VOLATILITY IN THE TURKISH STOCK MARKET: AN INDUSTRY-LEVEL ANALYSIS

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ÖZET

Bu çalışmanın amacı, 1992-1999 döneminde Türkiye hisse senedi piyasasındaki oynaklığı sektör düzeyinde incelemektir. Sektörler birbirinden farklı özellikler gösterdiğinden, her bir sektörün oynaklığı ayrı ayrı analiz edilmiştir. Firmalar, İMKB'nin sektör sınıflandırmasına uygun olarak 15 sektörde toplanmıştır. Her bir sektör için oynaklık serileri oluşturulmuştur. Elde edilen bulgulara göre, Kimya, Bankacılık ve Metal eşya, makina gibi büyük endüstürilerde oynaklık eğilimi daha fazladır. Örneklemizdeki büyük sectörlerden ikisinde, Kimya ve Bankacılık sektörlerinde endüstri betaları 1.0'den büyük, diğer sektörlerin betaları ise önemli ölçüde düşük bulunmuştur. Bu çalışmada oynaklık serilerinin zaman serileri analizleri de yapılmıştır. Bulgularımız, Gıda, Yatırım ortaklıkları, *Demir-Çelik ve Sigorta sektörlerinin pozitif trend, Metal eşya, makina sektörünün ise negatif trende sahip olduğunu göstermiştir. İmalat sektörünün oynaklık serilerinin devresel hareketleri de analiz edilmiştir. Bu sektöre ait oynaklık serilerinin , sektörün gelecekteki büyüme hızını tahminleme gücüne sahip olmadığı sonucuna ulaşılmıştır.*

ABSTRACT

This paper examines the volatility of Turkish stock market at the industry level over the period 1992-1999. Since the nature and composition of the industries are not the same, we study the volatility of each industry separately. Individual firms are aggregated into 15 industries according to the industry classification of ISE. The volatility series at the level of each industry are constructed. The results indicate that large industries, such as, Chemical, Banking, and Metal products, machinery, tend to have high-level volatility. The results also indicate that two of the large industries in our sample, Chemicals and Banking, have an industry-beta higher than 1.0. Other industries, however, have a substantially low industry beta. The time series behavior of volatility series is also analyzed. The results suggest that Food, Investment Trust, Ferrous Metals and Insurance industries exhibit significant positive trend and Metal products, machinery exhibit significant negative trend. The cyclical behavior of volatility series in industries belong to manufacture sector is also checked. The results indicate that the volatility series have no forecasting power for future output growth in that industry.

INTRODUCTION

Volatility of stock market has been the subject of most of the previous studies in finance literature. Sophisticated models such as the rolling standard deviation, parametric ARCH or stochastic-volatility models have been used to capture the variation in aggregate market volatility. In this study, our goal is to analyze historical movements of industry and firm specific volatility of Istanbul stock exchange. There are two reasons to be interested in these disaggregated volatility measures.

First, some investors have large holdings of individual stocks that belong to certain industries. These investors are affected by shifts in industry-level and firm-level volatility. Second, we know as a fact that the nature and composition of the industries are not the same. We do not have any evidence to believe that industry and firm level volatility in the textile sector behave in the same way as volatility in the food sector. Economic and social events in the country may affect industries differently. To get the information about the volatility of each industry, it is necessary to examine each industry separately.

There is surprisingly little empirical research on volatility at the level of the industry or firm. Black (1976), Christie (1982), Duffee (1995) use disaggregated data to study the "leverage" effect, the tendency for volatility to rise following negative returns. Loungani et al. (1990), Brainard and Cutler (1993) have used stock market data to test macroeconomic models of reallocation across industries or firms. Engle and Lee (1993) use a factor ARCH model to study the persistence properties of firm-level volatility for a few large stocks. Leahy and Whited (1996) explore the firm level relation between volatility and investment. Roll (1992) and Heston and Rouwenhorst (1994) decompose world market volatility into industry and country-specific effects and study the implications for international diversification. More recently Campbell, Lettau, Malkiel and Xu (2001) analyze the movements and cyclical behavior of the market, industry and firm level volatility of U.S. stock market.

All the previous studies for the volatility of emerging stock markets have only focused on aggregate market volatility. No study has investigated industry-level volatility of an emerging market. Therefore, the objective of this paper is to contribute this body of literature by examining the industry-level volatility in an emerging market, namely Turkish stock market.

Turkey provides an interesting arena to investigate the volatility of stock market. Istanbul stock exchange (ISE) is one of the fastest growing emerging stock markets. Market capitalization and number of listed companies have increased dramatically in recent years. At the end of 1990, the market capitalization value was \$18.74 billion and the number of listed company was 110. At the end of 2001, on the other hand, the market capitalization increased to \$47.69 billion and the number of companies increased to 310[1]. Although several studies investigated the Istanbul stock exchange[2], none of them examined the volatility of ISE at the industry level. Information on the industry-level volatility would be valuable for the domestic and global fund investors who are planning to invest in a small and open stock market such as Turkey.

The rest of the paper is organized as follows. Section 2 discusses the methodology used in this paper. Section 3 describes the data and provides the empirical results. Last section contains conclusions.

METHODOLOGY

We use the technique suggested by Campbell et al. (2001) to construct industry and firm level volatility. 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[3]. 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 returns in this paper are measured as an excess return over the Treasury bill rate.

Decomposition based on the Capital Asset Pricing Model (CAPM) implies that we can set intercepts to zero in the following equations:

$$R_{it} = \beta_{mi} R_{mt} + \tilde{\varepsilon}_{it} \tag{1}$$

$$R_{ift} = \beta_{mi} R_{mt} + \tilde{\varepsilon}_{it} + \eta_{ift} \tag{2}$$

[1] At the end of 1999 the market capitalization was \$120 billion. It dropped to \$47.6 billion at the end of 2001. The Turkish stock market in 2001 registered huge dollar losses due to the financial crises. The Turkish Lira depreciated by 100% in 2001 against the US dollar.

[2] Some of them are Yılmaz (1997), Kıymaz (1997), Kıymaz (2001), Kıymaz (2002) Kıymaz (2003), Durukan (1999), Güneş and Saltoğlu (1998), and Harris and Küçüközmen (2001).

[3] 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 weights as constant within period *t*.

β_{mi} denotes the beta for industry *i* with respect to the market return, and $\tilde{\varepsilon}_{it}$ is the industry-specific residual and η_{ift} is the firm-specific residual . Note that R_{mt} and $\tilde{\varepsilon}_{it}$ are orthogonal by construction and, so one can ignore the covariance between them. Therefore the variance of the industry return based on (1) is

$$Var(R_{it}) = \beta_{mi}^2 Var(R_{mt}) + \tilde{\sigma}_{it}^2 \tag{3}$$

$\tilde{\sigma}_{it}^2$ is the variance of $\tilde{\varepsilon}_{it}$ and is the measure of industry-level volatility. The variance of the average firm return in industry *i* is

$$\sum_{f \varepsilon i} w_{ift} Var(R_{ift}) = \beta_{mi}^2 Var(R_{mt}) + \tilde{\sigma}_{it}^2 + \sum_{f \varepsilon i} w_{ift} Var(\eta_{ift})$$

$$\sum_{f \varepsilon i} w_{ift} Var(R_{ift}) = \beta_{mi}^2 Var(R_{mt}) + \tilde{\sigma}_{it}^2 + \sigma_{\eta it}^2 \tag{4}$$

where $\sigma_{\eta it}^2 = \sum_{f \varepsilon i} w_{ift} Var(\eta_{ift})$ is the weighted average of firm-level volatility in the industry. We can use the residual in (1) and (2) to construct industry and firm-level volatility for individual industries. We use following procedure to estimate the two volatility components in (4).

For volatility in industry *i* we sum the squares of the industry-specific residual in (1) within period *t*:

$$\tilde{\sigma}_{it}^2 = IND_t = \sum_{d \in t} \tilde{\varepsilon}_{id}^2 \tag{5}$$

where *d* refers to daily return and *t* refers to months.

For firm-specific volatility we first sum the squares of the firm-specific residual in (2) for each firm in the sample:

$$\hat{\sigma}_{\eta ift}^2 = \sum_{d \in t} \eta_{ifd}^2 \,. \tag{6}$$

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

$$\hat{\sigma}_{\eta it}^2 = FIRM_t = \sum_{f \in i} w_{ift} \hat{\sigma}_{\eta ift}^2 \tag{7}$$

DATA AND RESULTS

Data

We use the firm- level return data set to estimate the volatility components in (4) based on the return composition (1) and (2). We aggregate individual firms into 15 industries according to the industry classification of ISE. Table 1 reports a list of those 15 industries.

We use daily data for the period 1992-1999. The data set were obtained from the ISE. 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 period are Chemicals, Banking, and Engineering.

Empirical Results

Market capitalization, total number of firms in 15 industries, and betas from the OLS regression are reported in Table 1[4]. 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 metal products, machinery and holdings.

Table 1 reports betas for each industry in the sample. Industry-beta is the measure of systematic risk and 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. Metal products, machinery has a beta of around unity. Other industries have a substantially low industry beta.

[4] In order to estimate the beta for each industry in the sample we run regression of industry level return series on market return series by using OLS method.

Table 1. Number of Firms, Market Capitalization Ratios and Betas of Individual industries

Industry	Number of firms (end of 1999)	Weight	β
Food	24	2.904	0.11
Textiles	34	2.953	0.12
Media and Publishing	13	2.256	0.10
Chemicals	19	22.011	1.36
Construction Materials	23	5.960	0.23
Ferrous Metals	10	1.536	0.07
Metal Products and machinery	25	17.105	0.99
Power	2	0.916	0.05
Wholesale and retail trade, hotels and restaurant	14	3.310	0.16
Transportation	3	5.879	0.39
Banking	13	20.190	1.19
Insurance	5	0.990	0.04
Financial Leasing and Factoring	7	0.448	0.01
Holdings	11	13.372	0.79
Investment trusts	19	0.139	0.007

Figures 1 to 15 plot the industry and firm-specific volatility in individual industries. The figures show huge spikes in almost all industry specific and firm specific volatility at the beginning of 1994 and end of 1998. The higher volatility level 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 deficit, 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 jump in industry and firm specific volatility.

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.

Figure 1A: Food IND

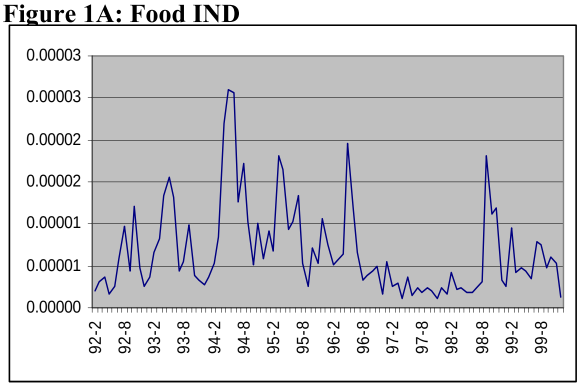


Figure 1B: Food FIRM

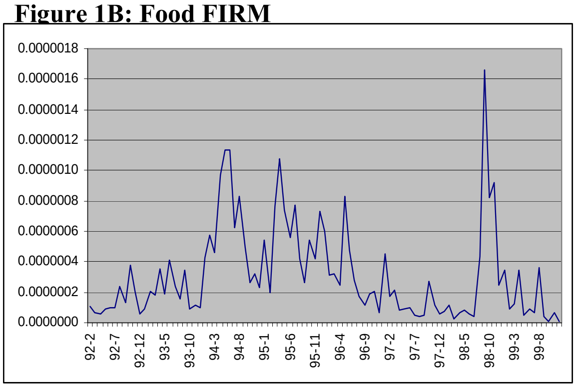


Figure 2A:Textiles IND

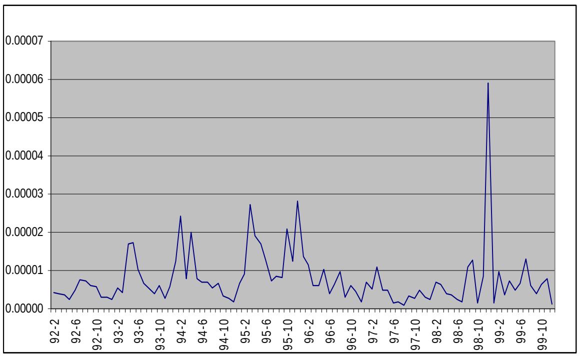


Figure 2B:Textiles FIRM

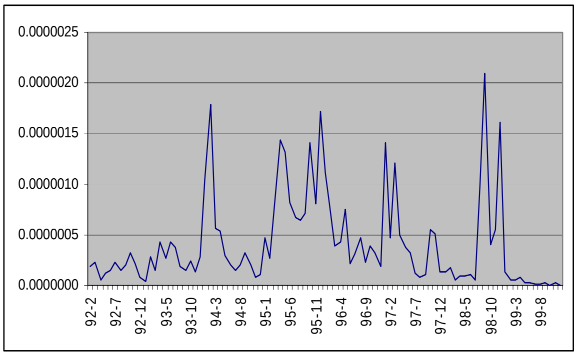


Figure 3A:Media&Publishing IND

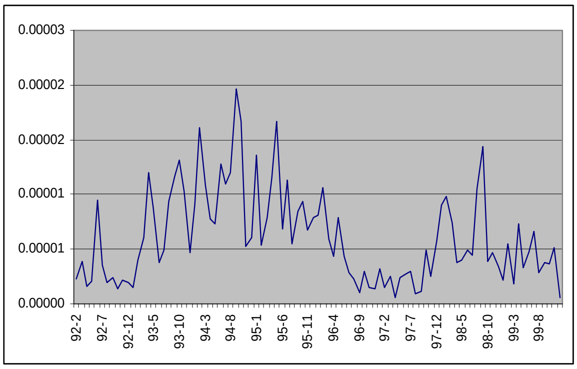


Figure 3B: Media&Publishing FIRM

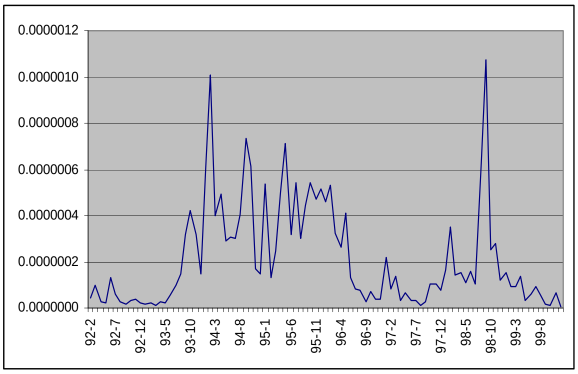


Figure 4A: Chemicals IND

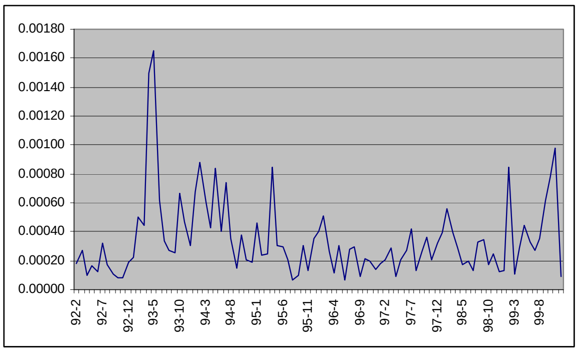


Figure 4B: Chemicals FIRM

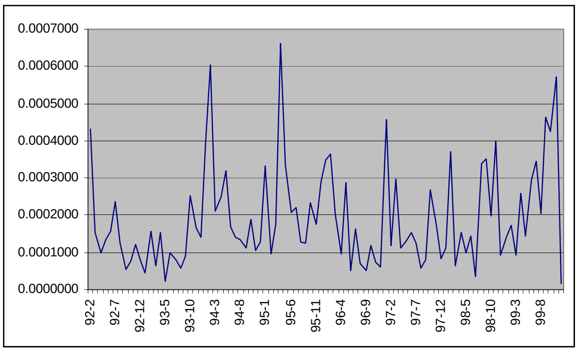


Figure 5A: Construction Materials IND

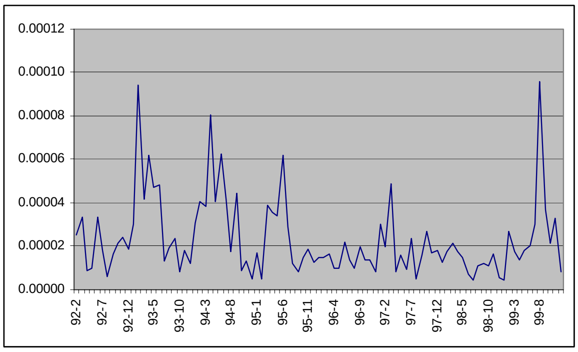


Figure 5B: Construction Materials FIRM

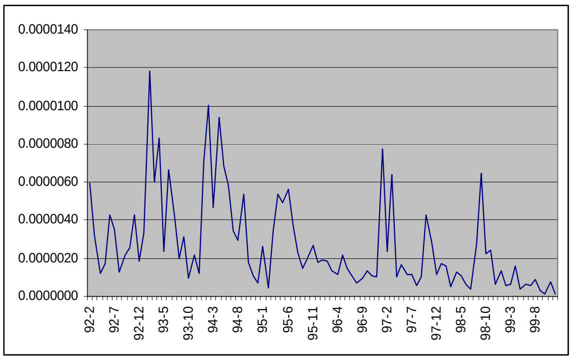


Figure 6A: Ferrous Metals IND

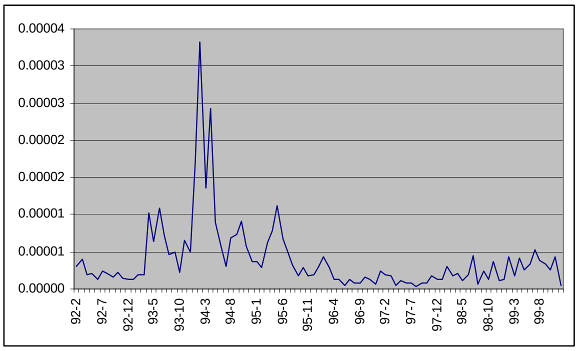


Figure 6B: Ferrous Metals FIRM

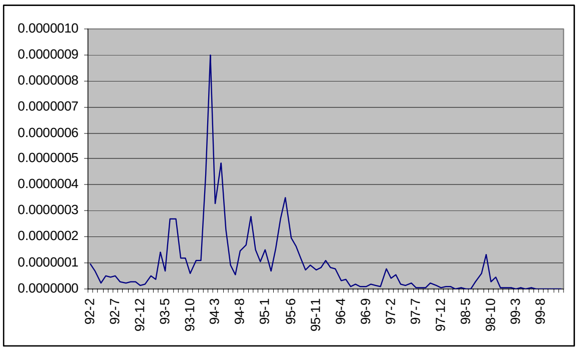


Figure 7A: Metal products IND

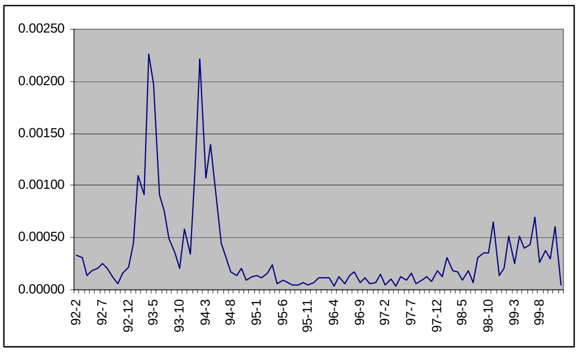


Figure 7B: Metal products FIRM

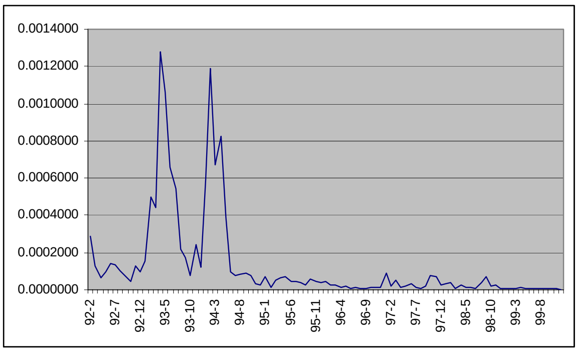


Figure 8A: Power IND

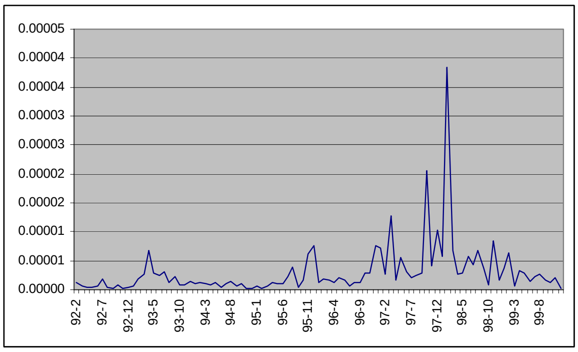
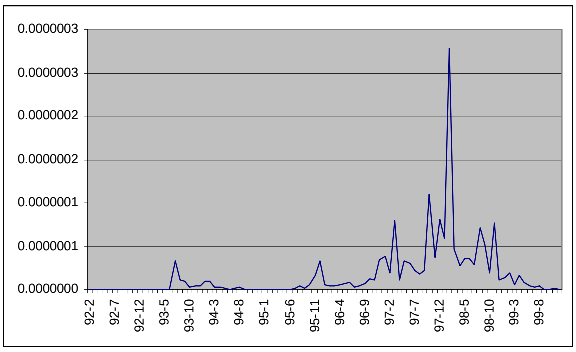


Figure 8B: Power FIRM



9A: Wholesale&Retail Trade IND

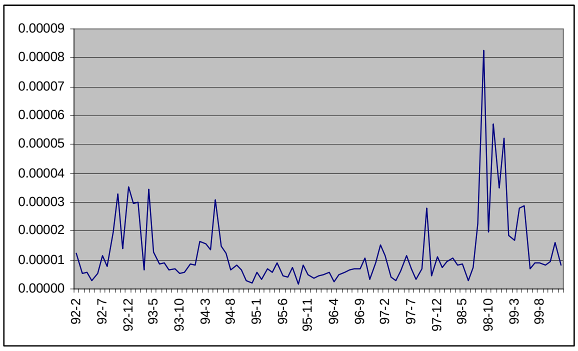


Figure 9B: Wholesale&Retail Trade FIRM

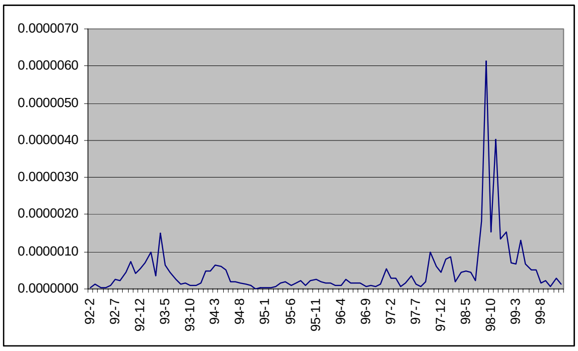


Figure 10A: Transportation IND

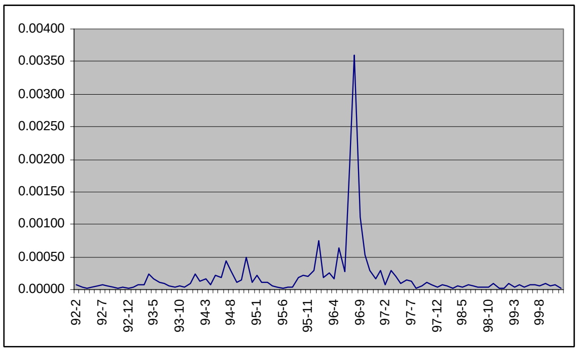


Figure 10B: Transportation FIRM

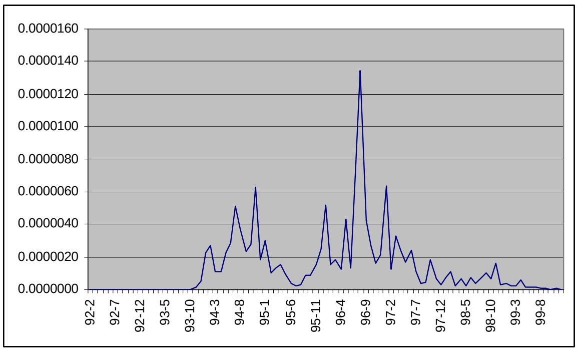


Figure 11A: Banking IND

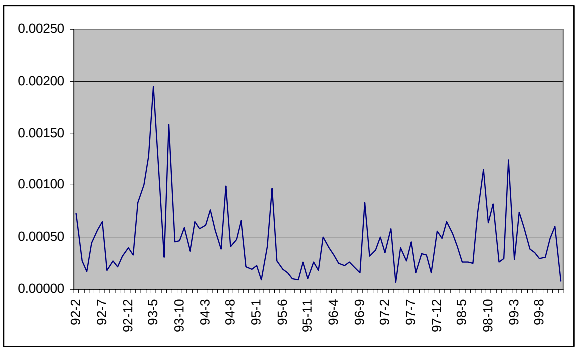


Figure 11B: Banking FIRM

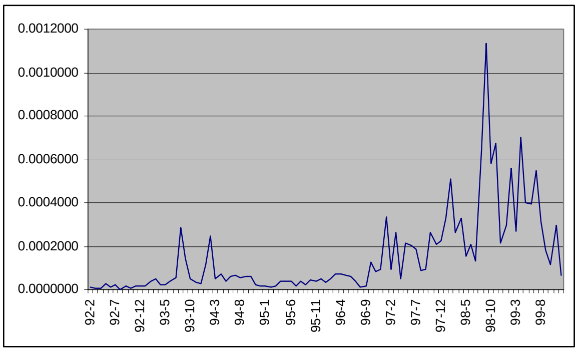


Figure 12A: Insurance IND

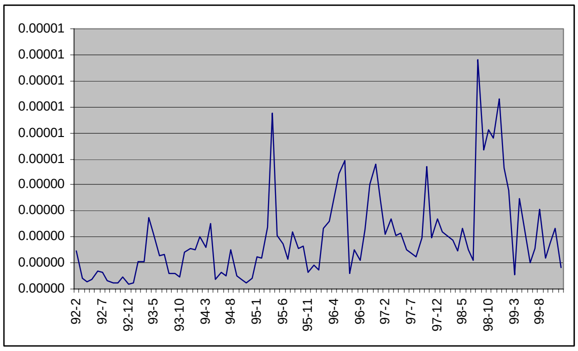


Figure 12B: Insurance FIRM

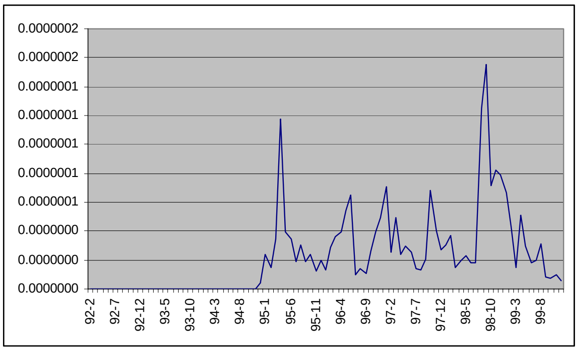


Figure 13A: Leasing&Factoring IND

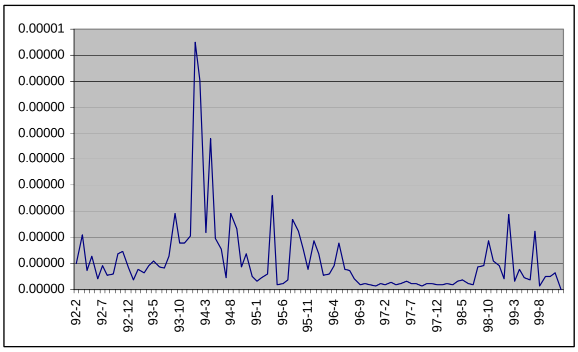


Figure 13B: Leasing&Factoring FIRM

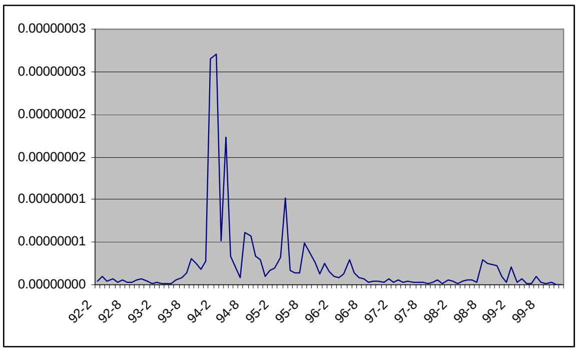


Figure 14A: Holdings IND

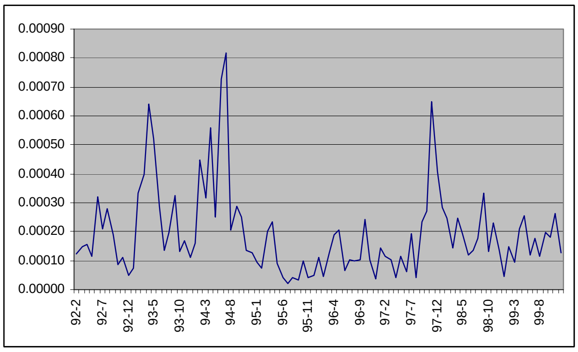


Figure 14B: Holdings FIRM

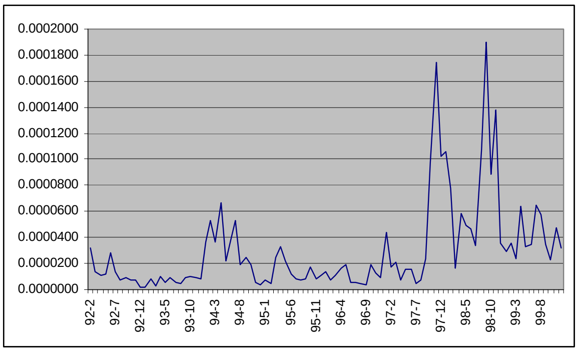


Figure 15A: Investment Trusts IND

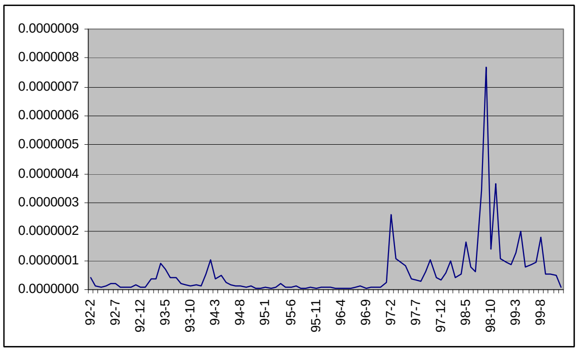


Figure 15B: Investment Trusts FIRM

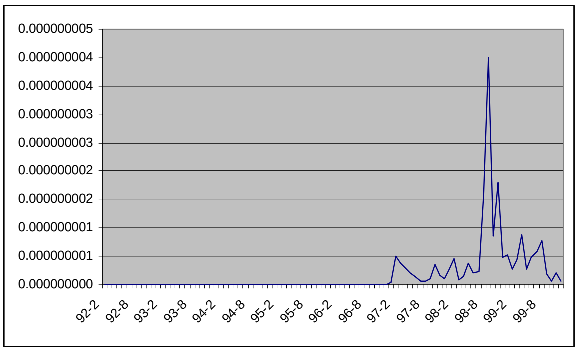


Table 2. Descriptive Statistics of Industry and Firm Level Volatility

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	0.077	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
Metal products, machinery	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 2 shows the descriptive statistics of industry and firm-level volatility. IND has higher mean than FIRM for each industry. 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. As seen in Table 2, large industries, such as Chemical, Banking, and Metal products, machinery tend to have high industry and firm level volatility on average. Although Table 2 does not report the skewness and kurtosis of the industry-level volatilities, they exhibit positive skewness and excess kurtosis.

Now we ask whether individual industries exhibit significant trends in volatility. First, we check whether or not the industry and firm-level volatility series contain unit roots. To check this, we employ augmented Dickey and Fuller (ADF) tests, based on regressions of time series on their lagged values and lagged difference terms that account for serial correlation. The number of lagged differences to be included can be determined by the Akaike information criterion (AIC). The ADF tests results are shown in Table 3[5]. The hypothesis of a unit root is rejected 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. 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[6]. The trend regression is specified as follows

$$\sigma_t^2 = \alpha + \beta t + \varepsilon_t \tag{8}$$

The trend is estimated using OLS with Newey-West corrected *t*-statistics. Table 4 reports the regression of the volatility series on deterministic trend.

In regressions on a linear time trend, Food, Construction Materials, Ferrous Metals, Metal products, machinery 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.

Cyclical Behavior of Volatility Measures in Individual Industries

The cyclical behavior and forecasting power of aggregate volatility measures have been examined for individual industries in manufacturing sector. Table 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. Negative correlation implies that volatility tends to be higher in economic downturns. We find that 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}, total industrial (manufacture) output growth, Δy_{t-1}, and industry and firm-specific volatility in the particular industry. For an industry *i*, consider the following regression:

$$\begin{aligned} \Delta y_{it} &= \alpha_0 + \alpha_1 \Delta y_{it-1} + \alpha_2 \Delta y_{t-1} \\ &+ \alpha_3 IND_{it-1} + \alpha_4 FIRM_{it-1} + e_{it} \end{aligned} \tag{9}$$

Using Newey-West corrected standard errors, we find that most of the variables especially industry and firm specific volatility have insignificant coefficients. 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.

[5] Unit root tests were also performed without trend. Similar results were obtained. Therefore, only the test results with trend are reported.

[6] Since some volatility series are integrated of order 1, first differences of these series are taken to make them stationary.

Table 3. ADF unit root tests for Stationarity

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)
Metal products, machinery	-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 figure in the parenthesis is the number of lags and it 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 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)
Metal products, machinery	-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.

Table 5. Correlation of Volatility Measures with Industrial Output

Industry	IND contemporaneous	IND lagged	FIRM contemporaneous	FIRM 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
Metal products, machinery	-0.174	-0.235	-0.329	-0.374

CONCLUSION

In this paper, we study the volatility of 15 individual industries separately. We analyze the time series behavior of our industry and firm level volatility series first and find that Food, Investment Trust, Ferrous Metals and Insurance industries exhibit significant positive trend and Metal Products and machinery exhibit significant negative trend in industry volatility. All industries except Food, Textile, Chemicals and Transportation show insignificant trend in firm level volatility.

We also 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 shows 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.

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