,567	41	10,285
1993	1,037	88	255,222	21,770	143	35,249
1994	2,573	92	650,864	23,203	396	100,062
1995	9,458	209	2,374,055	52,357	1,220	306,254
1996	12,272	153	3,031,186	37,737	1,583	390,917
1997	35,908	231	9,048,721	58,104	3,650	919,784
1998	72,701	284	18,029,967	70,396	9,042	2,242,531
1999	156,26	291	36,865,348	84,034	24,677	5,823,858

Table 2.4 Trading Value By Sector, ISE 1999

Sector	Trading Value (TL billion)
Holdings	9,350,998
Banks	7,462,892
Fabricated metal products, machinery and equipment	4,642,564
Chemicals and petroleum, rubber and plastic products	4,195,715
Consumer trade	2,040,638
Basic metal industries	1,937,956
Food, beverage and tobacco	1,247,572
Paper and paper products, printing and publishing	1,225,340
Non-metallic mineral products	1,195,398
Investment trusts	929,029
Textile, wearing apparel and leather	683,709
Insurance companies	388,091
Wholesale trade	305,365
Brokerage houses	79,175
Restaurants and hotels	69,390
Financial leasing and factoring companies	67,735
Wood products	32,918
Other manufacturing industry	31,129

Turnover Ratio, P/E and Dividend Yields

Table 2.5 reports the turnover ratios, price/earning ratios and dividend yields for the period 1986-1999. Turnover Ratio was 1.2% in 1986 while that number is 111.1% in 1999. P/E ratio also increased in 1999 compared to its value in 1986. Dividend yield, on the other hand shows lower percentage in 1999 compared to its value in 1986.

Table 2.5 Turnover Ratio, P/E and Dividend Yields, 1986-1999

Year-end	Turnover Ratio (%)	P/E ratio	Dividend Yield (%)
1986	1.2	5.07	9.15
1987	3.3	15.86	2.82
1988	7.3	4.97	10.48
1989	11.2	15.74	3.44
1990	27.7	23.97	2.62
1991	44.9	15.88	3.95
1992	66.5	11.39	6.43
1993	46.8	25.75	1.65
1994	77.8	24.83	2.78
1995	187.6	9.23	3.56
1996	92.5	12.15	2.87
1997	71.5	24.39	1.56
1998	142.4	8.84	3.37
1999	111.1	37.52	0.72

CHAPTER III

VOLATILITY OF AGGREGATE MARKET INDICES

Introduction

During the last decade or so the world financial market experienced a rapid growth in emerging stock markets. Studies related to these markets show that equities from emerging stock markets have different characteristics than equities from developed stock markets. Four distinguishing features of emerging market returns are higher sample average return, low correlations with developed market returns, more predictable returns and higher volatility. Because of the current international status and growth rate of emerging markets, many researchers focus on this last issue, the volatility of these markets. For example, Choudhry (1996) studies volatility, risk premia and the persistence of volatility in six emerging markets, Argantina, Greece, India, Mexico, Thailand and Zimbabwe, before and after the 1987 stock market crash. Santis and Imrohoroglu (1997) study the dynamics of expected stock returns and volatility in emerging financial markets. They find clustering, predictability and persistence in conditional volatility in these markets. Bekaert and Harvey (1997) analyze the reasons that volatility is different across emerging markets, particularly with respect to the timing of capital market reforms. They find that capital market liberalizations often increase the correlation between local market returns and the world market but do not drive up local market volatility. More recently Aggarwal, Inclan and Leal (1999) examine global and local events that cause large shifts in the volatility of emerging stock markets.

Different statistical models such as the rolling standard deviations, parametric ARCH or stochastic-volatility models have been used in previous studies. In this chapter we use traditional method of volatility estimation by computing the monthly standard deviations based on daily return observation to analyze the time-varying volatility of aggregate market indices of ISE. Our goal is to determine whether ISE can be characterized by high volatility. We examine when large changes in the volatility of ISE returns occur and what events (political, social, and economic) took place around the period of increased volatility.

Data and Volatility Measurement

The behavior of ISE stock volatility is analyzed using four daily aggregate indices: National 100, Financial Sector Index, Production Sector Index and Service Sector Index. National 100 composed of National market companies and it is the main index of the ISE. The other three indices are the sectoral indices of ISE. The data was obtained from the database of the Central Bank of the Republic of Turkey. However, the original data source is the ISE. The data for National 100, Financial Sector Index and Production Sector Index start from January 2, 1991 while Service Sector Index starts from January 2, 1997. The last day for all indices is December 22, 2000. Throughout this paper, stock market returns are defined as continuously compounded returns at time t, calculated as the natural log difference in the closing market index between two dates.

Following French, Schwert and Stambaugh (1987) and Schwert (1989), we use the monthly standard deviation of stock return as a measure of volatility. We estimate the monthly standard deviation of stock returns using the daily returns to four ISE market indices. The estimator of the variance of the monthly return is the sum of the squared daily returns after subtracting the average daily return in the month:

$$\hat{\sigma}_t^2 = \frac{1}{N_t - 1} \sum_{i=1}^{N_t} r_{it}^2 \qquad (1)$$

where there are N_t daily returns r_{it} in month t. Using nonoverlapping samples of daily data to estimate the monthly variance creates estimation error that is uncorrelated through time.

Behavior of Aggregate Market Indices

In figure 3.1 to 3.4 we plot the volatility of National 100, Financial Sector Index, Production Sector Index and Service Sector Index. All four plots appear to capture important political and economic events of Turkey. First consider the volatility of National 100 index. Figure 3.1 shows a huge spike in December of 2000 as well as higher levels of volatility in January 2000, September of 1998, February of 1994 and December of 1991. In general, Figure 3.1 shows an upward trend in volatility of National 100 index. The average monthly standard deviation for the period 1997-2000 is 33% which is higher than that for either the period 1991-1993 (26%) or the period 1994-1996 (27%).

The figure 3.1 reveals high levels of volatility during the 1991, especially at the end of the year. The Gulf crisis and resulting war dominated the ISE at the beginning of the year. The ISE Composite Index rose by 74% by the end of February. This was followed by a decline due to the world-wide recession and domestic political and economic uncertainty. The continuous depreciation of the Turkish Lira (TL) against the

US$ caused a 17% shrinkage of total market capitalization in US$ terms thereby making the ISE a relatively poor performer in 1991.

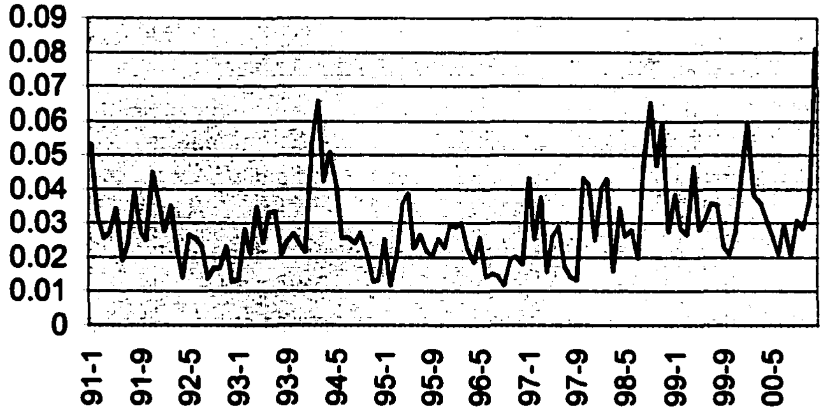

**Figure 3.1: Volatility of National 100 Index
(Monthly, January 1991-December 2000)**

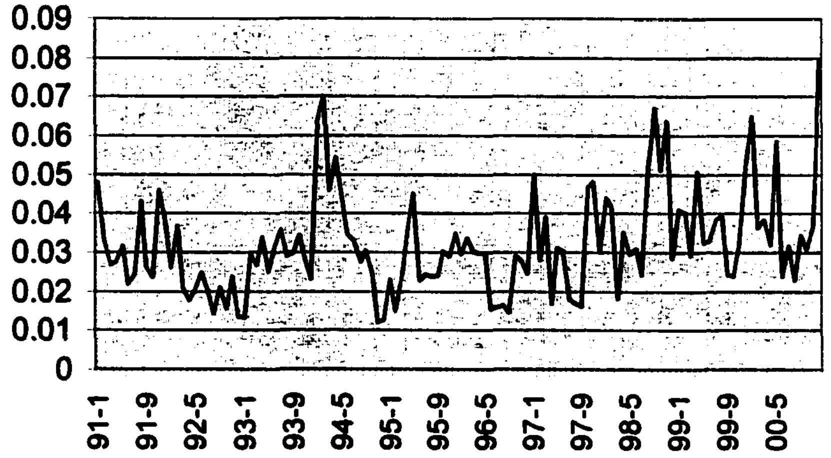

**Figure 3.2: Volatility of Financial Sector Index
(Monthly, January 1991-December2000)**

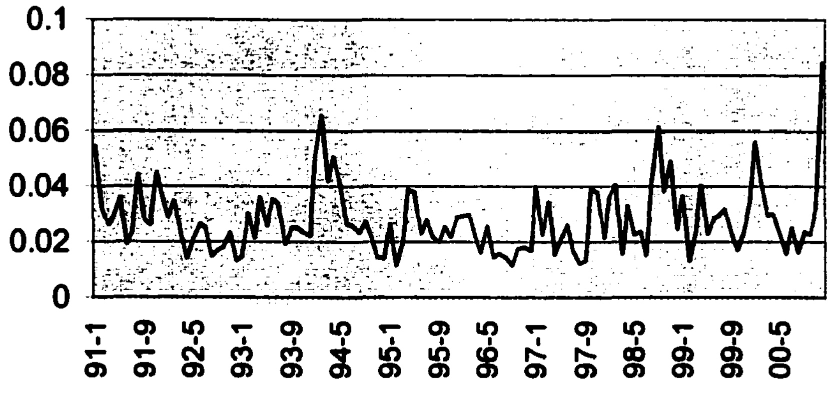

Figure 3.3: Volatility of Production Sector Index
(Monthly, January 1991-December 2000)

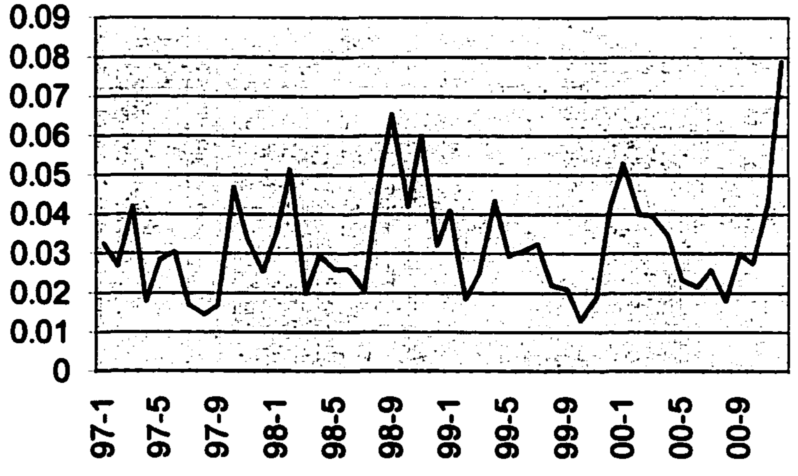

Figure 3.4: Volatility of Service Sector Index
(Monthly, January 1997-December 2000)

The higher volatility of the market in 1994 was the result of currency crisis. The world's second best performing emerging stock market in 1993 registered huge dollar losses in 1994 due entirely to 65 % devaluation in the Turkish Lira. ISE Composite Index rose 31.8% in lira terms but fell 50.7% in dollar terms. Volatile money markets and political instability undermined foreign confidence in the lira, while efforts to reduce Turkey's current account, budget and trade deficits were not enough to change the negative investment mood. The Turkish market had its worse monthly performance for 1994 in February. A lack of public confidence in the economic outlook dampened market sentiment dramatically and resulted in massive selling. This bad performance caused a big jump in market volatility.

National 100 index has another jump in September of 1998. Domestic political uncertainty mixed economic signals, and declines in emerging markets worldwide weighted heavily on Turkish equities in 1998. ISE Composite Index lost 24.7%. Especially the Russian equity free-fall had a severe negative impact on the Turkish market in August. Many portfolio managers carry Turkish and Russian equities in the same basket of stocks and the Russian turmoil prompted foreign investors to shift funds to developed markets. The slide continued through September, fueled by the worsening situation in neighboring Russia and confirmation that the government would impose capital gains in taxes in 1999.

The increased volatility during 2000 was due to the financial sector crisis. Beginning of year 2000, the market was bolstered by a positive investment environment supported by the IMF-backed disinflation program, with 5.6% GDP increase year-to-year, confidence in the lira, and a sharp decline in interest rates and inflation. Turkey expected to raise US$7.6 billion from privatization of state assets. Positive news included a new law allowing international arbitration between the government and foreign investors, and new measures to prevent insider trading. Despite these reforms, investor confidence declined and share prices plunged because of political turmoil. At the end of this year Turkey was hit by a banking crisis triggered by anxiety over bank liquidity problems and rumors of takeovers. The liquidity crunch peaked on November 22 and concerns about banking sector health led investors to pull US$7 billion from Turkey in two weeks. By the end of the December 11 bank are taken over by the Savings Deposit Insurance Fund. The banking sector instability and the application of the banking act against six banks kept investors away from financial stocks. The level of market volatility had its highest jump in December of 2000 as a result of this financial crisis.

Next consider volatility of Financial sector index in Figure 3.2 Volatility of financial sector index also has its highest jump in the December of 2000. The index has the higher levels of volatility in January of 2000, February of 1994 and September of 1998. Thus, financial crisis in 2000, currency crisis in 1994 and the Russian equity free-fall have big effect on the volatility of financial sector index. Figure 3.2 also shows an upward trend in volatility of financial sector index.

In Figure 3.3 we plot the volatility of Production sector index. Similar to financial sector index, the figure shows huge spike in volatility in December of 2000 as well as the higher levels of volatility in January of 2000, February of 1994 and September of 1998. Unlike volatility of financial sector index, we do not observe any trend in volatility of production sector index.

Figure 3.4 shows the volatility of Service sector index. The three highest jumps in volatility are in January and in December of 2000 and September of 1998. Volatility of Service sector also does not show any trend.

Table 3.1 presents summary statistics for the estimated monthly volatility series. Sample statistics for the volatility of various aggregate market indices highlight the following:

. The mean value of return volatility for index of Service sector is higher than the value for other three indices. Median volatility conform to the same ranking.

. Production index has the lowest variability compare to other indices.

. Volatility of all aggregate indices display positive skewness.

. National 100 index and Production index display excess kurtosis.

Conclusion

In this paper we characterize the behavior of ISE stock volatility using four daily aggregate indices. The monthly standard deviations of stock return were estimated as a measure of volatility. The plots of volatility measures show that the main index of ISE, National 100 index, has upward trend in volatility. Financial sector index has also increased over time. Production sector index and Service sector index, on the other hand, do not show any trend.

The plots of the volatility measures also revealed that large change in volatility occur during the important political, social and economic events of Turkey. The mean value of return volatility is higher for service sector index while Production sector index has the lowest variability. All volatility measures display positive skewness while only National 100 index and Production sector index display excess kurtosis.

Table 3.1 Summary Statistics for the Estimated Market Monthly Standard Deviation

	National 100 (1991-2000)	Financial Index (1991-2000)	Production Index (1991-2000)	Service Index (1997-2000)
Mean	0.0297	0.0321	0.0279	0.0325
Median	0.0266	0.0298	0.0253	0.0298
St. Deviation	0.0133	0.0130	0.0120	0.0138
Min	0.0117	0.0121	0.0117	0.0131
Max	0.0880	0.0793	0.0843	0.0790
Skewness	1.5834	1.1208	1.5431	1.2014
Kurtosis	3.5907	1.4923	3.8268	1.8013
No. of Obs.	132	120	120	48

CHAPTER IV

MARKET LEVEL, INDUSTRY LEVEL AND FIRM LEVEL VOLATILITY OF ISE

Introduction

In previous chapter we focused on aggregate stock market volatility of ISE and showed that it is not constant but changes over time. Now we turn our attention to disaggregated volatility measures. It is known that the return to an individual stock has three components: aggregate market return, industry-level shocks and firm-level shocks. Thus, volatility of an individual stock depends on the volatility of industry-specific and firm-specific shocks as much as the volatility of aggregate market return. There is, on the other hand, little empirical research on volatility at the level of the industry or firm.

A few papers, Black (1976), Christie (1982) and Duffee (1995), use disaggregated data to study the "leverage" effect, the tendency for volatility to rise following negative returns. Black (1976) conducted the first empirical work on the relation between stock returns and volatility using a sample of stock return volatility over the period of 1962-1975 by summing squared daily returns and taking the square root of the result. For each stock i, he then estimated

$$\frac{\sigma_{i,t+1} - \sigma_{i,t}}{\sigma_{i,t}} = \alpha_0 + \lambda_0 r_{i,t} + \varepsilon_{i,t+1} \tag{2}$$

where $\sigma_{i,t}$ is an estimate of the standard deviation of this return. He found that λ_0 was always negative and usually less than -1.

A similar approach is taken by Christie (1982). He conducts quarterly estimates of return volatility for 379 firms all of which existed throughout the period 1962-1978. He than estimates (3)

$$\log(\frac{\sigma_{t+1}}{\sigma_t}) = \alpha_0 + \lambda_0 r_t + \varepsilon_{t+1,0} \qquad (3)$$

over 1962-1978 for each firm and finds a mean λ_0 of –0.23. He studies whether this negative coefficient could be explained by the leverage effect and explains that leverage is a dominant but probably not the only determinant of λ_0.

Duffee (1995) follows the previous work in this area by using daily stock returns for the period of 1977-1991 but takes a different approach. The coefficient λ_0 in equation (3) equals the difference between λ_2 and λ_1 in the following equations:

$$\log(\sigma_t) = \alpha_1 + \lambda_1 r_t + \varepsilon_{t,1} \qquad (4)$$

$$\log(\sigma_{t+1}) = \alpha_2 + \lambda_2 r_t + \varepsilon_{t+1,2} \qquad (5)$$

He finds that for the typical firm traded on the American or New York Stock Exchange, λ_1 is strongly positive, while the sign of λ_2 depends on the frequency over which these relations are estimated. It is positive at the daily frequency and negative at the monthly frequency. In both cases, λ_1 exceeds λ_2, so λ_2 is negative in equation (3).

Some researchers, Bainard and Cutler (1993), Loungani, Rush and Tave (1990), have used stock-market data to test macroeconomic models of reallocation across industries or firms. Bernard and Cutler (1993) develop a new measure of reallocation shocks based on the variance of industry stock market excess returns to assess the contribution of sectoral reallocation to unemployment in the postwar U.S. economy. They first construct a time series of the variance of sectoral stock market excess returns, termed cross-section volatility and unemployment. They construct the cross-section volatility series using industry data on stock market excess returns. Excess returns for each industry through time, $\varepsilon_{j,t}$ are formed as the residual from the market model:

$$R_{j,t} = \beta_{0j} + \beta_{1j} R_{m,t} + \varepsilon_{j,t} \tag{6}$$

where $R_{m,t}$ is the return on the market portfolio at time t (the Standard & Poor Composite Index) and $R_{j,t}$ is industry j's return at time t. They form the industry-specific components of return variation:

$$n_{j,t} = \hat{\beta}_{0j} + \hat{\varepsilon}_{j,t} \tag{7}$$

The excess returns include the time-variant component of the industry-specific response in order to capture trend movements within industries. They form the measure of cross-section volatility as the weighted variance of one-quarter excess returns. Then they examine the relation between cross-section volatility and unemployment and find a positive and statistically significant correlation between them.

Loungani, Rush and Tave (1990) test the sectoral shifts hypothesis which suggests that unemployment is, in part, the result of resources being reallocated from declining to expanding sectors of the economy. Using US data from 1931 to 1987, they construct an index that measures the dispersion among stock prices from different industries. They find that lagged values of this index significantly affect unemployment.

Leahyand and Whited (1996) have used stock-market data to explore the firm-level relation between volatility and investment. They develop a measure of the uncertainty facing a firm from the variance of asset returns to study the relationship between investment and uncertainty for a group of firms. Their sample contains the daily returns of 772 firms from 1981 to 1987. Their results indicate that an increase in uncertainty decreases investment.

Roll (1992) and Heston and Rouwenhorst (1994) decompose volatility in industry and country-specific effects and study the implications for international diversification. Roll (1992) compares the stock price indices across countries to explain why they exhibit such disparate behavior. He first constructs global industry indexes by using the daily equity price indexes of 24 countries for the period of 1988 to 1991. Then he uses global industry indexes along with exchange rates to explain the time series behavior of each national markets daily return. The empirical evidence of the paper points to three explanatory influences for the differences in volatilities across markets. First, stock market indexes include different number of individual stocks; some indices are more diversified than others. Second, each country's industrial structure plays a major role in explaining stock price behavior. Third, the stock markets of most countries are influenced by exchange rates.

Heston and Rouwenhorst (1994) examine the influence on industrial structure on the cross-sectional volatility and correlation structure of country index returns for 12 European countries between 1978 and 1992. They find that industrial structure explains very little of the cross-sectional difference in country return volatilities, and that the low correlation between country indices is almost completely due to country-specific sources of return variation.

More recently Campbell et al. (2001) characterize the behavior of market, industry and firm level volatility of the US stock market. They study the historical movements of the market, industry and firm level volatility and use daily U.S. data over the period 1962-1997.

They find that the volatility of the market, industry and firm level volatilities are important components of the total volatility of the return of a typical firm. All three volatility measures experience substantial variations over time and they are positively correlated as well as autocorrelated. They also find that over their sample period, firm level volatility has a significant positive trend whereas market level and industry level volatility do not. They also study the lead-lag relations among their volatility measures and various indicators of the state of the aggregate economy and find that all three volatility variables, particularly industry level volatility, help to forecast economic activity and reduce the significance of the other commonly used forecasting variables.

Methodology

Following Campbell and Lettau (2001) we decompose the return on a typical stock into three components: the market-wide return, an industry-specific residual, and a firm-specific residual. Based on this return decomposition, time-series of volatility measures of the three components for a "typical" firm is constructed.

Industries are denoted by an i subscript while individual firms are indexed by f. The simple excess return of firm f that belongs to industry i in period t is denoted as R_{ift}. The excess return of industry i in period t is given by $R_{it} = \sum_{f \in i} w_{ift} R_{ift}$ where w_{ift} is the weight of firm f in industry i. In this paper, we use a value-weighting based on market capitalization. The industries are aggregated correspondingly. The weight of industry i in the total market is denoted by $w_{it}(=\sum_{f\in i} w_{ift})$ and the excess market return is $R_{mt}=\sum_i w_{it}R_{it}$. All the excess return in this paper are measured as an excess return over the Treasury bill rate.

In the next step we decompose firm and industry returns into the three components. Decomposition based on the CAMP implies that we can set intercepts to zero in the following equations:

$$R_{it}=\beta_{mi}R_{mt}+\tilde{\varepsilon}_{it} \tag{8}$$

for industry returns and

$$R_{ift}=\beta_{mf}R_{mt}+\beta_{if}\tilde{\varepsilon}_{it}+\tilde{\eta}_{ift} \tag{9}$$

for individual firm returns. In (8) β_{mi} denotes the beta for industry i with respect to the market return, and $\tilde{\varepsilon}_{it}$ is the industry-specific residual. Similarly, in (9) β_{mf} is the beta of firm f with respect to the market, β_{if} is the beta of firm f in industry i with respect to its industry shock, and $\tilde{\eta}_{ift}$ is the firm-specific residual. The weighted sum of the different betas equals unity:

$$\sum_i w_{it}\beta_{mi}=1,\quad \sum_{f\in i} w_{ift}\beta_{mf}=1,\quad \sum_{f\in i} w_{ift}\beta_{fi}=1 \tag{10}$$

The CAMP decomposition (8) and (9) guarantees that the different components of a firm's return are orthogonal to one another. Thus it permits a simple variance decomposition in which all covariance terms are zero:

$$Var(R_{it})=\beta_{mi}^2 Var(R_{mt})+Var(\tilde{\varepsilon}_{it}) \tag{11}$$

$$Var(R_{ift})=\beta_{mf}^2 Var(R_{mt})+\beta_{if}^2 Var(\tilde{\varepsilon}_{it})+Var(\tilde{\eta}_{ift}) \tag{12}$$

This decomposition requires knowledge of firm-specific betas, which are difficult to estimate. Therefore, we use simplified industry return decomposition, which drops the industry beta coefficient β_{mi} from (8):

$$R_{it} = R_{mt} + \varepsilon_{it} \tag{13}$$

Campbell, Lo and MacKinlay (1997, chapter 4) refer (13) as "market-adjusted-return model" in contrast to the market model of equation (8). Comparing (8) and (13), we have

$$\varepsilon_{it} = \tilde{\varepsilon}_{it} + (\beta_{mi} - 1)R_{mt} \tag{14}$$

The market-adjusted-return residual ε_{it} equals the CAMP residual of (11) only if the industry beta $\beta_{mi} = 1$ or $R_{mt} = 0$.

R_{mt} and ε_{it} are not orthogonal in this decomposition. So, one cannot ignore the covariance between them. Computing the variance of the industry yields

$$Var(R_{it}) = Var(R_{mt}) + Var(\varepsilon_{it}) + 2Cov(R_{mt}, \varepsilon_{it}) \tag{15}$$

where taking account of the covariance term once again introduces the industry beta into the variance decomposition. However, we can eliminate the individual covariances by taking the weighted average of variance across industries:

$$\sum_i w_{it} Var(R_{it}) = Var(R_{mt}) + \sum_i w_{it} Var(\varepsilon_{it}) \tag{16}$$

$$= \sigma_{mt}^2 + \sigma_{\varepsilon t}^2$$

The terms involving betas aggregate out since from (10) $\sum_i w_{it}\beta_{mi} = 1$. Therefore one can use the residual ε_{it} in (13) to construct a measure of average industry-level volatility that does not require any estimation of betas.

Individual firm returns can be decomposed in the same fashion. Consider a firm return decomposition that drops betas from (9):

$$R_{ift} = R_{mt} + \varepsilon_{it} + \eta_{ift} \tag{17}$$

where ε_{it} is defined in (14) and

$$\eta_{ift} = \tilde{\eta}_{ift} + (\beta_{mf} - 1)R_{mt} + (\beta_{if} - 1)\tilde{\varepsilon}_{it} \tag{18}$$

Just as with industry residuals, $\eta_{ift} = \tilde{\eta}_{ift}$ only if firm betas equal one or market and industry shocks are zero. The variance of the firm return is

$$\begin{aligned} Var(R_{ift}) &= Var(R_{mt}) + Var(\varepsilon_{it}) + Var(\eta_{ift}) \\ &\quad + 2Cov(R_{mt}, \varepsilon_{it}) + 2Cov(\varepsilon_{it}, \eta_{ift}) + 2Cov(R_{mt}, \eta_{ift}) \end{aligned}$$

The weighted average of firm variances in industry i after expressing the covariances in terms of betas and volatility become

$$\sum_{f \in i} w_{ift} Var(R_{ift}) = Var(R_{mt}) + Var(\varepsilon_{it}) + \sigma^2_{\eta it} + 2(\beta_{mi} - 1)Var(R_{mt})$$

Computing the weighted average across industries yields again a variance decomposition without any betas since the industry betas sum to one:

$$\begin{aligned} \sum_i w_{it} \sum_{f \in i} w_{ift} Var(R_{ift}) &= Var(R_{mt}) + \sum_i w_{it} Var(\varepsilon_{it}) + \sum_i w_{it} \sigma^2_{\eta it} \\ &= \sigma^2_{mt} + \sigma^2_{\varepsilon t} + \sigma^2_{\eta t} \end{aligned} \tag{19}$$

As in the case of industry returns, the simplified decomposition of firm returns (17) yields a measure of average firm-level volatility that does not require estimation of betas.

Data and Estimation

We use the firm- level return data set to estimate the volatility components in (19) based on the return composition (13) and (17). We aggregate individual firms into 15 industries according to the industry classification of ISE. Table 4.1 includes a list of those 15 industries.

Our sample runs from January 1992 to December 1999. The composition of firms in individual industries has changed dramatically over the sample period. The total number of firms covered by the ISE available data set increased from 92 in 92:1 to 222 in 99:12. The industry with most firms for the end of sample period is Textiles with 34 while the industry with the fewest firms is Power with 2. Based on market capitalization the three largest industries on average over the sample are Chemicals (22.01%), Banking (20.19%), and Engineering (17.10%).

Following procedure based on the methodology presented above is used to estimate the three volatility components in (19). The sample volatility of the market return in period t is computed as

$$MRK_t = \hat{\sigma}^2_{mt} = \sum_{d \in t} (R_{md} - \mu_m)^2 \qquad (20)$$

where μ_m is defined as the mean of the R_{md} over the sample. d refers to daily return and t refers to months. Market capitalization is used for the weights. For weights in period t we use the market capitalization of a firm in period $t-1$ and take the weighs as constant within period t.

For volatility in industry i we sum the squares of the industry-specific residual in (13) within period t:

$$\hat{\sigma}^2_{\varepsilon it} = \sum_{d \in t} \varepsilon^2_{id} \tag{21}$$

we average over industries to ensure that the covariances of individual industries cancel out. The average industry volatility is computed as

$$IND_t = \sum_i w_{it} \hat{\sigma}^2_{\varepsilon it} . \tag{22}$$

For firm-specific volatility we first sum the squares of the firm-specific residual in (17) for each firm in the sample:

$$\hat{\sigma}^2_{\eta ift} = \sum_{d \in t} \eta^2_{ifd} . \tag{23}$$

Next, we compute the weighted average of the firm-specific volatilities within an industry:

$$\hat{\sigma}^2_{\eta it} = \sum_{f \in i} w_{ift} \hat{\sigma}^2_{\eta ift} \tag{24}$$

and lastly we average over industries to obtain a measure of average firm-level volatility as

$$FIRM_t = \sum_i w_{it} \hat{\sigma}^2_{\eta it} \tag{25}$$

As for industry volatility this procedure ensures that the firm-specific covariances cancel out.

Table 4.1 Number of Firms and Market Capitalization Ratios of Individual Industries

Industry	Number of firms (end of 1999)	Market Capitalization (%)
Food	24	2.904
Textiles	34	2.953
Media and Publishing	13	2.256
Chemicals	19	22.011
Construction Materials	23	5.960
Ferrous Metals	10	1.536
Engineering	25	17.105
Power	2	0.916
Wholesale and retail trade	14	3.310
Transportation	3	5.879
Banking	13	20.190
Insurance	5	0.990
Financial Leasing and Factoring	7	0.448
Holdings	11	13.372
Investment trusts	19	0.139

CHAPTER V

BEHAVIOR OF MARKET LEVEL, INDUSTRY LEVEL AND FIRM LEVEL VOLATILITY

Graphical Analysis

How can we describe the movements of the three volatility components? We plot market volatility MRK, industry-level volatility IND, firm-level volatility FIRM in figure 5.1 to 5.3 to answer this question. The top panel shows the raw monthly time-series while the bottom panel plots the smoothed series, a lagged moving average of order 6. All three volatility series show great deal of variation.

First consider the behavior of market-level volatility in Figure 5.1. The first striking feature is that MRK is on average higher than FIRM and IND. This implies that market-specific volatility is the largest component of the total volatility of an average firm. The second important characteristic of MRK is that it trends up over the sample. Similar to the aggregate market Index of ISE, Our market volatility measure appears to capture major shocks (political and economic) to the market volatility. For example, market volatility was particularly high at the beginning of 1993, 1994 and towards the end of 1998.

According to IFC, ISE was the second best performing market in 1993, its Composite Index jumping by 416% in lira terms and nearly 210% in dollars terms. Declines in short-term interest rates, expectations of lower inflation, and announcements of strong year-end corporate earnings moved share prices on the ISE sharply higher. Growth in Turkish economy was also remarkable in 1993 with GNP rising despite restricted trade opportunities due to political difficulties in neighboring countries and the recession in Western Europe. GDP grew at an exceptionally high rate of 7%, up from 5.5% the previous year and exceeding initial governmental targets of 5%. Despite the remarkable economic conditions, it is surprising to observe that there is a big jump in market volatility in April of 1993. One possible explanation for this jump would be related to the political uncertainty created by the unexpected death of president Turgut Ozal. The period of uncertainty was ended during the middle of 1993 by the approval of the new Turkish president, Suleyman Demirel.

The currency crisis in February 1994 caused a huge spike in market volatility. The value of MRK in 02/94 is 0.0022, about two times as high as the second highest value. MRK has its second highest jump in September of 1998 due to the political uncertainty and Russian equity free-fall.

Next consider the behavior of volatility IND in Figure 5.2. Industry-level volatility shows the exact same pattern with the market volatility; as for MRK, IND was particularly high at the beginning of 1993, 1994 and the end of 1998. This implies that the effects of events in those years are significant for industry-specific volatility, although not as much as for market-level volatility.

Lastly, Figure 5.3 plots firm-level volatility. The important characteristic of FIRM is that it is on average much lower than MRK and IND. The plot of MRK looks similar to MRK and IND.

When we look at all the three volatility plots together, it is clear that three different volatility measures tend to move together. For example, all three of them increase during the crisis in 1994. However, there are some periods on which they move differently. For example, IND is very high compared to its long- term mean in the July 1994, April 1996 and August 1996 while MRK and FIRM remain low.

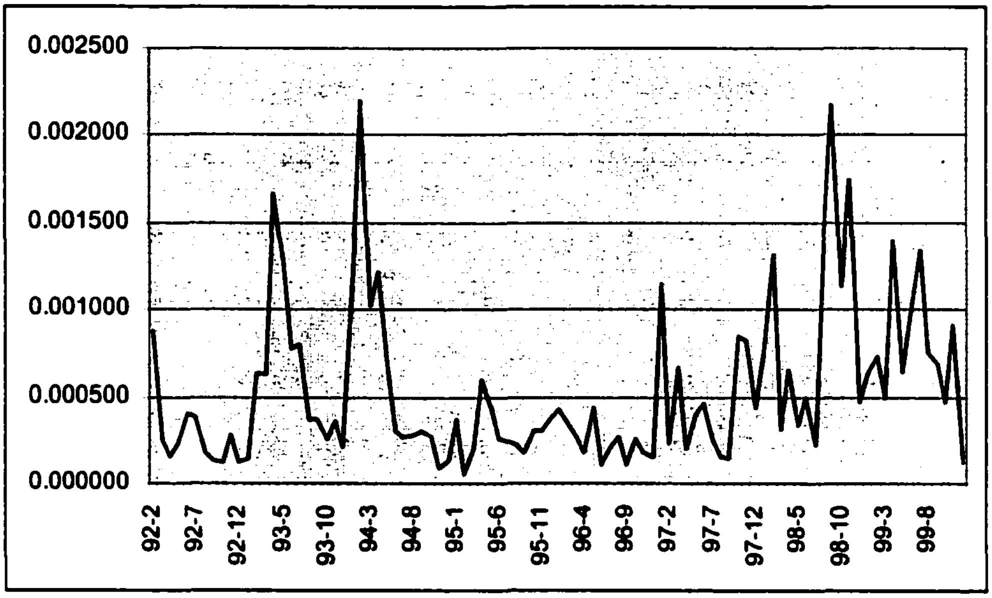

Figure 5.1A: MRK

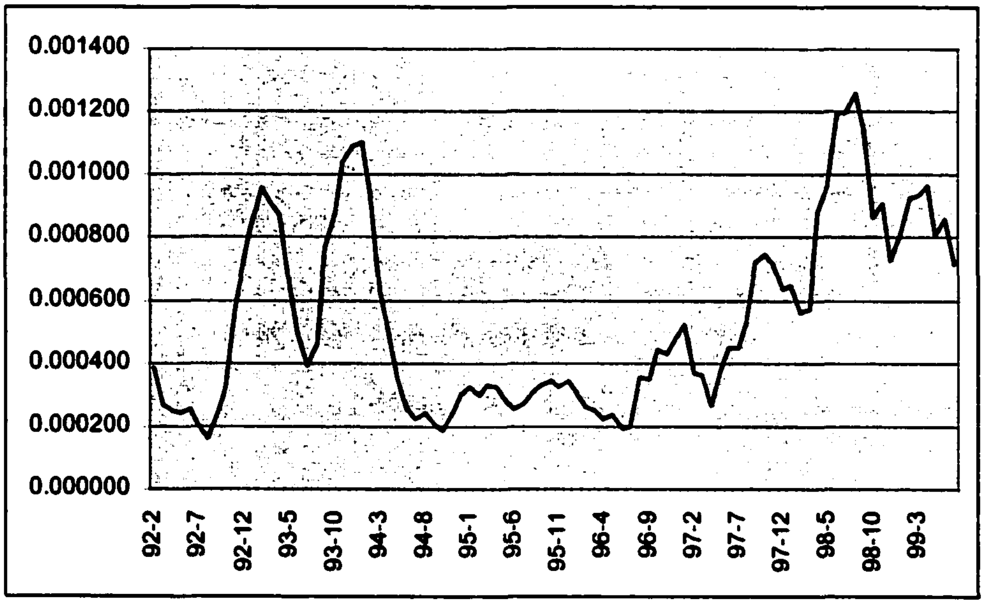

Figure 5.1B: MRK MA (6)

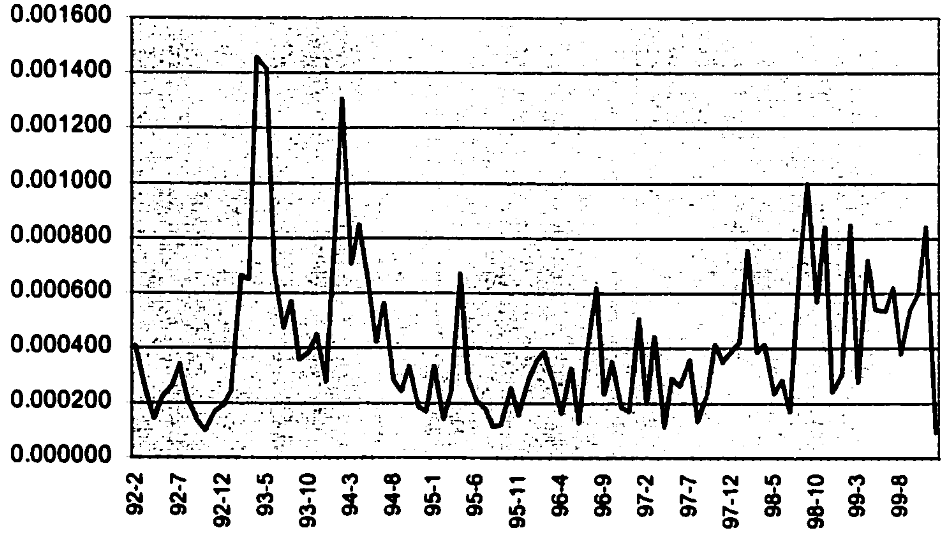

Figure 5.2A: IND

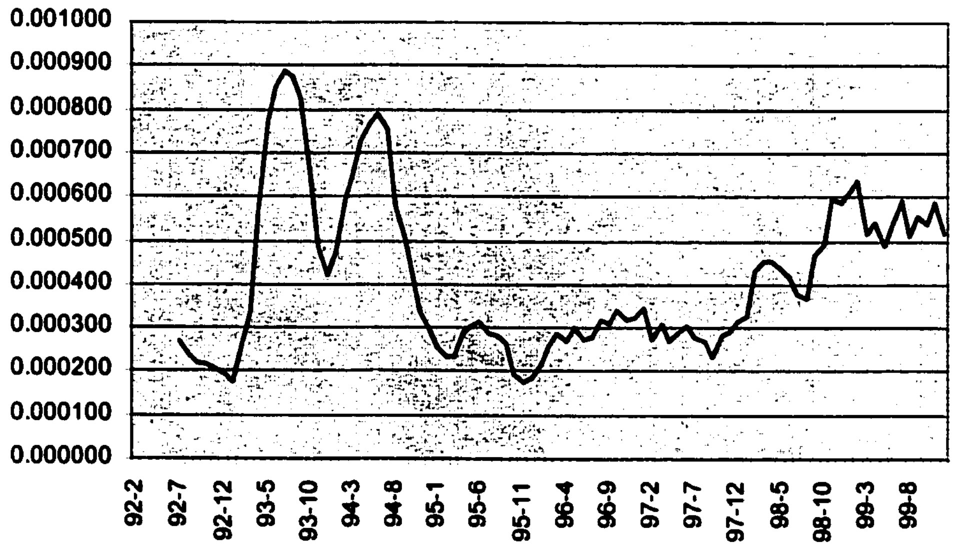

Figure 5.2B: IND MA (6)

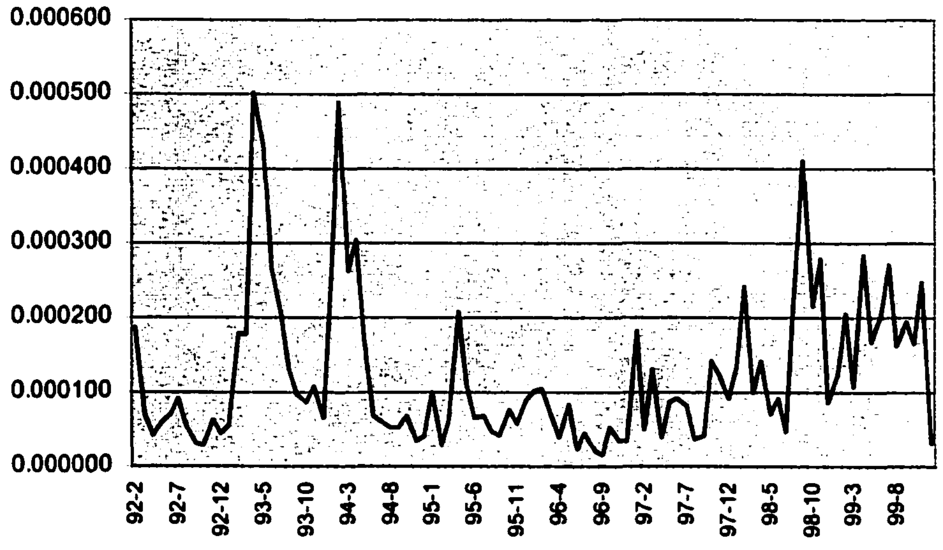

Figure 5.3A: FIRM

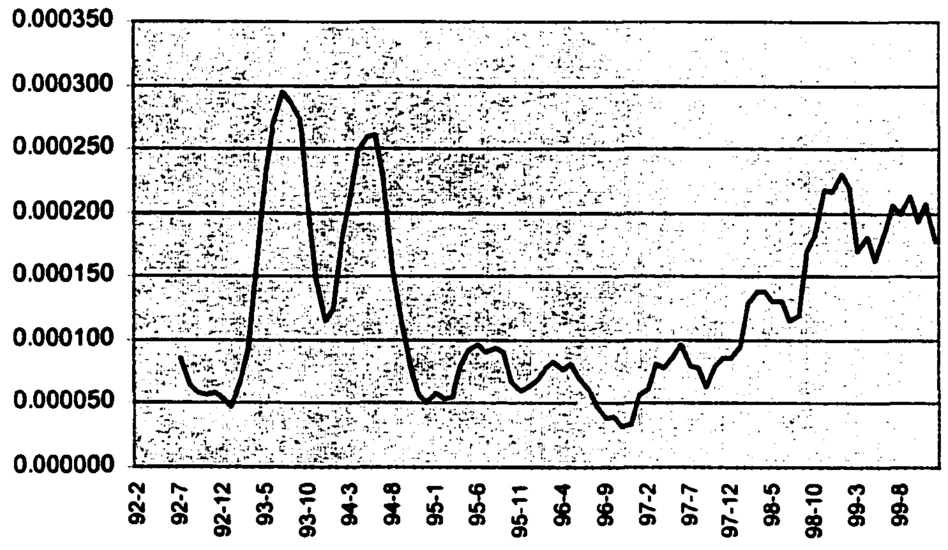

Figure 5.3B: FIRM MA (6)

Stochastic versus Deterministic Trend

Figure 5 to 7 suggest that the three volatility measures tend to move together and each series appears to exhibit a significant amount of serial correlation. Table 5.1 reports the autocorrelation structure of monthly volatility measures constracted from daily data. All three volatility series exhibit a high amount of serial correlation. This raises the possibility of unit root in the series.

To check this possibility, we employed augmented Dickey and Fuller (1979) test. The test consists of regressing each series on its lagged value and lagged difference terms. The number of lagged differences to be included can be determined by the Akaike information criterion. In table 5.2, the ρ-test is the Dickey-Fuller test statistic under the null hypothesis of unit root. The table also presents the number of lagged difference terms included in the regression estimated for the unit root tests. The hypothesis of a unit root is rejected at the 5% level for all three volatility series with or without a deterministic trend. Given these results, we continue to analyze the volatility of market, industry and firm in levels rather than first differences.

Table 5.3 reports some descriptive statistics. Mean of FIRM is 0.012 while IND has higher mean of 0.041. MRK is on average larger than both IND and FIRM with a mean of 0.053. Table 5.3 also reports unconditional standard deviations of the variance series. Industry and market-level volatility are more variable over time than firm-level volatility. This implies that market and industry-level uncertainty are important components of the total volatility of an average firm.

Table 5.1 Autocorrelation Structure

autocorrelation	MRK	IND	FIRM
ρ_1	0487	0.506	0.584
ρ_2	0363	0.355	0.406
ρ_3	0.189	0.232	0.205
ρ_4	-0.012	0.003	0.000
ρ_5	0.017	0.055	-0.002
ρ_6	-0.029	0.026	-0.023
ρ_7	0.017	0.009	0.077
ρ_8	0.014	0.065	0.113
ρ_9	0.257	0.226	0.248
ρ_{10}	0.295	0.137	0.262
ρ_{11}	0.144	0.127	0.174
ρ_{12}	0.091	0.108	0.135

Table 5.2 Unit Root Tests

	MRK	IND	FIRM
Constant			
ADF test statistic	-4.042	-4.128	-3.919
Lag order	1	1	1
Constant and trend			
ADF test statistic	-4.158	-4.097	-3.899
Lag order	1	1	1

Note: This table reports unit root test for monthly volatility series constructed from daily data. Critical values at the 5% level are –2.892 when a constant is included in the regression and –3.458 when a constant and a linear trend are included.

Table 5.3 Descriptive Statistics

	MRK	IND	FIRM
Mean * 100	0.053	0.041	0.012
Median * 100	0.036	0.034	0.008
Maximum * 100	0.219	0.145	0.050
Minimum * 100	0.005	0.009	0.001
Std. Deviation * 100	0.045	0.027	0.010
Std. Deviation * 100 detrended	0.044	0.027	0.010
Skewness	1.665	1.653	1.702
Kurtosis	2.747	3.369	3.093

All three volatility series display positive skewness. Industry and firm-level volatility display excess kurtosis that is their distribution has thicker tails than a normal distribution.

In table 5.2 the unit root hypothesis for market, industry and firm-level volatility were rejected. An alternative hypothesis is the existence of a deterministic linear time trend. Table 5.4 reports regression of three volatility series on deterministic trend. The trend regression $\sigma_t^2 = \alpha + \beta t + \varepsilon_t$ is estimated using OLS with Newey-West corrected t-statistics with the optimal lag length chosen according to Newey and West (1994).

Table 5.4 Linear Trends

	MRK	IND	FIRM
Linear trend $* 10^4$	0.366 (0.031)	0.004 (0.689)	0.003 (0.404)

Note: p-values are reported in parenthesis.

The trend regression for daily data shows that IND and FIRM have a small positive but insignificant trend coefficient at 5 % significant level. MRK, on the other hand, has substantially larger positive and significant trend coefficient than IND and FIRM have, confirming the visual evidence from plots. These results tell us that market volatility have increased over time.

Covariation and Lead-Lag Relationship

The plots of volatility series show that the three volatility measures tend to move together. We examine this aspect of the series in table 5.5, both for raw and detrended data.

Table 5.5 Correlation Structure

	Raw			Detrended		
	MRK	IND	FIRM	MRK	IND	FIRM
Contemporaneous	1.000	0.842	0.937	1.000	0.855	0.945
Correlation		1.000	0.935		1.000	0.935
			1.000			1.000

Table 5.5 shows that contemporaneous correlation between the three volatility series are around 0.9 for raw data. It is slightly higher for detrended data. This result confirms the visual evidence from the plots.

Table 5.6 asks how important the three volatility components are relative to the total volatility of an average firm. Over the whole sample, firm-level volatility accounts for 11% of the unconditional mean of total volatility while industry-level volatility accounts for 38%. The largest portion of total volatility is market-level volatility with 50%. A variance composition shows that most of the time-series variation in total volatility is due to variation in MRK and IND; firm volatility is more stable over time. The two largest components are MRK variance and the covariation of MRK and IND; together they account for about 65% of the total time-series variation. FIRM, on the other hand, is much less important, only about 2 % of the total variation in volatility. Relative to its mean, MRK shows the greatest time-series variation. These results are more or less unchanged when we detrend the data.

Do three volatility measures help to forecast each other? Table 5.7 and Table 5.8 investigate this question using Granger-causality tests. Table 5.7 reports p-values for bivariate VARs and Table 5.8 reports trivariate VARs. The VAR lag length was chosen using the Akaike information criterion and shown in brackets. In bivariate VARs we reject the null hypothesis that MRK Granger-cause IND and FIRM. IND also does not Granger-cause MRK and FIRM. We have similar result for FIRM. Overall, none of the volatility series appears to lead the other volatility measures. Trivariate VARs give the same results. Thus, we can conclude that volatility series do not help to predict each other.

Table 5.6 Mean and Variance Decomposition

		MRK	IND	FIRM
Mean		0.500	0.383	0.116
	With Trend			
	MRK	0.320	0.327	0.135
	IND		0.117	0.081
Variance	FIRM			0.016
	Detrended			
	MRK	0.312	0.331	0.135
	IND		0.120	0.083
	FIRM			0.016

Note: Entries are the shares in the total mean and variance of a typical stock. The mean and variance are computed from following equations:

$$1 = E(MRK_t)/E\sigma_{rt}^2 + E(IND_t)/E\sigma_{rt}^2 + E(FIRM_t)/E\sigma_{rt}^2$$

$$1 = \mathrm{var}(MRK_t)/\mathrm{var}(\sigma_{rt}^2) + \mathrm{var}(IND_t)/\mathrm{var}(\sigma_{rt}^2) + \mathrm{var}(FIRM_t)/\mathrm{var}(\sigma_{rt}^2)$$
$$+ 2\mathrm{cov}(MRK_t, IND_t)/\mathrm{var}(\sigma_{rt}^2) + 2\mathrm{cov}(MRK_t, FIRM_t)/\mathrm{var}(\sigma_{rt}^2)$$
$$+ 2\mathrm{cov}(IND_t, FIRM_t)/\mathrm{var}(\sigma_{rt}^2).$$

Table 5.7 Granger-Causality
Bivariate VAR

	MRK_t	IND_t	$FIRM_t$
MRK_{t-l}	–	0.661 (2)	0.681 (2)
IND_{t-l}	0.772 (2)	–	0.218 (2)
$FIRM_{t-l}$	0.560 (2)	0.303 (2)	–

Table 5.8 Granger-Causality
Trivariate VAR

	MRK_t	IND_t	$FIRM_t$
MRK_{t-l}	–	0.940	0.881
IND_{t-l}	0.899	–	0.129
$FIRM_{t-l}$	0.318 (1)	0.807 (1)	– (1)

Conclusion

In this paper we analyze the behavior of stock market volatility not only at the level of the market as a whole but also at the industry and idiosyncratic firm levels. We have used daily data to construct realized monthly volatility for the sample period 1992-1999.

We plot the volatility series first. The graphical analysis of the volatility series show that market level volatility is on average higher then industry and firm level volatility. All three volatility plots have significant jumps during the times of important political, social and economic events of Turkey.

We study the nature of any potential trend in the series next. The significant positive deterministic trend has been found in market level volatility. Industry and firm level volatility, on the other hand do not show similar trend. High contemporaneous correlation between the series implies that they move together. The analysis of volatility components relative to total volatility of an average form reveals that market level volatility has the largest portion of total volatility on average. The most of the time-series variation in total volatility is due to the variation in market and industry level volatility.

The Granger-causality test for bivariate and trivariate VAR has been performed. Our goal is to see whether three volatility measures help to forecast each other. We find that none of the series appear to lead other series.

CHAPTER VI

VOLATILITY OF ISE AND BUSINESS CYCLE

Introduction

It has been shown in previous section that market, industry and firm-level volatility are not stable but change over time. This raises the question of why stock return volatility is higher at some times than at others.

The price of equity at any point is equal to the discounted present value of expected future cash flows (including capital gains and dividends) to shareholders. It is clear that at the aggregate level the value of corporate equity depends on the health of the economy and a change in the level of uncertainty about future macroeconomic conditions would cause a proportional change in stock return volatility. If macroeconomic data provide information about the volatility of either future expected cash flows or future discount rates, they can help explain why stock return volatility changes over time.

Studies of financial volatility in relation to the business cycle have historically focused on aggregate market volatility using a broad stock market index of a developed stock market. Merton (1980), Pindyck (1984), Potarba and Summers (1986), French, Schwert and Stambaugh (1987), Bollerslev, Engle and Wooldridge (1988) and Abel (1988) relate these changes to expected returns to stocks. Shiller (1981a, b) argues that the level of stock market volatility is too high relative to the ex post variability of dividends. Officer (1973) relates changes in stock market volatility to the volatility of macroeconomic variables. He argues that market volatility is higher in economic downturns. Black (1976) and Christie (1982) argue that financial leverage partly explains this phenomenon. Schwert (1989) presents an extensive analysis of the relation of market volatility with the time-varying volatility of a variety of economic variables, confirming Officer's (1973) earlier result that market volatility is higher in economic downturns. He shows that stock market volatility increases with financial leverage, as predicted by Black (1976) and Christie (1982), but this factor explains a small part of the variation in stock volatility. Hamilton and Lin (1989) model the joint behavior of stock returns and industrial production growth in regime-switching model. They find that economic recessions explain about 60% of the variation in market volatility. All of these studies focus on aggregate volatility. More recently Campbell, Lettau, Malkiel and Xu (2001) analyze the cyclical behavior of their volatility measures for the U.S. stock market. They report that the volatility measures increase substantially in economic downturns and tend to lead recessions. They show that their volatility measures especially industry-level volatility help to forecast economic activity.

Market, industry and firm-level volatility of ISE plotted in Figure 5.1-5.3 exhibited a tendency to rise during the economic downturns. For example the economic crisis of 1994 had a significant effect on all three volatility series. Therefore, the hypothesis that market, industry and firm-level volatility might provide useful information with respect to the overall course of the business cycle cannot be rejected a priori. This result encourages a closer examination of the link between our volatility measures and macroeconomic variables.

In this section we extend the Schewert (1989) and Cambell et al. (2001) results and focus on the link between the three volatility measures and selected macroeconomic variables relevant for the characterization of the stance of the business cycle for Turkish economy. The chosen macroeconomic variables are GDP growth, Industrial production, inflation rate and exchange rate. All these variables measured in monthly frequency except GDP. It is measured on a quarterly frequency; hence we construct new volatility series on that frequency. We use daily returns within each quarter as before. The time series properties of the quarterly volatility series are analyzed in the next section. The last section focuses on the cyclical behavior of the volatility series.

Time Series Behavior of Market, Industry and Firm-level Volatility

This section repeats the analysis of monthly time-series for the quarterly volatility series. The quarterly series behave very much like the monthly ones. In Figure 6.1-6.3 we plot the three variance components, estimated quarterly using daily data. MRK is on average higher than IND and FIRM. Compared with market volatility, industry volatility is slightly lower on average. Firm is on average much lower than MRK and IND. All of the volatility series were high at the second quarter of 1993, first quarter of 1994 and third quarter of 1998. The behavior of the quarterly series is very similar to the behavior of the monthly series.

The plots of the series suggest that the three volatility series move together. The autocorrelation coefficients, not reported in here, exhibit high amount of serial correlation. To check the possibility of unit root, we employed augmented Dickey and Fuller test. Table 6.1 reports the unit root tests for quarterly series constructed from daily data. Unlike the monthly volatility series, the hypothesis of a unit root is not rejected for the quarterly volatility series at the 5% level, whether a deterministic time trend is allowed or not. We repeat the unit root test for the first differences of the series. The hypothesis of a unit root is rejected in this case. Given these results, we proceed to analyze the volatility series in first differences rather than in levels.

Table 6.2 reports some descriptive statistics. Mean of MRK is on average higher than both IND and FIRM. Unconditional standard deviations of the Market-level volatility and industry-level volatility imply that these two components are more variable than firm-level volatility. These results coincide with the results of the monthly volatility series.

The contemporaneous correlation structure of the data is examined in Table 6.3. High contemporaneous correlation among the series confirms the visual evidence of the plot that the three volatility measures tend to move together.

The importance of the volatility components in total volatility of an average firm is reported in Table 6.4. Similar to the behavior of monthly volatility series, market volatility accounts for the largest portion of unconditional mean of the total volatility with 51% while industry-volatility and firm-level volatility together account for 49%. The variance decomposition shows that variation in MRK and the covariation of MRK and IND are the two largest components of the time-series variation of total volatility.

Table 6.5 and Table 6.6 investigate the forecasting power of the volatility series using Granger-Causality test for bivariate VARs and trivariate VAR models. Lag lengths of the VAR models are selected based on Akaike information criteria and are shown in brackets. The results of Granger-Causality tests show that in both bivarite and trivariate VAR system volatility series do not help to forecast each other.

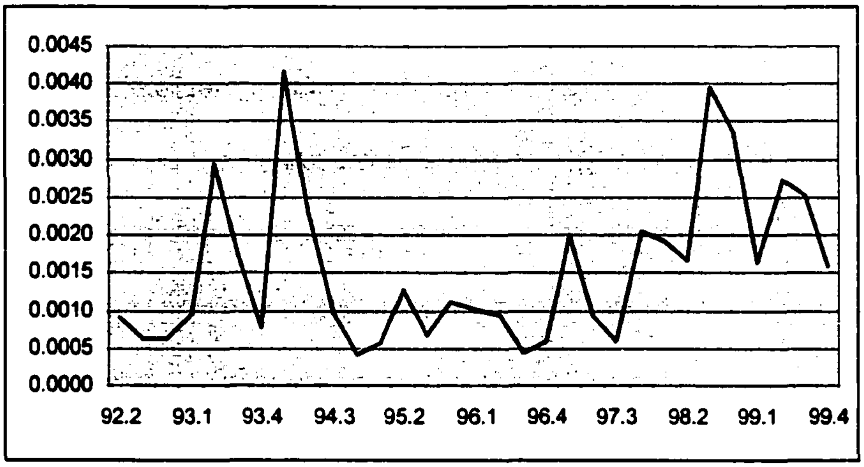

Figure 6.1: MRK

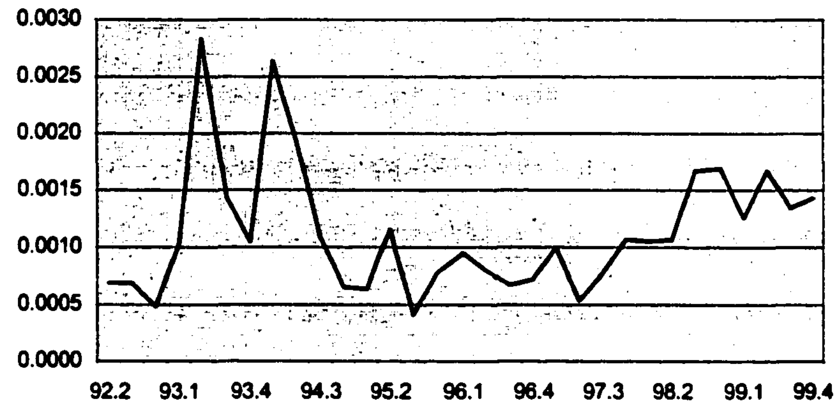

Figure 6.2: IND

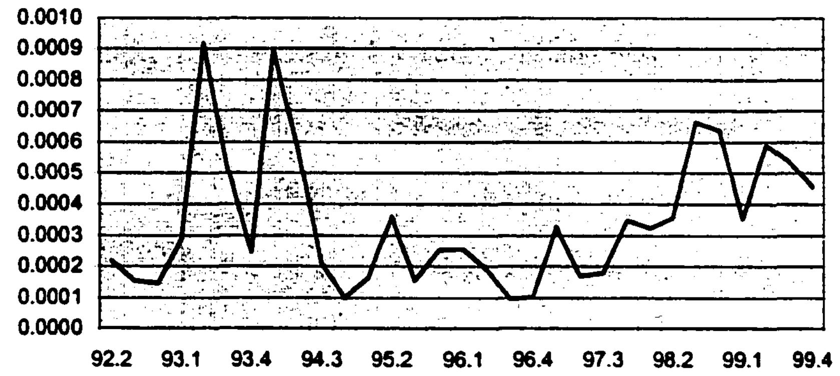

Figure 6.3: FIRM

Table 6.1. Unit root Test

	MRK	IND	FIRM
Constant			
ADF test statistic	-1.749	-2.006	-1.905
Lag order	2	7	7
Constant and trend			
ADF test statistic	-1.980	-1.520	-1.661
Lag order	7	7	7

Critical values at the 5% level are –2.99 when a constant is included in the regression and –3.621 when a constant and a linear trend are included. Number of lagged differences to be included in is determined by Akaike information criterion.

Table 6.2. Descriptive Statistics

	MRK	IND	FIRM
Mean * 100	0.155	0.113	0.034
Median * 100	0.111	0.105	0.029
Maximum * 100	0.415	0.282	0.091
Minimum * 100	0.040	0.041	0.009
Std. Deviation * 100	0.103	0.057	0.022
Skewness	1.040	1.375	1.064
Kurtosis	3.198	4.707	3.392

Table 6.3. Correlation Structure

	MRK	IND	FIRM
Contemporaneous Correlation	1.000	0.849	0.927
		1.000	0.963
			1.000

Table 6.4. Mean and Variance Decomposition

		MRK	IND	FIRM
Mean		0.510	0.374	0.114
	MRK	0.341	0.311	0.132
Variance	IND		0.105	0.076
	FIRM			0.015

Note: Entries are the shares in the total mean and variance of a typical stock. The mean and variance are computed from following equations:

$$
\begin{aligned}
1 &= E(MRK_t)/E\sigma_n^2 + E(IND_t)/E\sigma_n^2 + E(FIRM_t)/E\sigma_n^2 \\
1 &= \mathrm{var}(MRK_t)/\mathrm{var}(\sigma_n^2) + \mathrm{var}(IND_t)/\mathrm{var}(\sigma_n^2) + \mathrm{var}(FIRM_t)/\mathrm{var}(\sigma_n^2) \\
&\quad + 2\mathrm{cov}(MRK_t, IND_t)/\mathrm{var}(\sigma_n^2) + 2\mathrm{cov}(MRK_t, FIRM_t)/\mathrm{var}(\sigma_n^2) \\
&\quad + 2\mathrm{cov}(IND_t, FIRM_t)/\mathrm{var}(\sigma_n^2).
\end{aligned}
$$

Table 6.5. Granger-Causality
Bivariate VAR

	MRK_t	IND_t	$FIRM_t$
MRK_{t-l}	–	0.351 (6)	0.108 (6)
IND_{t-l}	0.130 (6)	–	0.424 (5)
$FIRM_{t-l}$	0.120 (6)	0.571 (5)	–

Table 6.6. Granger-Causality
Trivariate VAR

	MRK_t	IND_t	$FIRM_t$
MRK_{t-l}	–	0.278	0.117
IND_{t-l}	0.530	–	0.290
$FIRM_{t-l}$	0.494 (6)	0.346 (6)	– (6)

Cyclical Behavior of Volatility Measures

Here we study the relationship between our quarterly volatility series and GDP growth first. Table 6.7 presents cross-correlation coefficients for our three quarterly volatility measures and the change of real GDP up to a lead and lag of one year. Negative correlation implies that volatility tends to be higher in economic downturns. All three volatility series are negatively or positively correlated with GDP growth. In other words MRK, IND and FIRM exhibit anticyclical behavior with respect to real GDP prospects. This finding contradicts the finding of studies for the developed stock market.

Next, consider the forecasting power of market, industry and firm-level volatility. In Table 6.8 we present the result of various OLS regression with GDP growth as a dependent variable. The lagged GDP growth and the lagged volatility series are used as regressors. The first differences of each volatility series are included in the regression. All t-statistics and their p-values are Newey-West corrected with optimal lag length chosen according to Newey and West (1994). Regressing GDP growth on its own lag, lagged ISE National 100 value-weighted index return and each of the lagged volatility measures provide individually insignificant coefficients. The results of these regressions are reported in the first part of the table. Next, we include pairs of volatility variables as regressors. Market-level volatility has insignificant coefficient while industry-level volatility has significant coefficient in the first regression. In the second regression both market and firm-level volatility are individually and jointly significant. This regression has the highest R^2 value. The last regression provides insignificant coefficients for industry and firm-level volatility. The bottom of the table reports the regression results when all three volatility variables are included. Market and firm level volatility are individually significant. The p-value for F-test that all coefficients of the volatility variables are zero is 0.047. In other words, volatility measures are jointly significant. The results of various OLS regression show that market and the firm level volatility may have forecasting power of GDP growth.

We next do the similar analysis with our monthly volatility measures and macroeconomic variables. Table 6.9 presents the cross-correlation coefficients between my market-level volatility and monthly percentage change in the index of industrial production, monthly percentage change in consumer price index and the spot exchange rate of the Turkish Lira/U.S. Dollar exchange rate. Market-level volatility seems to have negative correlation with most of the leads and lags of industrial production growth. This result implies that market volatility is affected by the business cycle. Even though this is the case, we cannot conclude that market volatility exhibits cyclical behavior because some of the correlation coefficients are not negative. The correlation coefficients between market volatility and inflation rate do not show any pattern while we observe positive correlation between market-level volatility and the spot exchange rate.

Table 6.10 and Table 6.11 report the cross-correlation coefficient between these macroeconomic series and industry-level and firm-level volatility respectively. Industry-level volatility have seems to have positive correlation with all the leads and lags of inflation rate and with the most of the leads and lags of exchange rate. The correlations between the industry-level volatility and industrial production are negative in most of the cases but again we do not observe any pattern to conclude that industry-level volatility exhibits cyclical behavior. The findings for firm-level volatility are very similar to findings of market-level volatility. Thus one can interpret the results of Table 6.10 in a similar fashion.

We now ask whether our monthly volatility series have any power to forecast industrial production. In table 27 we present the results of OLS regressions with industrial production growth as a dependent variable. As regressors we use lagged industrial production, lagged return on the ISE National 100 value-weighted index and lagged volatility series. All t-statistics are Newey-West corrected with the optimal lag length chosen according to Newey and West (1994). The volatility series are detrended. We regress industrial production growth on its own lag, lagged of ISE index return and each of the lagged volatility measures in turn. In all of these regressions lagged industrial production growth and lagged ISE index return have significant coefficients while each of the volatility measures has insignificant coefficients.

Next, we include pairs of volatility variables as regressors. Again, in all of these regressions the lagged industrial production and the lagged ISE index return yields individually significant coefficients. Only the coefficient of market level volatility is significant when MRK and IND are included in the regression. While all other volatility series are individually insignificant, they are strongly jointly significant. The results are similar when all three volatility variables are included. None of them is individually significant but the joint significance level is 1 %. These results suggest that there is no conclusive evidence as to which of the three volatility measures has the most forecasting power.

Table 6.7. Correlation Coefficients of GDP with MRK, IND and FIRM Volatility

Quarters	MRK	IND	FIRM
-4	-0.269	-0.314	-0.308
-3	-0.156	-0.263	-0.270
-2	0.201	0.190	0.186
-1	0.118	0.306	0.287
0	-0.131	-0.223	-0.177
1	0.180	-0.268	-0.270
2	**0.210**	0.224	0.183
3	0.146	**0.319**	**0.307**
4	-0.161	-0.352	-0.255

Note: The first difference of each volatility series is taken. The bold figures denote the absolute maximum of the calculated correlation coefficients.

Table 6.8. GDP Growth and Forecasting Power of MRK, IND and FIRM

GDP_{t-1}	$INDEX_{t-1}$	MRK_{t-1}	IND_{t-1}	$FIRM_{t-1}$	R^2 (p-value)
-0.207	0.007	0.057			0.093
(0.294)	(0.221)	(0.607)			
-0.159	0.006		0.274		0.140
(0.413)	(0.268)		(0.182)		
-0.172	0.006			0.684	0.144
(0.374)	(0.244)			(0.194)	
-0.128	0.004	-0.270	0.710		0.202
(0.505)	(0.408)	(0.208)	(0.081)		(0.244)
-0.114	0.003	-0.751		4.135	0.321
(0.518)	(0.522)	(0.019)		(0.009)	(0.031)
-0.161	0.006		0.222	0.138	0.147
(0.421)	(0.278)		(0.760)	(0.941)	(0.491)
-0.139	0.003	-0.957	-0.815	7.024	0.354
(0.433)	(0.504)	(0.012)	(0.287)	(0.029)	(0.047)

Note: The table reports results of various OLS regression with GDP growth as the dependent variable. All regressors are lagged by one quarter. INDEX denotes the excess return of the ISE value-weighted portfolio. We have created this index from the National 100 price index of ISE. The p-values are reported in the parenthesis. The p-values in the last column are for an F-test of joint significance of the volatility measures. All p-values in parenthesis are computed using Newey-West standard errors. The volatility is quarterly constructed from daily returns and differenced once.

Table 6.9. Correlation Coefficients of Macroeconomic Series with MRK

Months	Industrial Production	Inflation Rate	Exchange Rate
-12	-0.137	0.265	0.103
-6	0.152	-0.077	0.138
-3	-0.072	0.183	0.162
-1	-0.058	0.066	0.143
0	-0.158	0.144	0.097
1	-0.089	-0.009	0.110
3	-0.155	-0.005	0.110
6	0.091	-0.052	0.111
12	-0.124	0.003	0.092

Note: The Volatility series is detrended

Table 6.10. Correlation Coefficients of Macroeconomic Series with IND

Months	Industrial Production	Inflation Rate	Exchange Rate
-12	-0.121	0.403	-0.006
-6	0.025	0.046	0.068
-3	-0.036	0.050	0.090
-1	-0.018	0.038	0.142
0	-0.071	0.111	0.096
1	-0.113	0.027	0.097
3	-0.249	0.022	0.088
6	0.035	0.013	0.078
12	-0.089	0.003	0.038

Table 6.11. Correlation Coefficients of Macroeconomic Series with FIRM

Months	Industrial Production	Inflation Rate	Exchange Rate
-12	-0.132	0.361	0.011
-6	0.114	-0.012	0.090
-3	-0.032	0.026	0.141
-1	-0.040	0.063	0.166
0	-0.105	0.140	0.126
1	-0.095	0.033	0.134
3	-0.210	-0.067	0.129
6	0.082	-0.019	0.124
12	-0.102	0.011	0.101

Table 6.12. Growth of Industrial Production and Forecasting Power of MRK, IND, FIRM

PRD_{t-1}	$INDEX_{t-1}$	MRK_{t-1}	IND_{t-1}	$FIRM_{t-1}$	R^2 (p-value)
-0.191	-0.010	-0.325			0.118
(0.059)	(0.004)	(0.149)			
-0.171	-0.009		-0.208		0.101
(0.090)	(0.008)		(0.556)		
-0.177	0.010			-0.926	0.107
(0.079)	(0.006)			(0.335)	
-0.210	-0.011	-0.779	0.828		0.133
(0.040)	(0.003)	(0.072)	(0.217)		(0.006)
-0.211	-0.011	1.097		3.472	0.132
(0.039)	(0.003)	(0.108)		(0.230)	(0.007)
-0.184	-0.010		0.858	-3.113	0.114
(0.069)	(0.005)		(0.385)	(0.248)	(0.018)
-0.213	-0.011	-1.012	0.511	1.830	0.135
(0.038)	(0.002)	(0.151)	(0.613)	(0.673)	(0.018)

Conclusion

In this paper we study the relationship between market, industry and firm level volatility and macroeconomic variables. We choose four macroeconomic variables: GDP, industrial production, inflation rate and exchange rate. GDP is measured in quarterly frequency while other three variables are measured monthly frequency. Thus, we construct new volatility series in quarterly frequency.

We first analyze the time series behavior of quarterly series. We find that quarterly volatility series behave very much like the monthly ones. We next study the correlation between our volatility measures and leads and lags of macroeconomic variables. Market and firm level volatility have positive correlation with leads and lags of exchange rate while industry level volatility has positive correlation with inflation rate. We also find that all the components of volatility do not exhibit counter-cyclical behavior with respect to GDP growth and industrial production.

We run various OLS regression to see whether our volatility series have any forecasting power of GDP growth and industrial production. The results of these regressions reveal that market and firm level volatility have forecasting power for GDP growth. While three volatility measures have forecasting power jointly for industrial production.

CHAPTER VII

INDUSTRY LEVEL VOLATILITY

Introduction

Previous chapters consider the behavior of average industry volatility. This volatility measure contains information about an average industry based on the assumption that the variation in industries show similar pattern. We know as a fact that the nature and composition of the industries in our sample are not the same. To get the information about the volatility of each industry we now examine the 15 industries separately.

Our estimation procedure needs to be changed to construct volatility measures for individual industries. The methodology in this chapter is very similar to the one we have used to estimate average industry and firm-level volatility. The only difference is we no longer have to average over firms and industries. Therefore, we have to alter the return composition in a way that we can estimate both the individual industry volatility and the firm-level volatility for each industry. We can rewrite the return composition in (13) as following:

$$R_{it} = \beta_{mi} R_{mt} + \tilde{\varepsilon}_{it} \tag{26}$$

R_{mt} and $\tilde{\varepsilon}_{it}$ are orthogonal by construction and therefore the volatility of the industry return is

$$Var(R_{it}) = \beta_{mi}^2 Var(R_{mt}) + \tilde{\sigma}_{it}^2 \tag{27}$$

Individual firm return composition in (17) can be rewritten in similar fachion.

$$R_{ift} = \beta_{mi} R_{mt} + \tilde{\varepsilon}_{it} + \eta^{*}{}_{ift} \tag{28}$$

The average firm volatility in industry i

$$\sum_{f \in i} w_{ift} Var(R_{ift}) = \beta_{mi}^{2} Var(R_{mt}) + \tilde{\sigma}_{it}^{2} + \sigma_{\eta it}^{2*} \tag{29}$$

We can use the residual in (26) and (28) to construct industry and firm-level volatility for individual industries. Note that the only additional parameters to be estimated are the industry betas on the market β_{mi}. We use OLS regressions assuming that the betas are constant over the sample.

Volatility of Individual industries

Market capitalization and total number of firms in 15 industries have been summarized in Table 4.1. We list the individual industries, their weights and the result of OLS regression in Table 28. Chemical is the largest industry in our sample with an average share of 22% of the total market capitalization over the whole sample period. Banking industry is the second largest industry with 20% of the total market capitalization followed by engineering and holdings.

Industry-beta is the measure of systematic risk. It reflects the responsiveness of the industry's expected return to changes in the value of the market portfolio. If industry-beta is greater than 1.0, that means industry portfolio carries greater systematic risk than the market portfolio. Two of the large industries in our sample, chemicals and banking, have an industry-beta higher than 1.0. Engineering has a beta of around unity. Other industries have a substantially lower beta.

Table 7.1. Market Capitalization ratios and Betas of Individual Industries

Industry	Weight	β
Food	2.904	0.11
Textiles	2.953	0.12
Media and Publishing	2.256	0.10
Chemicals	22.011	1.36
Construction Materials	5.960	0.23
Ferrous Metals	1.536	0.07
Engineering	17.105	0.99
Power	0.916	0.05
Wholesale and retail trade, hotels and restaurant	3.310	0.16
Transportation	5.879	0.39
Banking	20.190	1.19
Insurance	0.990	0.04
Financial Leasing and Factoring	0.448	0.01
Holdings	13.372	0.79
Investment trusts	0.139	0.007

Figures 7.1 to 7.15 plot the industry and firm-specific volatility in individual industries. The figures show huge spikes in both industry-specific and firm-specific volatility in almost all of the industries during the financial crisis of 1994 as well as the higher levels of volatility during the crisis of 1998.

Next, consider the descriptive statistics of industry and firm-level volatility in Table 7.2. IND has higher mean than FIRM for each industry just like the case of aggregated IND and FIRM. However, the means and the standard deviations of individual IND and FIRM are much lower than that of the aggregated IND and FIRM. For example, the mean of IND for textile is about one-fifth of IND in aggregated data. The spread for firm-level volatility is much higher. Industries with the high average industry-level volatility also tend to have a high firm-level volatility; the correlation of the means of IND and FIRM across industries is 0.90. Large industries tend to have high IND and FIRM on average. Table 7.3 does not report the skewness and kurtosis of the industry-level volatilities but all industry volatility exhibits positive skewness and excess kurtosis.

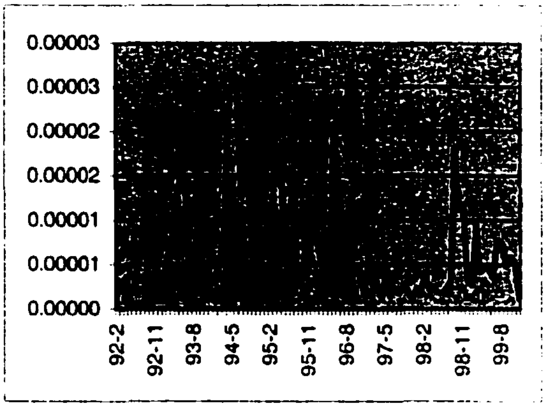

Figure 7.1A: Food IND

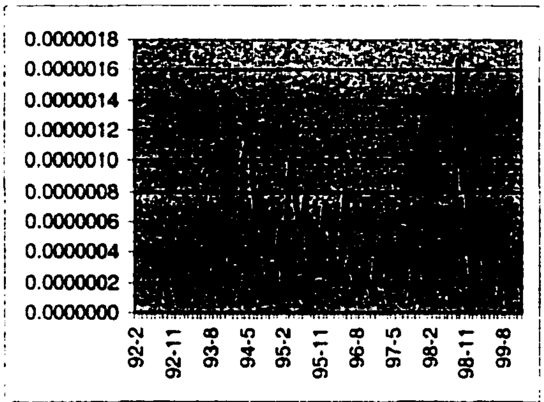

Figure 7.1B: Food FIRM

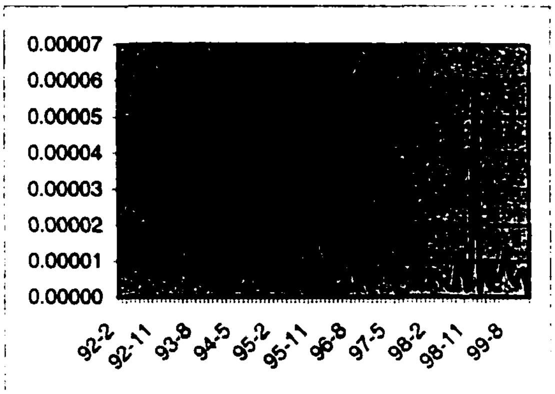

Figure 7.2A: Textiles IND

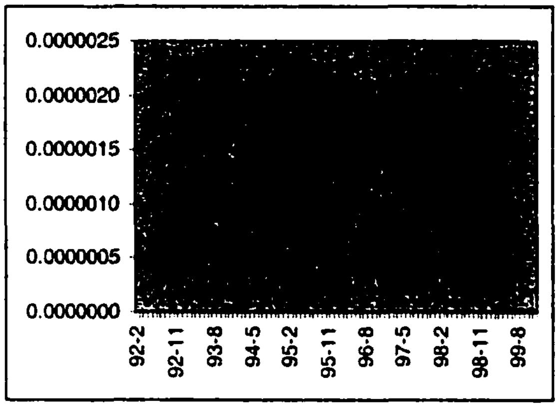

Figure 7.2B: Textiles FIRM

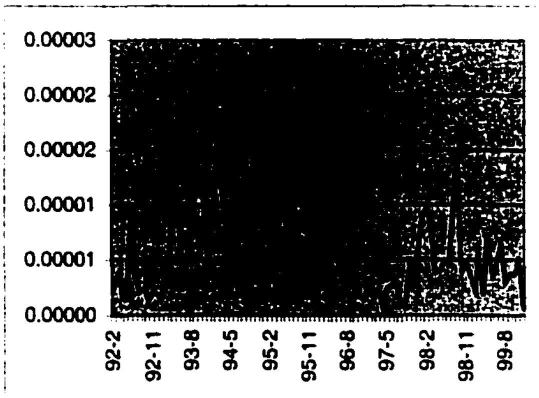

Figure 7.3A: Media & Publishing IND

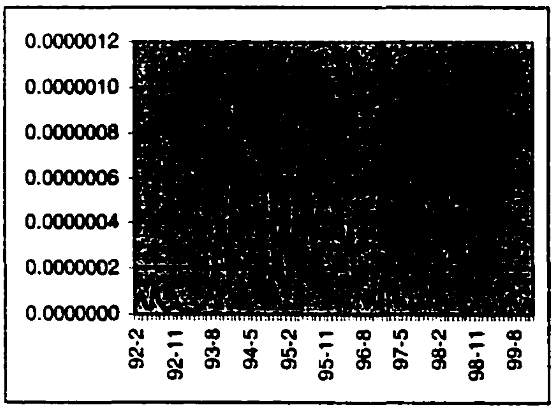

Figure 7.3B: Media & Publishing FIRM

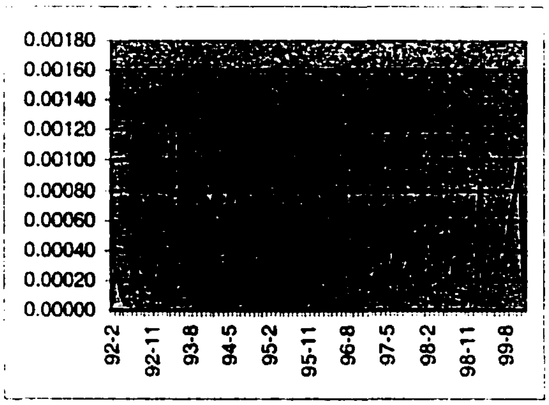

Figure 7.4A: Chemicals IND

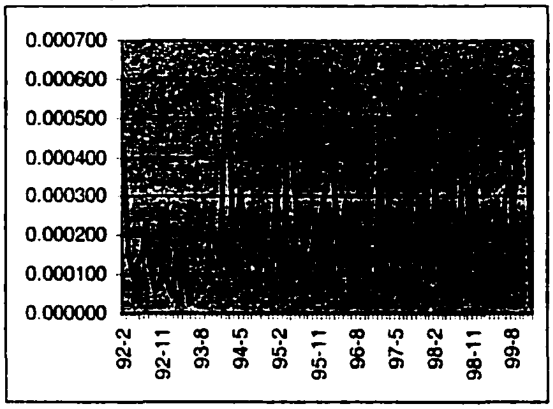

Figure 7.4B: Chemicals FIRM

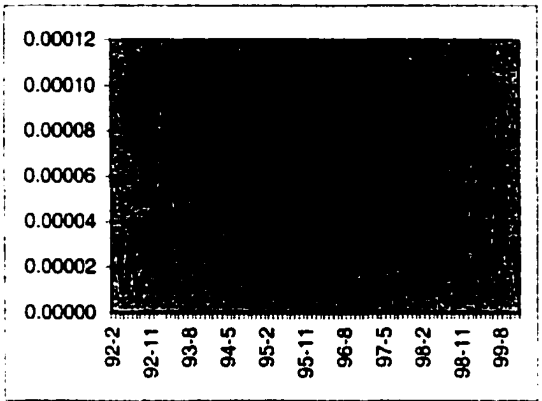

Figure 7.5A: Construction Materials IND

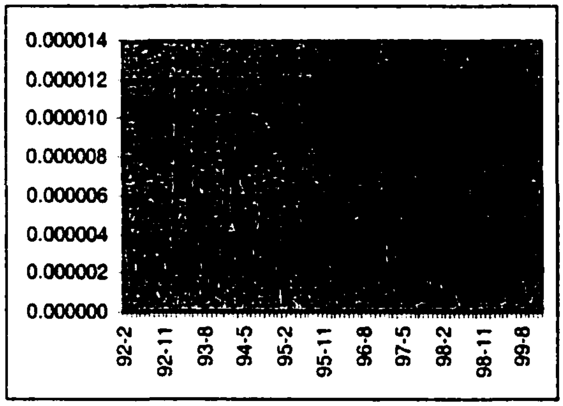

Figure 7.5B: Construction Materials FIRM

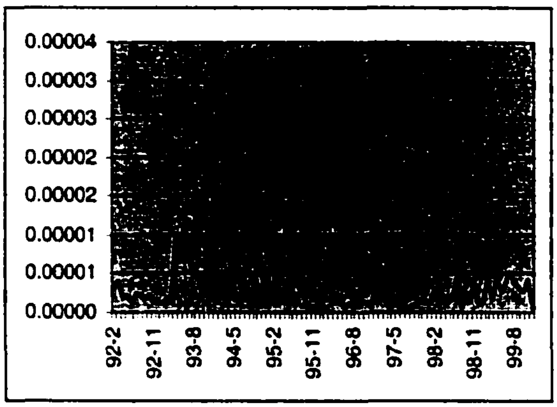

Figure 7.6A: Ferrous Metals IND

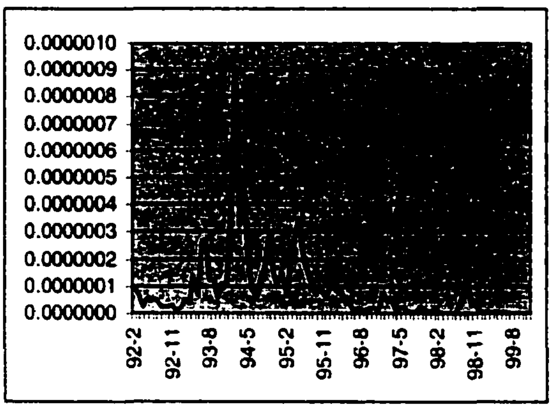

Figure 7.6B: Ferrous Metals FIRM

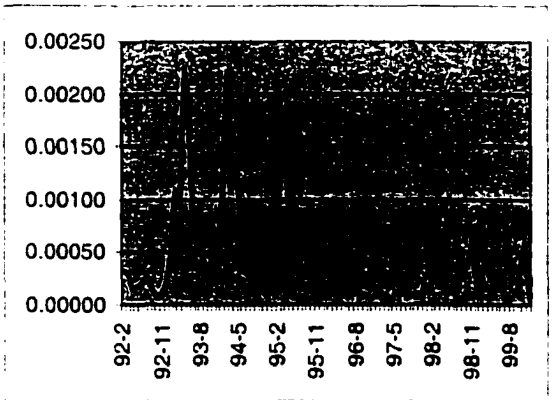

Figure 7.7A: Engineering IND

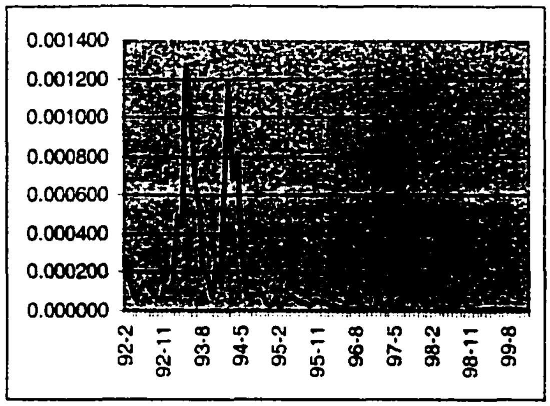

Figure 7.7B: Engineering FIRM

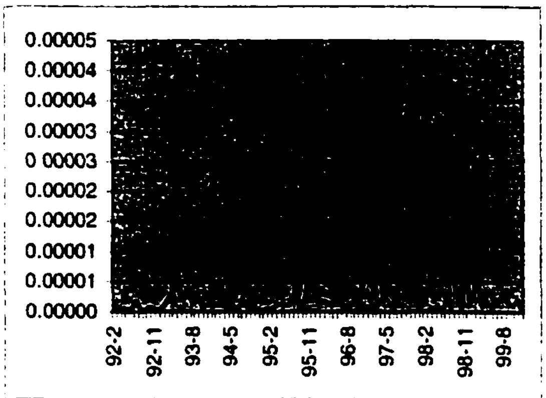

Figure 7.8A: Power IND

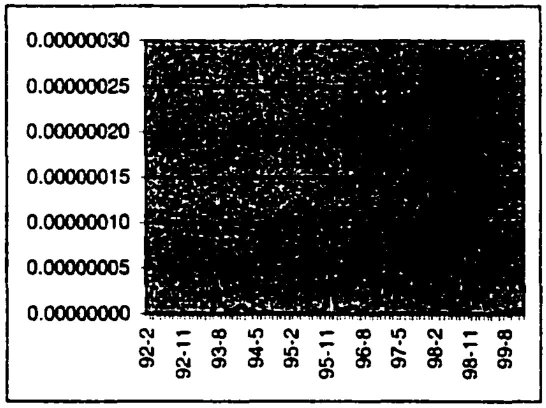

Figure 7.8B: Power FIRM

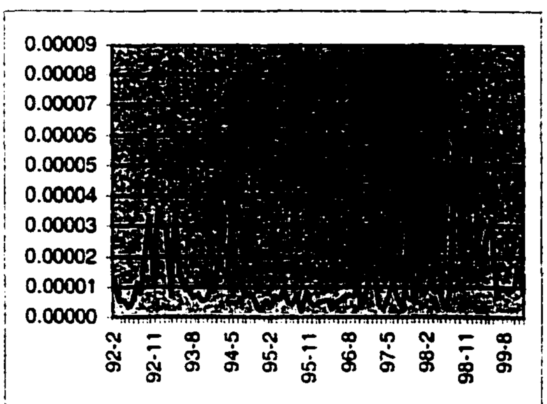

Figure 7.9A:Wholesale & Retail Trade IND

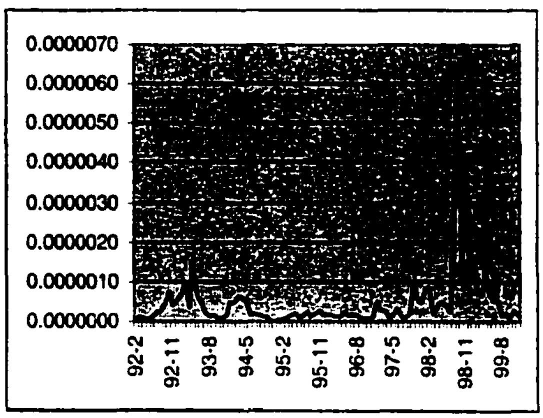

Figure 7.9A:Wholesale & Retail Trade FIRM

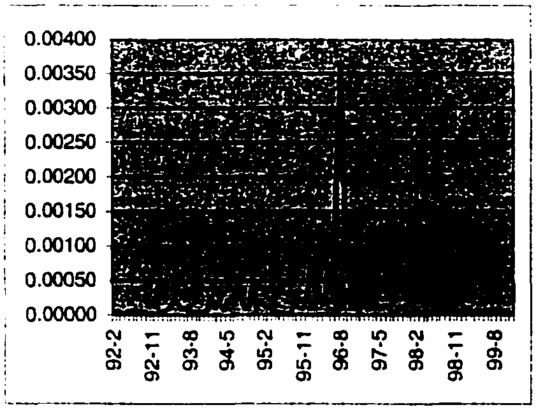

Figure 7.10A: Transportation IND

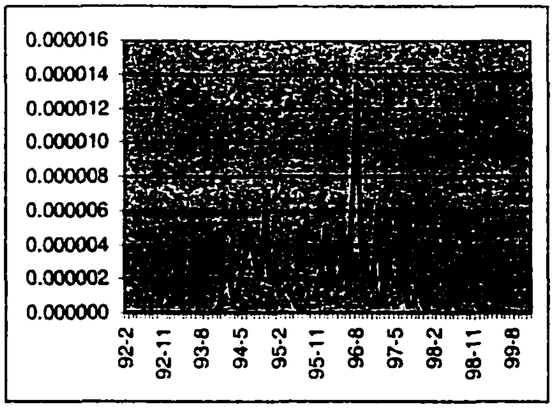

Figure 7.10B: Transportation FIRM

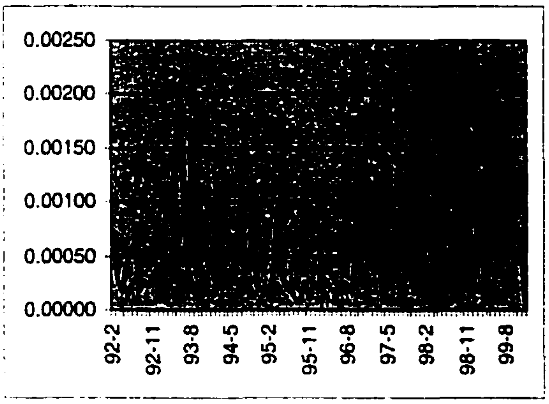

Figure 7.11A: Banking IND

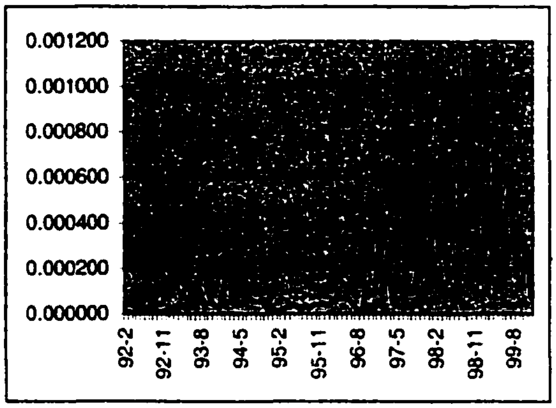

Figure 7.11B: Banking FIRM

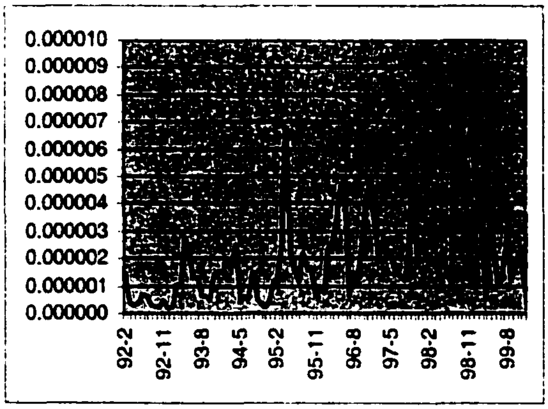

Figure 7.12A: Insurance IND

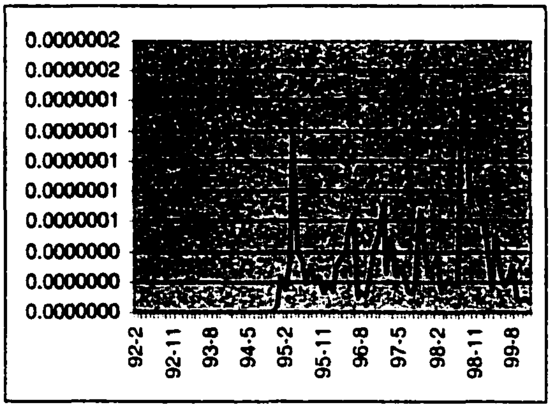

Figure 7.12B: Insurance FIRM

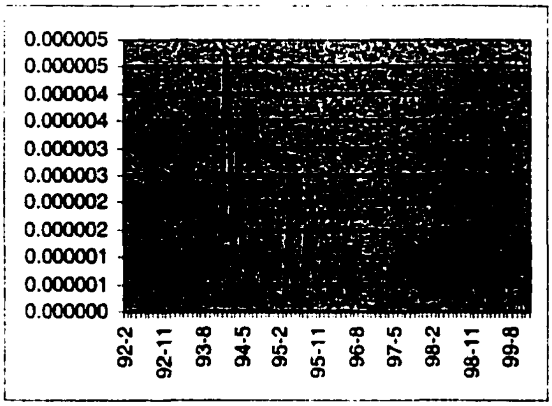

Figure 7.13A: Leasing and Factoring IND

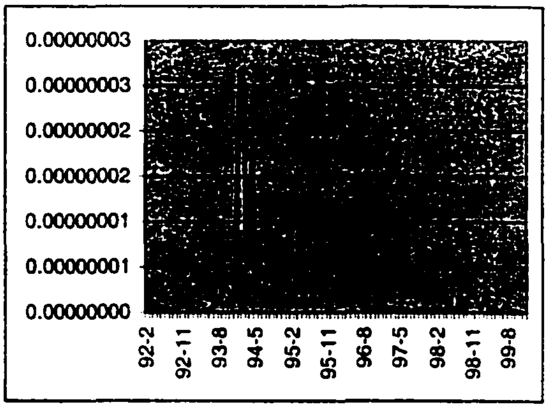

Figure 7.13B: Leasing and Factoring FIRM

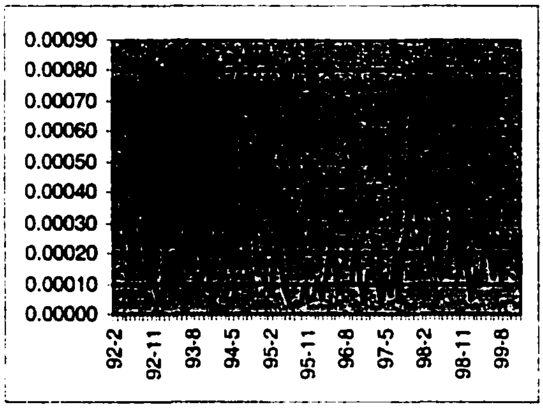

Figure 7.14A: Holdings IND

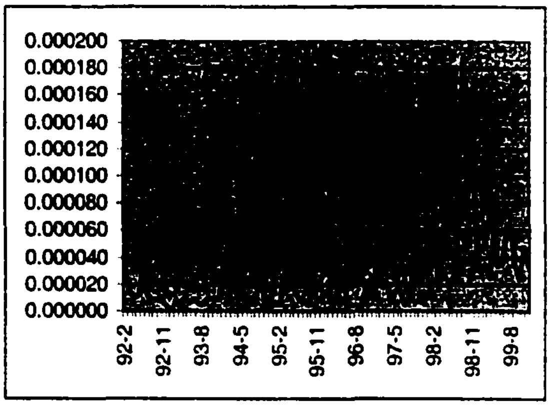

Figure 7.14B: Holdings FIRM

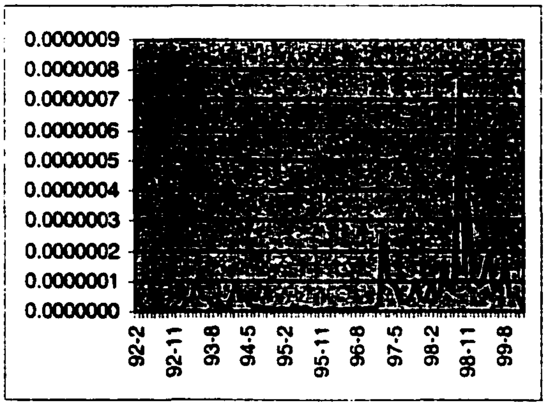

Figure 7.15A: Investment Trusts IND

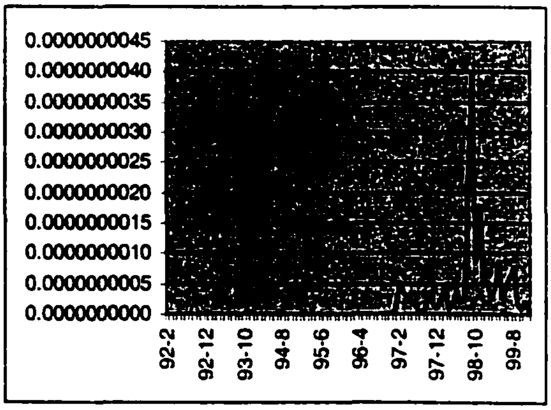

Figure 7.15B: Investment Trusts FIRM

In Chapter V we found the existence of upward trend only in market volatility; industry and firm-level volatility had insignificant trend coefficients. Now we ask whether individual industries exhibit significant trends in volatility. First, we perform unit root tests on all industry and firm level volatility series. The results are reported in Table 7.4. We reject the hypothesis of unit root for most of the industry and firm-level volatility series. The hypothesis of unit root is not rejected for Media and Publishing, Wholesale and retail trade, hotels and restaurant, and Financial Leasing and Factoring at the industry and firm level. In addition to these industries, we find the unit root in Power industry at the industry level and in Banking at the firm level. We next consider the trend regressions for the stationary volatility series. Table 7.5 reports the regression of the volatility series on deterministic trend. The trend regression $\sigma_t^2 = \alpha + \beta t + \varepsilon_t$ is estimated using OLS with Newey-West corrected t-statistics with the optimal lag length chosen according to Newey and West (1994).

In regressions on a linear time trend, Food, Construction Materials, Ferrous Metals, Engineering and Insurance industries exhibit significant negative trends while Investment trusts exhibits significant positive trend in IND. Among all 11 industries only three industries, Food, Textile and Transportation have insignificant trend coefficients in FIRM.

Table 7.2. Descriptive Statistics of Industry and Firm Level Volatility

Industries	IND		FIRM	
	Mean $*10^4$	S.d. $*10^4$	Mean $*10^5$	S.d. $*10^5$
Food	0.067	0.054	0.037	0.031
Textiles	0.078	0.0768	0.041	0.045
Media and Publishing	0.061	0.042	0.021	0.022
Chemicals	3.460	2.740	19.10	13.33
Construction Materials	0.234	0.180	0.271	0.241
Ferrous Metals	0.039	0.047	0.008	0.012
Engineering	3.360	4.330	13.20	24.90
Power	0.030	0.047	0.001	0.003
Wholesale and retail trade, hotels and restaurant	0.125	0.127	0.046	0.079
Transportation	1.920	4.310	0.136	0.200
Banking	4.700	3.280	15.10	19.50
Insurance	0.019	0.016	0.002	0.002
Financial Leasing and Factoring	0.005	0.007	0.0002	0.0004
Holdings	1.950	1.520	3.000	3.530
Investment trusts	0.0005	0.0009	0.00001	0.00004

Table 7.3. Unit Root Tests

Industries	IND	FIRM
Food	-4.246 (1)	-3.605 (1)
Textiles	-5.253 (1)	-4.214 (1)
Media and Publishing	-3.157 (2)	-2.876 (2)
Chemicals	-4.280 (1)	-4.631 (1)
Construction Materials	-4.177 (1)	-4.604 (2)
Ferrous Metals	-3.759 (2)	-3.796 (1)
Engineering	-4.249 (3)	-5.119 (3)
Power	-2.792 (3)	-4.207 (1)
Wholesale and retail trade, hotels and restaurant	-3.279 (1)	-3.343 (1)
Transportation	-4.758 (1)	-3.838 (1)
Banking	-3.808 (3)	-2.474 (4)
Insurance	-4.502 (1)	-4.447 (1)
Financial Leasing and Factoring	-3.424 (2)	-3.562 (2)
Holdings	-4.080 (1)	-4.018 (1)
Investment trusts	-4.421 (1)	-4.278 (1)

Note: This table reports the Augmented unit root test statistics for monthly industry and firm-level volatility series. Constant and trend are included in the tests. The number of lags is determined by the Akaike Information Criteria. Critical values at the 5 % level are -3.4586 with 1 lag, -3.4591 with 2 lags, - 3.4597 with 3 lags and –3.4602 with 4 lags.

Table 7.4. Trend Regression

Industries	$IND*10^6$	$FIRM*10^7$
Food	0.042 (0.003)	0.008 (0.460)
Textiles	0.003 (0.898)	0.0006 (0.969)
Chemicals	0.699 (0.505)	9.360 (0.063)
Construction Materials	-0.132 (0.053)	-0.405 (0.000)
Ferrous Metals	0.048 (0.006)	0.017 (0.000)
Engineering	-4.110 (0.012)	-0.427 (0.000)
Power	---	0.004 (0.000)
Transportation	0.420 (0.800)	0.039 (0.607)
Banking	-1.530 (0.220)	---
Insurance	0.031 (0.000)	0.005 (0.000)
Holdings	-0.892 (0.125)	6.110 (0.000)
Investment trusts	0.001 (0.000)	0.0008 (0.000)

Note: p-values are reported in parenthesis.

Cyclical Behavior of Volatility Measures in Individual Industries

The cyclical behavior and forecasting power of aggregate volatility measures have been examined in previous chapter. In this section we repeat our analysis for individual industries in manufacturing sector. Table 7.5 reports simple correlations of the output growth rate in industry i with contemporaneous and one-period lagged industry and firm-specific volatility of industries. Unlike the aggregate IND and FIRM, almost all the correlations are negative. These results imply that industry and firm-level volatility are counter-cyclical at the industry level.

Next, we investigate whether the volatility components have forecasting power for future industry output growth. As regressors we use lagged values of the industry output, Δy_{it-1}, return on ISE industry index, R_{t-1}, total industrial (manufacture) output growth, Δy_{t-1}, and the three aggregate volatility measures as well as industry and firm-specific volatility in the particular industry. For an industry i, consider the following regression:

$$\Delta y_{it} = \alpha_0 + \alpha_1 \Delta y_{it-1} + \alpha_2 \Delta y_{t-1} + \alpha_3 R_{t-1} + \alpha_4 MRK_{t-1} + \alpha_5 IND_{t-1}$$

$$\alpha_6 FIRM_{t-1} + \alpha_7 IND_{it-1} + \alpha_8 FIRM_{it-1} + e_{it} \qquad (30)$$

Using Newey-West corrected standard errors, we find that most of the variables have insignificant coefficients. The only significant coefficients are lagged industry output growth in Textile industry, lagged industry output growth in Media and Publishing, lagged industry output growth in Chemical industry and lagged industry output growth and lagged output growth in Ferrous Metals. The point estimate of α_1 in Textile industry is –0.656 with a t-statistic of –4.731. The same point estimate in Media and Publishing is –0.489 with a t-statistic of –4.232 while it is –0.514 with a t-statistic of –4.679 in Chemical industry. The point estimate of α_1 is –0.404 with a t-statistic of –3.333 and α_2 is 0.248 with a t-statistic of 2.044 in Ferrous Metals. Insignificant individual industry and firm-level volatility coefficients imply that these volatility measures in a given industry do not have any forecasting power for future output growth in that industry.

Table 7.5. Correlation of Volatility Measures with Industrial Output

	IND		FIRM	
Industry	contemporaneous	lagged	contemporaneous	lagged
Food	-0.088	-0.062	0.053	0.033
Textiles	-0.257	-0.181	-0.011	0.024
Media and Publishing	0.161	0.190	0.156	0.140
Chemicals	-0.223	-0.115	-0.179	-0.144
Construction Materials	-0.113	0.031	-0.230	-0.079
Ferrous Metals	-0.236	-0.235	-0.309	-0.287
Engineering	-0.174	-0.235	-0.329	-0.374

Conclusion

In this paper we study the volatility of 15 individual industries separately. New volatility series at the level of each industry have been constructed. We analyze the time series behavior of our new industry and firm level volatility series first. We find that Food, Investment trust, Ferrous metals and Insurance industries exhibit significant positive trend and Engineering exhibit significant negative trend in industry volatility. All industries except Food, Textile, Chemicals and Transportation show insignificant trend in firm level volatility.

We study the cyclical behavior of volatility series in industries belong to manufacture sector next. The correlation coefficients of the output growth rate in industry i with contemporaneous and one-period lagged industry and firm-specific volatility of industries show that industry and firm-level volatility move counter-cyclical. We run the OLS regression to investigate whether the volatility components have forecasting power for future industry output growth. We find that none of the volatility series have any forecasting power for future output growth in that industry.

CHAPTER VIII

CONCLUSION

Istanbul Stock Exchange (ISE) is the one of the fastest growing emerging stock markets. In this dissertation we have characterized the behavior of ISE volatility both at the level of the market and at the industry and firm levels. We followed the methodology suggested by Campbell et al. (2001) to find disaggregated volatility measures for ISE.

There are two important characteristic features of the approach we have taken. First, we have used daily data to construct realized monthly volatility which we then treat as observable. That way it was possible for us to use standard econometric methods to describe time-series variation of realized volatility instead of the more complex methods that are necessary when volatility is treated as an unobservable latent variable. Second, the total volatility of a typical firm was defined as the sum of three volatility components. This definition allows us to avoid calculation of covariance terms and beta coefficients. The main findings of the dissertation is summarized as follows:

In Chapter III we analyze the behavior of aggregate volatility measures by using market and sectoral indices: National 100, Financial sector index, Production sector index and Service sector index. Using the daily returns, the monthly standard deviations of stock returns are estimated as a measure of volatility. The plots of the volatility measures show an upward trend in volatility of National 100 index. This result confirms that the public has the correct impression about the increased stock market volatility in ISE. The plots also reveal that among the sectoral indices only Financial sector index shows upward trend. All volatility plots have significant jumps during the times of important political and economic events of Turkey.

We analyze the behavior of our disaggregated monthly volatility measures in chapter V. Four important results have been found from the analysis of the volatility series. First, in our 1992-1999 sample period there is strong evidence of a positive deterministic trend in market-level volatility. Industry and firm-level volatility do not show similar trend. Second, all three volatility plots appeared to capture important political and economic events of Turkey. Third, the plots of volatility series show that they tend to move together. High contemporaneous correlation between the series confirms this visual evidence. Fourth, market-level volatility accounts for the greatest share of total firm volatility on average. It has also the greatest share of the movements over time in total firm volatility. Relative to its mean, market volatility displays the greatest time-series variation. The results of bivariate and trivariate VAR show that volatility series do not help to predict each other.

In Chapter VI we focus on the cyclical behavior of our disaggregated volatility measures. We study the link between market, industry and firm-level volatility and macroeconomic variables relevant to the characterization of the business cycle for Turkish economy. The chosen macroeconomic variables are GDP, industrial production, inflation rate and exchange rate. GDP is measured in quarterly frequency. Thus, we construct new volatility series with that frequency. The analysis of a quarterly series shows that they behave very much like the monthly ones. We find that market and firm-level volatility have positive correlation with the leads and lags of exchange rate while industry-level volatility has positive correlation with inflation rate. We also find that all the components of volatility do not exhibit counter-cyclical behavior with respect to macroeconomic variables. The results of various OLS regression show that market and firm-level volatility may have forecasting power of GDP growth. The same regression analysis for industrial production and monthly volatility series revealed that even though three volatility measures have forecasting power jointly for industrial production, there is no conclusive evidence which of the three volatility series has the most forecasting power.

The volatility of 15 individual industries is the focus of chapter VII. We construct new disaggregated volatility measures at the level of each industry. We repeat the previous analysis on our new industry and Firm-level volatility. We find that Food, Construction materials, Ferrous metals, Engineering and Insurance industries exhibit significant negative trend while investment trust exhibit significant positive trend in industry-level volatility. All industries except Food, Textile and Transportation show significant trend in firm-level volatility. We also study the cyclical behavior of volatility series in industries belongs to manufacture sector. We find that industry and firm-level volatility move counter-cyclical with respect to industrial output but they do not have any forecasting power for future output growth in that industry.

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