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MACROECONOMIC SENSITIVITY AND FIRM LEVEL VOLATILITY: THE CASE OF NEW YORK STOCK EXCHANGE

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Abstract. *Purpose* – This paper investigates whether the macroeconomic factors affect the firm stock returns volatility differently depending on their location in different sectors. For this purpose, daily financial time-series data for 683 firms located in nine US sectors for the period of 2000 to 2017 are employed.

Research methodology – The GARCH (1,1) model was applied to each firm located in nine US sectors. The four macroeconomic factors, namely, exchange rate, treasury yield spread, oil prices, and market return, are included in both mean and variance equations of GARCH (1,1) model to estimate the effect.

Research limitations – This research study is limited to the New York Stock Exchange; therefore, it can be extended to the other economies as well. Further, this study uses one firm feature that is the sectoral location of the firm; it is recommended that some other firm features should be studied to explore the volatility behaviour of firms. In the methodological part, this study does not include the lag effect, since it is recognised in the literature that the investors underreact to public information, so future research can be extended to test the underreaction hypothesis.

Practical implications – This study has implications for the investors and policymakers. Since it has emerged from the findings that some sectors are more sensitive than others to macroeconomic changes, so this knowledge will help the investors to diversify their portfolio and policymakers to maintain macroeconomic discipline.

Originality/Value – The main contribution of this study is that it undertakes the assumption of heterogeneous nature of firms and conducts a detailed firm level analysis by sector covering a more extended period of time to investigate the impact of four macroeconomic factors, namely, exchange rate, treasury yield spread, oil prices, and market return on firm stock returns, volatility using daily data. Further, this study contributes by including all the macroeconomic factors together as an exogenous variable in mean and conditional variance equations of the GARCH (1,1) model to investigate the effect simultaneously.

Keywords: macroeconomic sensitivity, firm volatility, heterogeneous nature of firms.

JEL Classification: E44, G10, G11, G15.

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Introduction

This study is motivated by the literature that has recognized the heterogeneous nature of firms, and more precisely, in the case of the US stock market, it is empirically recognized that the firms and the sectors are heterogeneous (Sharma & Narayan, 2014). Since firms belong to different sectors and each sector has its own dynamics and market structure, then it is expected that the changes in the macroeconomic factors will affect the firm stock returns volatility differently depending on their sectoral location. However, the literature on the effect of macroeconomic factors on stock returns volatility is limited to the aggregate market analysis (Beltratti & Morana, 2006; Choudhry et al., 2016; Corradi et al., 2013) or sectoral level analysis (Cai et al., 2015; Chinzara, 2011; Nathan & Panayiotis, 2006). These two branches of studies considered the macro approach to analyse the significance of macroeconomic factors in determining the stock volatility. This paper is focusing on the micro perspective. Further, it has been recognised that the firms are heterogeneous even in a narrowly defined sector (see, Ewing et al., 2005; Sharma et al., 2014). However, the limitation of previous studies is the assumption of perceiving firms and sectors as homogeneous; whereas a large portion of scientific literature challenges this assumption and asserted that the results are spurious in the presence of heterogenous firms (Khan et al., 2016; Narayan & Sharma, 2011). To avoid spurious outcomes, this study considers the heterogeneous nature of firms located in different sectors and contributes to the existing scientific literature on finance. Further, the literature analysis revealed that if the macroeconomic factors affect the first moment (stock returns) it will also affect the second moment (stock volatility) (Narayan & Sharma, 2014), hence macroeconomic factors can be placed in both the mean and variance equation of GARCH (1,1) model to simultaneously investigate the effect of macroeconomic factors on stock returns volatility. This approach was first used by Davis and Kutan (2003) to investigate the impact of inflation and real output on the stock market volatility of 13 industrial and developing countries. As the literature review for this paper showed, no other study has used this approach at the firm level. So, this study follows the same approach and includes the macroeconomic factors, namely, exchange rate, treasury yield spread, oil prices, and market return, in both the mean and variance equations of the GARCH (1,1) model to simultaneously investigate the effect on stock returns volatility at the firm level.

In the context of the New York Stock exchange, this study aims at the firm level analysis to investigate the impact of macroeconomic changes on firm stock returns volatility considering the sectorial location of a firm. The arbitrage pricing theory (APT) and the dividend discount model lays the theoretical foundation that provides a channel through which the macroeconomic factors can affect the stock prices (Chen et al., 1986; Chinzara, 2011). Considering this approach, the macroeconomic factors that are included in this study are exchange rate (Trade Weighted US Dollar Index), treasury yield spread (10 year treasury bill yield minus 3-month treasury bill yield), oil prices (West Texas Intermediate) and market return (S&P-500 Index).

1. Literature review

The stock market volatility has been given considerable attention in the academic literature as well as in the financial press. Several studies established linkages between macroeconomic factors and aggregate stock market volatility (Beltratti & Morana, 2006; Choudhry et al., 2016; Engle et al., 2013). However, firm level volatility in this regard has not been given the due attention since it has been recognized that the firm level volatility and aggregate market volatility exhibit a diverging trend at the same time period (Campbell et al., 2001; Sharma et al., 2014; Xu & Malkiel, 2003). In this regard, most of the studies pointed out the heterogeneous behaviour of firms due to their unique characteristics (Chun et al., 2009; Comin & Mulani, 2006; Davis & Kahn, 2008), thus the firms may exhibit different volatility behaviour depending on their unique characteristics. In addition, Chun, Kim, Morck, and Yeung (2008) pointed out that the firm level volatility will be cancelled out in the aggregate analysis. Chou, Ho, and Ko (2012), pointed out that the firms may have different sensitivities to the macroeconomic changes depending on the firms operations in different sectors.

A few studies documented the heterogeneous nature of firms even in a narrowly defined sector (Bernard et al., 1995; Melitz & Redding, 2012; Yeaple, 2005) and more precisely in the case of the US stock market (Sharma & Narayan, 2014). Moreover, several studies suggested that the hypotheses testing in the presence of heterogeneous firms may lead to spurious outcomes (Khan et al., 2016; Narayan & Sharma, 2011; Sharma & Narayan, 2014; Sharma et al., 2014). Some other prominent studies raised the question of generalizability of results provided by the aggregate analysis in the presence of heterogeneous firms (Chun et al., 2008; Ewing et al., 2005).

The remaining paper is organized as follows. In Section 2, sampling and procedure are explained. Section 3 discusses research methodology. In Section 4, results are reported and discussed, and in last section conclusions are presented.

2. Sample and procedure

The data on daily closing stock prices for 683 firms listed on New York Stock Exchange (NYSE) are obtained from Thomson One Banker for the period 3rd Jan 2000 to 30th June 2017. Since a large number of firms are listed on NYSE, a common filtering approach is used to select the firms. In this regard, this study follows the Sharma and Narayan (2014) approach for the selection of firms. This is as follows: (1) stock prices must not be less than $5 or more than $500. This ensures avoiding the undue influence of low- and high-priced stocks on the results. (2) Listed stock must be traded actively for the entire period. The firms are then categorized into nine US sectors, namely, industrials (IND), consumer discretionary (CD), financials (FIN), energy (EN), materials (MAT), utilities (UT), health care (HC), consumer staples (CS), and information technology (IT) based on Global Industry Classification System (GICS). The daily data on the macroeconomic factors, namely, exchange rate, oil prices, and treasury yield spread, are obtained from the Federal Reserve economic data. The daily closing data on S&P-500 Index (market return) is collected from yahoo finance. All the times series data are expressed in terms of logarithmic differences (i.e; Ln Pt – Ln Pt-1). Table 1 shows the number of firms categorised by sector based on GICS classification.

Table 1. Firms categorized by sectors

Firms	IND	CD	FIN	EN	MAT	UT	HC	CS	IT	Total Firms
Number of Firms	141	112	101	75	65	55	46	45	43	683

3. Research methodology

It is widely recognized that the financial time series data exhibit some stylized facts such as volatility clustering, heteroscedasticity or non-normal distribution of returns known as leptokurtosis (Brooks, 2002). In the presence of stylized facts in financial time series data, the traditional linear models may lead to spurious results. The GARCH-model is preferred because it incorporates heteroscedasticity and leptokurtosis (Elyasiani & Mansur, 2003; Mandimika & Chinzara, 2012; Zakoian, 1994). To investigate the volatility dynamics in the time series data various studies used the GARCH (1,1) model (Cai et al., 2015; Chinzara, 2011; Elyasiani et al., 2011). Further, the GARCH (1,1) model is considered to be sufficient to capture the volatility dynamics in the financial time series data and overruled the use of high order GARCH models in the academic literature (Chinzara, 2011). Most specifically in the case of daily data, the standard GARCH (1,1) model is preferred because it outperforms the other advanced GARCH models in capturing the volatility dynamics (Sharma & Vipul, 2015). Considering this study, GARCH (1,1) model is the most appropriate to investigate the impact of macroeconomic factors on firm stock returns volatility with respect to the sectoral location of firm using daily data.

This study applied the GARCH (1,1) model (Bollerslev, 1986; Engle, 1982) to investigate the impact of macroeconomic factors on firm stock returns volatility located in nine US sectors. The macroeconomic factors, namely, exchange rate, treasury yield spread, oil prices, and market return, together are included in the mean and variance equation of the GARCH (1,1) model as exogenous variables to estimate simultaneously the effect of these variables on the firm volatility following the Davis and Kutan (2003) approach.

The GARCH (1,1) model will take the following form.

$$R_t = \alpha_0 + \alpha_1 \Delta EX_t + \alpha_2 \Delta TYS_t + \alpha_3 \Delta OP_t + \alpha_4 R_{m,t} + \varepsilon_t ; \quad (1)$$

$$h_t = \lambda_0 + \lambda_1 \varepsilon_{t-1}^2 + \lambda_2 h_{t-1} + \lambda_3 \Delta ER_t + \lambda_4 \Delta TYS_t + \lambda_5 \Delta OP_t + \lambda_6 R_{m,t} \quad (2)$$

$$\lambda_0 > 0, \lambda_1 + \lambda_2 < 1, \ \mu_t \sim N(0, h_t).$$

Eq. (1) is the mean equation, and Eq. (2) is the variance equation.

Where as:

R_t is the return on firm stock on time t; ΔEX_t is the change in the exchange rate from the previous day; ΔOP_t is the change in oil prices from the previous day; ΔTYS_t is change in treasury yield spread from the previous day; $R_{m,t}$ is a market return at time t; λ_0 is a constant; variance term λ_t denotes the conditional stock returns volatility. λ_1 coefficient is the ARCH term and λ_2 coefficient is the GARCH term. To meet stationary conditions in the

GARCH (1,1) model it is necessary for $\lambda 1 + \lambda 2$ to be less than 1. Otherwise, violation of this assumption leads to highly undesirable properties, such as the convergence of the conditional variance not occurring (Brooks, 2002).

To justify the need for GARCH (1,1) model, it is important to check the time series assumptions. The investigation process takes the following steps. First, descriptive statistics including Jarque-Bera statistics, skewness and kurtosis were used to check the normality of each financial time series data. Second, the Augmented Dicky Fuller (ADF) test and the Philip Parron (PP) test were used to check the stationarity of the time series data. After satisfying the stationarity conditions, the third step is to test the appropriate mean equation. In the fourth step, the Ljung and Box (1978) statistics for both residuals LB(12) and for squared residuals $LB^2(12)$ are used to determine the autocorrelation, and, volatility clustering and heteroscedasticity, respectively. This justifies the need to use the GARCH (1,1) model (Mandimika & Chinzara, 2012). Moreover, ARCH-LM test was also used to check the heteroscedasticity in the residuals. After satisfying the conditions in the fifth step, the GARCH (1,1) model was tested for all individual firms. In the GARCH (1,1) estimation the equation (1) represents the mean equation and equation (2) represents the variance equation with estimations for 683 firms. Since the focus of the study is the firm stock returns volatility, the results obtained from the variance equation (Eq. (2)) for all individual firms were then aggregated in their respective sectors. These results are reported and discussed by sector in the following section.

4. Results

In this section, the results obtained from Eq. (2) for each of 683 firms are aggregated in their respective sectors. The effect of each macroeconomic factor (exchange rate, treasury yield spread, oil prices and market return) on firm stock returns volatility by sector are reported and discussed separately.

4.1. Exchange rate and firm volatility

The results reported in Table 2 are related to the impact of exchange rate on firm stock returns volatility with respect to the sectorial location of the firm are reported.

The results are summarized as follows. First, in general, the results indicated that the largest percentage of firms located in nine sectors, exchange rate changes have a significant positive effect on firm stock returns volatility , compared to the corresponding negative significant effect on firm stock returns volatility. Since this study uses a trade-weighted index as a proxy to measure the value of the US currency, hence an increase in the index means the appreciation of the US dollar. Thus, it implies that the appreciation in the US dollar is affecting firm stock returns volatility across nine US sectors more than the depreciation in the US dollar. This might be due to two reasons. First, the majority of firms in the US are exporting firms. An increase in the exchange rate may adversely affect the cost and profitability of exporting firms. Consequently, this may lead to a decrease in the competitiveness of these firms in the international trade. Second, cheaper imports may also affect the local industry.

Table 2. GARCH (1,1) model results – exchange rate and firm stock returns volatility (sectoral location of the firm)

Sectors	Sig. (+)	Sig. (–)	Insig. (+)	Insig. (–)
EN	51(68%)	5(6.67%)	11(14.67%)	8(10.67%)
MAT	36(55.38%)	7(10.77%)	14(21.54%)	8(12.31%)
IND	81(57.44%)	26(18.44%)	22(15.60%)	12(8.51%)
FIN	45(44.55%)	17(16.83%)	28(27.72%)	11(10.89%)
CD	40(35.71%)	30(26.79%)	23(20.54%)	19(16.96%)
CS	29(64.44%)	6(13.33%)	6(13.33%)	4(8.89%)
HC	20(43.48%)	14(30.43%)	6(13.04%)	6(13.04%)
IT	17(39.53%)	13(30.24%)	4(9.30%)	9(20.93%)
UT	40(72.73%)	1(1.82%)	12(21.82%)	2(3.64%)

Note: Sig. (+) represents the positive and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Sig. (–) represents the negative and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Insig. (+) and Insig. (–) represents the number and percentage of statistically insignificant firms in their respective sectors. The number of firms is divided by the total number of firms in each sector to convert into percentages and is reported in parenthesis. All results are reported at 5 per cent significance level.

In this scenario, it is difficult for the local industry to compete with cheap foreign goods (Aggarwal, 1981; Agrawal, 2010). Moreover, "Organization for Economic Cooperation and Development Economic Surveys: United States" (Organization for Economic Cooperation and Development, 2016) indicated that the weakening global demand and sharp exchange rate appreciation since 2014 are creating a greater risk for the US firms and most particularly for the firms involved in the international trade. Theoretically, the results are in line with the flow-oriented approach (Dornbusch & Fischer, 1980). According to this approach, the exchange rate appreciation increases the cost of export and affects the competitiveness of firms internationally. This may decline the profits and have an adverse effect on the stock prices.

Second, the results indicated that the largest positive and statistically significant effect of exchange rate on firm stock returns volatility is observed in the firms belonging to the utilities sector, and the lowest percentage is observed in consumer discretionary sector firms. In the utilities sector it is around 72.73 per cent, and in the consumer discretionary sector it is around 35.71 per cent of firms experiencing an increase in firm volatility due to a significant positive change in the exchange rate. The percentage of firms in other sectors that experienced a significant positive effect of exchange rate on firm stock returns volatility is around 68 per cent of firms in the energy sector, 64.44 per cent of firms in the consumer staples, 57.44 per cent in the industrial sector, 55.38 per cent of firms in the materials, 44.55 per cent in the financial sector, 43.48 per cent of firms in health care, and 39.53 per cent of firms in the information technology sector.

In summary, the results unfold three new findings. First, it is found that the largest percentage of firms across all sector experienced a significant positive effect of exchange rate on firm stock returns volatility. Second, the significant positive effect of exchange rate on firm

stock returns volatility varies with respect to the sectorial location of firms. Third, the utilities sector appeared to be highly sensitive against the exchange rate appreciation, while the consumer discretionary sector emerged as the least sensitive to the exchange rate appreciation. These findings are helpful for the policymakers to devise effective fiscal and monetary policy considering the varying impact of exchange rate changes on firm stock returns volatility with respect to the sectors. Further, it is also important for the regulators to understand the relationship between exchange rate changes and firm stock returns volatility at the sectorial level to foresee future crisis (Kumar, 2013). It is also useful for the portfolio managers to improve their risk management strategies. These findings also carry significance for the multinational companies and exporters because these companies are involved in foreign sales and international trade, respectively.

4.2. Treasury yield spread and firm volatility

The results related to the impact of changes in treasury yield spread on firm stock return volatility belonging to nine US sectors are reported in Table 3.

The overall results indicated that the treasury yield spread is affecting firms stock returns volatility differently depending on the sectoral location of the firm, both in terms of magnitude and sign. Results are summarized as follows. First, it is identified for the largest percentage of firms in three sectors: financial, consumer discretionary, and energy sectors; the effect of treasury yield spread on firm stock return volatility is significant negative, which is more than the significant positive effect. The percentage of firms belonging to the financials, the consumer discretionary, and the energy sectors that experienced a negative and statistically significant relationship are around 39.60 per cent, 32.14 per cent and 30.67 per cent,

Table 3. GARCH (1,1) model results – treasury yield spread and firm stock returns volatility (sectoral location of the firm)

Sectors	Sig. (+)	Sig. (–)	Insig. .(+)	Insig. (–)
EN	15(20%)	23(30.67%)	15(20%)	22(29.33%)
MAT	21(32.31%%)	8(12.31%)	24(36.92%)	12(18.46%)
IND	46(32.62%)	33(23.4%)	23(16.31%)	39(27.66%)
FIN	22(21.78%)	40(39.6%)	17(16.83%)	22(21.78%)
CD	26(23.21%)	36(32.14%)	29(25.89%)	21(18.75%)
CS	21 (46.67%)	12(26.67%)	4 (8.89%)	8(17.78%)
HC	22(47.83%)	6(13.04%)	10(21.74%)	8(17.39%)
IT	16(37.21%)	12(27.91%)	6(13.95%)	9(20.93%)
UT	23(41.82%)	3(5.45%)	21(38.18%)	8(14.55%)

Note: Sig. (+) represents the positive and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Sig. (–) represents the negative and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Insig. (+) and Insig. (–) represents the number and percentage of statistically insignificant firms in their respective sectors. The number of firms is divided by the total number of firms in each sector to convert into percentages and is reported in parenthesis. All results are reported at 5 per cent significance level.

respectively. The negative relationship described by Chen et al. (1986) asserts that when the long-term interest rates decline, the return on any form of capital declines as well. Thus, such stocks contain negative risk premier. Moreover, the term structure is also considered as a good predictor of an economy and more specifically, in the US economy (Li, 2014). These results can also be explained in the light of expectation theory of interest rate that postulates the term structure contains information about the future interest rates and inflation which in turn explains the expectation about the future economic condition (Li, 2014). When the long-term interest rates are declining or lower than the short-term interest rate the investors are expecting a recession in the economy and are more uncertain about the future of the economy. This uncertainty is reflected in the cash flows of the firms as well as in the stocks (Chen et al., 2013). Further, Schwert (1989) concludes that stock volatility rises during a recession. Thus, the firms located in these three sectors are more sensitive to the expectations about the recession in the economy.

Second, the largest percentage of firms belonging to health care, consumer staples, utilities and information technology sectors experienced a significant positive effect of treasury yield spread on firm stock returns volatility more than the corresponding significant negative effect. The percentage of firms that experienced a positive and statistically significant effect in health care sector is around 47.83 per cent, in consumer staples 46.67 per cent, in the utilities sector 41.82 per cent, in information technology 37.21 per cent, in materials 32.31 per cent, and in industrials sector 32.62 per cent. The positive relationship between treasury yield spread and stock returns volatility implies that the investors are expecting interest rates and inflation to increase in the economy that, in turn, increases the expectations on the yield of the stock. The additional compensation required by the investors will increase the discount rate and ultimately the stock prices go down. This fact is supported by many researchers such as Shiller (1980 , 1981); Christie (1982); Mankiw et al. (1985), and Li (2014).

Third, it is noted that the largest percentage of firms belonging to the materials sector and utility sector experienced an insignificant relationship between the treasury yield spread and firm stock return volatility. In summary, there is an ample evidence that the effect of treasury yield spread on firm volatility varies both in terms of magnitude and sign depending on the sectoral location of firm.

4.3. Oil prices and firm volatility

The results related to the impact of changes in oil prices on firm stock return volatility located in nine US sectors are reported in Table 4.

The main finding supports the expected connotation that the impact of oil prices on firm volatility varies with respect to the sectoral location. The summary of the results is as follows. First, it is noted that for most firms across all sectors, the oil prices have a negative significant effect on firm stock returns volatility more than the positive significant effect. Further, the negative significant effect differs in terms of magnitude across all sectors. The significant negative effect of oil prices ranges from 49.09 per cent of firms in the utilities sector to 86.67 per cent of firms in the energy sector. The utilities sector appeared to be the most sensitive and the utilities sector appeared to be the least sensitive against the negative oil price changes.

Table 4. GARCH (1,1) model results – oil prices and firm stock returns volatility (sectoral location of the firm)

Sectors	Sig. (+)	Sig. (–)	Insig. (+)	Insig. (–)
EN	1 (1.33%)	65(86.67%)	2(2.67%)	7(9.33%)
MAT	6(9.23%)	44(67.69%)	9(13.85%)	6(9.23%)
IND	21(14.89%)	93(65.96%)	9(6.38%)	18(12.77%)
FIN	12(11.88%)	67(66.34%)	07(6.93%)	15(14.85%)
CD	17(15.18%)	72(64.29%)	9(8.04%)	14(12.5%)
CS	05(11.11%)	32(71.11%)	05(11.11%)	03(6.67%)
HC	12(26.09%)	25(54.35%)	02(4.35%)	07(15.22%)
IT	03(6.98%)	32(74.42%)	03(6.98%)	05(11.63%)
UT	05(9.09%)	27 (49.09%)	05(9.09%)	18(32.73%)

Note: Sig. (+) represents the positive and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Sig. (–) represents the negative and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Insig. (+) and Insig. (–) represents the number and percentage of statistically insignificant firms in their respective sectors. The number of firms is divided by the total number of firms in each sector to convert into percentages and is reported in parenthesis. All results are reported at 5 per cent significance level.

Second, the largest percentage of firms in other sectors that experienced a negative significant relationship are information technology (74 per cent), consumer staples (71 per cent), materials (68 per cent), industrials (66 per cent), financials (66 per cent), consumer discretionary (64 per cent) firms, health care (54 per cent) firms, and utilities (49 per cent). These results confirmed the variation in terms of magnitude.

The overall results indicated that the oil prices are affecting stock returns volatility of firms belonging to different sectors differently in terms of magnitude. This heterogeneous response of firms across different sectors is supported by many researchers; though, their focus was on discovering the relationship between oil prices and stock returns. Some valuable researches in this regard are Narayan and Sharma (2011) and (Tsai, 2015).

4.4. Market return and stock return volatility

Table 5 reported the results regarding the effect of market return on firm stock returns volatility belonging to nine sectors.

The results indicated that market return has a significant negative effect on firm volatility for the largest percentage of firms in all sectors. Further, there is ample evidence that the effect of market returns on firm volatility varies in terms of magnitude with respect to the sectoral location of the firm. So, all sectors are not equally sensitive to the shock in market returns. The summary of the specific results is as follows. First, the significant negative effect of market return on firm stock returns volatility is the largest for the information technology sector firms (58.14 per cent) and the lowest for the utilities sector firms (34.55 per cent). In that case information technology sector is the most sensitive and the utilities sector is the least sensitive among all other sectors. Second, the firms in the other sectors that experienced

Table 5. GARCH (1,1) model results – market return and firm stock returns volatility (sectoral location of the firm)

Sectors	Sig. (+)	Sig. (–)	Insig. (+)	Insig. (–)
EN	08(10.67%)	42(56%)	09(12%)	16(21.33%)
MAT	13(20 %)	31(47.69%)	05(7.70%)	16(24.62%)
IND	22(15.60%)	73(51.77%)	23(16.31%)	23(16.31%)
FIN	19(18.81%)	41(40.59%)	21(20.79%)	20(19.80%)
CD	24(21.43%)	50(44.64%)	19(16.96%)	19(16.96%)
CS	09(20%)	25(55.56%)	03(6.67%)	08(17.78%)
HC	10(21.74%)	23(50%)	3(6.52%)	10(21.74%)
IT	09(20.93%)	25(58.14%)	03(6.98%)	06(13.95%)
UT	06(10.91%)	19(34.55%)	10(18.18%)	20(36.36%)

Note: Sig. (+) represents the positive and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Sig. (–) represents the negative and statistically significant coefficient for the number of firms and percentage of firms in their respective sector. Insig. (+) and Insig. (–) represents the number and percentage of statistically insignificant firms in their respective sectors. The number of firms is divided by the total number of firms in each sector to convert into percentages and is reported in parenthesis. All results are reported at 5 per cent significance level.

a largest negative significant effect of market return on firm stock returns volatility are energy sector (56 per cent), consumer staples (56 per cent) and industrials (52 per cent). Third, the other sectors that are less affected by the negative and statistically significant effect of market return are materials (48 per cent), consumer discretionary (45 per cent), and financials (41 per cent).

The overall results indicated that the largest percentage of firms belonging to nine US sectors are more sensitive to the negative shock in the market return than to the positive shock. The stock market provides information about the economy and is reflected in the stock prices (Mwang & Mwit, 2015). The negative return in the stock market is reflecting the bad news about the economy that may affect the firm's future cash flows or the discount rate because of the increased risk premium. Moreover, the stock market and the firms share economic ties because the stock market return is a function of aggregate firm returns (Sharma et al., 2014). This might be a fair reason for most of the firms to follow the market and the firm stock prices fall. This fall in stock prices increases the firm stock returns volatility (Black, 1976; Cheung & Ng, 1992; Christie, 1982). However, the response of firms is different in terms of magnitude because of their location in different sectors. So, the results provided sufficient support that the market return has a heterogeneous effect on firm stock returns volatility with respect to the sectoral location of the firm.

Conclusions

The main contribution of this study is that it undertakes a detailed firm level analysis by sector for a longer period of time to investigate the impact of four macroeconomic factors, namely, exchange rate, treasury yield spread, oil prices, and market return on stock returns

volatility. Further, this study contributes by including all the macroeconomic factors together as an exogenous variable in mean and conditional variance equations of the GARCH (1,1) model. The empirical analysis is based on 683 firms listed on NYSE and located in nine US sectors. The overall results indicated that the given macroeconomic factors affect firm stock returns volatility differently depending on the sectoral location of a firm, confirming the expectation of this study. In summary, the main contributing findings of this study are as follows. First, for the majority of firms belonging to nine sectors, a change in the exchange rate has a significant positive effect on the firm stock returns volatility but differs in terms of magnitude. Further, the utilities sector firms appear to be the most sensitive and the consumer discretionary sector firms are the least sensitive to the exchange rate appreciation. Second, for the largest percentage of firms located in three sectors – financial, consumer discretionary and energy – the effect of treasury yield spread on firm stock return volatility is significant negative. On the contrary, a large percentage of firms belonging to health care, consumer staples, utilities and information technology sectors experienced a significant positive effect of treasury yield spread on firm stock returns volatility. Third, for all sectors, the oil prices have a significant negative effect on firm volatility. Further, firms in the energy sector are highly sensitive and firms in the utilities sector are the least sensitive to the negative oil price changes. Fourth, market return has a significant negative effect on firm stock returns volatility for the largest percentage of firms in all sectors. In this case, the negative significant effect of market return on firm stock returns volatility is the largest for information technology sector firms and the lowest for utilities sector firms. Thus, the findings of this study revealed that the macroeconomic factors have a significant heterogenous effect on firm stock returns volatility located in nine US sectors.

The outcomes of this study have implications for the policymakers and investors. It has emerged from the findings that exchange rate, oil prices, treasury yield spread, and market return significantly affect the firm stock returns volatility, so it is important for the policy makers to closely monitor these macroeconomic factors. Since the world financial markets are well integrated due to globalisation and technological advancement, an increase in volatility may spill over form one sector to the other sectors and from one financial market to the other financial markets in the world, as was witnessed in the US financial crisis of 2007-08. Further, an increase in volatility after a certain limit may disrupt the smooth functioning of the financial market and may result in capital flight. So, to maintain a macroeconomic discipline in the country and to avoid the financial crisis, the policymakers must have a clear understanding of the factors that can increase the volatility in the sectors that may lead to increase the volatility in the aggregate market. Boni and Womack (2006) pointed out that the analysts in the US stock market evaluate the stocks by taking industry perspective and making recommendations to the investors based on their location in different industries. Since the findings of this study indicated that the firms located in different sectors exhibit a different level of sensitivity against the macroeconomic changes, such a knowledge will be beneficial for the investors to diversify their investment considering the volatility behaviour of firms against the macroeconomic changes located in different sectors. Further, for the researchers it is important to consider the heterogenous nature of firms while studying the financial markets to avoid spurious results.

This research study is limited to the New York Stock Exchange, so it can be extended to the other economies as well. Further, this study uses one firm feature that is sectoral location of the firm, it is recommended that some other firm features is studied to explore the volatility behaviour of firms. In the methodological part this study does not include the lag effect, since it is recognized in the literature that the investors underreact to public information, so future research can be extended to test the underreaction hypothesis.

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