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Jump Diffusion Phenomenon, Realized Jumps and Stock Returns: Panel Quantile Regression Analysis of Aggregate Market and Sectors

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Abstract

Financial crisis and uncertain dynamics of stock market caused the highly volatile trend of stock prices and returns. These volatility conditions may affect investors and financial managers severely. Therefore, it is necessary to find comprehensive framework to understand the dynamics of stock return volatility. This study is aimed at examination of dynamics of jump diffusion phenomenon of stock return volatility. Comparative insight of aggregate stock market and sectoral stock returns in response with diffusive risk, jump risk, return asymmetry, and total volatility measures of jump diffusion are provided in this research. This research uses panel data quantile regression with fixed effect estimates for statistical results. The results indicate that non-linear events with proxy results of realized jumps have significant negative impact on aggregate stock market return. Yet, sectoral stock returns show mixed of positive and negative linkages with realized jumps. Jump diffusion components of volatility results confirmed non-linear positive and negative impact on sectoral stock returns of various sectors.

Key Words: Jump Diffusion Processes, Realized Jumps, Volatility, Non-Linear Events, Financial risk.
JEL Codes: C32, G12, G14, G32

1 Introduction

Stock market is the most significant platform for the businesses and investors for their businesses and investing decisions. Stock market does not only play significant role in the

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economic growth of the businesses but also provide benefits to the investors for their desired returns. According to the Efficient Market Hypothesis (EMH, henceforth) (Fama, 1965), efficient market incorporates all information of macroeconomic indicators, firm's characteristics and other exogenous factors in its stock prices. However, the dynamics of stock market is highly volatile and vulnerable in response with large numbers of uncertain events, firm's characteristics, macroeconomic indicators, and other exogenous factors. EMH also claims that stocks in strong and semi-strong efficient market exhibit volatility of macroeconomic and financial variables (Fama, 1965). Different stock market crash, collapses and abnormal events lead the higher positive and negative jumps in stock return volatility at both market level and firm level (Mishkin & White, 2002). Therefore, it is perceived that jumps and volatility have significant impact on stock returns and ultimately affect the investors' required returns (Jiang & Yao, 2013). These phenomena contradict the EMH in its wide range of arguments.

More specifically, volatilities of stock returns actually are the combination of two components known as diffusion and jumps. Jump diffusion model of Merton (1975) explained the behavior of both of these components with combination of normal distribution and Poisson distribution components in one model. Individually, there are some researches are available to determine the impact of these jumps and diffusive parts of volatility on stock returns (see for instance, (Todorov & Tauchen, 2011; Jiang & Yao, 2013). Above studies showed mixed evidences of positive and negative impact of jumps on stock returns.

Most of the past studies are focused on the linear components of volatilities and linear relationships of stock returns with key determinants (Ahmed & Hla, 2019; Handayani et al., 2018; Jan & Jebran, 2015; Thampanya et al., 2020). Some of the time-varying factors and business cycle features like economic states of bullish and bearish markets may also have significant impact in generation of stock prices and returns (Schwert, 1989). Similarly, some of the unexpected events like stock market crash, certain macroeconomic announcements, certain news surprises and economic crisis may also create the abnormal jumps in stock returns and causing volatility too. In this concern, previous research majorly focused on the stock market returns in relation with these factors, but the responses of different stock returns at aggregate stock market and sectoral level to these factors in relation with its' stock return volatility components and realized jumps is still pending to be further explored.

The concept of stock return volatility is very complicated and associated with numbers of different market and firms' phenomenon like abnormal events, market crisis or crash, macroeconomic conditions, news arrivals in the market, firm related policies and factors. Number of these phenomena lead to the jumps and diffusive components of total volatilities. All of these phenomena had been discussed for the market level volatilities in limited studies. In some extent, rarely attempt to find the impact of these issues at sectoral or industrial level. Theoretically, there are ambiguous relationship between return and volatility (see for example, Campbell et al., 2001). We are still unable to find clear distinct relationship between return and volatility at both market and industrial level in different dimensions of these phenomena. On the other hand, it is also still ambiguous about the nature of relationship between stock returns and volatility components of jumps and diffusion in case of abnormal volatility.

Jumps and diffusion components of volatility are the key abnormal and normal variations of stock returns. Pakistan Stock Exchange is also considered as highly unpredictable stock market, where investors and institutional shareholders are taking their investing decisions on different sets of approaches. Most of the investors ignore different background phenomena in determining stock return volatilities and predicting stock returns. Theoretically, there are different firm related and market related factors those have close relationship with stock return and its volatility. In the concern of stock market, very limited and insufficient empirical evidence are found in addressing the phenomenon of jumps and diffusive volatility behavior in stock returns. The Pakistan stock exchange (PSX), formerly Karachi Stock Exchange (KSE) is highly volatile market. Investors and managers are concerned about constant growth of their desired profits and revenues. Investors are concerned with investing in different firms and various sectors. Each firm and sector have different prospects to respond various economic and uncertain events in the market, which ultimately leads to the stock return volatility. In past history, it had also been observed that certain sectors and firms behaved and responded differently as per their size and ability to deal with the market crisis and abnormal events. Different volatility shocks affect various sectors and firms in various manners. So, in the concern of managing these risks, most of the market investors and managers are not really much aware of risk seeking and risk averse firms to respond uncertain events and volatility shocks.

This research would contribute in terms of providing unique insight of jump diffusion components of volatility in relation with stock returns both at market level and sectoral level. This research is novel in terms of identification of various volatility components in terms of jump risk, diffusive risk, total volatility and return asymmetry, then finding its key linkages with stock market and sectoral stock returns of various stocks at various quantiles. This research will also help the managers and investors to evaluate significance of different jump diffusion components of volatility in determining better forecast of future stock returns.

The problem area of research leads to set the basic aim of this research as to find the impact of realized jumps as a proxy of uncertain and non-linear events and various components of stock return volatility on the stock return at aggregate market and sectoral level. This research assesses the impact of realized jumps and volatility components on aggregate stock market returns. Moreover, it is focused on analysis of the effect of realized jumps and various volatility components on sectoral stock return. It will provide the comparative insight of various responses of different sectors to realized jumps and volatility components.

In later sections literature review, data and econometric modelling, results and analysis and conclusions are given subsequently.

2 Literature Review

There are very few empirical studies found to examine the impact of abnormal events on the stock returns with contradictory arguments of positive and negative impact of these events on stock returns and volatility (see for instance, Chao et al., 2017; Mathy, 2016). Empirically, Whaley (2000) conclude contemporaneous negative relationship between stock return and volatility. On the other hand, Talpsepp and Rieger (2010) find that intensity of volatility response is higher against negative return shocks than positive shocks that leads to the asymmetric return-volatility relationship. In other mainstream literature, it is also proved that short-term price and dividend expectations lead to the negative return volatility relation in the long run. Previously, some of the studies have been studied in determining nonlinear relationship of stock return volatility in the context of behavioral finance in terms of investor sentiments and investor behavior (Fei, 2019; He et al., 2020). Moreover, some of the other researches regarding stock return volatility was only concerned with identification of more accurate predictability models in the presence of nonlinear and linear trend like jump and diffusion components of stock return volatility in the context of option pricing and other concerned variables (see for instance, Albani & Zubelli, 2020; Chen & Ye, 2021; Li et al., 2019; Li & Zakamulin, 2020). There are very limited and contradictory evidence found, as per best knowledge of researcher, in combination of aggregate market and sectoral stock returns. Previous research do not focus on different components of stock return volatilities with the focus on finding its' determinants and responses to different sectors' stock returns. There is a clear research gap regarding examination of stock return volatility deeply by identifying its' linear and non-linear components and then find its association with aggregate and sectoral returns.

Different macroeconomic variables impact on stock return and its volatilities have already been tested. Globally, very few studies are available to find the impact of these factors in the presence of jumps on stock returns and volatility (see for instance, Hsu et al., 2016; Kou, 2002; Merton, 1975; Thampanya et al., 2020). On the other hand, impact of firm characteristics on stock return and volatility in the presence of jumps was rarely studied before. It is also drawback, that most of the studies specifically examined the volatility of stock returns either in the response of macroeconomic factors or firm specific factors or determinants. Moreover, previous studies just focused on the stock market returns (Bartram et al., 2012).

In determination of firm related and macroeconomic determinants of stock returns and volatility, some of the previous literature is also concerned about the impact of macroeconomic news surprises and abnormal events on the stock returns volatilities (Flannery & Protopapadakis, 2002). In this regard, Ané & Geman (2000) discussed the phenomenon of price and volatility changes through trades in response with certain information. These researches also claim that firm's stock prices have tendency to respond abruptly in response with information and event. Jumps in prices can be observed in case of presence of discontinuities in information flow. On the basis of this argument, several empirical studies rejected the continuous models in explanation of price jumps responses (Maheu & McCurdy, 2004). These jumps play significant role not only in defining characterizing features of information process for returns but also in explaining transmission mechanism of policy decisions. For example, Das (2002) and Johannes (2004) examined interest rates and concluded that jumps are primary channel through which macroeconomic information enters the term structure. Empirically, researchers found asymmetric relationship between macroeconomic news announcements and stock return volatility in reference to jumps. In this concern, (Rangel, 2011) observed that jumps are more frequent on announcement days in comparison of non-announcement days. Similarly, (Huang, 2007) examined the financial market responses in terms of continuous volatility effects and jumps on news days. His results also confirmed that there are more days for large jumps on announcement days in comparison of non-announcement days for various macroeconomic announcements. This study also confirmed that macroeconomic news has significant impact on jump intensity. These previous results indicate that jumps are characterised by different abnormal events and news surprises. Therefore, jumps can be used as valid proxy for uncertain events and news surprises to find out the impact of abnormal events on stock return and volatility at aggregate market, sectoral and firm level.

In the concern of determinants of stock returns, there are several empirical and theoretical justifications are present in previous literature about macroeconomic determinants of stock returns (see for instance, Abaidoo, 2019; Hanif & Bhatti, 2018; Naseem et al., 2019; Thampanya et al., 2020). In this regard, inflation, consumer price index, purchase price index, GDP growth, taxation policies, FDI, aggregate demand, aggregate supply and money supply along with exchange rates have been considered as key determinants of stock returns. In the same way, some of the previous researches have already been done to find the relationship between firm characteristics on stock returns (Chen & Petkova, 2012). In this concern, profitability, leverage, market to book value, illiquidity, earning ratios and cash flow positions were considered as key internal determinants of stock returns and stock return volatilities at market and industrial level. All of these macroeconomic and firm level characteristics are still unexplored to find its impact in the presence of realized jumps and different volatility components collectively in a single study.

There are mixed results found regarding relationship between idiosyncratic risk and stock returns. In this concern, Vozlyublennaia (2013) found significant inverse relationship between size of the firm and idiosyncratic volatility. It means that the firms holding smaller size are highly disposed to idiosyncratic volatility and vice versa. According to Wang et al. (2009) and Richardson and Peterson (1999) firms with big size are more responsive to information than small size firms. Therefore, large firms consistently earn higher returns. In the same way the large firms lose higher returns in response of negative information. Cheung and Ng (1992) conclude positive correlation between stock return and stock return volatility for the smaller sized firms. These studies also indicate that stock returns are more positively skewed for small size firms than large size firms.

Theoretically, there is positive relationship between book-to-market ratio and stock return volatility, which indicates that firms having higher book-to-market ratio hold stocks, which are less likely to be growth stock and have lower risk in the market. However, Wang et al. (2009) believe that book to market ratio normally does not consider a valid determinant of stock return during the crisis period. Miyajima and Yafeh (2007) also find that firms with low book to market ratio suffer more during the crisis period. All of these results also support the theoretical justification of Fama & French (1993) that firms with low book to market ratio are exposed to higher risk of losing market share. In the concern of relationship between stock liquidity and stock returns, Amihud et al. (1990) find significant negative relationship between illiquidity and stock returns. As like Wang et al. (2009) found significant positive relationship between these variables. In the same way Wang et al., (2009) also find significant relationship between stock return volatility measure and stock returns.

In the concern of firm's related characteristics, leverage, liquidity, cash flow and profitability measures have strong and significant impact on the stock returns in both normal and crisis period. Empirically, Miyajima and Yafeh (2007) and Wang et al. (2009) found significant relationship between total debt to total asset ratio (as a proxy of leverage of the firm) and stock returns. Highly leveraged firms observed great losses during the crisis periods. Liquidity measures shown mixed results of positive and negative relationships with stock returns. In this regard, Bonfim (2009) found that firm with high liquidity is likely to have lower risk of bankruptcy and losses. Conversely, Gadarowski et al. (2007) and Acharya et al. (2012) concluded that firm with highly liquidity is more vulnerable to face to great losses due to its inefficient management of optimizing assets. Cash flow per sales ratio has strong positive relationship with stock returns. During the crisis period the firms with strong cash flow position are less likely to suffer great losses (Carpenter & Guariglia, 2008). It is also proved empirically that profitability measures like basic earning power have strong positive impact on stock returns. It means that firms with having sound profitability position are least likely to suffer great losses (Bonfim, 2009).

Existing studies have no consensus on finding the impact of volatility on stock returns. These studies did not address the various volatility components along with non-linear events and realized jumps on various quantiles of aggregate stock market returns and sectoral stock returns of various sector. This study would involve in micro analysis with comparative insights of sectoral stock returns in response with jump diffusion components of stock return volatility.

2.1 Theoretical Background

Theoretically and empirically, there are large numbers of researches and findings available in discussion of these phenomena and impact of these issues on stock returns. There are some theoretical explanations of return-volatility relationship in the way of classical approaches of return-volatility relationship, which are also useful to understand the extent of this relationship. Classical approaches are concerned with the leverage hypothesis

(Black, 1976) and feedback hypothesis (Poterba & Summers, 1988) with indicating the asymmetric relationship between stock returns and volatility. But empirical testing and evidence do not fully justify these asymmetric relationships between stock returns and volatilities. (For instance see, Hibbert et al., 2008). Very few empirical studies support the existence of negative asymmetric relationship of return and volatility (see for instance, Badshah et al., 2016). Hou & Li (2014) tested feedback hypothesis and confirm that this hypothesis is indicating positive empirical evidence of asymmetric relationship of actual volatility of stock returns with perceptions of investors.

On the other hand, CAPM model (Lintner, 1965; Sharpe, 1964) also provides the linear relationship between non-diversifiable risk and asset required returns. Moreover, (Black, 1976) tested empirically this model and found that average returns are positive and have closely linear correlation with betas. Fama and MacBeth (1973) also confirmed the positive linear relationship between asset returns and betas. In this concern, diversification of firm-specific elements of the returns is only possible through the combination of portfolio of set of less risky and high risky assets. Highly volatile and risky assets carry higher returns but also exposed to be disposed-off with negative returns due to high volatility. Therefore, it is also an issue to find the firm-specific diversifiable factors that can be used in determination of higher return of assets with certain volatilities. On the basis of these theories, there is an issue to find reliable justifications of different determinants of stock returns with finding key linkages of jumps volatility components with stock returns.

3 Data and Econometric Modelling

3.1 Data and Sample Description

This research is focused on the data of stock returns and volatilities. Daily stock prices of 8 non-financial sectors related firms are taken for this study. There is total 276 firms are related to these selected sectors. Around 251 firms are sampled during the period 2006 to 2018. Rest of the companies are not included in this study due to unlisted and non-operational status during the concerned period. Daily stock prices are used for the calculations of stock returns and volatility components. Around 459,928 daily stock prices were taken in the calculations of daily stock returns, jumps, realized jumps and diffusive volatility components. All of these daily calculations are annualized later to form uniformity with other variables. For aggregate market returns PSX market index is used. Volatility components are also based upon these market-based returns. The major sectors here used for analysis are food products, fuel and energy, information, communication and transport, other services activities, paper and paper board products, petroleum, sugar, and textile overall. These sectors and selected firms hold around 51% of overall market capitalization of PSX. All of these factors are also contributing well to GDP growth of Pakistan. The daily stock prices, returns, sectoral returns, GDP growth and firm related data are collected for the time period of 2006 to 2018. All the concerned data is gathered from PSX database, annual reports of the selected firms and State Bank of Pakistan Database.

In the study of jumps phenomenon concern, Merton (1976) Jump-Diffusion model has widely been used in previous researches. In this regard, stock return variations and volatility contain two elements. One element of total volatility depicts normal variations in stock returns and can be modelled on the basis of normal distribution. Second component of this volatility is concerned with abnormal variations in stock returns due to transmission of abnormal information in stock returns. This second component can be modelled based upon Poisson distribution. On the basis of these theoretical bases, jumps and diffusion parts of stock return volatility can be used in further studies as a variable to find its impact on stock return.

Along with finding key determinants of stock return volatility, there is a big issue to follow the assumptions of OLS for the model regarding nonlinearities and dispersion of random variables due to time or other factors. OLS or simple regression model normally provides the estimates based upon the conditional mean of the distribution. To resolve this issue, Koenker & Bassett (1978) proposed the Quantile regression model to help in the investigations of asymmetric characteristics of stock returns and volatility distribution. This model allows producing the estimates at different conditional median or quantiles. This model is an extension of traditional OLS and comparatively produces more accurate and specific results than using OLS. QR models are more flexible in estimation of average dependence as like in OLS and then also estimate the lower and upper tail dependence. Therefore, QR model can minimize the issues of outliers, heteroskedasticity in the data by separating whole distribution into different quantiles. This study is based on aggregate and sectoral stock returns which are normally skewed and not following normal distributions. Therefore, for analysis purpose, we will use Panel Data Quantile Regression with fixed effect model here. In general, panel quantile regression model Zhou et al. (2014) can be written as

$$Qyi,j\ (\tau|xi,j)\ =\ \alpha i\ +\ x_{i,j}^{T}\,\beta(\tau)$$

$$i\ =\ 1, \dots\dots, m;\ \ j\ =\ 1, \dots., n. \tag{1}$$

In this above equation, α's indicates the pure location shift effect on various conditional quantiles of the response. Moreover, covariates effects of xij are allowed to show the dependency on the concerned quantiles τ. i is the subscript used for index of individual cross section with number of companies or sectors of m while, j is considered as index of time with number of observation of n.

This research is focused on finding the impact of systematic risk, idiosyncratic factors, realized jumps and firm characteristics. In consideration of stock market return and sectoral return, our panel data quantile regression model can be written as followed.

$$Q_{\tau}(\tau|RET_{i,t})\ =\ \beta_{\tau 0}\ +\ a_{\tau i}\ +\ \beta_{\tau 1}RJ_{i.t} +\ \beta_{\tau 2}BETA_{i,t}\ + \beta_{\tau 3}SIZE_{i,t} +\ \beta_{\tau 4}MVBV_{i,t}\ +\ \beta_{\tau 5}ILLIQ_{i,t}\ +\ \beta_{\tau 6}LAR_{i,t}\ + \beta_{\tau 7}CFPS_{i,t} +\ \beta_{\tau 8}EPS_{i,t} +\ \beta_{\tau 9}TDTC_{i,t}\ +\ \beta_{\tau 10}GDP_{i,t}\ + \beta_{\tau 11}TVOL_{i,t} +\ \beta_{\tau 12}DIFFRISK_{i,t}\ +\ \beta_{\tau 13}JUMPR_{i,t}\ + \beta_{\tau 14}\,SKEWN_{i,t} +\ \varepsilon_{\tau i,t} \tag{2}$$

In above model 2 $RET_{i,t}$ is the daily stock return used as dependent variable and it will be calculated as $RET_{i,t} = log([P_{i,t}\ -\ P_{i,t-1}]/P_{i,t-1})$. This model can separately be determined for aggregate stock returns and sectoral stock return. For aggregate stock market returns RET_M is used here. PSX 100 index are used here to calculate the aggregate stock market returns. While RET_S is showing sectoral stock returns. Sectoral stock returns are derived from average of daily firms' stock returns underlying in the concerned sector. In this concern only eight sectors are going to use in this study. These sectors are food products, fuel and energy, Information, communication and transport, other services activities, paper & paper board products, petroleum, sugar and textile overall. For each sector separate panel quantile regression model is estimated here in this research.

$\beta_{\tau 0}$ is the conditional intercept at different quantiles. ai is the time invariant fixed effect of individual cross section in panel data model.

Here the variable realized jump (RJ) is going to introduce to find its impact on the stock return volatility. Realized jumps are considered as proxy of uncertain and non-linear events of the aggregate market. Barndorff-Nielsen and Shephard (2004), Huang and Tauchen (2005) and Tauchen and Zhou (2011) discussed the concept of realized jumps and provided its measurement on the basis of intraday trading. The previous literature supports this argument that measurement of short-term volatility on the basis of high frequency data is better than the measures of variances from the low frequency data (Meddahi, 2002). Moreover, Christensen et al. (2014) proved that measures of jumps based on the high frequency data are showing spurious results. Therefore, theoretical grounds of stochastic process of stock prices indicate that jumps are normally large in size and rare in frequency. To resolve the spurious result issue Barndorff-Nielsen & Shephard (2004) provided the following measures of realized variance (RVt) and realized bi-power variance (BVt) at time t. On the basis of daily stock price data these realized variance and bi-power variances can be calculated as followed.

$$RV_t = \sum_{i=1}^{M}(r_{i,t})^2 \longrightarrow \int_{t-1}^{t} \sigma^2 ds + \sum_{i=1}^{M} J_{i,t}{}^2 \quad (3)$$

$$BV_t = \frac{\pi}{2}\sum_{i=1}^{M} |r_{i,t}| \cdot |r_{,t-1}| \rightarrow \int_{t-1}^{t} \sigma^2 ds \quad (4)$$

In above calculations, $r_{i,t} \equiv log(S_{i,t} / S_{i,t-1})$ is the ith (cross sectional) return on day t, while $S_{i,t}$ indicates the daily stock prices. M is considered as sample frequency while, σ^2 and $J_{i,t}$ are the diffusion and jump components of stock prices respectively. Huang & Tauchen (2005) provided the ratio statistics of realized jumps as follows.

$$RJ_t = \frac{RV_t - BV_t}{BV_t} \quad (5)$$

If the value of difference between RV_t and BV_t is positive it indicates that there is a jump or zero otherwise. So, this value of realized jumps will be used here in this model as $RJ_{i,t}$.

After detecting these jumps, we can calculate different components of jump diffusion volatility. For this purpose, we are going to use approach of Masrorkhah & Lehnert (2017) to find jumps and diffusive components from the formula of total stock return volatility as follows.

$$TVOL_{i,t} = \sqrt{\sigma_{i,t}^2 + \lambda_{i,t} x_{i,t}^2} \quad (6)$$

Here λi and x are concerned variables of jump intensity and jump size respectively Both of these variables can be derived from the calibration method on stock return data as following approach of Masrorkhah & Lehnert (2017). $\sigma_{i,t}^2$ is considered as standard deviation of realized jumps. After having these variables we can use the above formula to calculate the total volatility. In above formula,

$DIFFRISKi,t = \sigma_{i,t}^2$

$JUMPR\ i,t = \lambda_{i,t} x_{i,t}^2$

$SKEWNi,t = \lambda_{i,t} x_{i,t}^3$

Alternatively, jump intensity and jump size can be calculated as below.

λ_i = Number of Realized jumps days / Number of trading days

x = Mean of realized jumps

$\sigma_{i,t}^2$ = Standard deviation of realized jumps

Here DIFFRISK is considered as diffusive risk which can be used as diffusive component of stock return volatility. JUMPR is the variable used as jump risk as a proxy of jump components of stock return volatility. It is also necessary to estimate the results of return asymmetry in relations with aggregate stock market returns and sectoral returns. Therefore, SKEWN is considered as skewness which is used here as a proxy of return asymmetry. TVOL is termed as total volatility with the combination jump and diffusive components as mentioned in above formula. This research is focused on the calculation of these volatility components based upon aggregate market returns to study the impact of aggregate market volatility in terms of diffusive risk, jump risk and return asymmetry on aggregate stock market returns and sectoral returns.

In above model, BETA is the systematic risk and calculated from direct formula of market Beta as the ratio of covariance of individual firm's stock returns and market stock return to the variance of market return. It can be notated as below.

$$BETA = Cov\,(e,m)/\,\sigma m^2 \quad (7)$$

SIZE is the market capitalization of firms and it can be derived with logarithm of firms' market capitalization. MVBV is considered as market value to book value ratio and it can be measured from the ratio of firm's market capitalization to book value. ILLIQ is termed as stock illiquidity and is measured on the basis of formula as discussed in the study of Amihud (2002).

$$ILLIQ\ i,t = \frac{1}{N}\sum_{t=1}^{T}\frac{|\,RETi,t\,|}{Volume} * 10{,}000 \quad (8)$$

Where, RET is firms individual stock returns, N is the numbers of returns in given time and volume is volume of shares trading during time.

LAR can be said as liquid asset ratio and normally formulate by taking ratio of cash and short-term investment to total assets. It is used as a proxy of liquidity of the firms. CFPS is cash flow per share and is considered as proxy of cash flow. This can be measured from ratio of operating cash flow minus preferred dividend to the outstanding common share. EPS is called earning per share and this will be used as proxy of profitability. This can be calculated with the ratio of net income minus preferred dividend to the total numbers of outstanding ordinary shares. TDTC is abbreviated form of total debt to total capital ratio. It is the proxy of leverage of the firms.

GDP_t is considered as gross domestic product during the time t. but her GDP_t is short form of GDP growth. Both of these indicators are used as macroeconomic indicators to determine the impact of macroeconomic indicators on stock return volatility, stock return and other concern variables of volatility components. $\varepsilon_{\tau i,t}$ is the error term at different quantiles here in this model.

4 Results and Analysis

4.1 Descriptive Statistics

Basic summary statistics results are presented in Table 1. These results are showing values of mean, media, standard deviation, skewness, and kurtosis values of all concerned variables of our research model. These skewness and kurtosis values are very high for MVBV, ILLIQ, LAR, EPS and TDTC. JB is used here for Jarque- Bera test of normal distribution.

Table 1

Basic Summary Statistics

Var.	Mean	Median	Std.Dev	Min	Max	Skewness	Kurtosis	JB	ADF
				Dependent Variables					
RET_M	0.036	0.043	0.045	-0.034	0.097	-0.229	1.689	234.1***	1377.60***
RET_S	-0.01	-0.016	0.094	-0.242	0.265	0.421	2.762	93.04***	932.99***
				Independent Variables					
RJ	0.984	0.999	0.068	0.85	1.089	-0.496	2.676	132.4***	1122.32***
BETA	0.766	0.731	0.642	-0.171	1.783	0.117	1.868	161.5***	1230.54***
SIZE	13.294	13.011	2.007	10.692	16.887	0.397	1.995	199.1***	738.80***
MVBV	0.856	0.491	0.931	0.052	3.211	1.468	4.051	1180***	1100.82***
ILLIQ	0.001	0.000	0.004	-0.001	0.011	2.014	5.343	2636***	1394.54***
LAR	0.043	0.014	0.061	0.002	0.207	1.747	4.805	1868***	1368.70***
CFPS	0.725	0.23	1.341	-0.857	3.593	1.001	2.917	454.0***	1157.00***
EPS	5.068	1.757	10.325	-6.293	28.767	1.140	3.333	644.1***	1039.06***
TDTC	11.751	0.652	243.947	0.003	5690.6	22.138	493.659	299.9***	867.79***
GDP	0.041	0.047	0.014	0.017	0.058	-0.427	1.803	262.6***	1397.21***
TVOL	20.788	12.497	16.565	6.024	48.157	0.769	1.896	431.1***	1748.04***
DIFFRISK	702.78	152.704	911.271	33.935	2314	1.015	2.232	566.9**	1586.16***
JUMPR	3.824	3.39	1.53	2.163	6.19	0.439	1.659	311.1**	2229.29***
SKEWN	9.803	7.666	5.715	4.032	18.881	0.558	1.722	348.8***	2233.09***

Source: Authors' calculations

* p<0.05, ** p<0.01, *** p<0.001

These results are indicating the results of normality. All variables are showing significant values of chi-square which leads to the conclusion that these variables are not following normal distributions. In this regard, usage of penal data quantile regression is justified which can also be used to relax the assumption of normal distribution of data.

For panel data unit root test, we applied fisher-type unit root test because this research is based upon unbalanced panel with some missing data in various years due to unavailability of data. Augmented Dickey-Fuller tests values with asterisks are showing that series of all variables are stationary.

Table 2 results are indicating the descriptive statistics measures of sectoral stock returns. Different 8 sectors have different values of mean, median and standard deviation. Skewness and kurtosis value of petroleum sector is highest with the value of 5.00 indicating that sectoral returns of petroleum do not follow normal distribution. All sectors are negatively skewed except food products and textile overall.

Table 2
Basic Summary Statistics for Sectoral Stock Returns

Sectors	Mean	Median	St.Dev	Min	Max	Skewness	Kurtosis
Food Products	0.027	0.014	0.086	-0.0840	0.187	0.3660	2.2190
Fuel and Energy	-0.02	-0.016	0.070	-0.1430	0.085	-0.3630	1.9780
Info & Comm	-0.02	-0.024	0.100	-0.2250	0.120	-0.4030	2.5260
Other Service	0.003	0.016	0.112	-0.2180	0.144	-0.5160	2.2760
Paper Products	0.001	-0.009	0.099	-0.1620	0.156	-0.1480	1.8630
Petroleu m	-0.01	0.011	0.087	-0.2420	0.102	-1.3110	5.0000
Sugar	0.005	-0.001	0.066	-0.0980	0.108	0.2630	2.0250

Textile Overall	-0.02	-0.032	0.101	-0.1584	0.174	0.5249	2.4300

Source: Authors' Calculations

4.2 Aggregate Stock Market Returns and Jump Diffusion Components

For all model of estimations panel data quantile regression model is used here. Panel data quantile regression model relaxes the assumption of normality of the data. Descriptive statistics results show that the data is not normal. Therefore, quantile regression provide the valid results of estimation in dealing with this type of non-normal data. In this regard, five different quantiles of 0.10, 0.25 (lower), 0.50, 0.75 (middle), and 0.90 (upper) are estimated. Table 3 reports the negative coefficients of realized jumps (RJ), BETA and SIZE at all quantiles. It means that in case of non-linear events and abnormal events aggregate market returns are highly volatile to lose higher value of investment. Larger the size of the company may lead to increase in loss of stock returns in the presence of non-linear events and jumps. Negative coefficients of RJ means that larger the volume and frequency of realized jumps lead to negative returns in overall market. MVBV is showing negative coefficients at lower and middle quantiles indicating the companies with high value of MVBV may lead to reduction in stock returns in the presence of non-linear events and realized jumps. But MVBV is showing positive significant coefficient at upper quantile. It indicates that higher median level the firms having high MVBV has positive significant impact on the aggregate market return. Illiquidity is showing positive beta value at lower and moderate quantiles while negative coefficient is shown at quantile 0.90.

In the concern of jump-diffusion components of volatility, four proxies of total volatility (TVOL), diffusive risk (DIFFRISK), jump risk (JUMPR) and return asymmetry (SKEWN) results are estimated. All of these jump diffusion components of volatility are measured on the basis of stock market returns. TVOL reports negative coefficients at all quantiles except 25th percentile indicating high volatility leads to lower of the market returns. DIFFRISK has positive coefficients for all quantiles. These results indicate that casual volatility may have positive impact on aggregate stock market returns. These coefficients are showing nonlinear impact of diffusive risk on stock market returns.

Table 3
Panel Data Quantile Regression Estimates for Aggregate Stock Market Returns

	FE	Q(0.10)	Q(0.25)	Q(0.50)	Q(0.75)	Q(0.90)
RJ	-0.0353*	-0.00205***	-0.0266***	-0.0340***	-0.0154***	-0.0110***
	(0.023)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BETA	-0.007***	-0.000443***	-0.00718***	-0.0165***	-0.00935***	-0.00239***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	-0.0085***	-0.0000328***	-0.00220***	-0.00265***	-0.00201***	-0.00272***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MVBV	-0.00202	-0.000307***	-0.00142***	-0.000851***	-0.00171***	0.000494***
	(0.226)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ILLIQ	0.528*	0.121***	1.889***	0.0818***	0.294***	-0.0569***
	(0.041)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAR	0.00281	0.00143***	0.0196***	-0.0171***	-0.0268***	-0.0142***
	(0.897)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFPS	0.00358***	0.000303***	0.00456***	0.00450***	0.00217***	0.000709***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EPS	-0.000243	-0.000021***	-0.000183***	-0.000414***	-0.000181***	0.0000704***
	(0.081)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TDTC	0.00000152	0.000000588***	0.00000244***	-0.000006***	0.00000253***	-0.0000006***
	(0.810)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.445***	0.336***	0.797***	0.407***	0.349***	0.0912***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

TVOL	0.000381	-0.000384***	0.00152***	-0.000919***	-0.00203***	-0.000841***
	(0.416)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DIFFRISK	0.0000217**	0.0000321***	0.0000237***	0.0000535***	0.0000331***	0.00000142***
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
JUMPR	0.0354***	0.0111***	0.0260***	0.0737***	0.0136***	-0.000345*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.041)
SKEWN	-0.0133***	-0.00567***	-0.0133***	-0.0241***	-0.00331***	0.00149***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
_Cons	0.145***					
	(0.000)					
N	2674	2674	2674	2674	2674	2674

Source: Author's Calculations

p-values given in parentheses. *p<0.05, ** p<0.01, *** p<0.001

For the return asymmetry SKEWN results prove negative impact of return asymmetry on the stock market returns. At the 90th quantile SKEWN reports positive coefficient indicating positive impact of return asymmetry on the aggregate stock market returns. All of these mixed and diversified results indicate nonlinear impact of jump diffusion components of stock return volatility on aggregate stock market returns.

In the firm characteristics concern, LAR is showing positive results at lower quantile and negative coefficients at the moderate and higher quantiles. CFPS presents the all positive results of coefficients at all quantiles. This means improved level of cash flow positions of firms lead to increase in aggregate stock market returns. EPS reports negative coefficients at lower and moderate quantiles but positive significant coefficient is resulted at 90th percentile. These results prove that companies with improved values of earnings are more risky to face higher risk of losing market share in the presence of realized jumps in bearish market.

Positive coefficient at 0.90 quantile means at bullish trend of market higher EPS leads to the improved aggregate stock market returns. Leverage ratio is showing negative results at 0.50

and 0.90 quantiles. Positive coefficients of GDP enforce that higher GDP growth leads to the higher stock market returns.

4.3 Sectoral Stock Returns and Jump Diffusion Components of Volatility

Sectoral stock returns and its linkages with jump diffusion phenomenon studied here. Comparative analysis of all selected sectors in the context of realized jumps, jump-diffusion components of stock market volatility and its impact on sectoral stock returns is given below in tables 4, 5 and 6. Realized jumps (RJ) show different mixed results at different quantiles of different sectors. At most of the quantiles RJ has significant negative coefficients. Food products sector proves the significant negative impact at 0.25, 0.75 and 0.90 quantiles while, positive impact has been shown on 0.10, 0.50 quantile. It reveals that food sector respond positively to the realized jumps at lower and middle quantiles. Fuel & energy and sugar sector show significant positive results at lower quantile of 0.10 and negative coefficients are exhibited at middle and upper quantiles. Other service activities and petroleum sector results confirm significant negative linkages of RJ with sectoral returns at middle and upper quantiles while significant positive association is revealed at lower quantiles. It means both of these sectors performed well in terms of responding uncertain events at bearish trend of market. Information, communication and transport show significant association of RJ with negative impact at lower and middle quantiles. However, positive significant results are revealed at lower quantile. Paper & paperboard product and textile overall sectors results show significant positive impact of RJ at lower and upper quantiles of 0.25 and 0.90. All positive estimates show that increase in the size of realized jumps lead to increase in sectoral stock returns. But negative coefficients reveal that increase in values of RJ causing reduction in sectoral returns. FE model results are not showing consistent results with panel QR model results in terms of significance. All of these sectors have mixed of positive and negative results which indicate the nonlinear significant impact of realized jumps on sectoral stock returns.

In the concern of jump diffusion components of stock return volatility, panel quantile regression estimates are given in table 6. These volatility components are divided into total volatility (TVOL), diffusive risk (DIFFRISK), jump risks (JUMPR) and return asymmetry (SKEWN). TVOL results of food sector indicate significant negative impact on sectoral returns at lower and middle quantiles of 0.10, 0.25, 0.50. At upper quantile this sector shows significant positive linkages with sectoral returns. It leads to the view that increase in total volatility of stock market direct the sectoral returns of food sector in decreased trend in bearish and normal growth period.

Table 4:
Panel Quantile Regression Estimates of Sectoral Returns, RJ & Market Factors

	_cons	RJ	BETA	SIZE	MVBV	ILLIQ
			Food Products Sector			
FE	0.337	-0.202	0.00436	-0.0207*	0.000863	-5.184
	(0.123)	(0.124)	(0.805)	(0.039)	(0.946)	(0.087)
Q(0.10)		0.00603***	0.00245***	0.0000381***	-0.00031***	0.102***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		-0.0102***	-0.00356***	-0.00307***	0.0000922	-0.117
		(0.000)	(0.000)	(0.000)	(0.869)	(0.585)
Q(0.50)		0.00784***	0.0125***	-0.00485***	0.00844***	-0.330***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.417***	-0.0178***	-0.0123***	0.00826***	-4.898***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)		-0.0614***	-0.00900***	-0.00395***	0.0103***	-17.01***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
			Fuel & Energy Sector			
FE	-0.0362	-0.155	-0.0223	-0.00775	-0.0116	-2.263
	(0.893)	(0.150)	(0.090)	(0.583)	(0.093)	(0.259)
Q(0.10)		0.00208***	0.00271***	-0.000209***	-0.00164***	0.949***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		-0.0172***	-0.00645***	-0.00328***	-0.00634***	-0.929***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.0592***	-0.00987***	-0.00333***	-0.00105***	-0.585***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.0577***	-0.00820***	-0.00279***	-0.00237***	-1.713***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)		-0.0328***	-0.00878***	-0.00164***	-0.00104***	-5.791***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Information, Comm. &Transport Sector						
FE	0.385	-0.459*	0.0485*	-0.0197	-0.00458	6.793
	(0.218)	(0.028)	(0.033)	(0.124)	(0.692)	(0.207)
Q(0.10)		-0.302***	0.00267***	0.00100*	-0.0120***	12.81***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		-0.452***	0.0144***	0.00186***	-0.0161***	11.56***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.623***	0.0209***	0.000878***	-0.00247***	1.278***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.286***	0.0453***	-0.00495***	0.0107***	-3.230***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)		0.303***	0.00276***	-0.00414***	-0.00175***	-12.11***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other Service Activities Sector						
FE	0.904*	-0.0349	-0.0317	-0.0643**	0.0123	-3.246
	(0.027)	(0.868)	(0.138)	(0.003)	(0.551)	(0.314)
Q(0.10)		0.0738***	0.000217	-0.00454***	0.00555***	-1.138***
		(0.000)	(0.806)	(0.000)	(0.000)	(0.001)
Q(0.25)		0.138***	-0.0110***	-0.0115***	0.00574***	-2.203***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.113***	-0.00158	-0.0272***	-0.0304***	-4.069***
		(0.000)	(0.523)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.0514***	-0.0127***	-0.00439***	-0.00836***	-5.677***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)		-0.818*	-0.0751***	0.0526**	0.0937**	-1.95
		(0.013)	(0.000)	(0.004)	(0.007)	(0.545)
Paper & Paperboard Products Sector						
FE	0.321	-0.198	0.0151	-0.0189	0.00382	4.023
	(0.556)	(0.403)	(0.632)	(0.536)	(0.904)	(0.4190
Q(0.10)		0.0350***	0.0250***	-0.00217***	0.0123***	3.595***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		0.0175***	0.0172***	-0.00249***	0.00513***	1.831***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.190***	-0.000393	-0.00454***	-0.0180***	7.430***
		(0.000)	(0.665)	(0.000)	(0.000)	(0.000)
Q(0.75)		0.0361***	-0.0541***	0.00401***	-0.0148***	1.038*
		(0.000)	(0.000)	(0.000)	(0.000)	(0.027)
Q(0.90)		0.0557**	-0.0589***	-0.00243	0.0194*	5.236***
		(0.007)	(0.000)	(0.269)	(0.010)	(0.000)

Petroleum Sector						
FE	-1.023**	-0.0719	-0.0254	0.0181	-0.0160*	0.4786**
	(0.003)	(0.633)	(0.298)	(0.203)	(0.049)	(0.002)
Q(0.10)		0.00904	0.000552	-0.000163	-0.000319	0.86.16***
		(0.082)	(0.333)	(0.467)	(0.187)	(0.000)
Q(0.25)		0.00107***	-0.000021***	-0.000346***	0.00000533*	2.743***
		(0.000)	(0.000)	(0.000)	(0.044)	(0.000)
Q(0.50)		-0.0389***	-0.00760***	0.00680***	-0.00412***	1.0060***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.000354	0.000106***	0.000475***	-0.00000088	4.793***
		(0.115)	(0.000)	(0.000)	(0.927)	(0.000)
Q(0.90)		-0.0561**	0.00878*	-0.00668*	0.000671	5.204***
		(0.007)	(0.012)	(0.026)	(0.348)	(0.000)
Sugar Sector						
FE	0.178	-0.0499	-0.000858	0.000285	-0.014	0.345
	(0.126)	(0.375)	(0.899)	(0.964)	(0.056)	(0.715)
Q(0.10)		0.0489***	0.00226***	-0.00449***	-0.00395***	0.725***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		-0.00235*	0.00564***	-0.00334***	-0.000422***	4.207***
		(0.010)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.0348***	-0.00362***	-0.000424***	-0.00464***	1.218***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.0999***	0.00104***	0.000369*	-0.00799***	-1.330***
		(0.000)	(0.001)	(0.013)	(0.000)	(0.000)
Q(0.90)		-0.0367***	-0.00454***	-0.00165***	-0.00351***	-4.753***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Textile Overall Sector						
FE	0.133	-0.0291	0.00195	-0.00779	-0.0161**	-2.647***
	(0.132)	(0.522)	(0.662)	(0.134)	(0.008)	(0.000)
Q(0.10)		-0.0219***	0.00725***	0.00136***	0.000487***	-0.099***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)		0.00516***	0.00338***	-0.00253***	0.000336***	-1.418***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)		-0.000334	0.00321***	-0.00544***	-0.00227***	-1.409***
		(0.682)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)		-0.0843***	0.00355***	-0.0109***	-0.0101***	-7.520***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.00662***	0.00119***	-0.00142***	-0.00554***	-3.054***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Source: Author's Calculations

p-values given in parentheses. *p<0.05, ** p<0.01, *** p<0.001

Information sector results reveal significant negative impact of TVOL on sectoral returns at all quantiles except 0.10 quantile where results are insignificant. Fuel and energy sector indicate positive trend of sectoral returns in response with TVOL at lower and upper quantiles while it shows negative influence with TVOL at middle quantile of 0.50. Other service activities and paper, paperboard product sector proved negative significant impact of TVOL at upper quantiles and positive linkages are shown at lower and middle quantiles. Petroleum sector indicates negative causal effects of TVOL on sectoral returns with higher absolute value of coefficients at lower quantiles and lower absolute values of estimates at upper quantiles. These results are also consistent with the FE model estimates with negative significant coefficients of TVOL. Sugar sector estimates indicate positive linkages of TVOL with sectoral TVOL with sectoral returns. Textile sector results show significant negative impact of TVOL on sectoral returns at 0.25 and 0.50 quantiles rest of other quantiles present positive association of TVOL with sectoral returns. Mixed of significant positive and negative results of TVOL at various quantiles, confirmed that total volatility has significant nonlinear impact on sectoral returns.

Diffusive risk (DIFFRISK) estimates of information and petroleum sector are significantly positive at all quantiles which means that diffusive volatility increase lead to the increase in sectoral returns of the concerned sector. Fixed effects model results are also consistent with quantile regression results of these sectors. Food and sugar sector results show significant positive coefficients of DIFFRISK at lower and middle quantiles. Both of these sectors are indicating significant negative causal linkages of DIFFRISK with sectoral stock returns. The trends of coefficient results are leading to nonlinear trend of sectoral returns in response with DIFFRISK. Fuel and energy sector show different results than those of other sectors with negative coefficients of DIFFRISK at 0.25, 0.50 and 0.75 quantiles while, positive significant coefficients are shown at 0.10 and 0.90 quantiles.

These results also confirmed nonlinear impact of DIFFRISK on sectoral stock returns of fuel and energy sector.

Paper products and textile sectors results confirmed the positive significant impact of diffusive volatility on sectoral returns at 0.25, 0.50 and 0.90 quantiles. 0.10 quantile estimates show significant negative coefficient for textile sector but paper products sector is showing insignificant results. Other service sector results proved positive impact of diffusive volatility on sectoral returns at lower and upper quantiles and negative association of DIFFRISK with sectoral returns at middle quantiles. All of these results confirmed significant nonlinear impact of diffusive risk on sectoral returns. Jump risk (JUMPR) is a proxy of jump component of stock return volatility. Panel quantile regression results predicted coefficients of jump risk in relationship with different sectoral returns. Food products, information and petroleum sector show significant positive causal relationship between sectoral returns and jump risk. It means these three sectors are not risky in terms of responding jumps and sharp significant changes in stock market returns. On the other hand, fuel & energy and other service activities results confirmed positive significant impact of JUMPR on sectoral returns at 0.25, 0.50 and 0.75 quantiles. These results are showing significant negative coefficients of JUMPR indicating negative influences on sectoral return on the given quantiles.

Table 5

Panel Quantile Regression Estimates of Sectoral Returns & Firm Characteristics

	LAR	CFPS	EPS	TDTC	GDP
			Food Products Sector		
FE	0.198	0.011	0.00155	-0.0282	0.992
	(0.187)	(0.141)	(0.227)	(0.533)	(0.087)
Q(0.10)	0.0102***	0.000406***	-0.00005***	0.00228***	0.122***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	0.0586***	0.00405***	0.000210***	0.0283***	1.503***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.0235***	0.00901***	-0.000698***	0.000678*	1.680***
	(0.000)	(0.000)	(0.000)	(0.037)	(0.000)
Q(0.75)	-0.0514***	0.00512***	0.00158***	-0.0136***	0.776***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.197***	-0.000355***	0.000142***	0.0136***	-3.717***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
			Fuel & Energy Sector		
FE	0.0284	0.0135*	0.00056	0.0585	1.116**

	(0.796)	(0.028)	(0.656)	(0.072)	(0.002)
Q(0.10)	-0.0351***	0.000492***	0.000128***	-0.00232***	2.700***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.119***	0.00586***	0.000199***	0.00598***	2.289***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.0295***	0.00149***	0.000313***	0.00314***	0.910***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.0280***	0.00229***	-0.0000119	0.00405***	0.443***
	(0.000)	(0.000)	(0.486)	(0.000)	(0.000)
Q(0.90)	-0.0226***	0.00161***	0.0000992***	0.00374***	-2.300***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Information, Comm. &Transport Sector					
FE	0.0276	-0.0164	0.00151	-0.0626	2.169***
	(0.893)	(0.252)	(0.438)	(0.109)	(0.001)
Q(0.10)	-0.0665***	-0.00820***	0.00131***	0.00501***	2.177***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.174***	-0.00870***	0.00105***	-0.0236***	2.833***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.0935***	-0.0142***	0.000741***	-0.0223***	1.343***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.283***	-0.0231***	0.00134***	-0.0100***	1.263***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.136***	-0.0142***	0.000848***	-0.00164***	-0.213***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other Service Activities Sector					
FE	0.157	0.0362	0.00214	0.131	4.741***
	(0.530)	(0.073)	(0.301)	(0.238)	(0.000)
Q(0.10)	-0.0438	0.00384***	-0.000380**	0.00239	4.261***
	(0.077)	(0.000)	(0.001)	(0.253)	(0.000)
Q(0.25)	-0.0822***	0.0000718	0.00193***	-0.0116***	3.955***
	(0.000)	(0.823)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.150***	0.0196***	0.00462***	0.0957***	2.569***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.105***	-0.00243***	0.00121***	0.0180***	2.199***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.875**	0.0233	-0.00767**	-0.161***	0.684**
	(0.002)	(0.089)	(0.006)	(0.000)	(0.004)
Paper & Paperboard Products Sector					
FE	0.23	0.0153	-0.00072	-0.025	2.061
	(0.355)	(0.273)	(0.273)	(0.782)	(0.051)
Q(0.10)	0.00949***	-0.00512***	0.000124*	-0.0146***	2.967***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	0.0148***	-0.000292***	-0.000300***	-0.0201***	2.978***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.0174***	0.00855***	-0.0000595***	-0.0291***	1.889***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.0421***	0.00578***	-0.000387***	0.0245***	-0.284***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.201***	-0.00845*	0.000512	-0.00258	0.817***
	(0.000)	(0.028)	(0.336)	(0.458)	(0.000)

Petroleum Sector					
FE	-0.181	0.00253	-0.00121	-0.024	1.350**
	(0.116)	(0.481)	(0.083)	(0.678)	(0.004)
Q(0.10)	-0.00909	0.0000947	-0.0000378	-0.00204	3.167***
	(0.121)	(0.274)	(0.053)	(0.192)	(0.000)
Q(0.25)	-0.00030***	0.0000138***	-0.0000039***	2.57E-07	2.765***
	(0.000)	(0.000)	(0.000)	(0.993)	(0.000)
Q(0.50)	-0.0154***	0.00211***	-0.000304***	-0.00844***	0.101***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.000151	0.0000213***	-0.0000043***	0.000194***	1.719***
	(0.382)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.0301*	-0.0000719	0.000113	-0.0112**	1.623***
	(0.016)	(0.915)	(0.164)	(0.004)	(0.000)
Sugar Sector					
FE	-0.113	0.00956***	-0.000314	-0.0145	0.155
	(0.142)	(0.000)	(0.536)	(0.338)	(0.607)
Q(0.10)	0.0251***	0.00516***	0.000578***	-0.00125***	0.359***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	0.0404***	0.00436***	0.0000619***	-0.00387***	0.681***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.115***	0.00749***	-6.07E-06	-0.00545***	0.149***
	(0.000)	(0.000)	(0.688)	(0.000)	(0.000)
Q(0.75)	-0.0483***	0.00575***	-0.000334***	-0.0100***	0.0458***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.0255***	0.00187***	0.0000448***	-0.00369***	-0.362***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Textile Overall Sector					
FE	-0.210**	0.00859***	0.00236***	0.000002	0.478
	(0.007)	(0.001)	(0.000)	(0.894)	(0.056)
Q(0.10)	-0.0915***	0.000335***	0.000142***	0.00000522***	-0.489***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.0596***	0.00284***	0.000586***	-0.0000054***	0.811***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.0361***	0.00405***	0.000939***	0.00000127***	1.536***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	-0.178***	0.00752***	0.00248***	2.90E-08	-0.700***
	(0.000)	(0.000)	(0.000)	(0.958)	(0.000)
Q(0.90)	-0.0967***	-0.000775***	0.000452***	-0.0000448***	-4.875***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Source: Author's Calculations

p-values given in parentheses. *p<0.05, ** p<0.01, *** p<0.001

Paper products sector results reveal significant negative causal linkages of JUMPR with sectoral returns at 0.10, 0.25 and 0.50 quantiles. At the upper quantiles these results are positively associated. Sugar sector results confirmed the negative impact of jump risk on sectoral returns at middle and upper quantiles while, sectoral returns of sugar sector respond jump risk positively at lower quantiles of estimation. In comparison to these sectors, textile results proved that increase in jump risk lead to decrease in median value of sectoral returns at lower and 0.75 quantiles. However, at 0.50 and 0.90 quantiles textile sector results confirm positive linkages of jump risk and sectoral stock returns.

Skewness (SKEWN) results exhibit in table 6. The results of food products, information and petroleum sectors reveal that SKEWN has significant negative impact on sectoral returns at all quantiles. Information and petroleum sector show intensified negative coefficients at lower quantiles and lower absolute value of coefficients at middle and upper quantiles. The results of fuel & energy sector and paper products sector also confirmed the significant negative impact of SKEWN on sectoral returns at all quantiles except 0.90 quantile of fuel & energy sector and 0.50 quantile of paper products sector which show significant positive results. Other service activities sector results prove significant negative linkages of SKEWN with respective sectoral stock returns at lower and upper quantiles of 0.10, 0.25 and 0.90. Similarly, sugar sector estimations reveal significant negative association of SKEWN with sectoral returns at lower (0.10, 0.25) and middle (0.50) quantiles. Panel quantile regression estimates of textile sector proved significant negative of SKEWN on sectoral returns at middle and upper quantiles. Lower quantiles results confirm the positive association of SKEWN with sectoral returns. These results reveal nonlinear impact of return asymmetry on sectoral stock returns with significant coefficients.

In the concern of other variables with consistent significant results of FE model, SIZE has significant negative nonlinear impact on sectoral stock returns of food products and other service activities. Petroleum sector sectoral returns show significant linkages with MVBV with negative coefficients while, ILLIQ and GDP have significant positive impact on sectoral returns. It means higher the market value to book value of the firm of petroleum sector would lead to lose huge share of sectoral returns. Higher values of ILLIQ indicate the higher restrictions on shares liquidity which lead to increased demands of petroleum sector’s shares and then ultimately have significant influence on improved positive stock returns. GDP growth show positive significant impact on fuel & energy, information, other service activities and petroleum sector. This positive impact reveals that improved or higher GDP growth influence sectoral returns positively. Cash flow per share (CFPS) exhibits significant positive coefficients for fuel & energy, sugar and textile sector. Effective management of cash flow has significant positive effects on sectoral returns. Textile sector show significant negative association of MVBV, ILLIQ and LAR with sectoral returns. Negative coefficients of ILLIQ means that increase in the stock liquidity restrictions lead to influence sectoral returns of textile sector negatively. Similarly, higher the liquid asset ratio may also have significant negative impact on sectoral returns.

Table 6

Panel Quantile Regression Estimates of Sectoral Returns Jump Diffusion Components

	TVOL	DIFFRISK	JUMPR	SKEWN
		Food Products Sector		
FE	0.000996	0.0000432	0.0991	-0.0328
	(0.795)	(0.476)	(0.253)	(0.207)
Q(0.10)	-0.0022***	0.0000989***	0.0436***	-0.0143***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.00535***	0.000178***	0.0703***	-0.0274***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.00099***	0.0000556***	0.162***	-0.0433***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.0000478	0.0000465***	0.350***	-0.0981***
	(0.823)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.00216***	-0.0000340***	0.110***	-0.0313***
	(0.000)	(0.000)	(0.000)	(0.000)
		Fuel & Energy Sector		
FE	0.00328	0.0000745	0.256***	-0.0886***
	(0.223)	(0.127)	(0.000)	(0.000)
Q(0.10)	0.0101***	-0.000057***	-0.0549***	-0.00357***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	0.00920***	0.0000543***	0.288***	-0.111***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.00231***	0.000272***	0.571***	-0.188***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.00115***	0.0000636***	0.275***	-0.0842***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.00433***	-0.0000640***	-0.0362***	0.00709***
	(0.000)	(0.000)	(0.000)	(0.000)
		Information, Comm. &Transport Sector		
FE	-0.00627	0.000237*	0.332**	-0.108**
	(0.236)	(0.011)	(0.006)	(0.003)
Q(0.10)	0.000556	0.000150***	0.549***	-0.170***
	(0.085)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.00489***	0.000254***	0.547***	-0.172***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.00969***	0.000270***	0.320***	-0.101***

	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	-0.0163***	0.000405***	0.367***	-0.115***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.00211***	0.0000354***	0.0460***	-0.0136***
	(0.000)	(0.000)	(0.000)	(0.000)
Other Service Activities Sector				
FE	-0.00024	0.0000375	-0.0816	0.0174
	(0.968)	(0.715)	(0.561)	(0.656)
Q(0.10)	-0.00401***	0.000127***	0.0553**	-0.0180***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	0.00183***	0.0000769***	-0.0147***	-0.00715***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.00559***	-0.000113***	-0.328***	0.0884***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.00226***	-0.0000564***	-0.0594***	0.0176***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.0230**	0.000377**	0.324*	-0.0708*
	(0.002)	(0.003)	(0.019)	(0.028)
Paper & Paperboard Products Sector				
FE	0.00255	0.0000646	0.0554	-0.0297
	(0.701)	(0.574)	(0.730)	(0.522)
Q(0.10)	0.00905***	0.00000331	-0.0296***	-0.0185***
	(0.000)	(0.186)	(0.000)	(0.000)
Q(0.25)	0.00766***	0.00000947***	-0.0486***	-0.0106***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.00455***	0.0000396***	-0.0801***	0.00611***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.00700***	-0.0000293***	0.209***	-0.0702***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.00269*	0.000132***	0.530***	-0.153***
	(0.045)	(0.000)	(0.000)	(0.000)
Petroleum Sector				
FE	-0.0137***	0.000531***	0.948***	-0.295***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.10)	-0.0317***	0.00116***	1.569***	-0.505***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.0139***	0.000613***	0.815***	-0.268***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.0138***	0.000435***	0.769***	-0.235***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	-0.0109***	0.000568***	1.106***	-0.352***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	-0.00936***	0.000525***	1.048***	-0.334***
	(0.000)	(0.000)	(0.000)	(0.000)
Sugar Sector				
FE	0.0023	-0.00000286	-0.0687*	0.011
	(0.187)	(0.919)	(0.030)	(0.235)
Q(0.10)	-0.00003***	0.0000393***	0.0220***	-0.0119***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.00138***	0.0000620***	0.00859***	-0.00807***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	0.00304***	0.0000290***	-0.00132*	-0.0125***
	(0.000)	(0.000)	(0.016)	(0.000)

Q(0.75)	-0.000314*	0.0000324***	-0.115***	0.0224***
	(0.012)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.00153***	-0.0000268***	-0.0860***	0.0200***
	(0.000)	(0.000)	(0.000)	(0.000)
Textile Overall Sector				
FE	0.00226	0.0000196	-0.0126	-0.00484
	(0.118)	(0.375)	(0.625)	(0.523)
Q(0.10)	0.00620***	-0.000058***	-0.0211***	0.000308***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.25)	-0.00019***	0.0000488***	-0.0226***	0.000949***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.50)	-0.00585***	0.000161***	0.00827***	-0.00512***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.75)	0.00452***	-0.0000058***	-0.0121***	-0.00600***
	(0.000)	(0.000)	(0.000)	(0.000)
Q(0.90)	0.000235***	0.0000218***	0.0319***	-0.0127***
	(0.000)	(0.000)	(0.000)	(0.000)

Source: Author's Calculations

p-values given in parentheses. *p<0.05, ** p<0.01, *** p<0.001

These negative results indicate that higher value of investment by the textile industry is engaged in other risky investments projects which could affect the investor confidence that ultimately lead to reduce in sectoral returns of textile sector. BETA i.e. systematic risk has significant positive influence on sectoral returns of information sector. It means that firms of information sector positively deal with the sectoral returns.

5 Conclusion

This research is aimed at identification of jump-diffusion components of volatility and realized jumps, then finds the impact of these components at aggregate stock market and sectoral stock returns. All of these aggregate market and sectoral stock returns showing mixed responses of positive and negative influences with the changes of jump risk. The major reason of these mixed results of each sector at various quantiles is to have mixed of strong and weaker financial position of the firms within the sector to deal with the jump risk and other volatility components of stock market returns. Positive results show strengths of the firms in terms of improving stock returns in response with jump risk but negative results indicate risk of the losing share of sectoral returns by the firms within the sector.

Other market and firm related factors also proved significant impact of SIZE, MVBV, ILLIQ, CFPS, EPS and GDP growth on sectoral returns.

In this regard, investors and managers may consider these firms related and market level factors along with realized jumps and jump diffusion components of stock return volatility in evaluation of portfolio of investment for better stock returns.

After having these concluded mixed and nonlinear results of jump diffusion phenomenon, realized jumps and sectoral stock returns, a clear policy is very difficult to make. However, on the basis of these results financial managers and investors can make diversified portfolio by choosing positively responded sectoral firms to realized jumps and jump-diffusion components of volatility in various conditions of market. Financial managers may also consider some other factors related to improved firm characteristics and market which will help them to make growth in their portfolios and investment returns.

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