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Stock Market Volatility and Macroeconomic Factor Volatility

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ABSTRACT

A stock market, which is established well and huge capital is trading over here, is providing a number of opportunities of saving and investing to its investors. The main objective behind the establishment of stock market is to make an easy process for savers and borrowers, as it takes savings from different groups and provide them a stand to change these savings into successful investments. A stock market plays its key role for the reallocation of funds in multiple sectors of an economy. It works as such a stand where many variables collectively move together to make the economy of any country well groomed. The macroeconomic factors have important concerns with stocks traded in the stock market and these factors make investors to choose the stock because investors are interested to know about the factors affecting the working of stock to manage their portfolios. Abrupt variations and unusual movements of macroeconomic variables cause the stock returns to fluctuate due to uncertainty of future gains.

Keywords: Stock market, macroeconomic factors, volatility.

INTRODUCTION

A stock market, which is established well and huge capital is trading over here, is providing a number of opportunities of saving and investing to its investors. The main objective behind the establishment of stock market is to make an easy process for savers and borrowers, as it takes savings from different groups and provide them a stand to change these savings into successful investments. A stock market plays its key role for the reallocation of funds in multiple sectors of an economy. It works as such a stand where many variables collectively move together to make the economy of any country well groomed. The macroeconomic factors have important concerns with stocks traded in the stock market and these factors make investors to choose the stock because investors are interested to know about the factors affecting the working of stock to manage their portfolios. Abrupt variations and unusual movements of macroeconomic variables cause the stock returns to fluctuate due to uncertainty of future gains.

Volatility is the risk or uncertainty to stock prices, which can either be measured by using the annualized standard deviation of daily changes in price of stock/ security (Chen, Dub, Li & Ouya, 2013). Volatility of stock price is a form of market efficiency (Hameed, 2006), which is the reaction to the incomplete information in the market (i.e. uncertainty). If prices of the stocks move up and down rapidly then there would be high volatility existing in the market. If there are almost no changes in prices then there exists low volatility. Prices of stock are highly volatile in Pakistani capital market. This unpredictability of returns makes the stock a more risky investment. As a result, investors demand higher return for the increased risk. Companies with high volatile stocks need grow profitably, showing a sudden increase in earnings and stock price over the time, or pay very high dividends. Some investors mistakenly believe that stock prices volatility is based on directional trend in the stock prices but actually volatility is amount of fluctuation in stock prices (Malkiel & Xu, 1999). Volatility in macroeconomic fundamentals is existing either in the form of unidirectional or bidirectional. This study has made substantial improvement on modeling the volatility which is changing with time. There is a better understanding of predicting volatility over the short periods of time with a time span of one day to one month.

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Basically this study is conducted to analyze the relationship among the uncertain behavior of stock market returns and of macroeconomic variables like inflation (INF), real interest rate (RIR), gross domestic production (GDP), money supply (M2) and industrial production growth rate (IP). These macroeconomic fundamentals are chosen through the extensive literature upon the variables and their relationship of dynamic nature with stock market returns. Fascinatingly, although the successive financial econometric volatility is so considerable but it remains silent on the relationships among the volatility of stock returns and its determinants. In particular, the relationship between stock market volatility and uncertainty of macroeconomic fundamentals stay unstudied most of the times; often the modeling and forecasting of capital market volatility is done in separation of volatility of macroeconomic fundamentals. Here the fundamental volatility is defined as the volatility of basic economic indicators.

Theoretical Background

Arbitrage Pricing Theory

There are different applications for financial equilibrium models and purpose of these applications by far and more is to predicting the systematic risk and capital cost. In earlier periods of investigation, capital asset pricing model was proposed and refined with time by Sharp (1964), Linter (1965) and Mossin (1966). This model was also known as one factor model as it suggested that stock returns are generated by one-factor model and this one factor is one which represents the market portfolio of all risky assets.

Dividend Discounted Model

Another model which explains the study is one of the evaluation methods, dividend discounted model. According to this model a security's values is the present value of expected cash flows on the security, discounted back at a rate that reflects the riskiness of relevant cash flows. This model forecasts that any expected or unexpected influx of new information regarding the macroeconomic fundamentals will have impact on stock returns through its impact on expected dividends, the discount rate or both. When it is known that anticipated cash flow and anticipated discount rate impact the stock returns, it should be reasonable to state that conditional variation of current stock returns will be a function variation of anticipated future cash flows and future discount rate, as well as the covariance between future cash flows (Liljeblom and Stenius, 1997;Morelli, 2002).

Problem Statement

Numerous studies have been conducted to forecast the volatility in asset returns and also to predict the volatility in macroeconomic fundamentals. Whereas only a few studies have been conducted to analyze the relationship among the volatility of asset returns and volatility of macroeconomic fundamentals although many studies exist which only elaborate the linkage between macroeconomic factors and stock returns. Furthermore, studies conducted in developed markets may not necessarily have any application in context of Pakistan. Because the financial market in Pakistan unlike developed markets is characterized by weak corporate governance and control and inadequate disclosure. It is documented that emerging markets of Asian countries have high information asymmetries and market inefficiencies such as less robust legal investor protection and disclosure systems (Tsai, Young & Hsu, 2011). Such like study have also been conducted on Indian capital market but no significant study exists in Pakistani context where market is highly volatile and variations among macroeconomic factors also exist.

Research objectives

To analyze the volatility in stock returns of Karachi stock exchange

To analyze the relationship among volatility in inflation and volatility in stock returns of Karachi stock exchange

To analyze the relationship among volatility in real interest rate and volatility in stock returns of Karachi stock exchange

To analyze the relationship among volatility in industrial production and volatility in stock returns of Karachi stock exchange

To analyze the relationship among volatility in exchange rate and volatility in stock returns of Karachi stock exchange

To analyze the relationship among volatility in money supply and volatility in stock returns of Karachi stock exchange

To analyze the theoretical linkage between volatility of macroeconomic fundamentals and volatility of stock return

Research Questions

Following are the research questions of the study;

Does there exist volatility in stock returns in Karachi stock exchange?

Does there exist relationship among volatility in inflation and volatility in stock returns in Karachi stock exchange?

Does there exist relationship among volatility in real interest rate and volatility in stock returns in Karachi stock exchange?

Does there exist relationship among volatility in industrial production and volatility in stock returns in Karachi stock exchange?

Does there exist relationship among volatility in exchange rate and volatility in stock returns in Karachi stock exchange?

Does there exist relationship among volatility in money supply and volatility in stock returns in Karachi stock exchange?

Does there exist theoretical linkage between volatility of macroeconomic fundamentals and volatility of stock return?

Significance of Study

The study on relationship of volatility of macroeconomic factors and stock returns contributes in literature empirically and contextually. Voluminous literature is available on the subject of volatility in different contexts. Studies have been conducted to analyze the volatility relationships by Liljeblom and Stenius (1997), Morelli (2002), Coetzee (2002), Chowdhury and Rahman (2004), Chinzara (2011), Kumari and Mahakud (2014) and in Pakistan this was conducted by Attari and Safdar (2013) who worked using the data from Karachi stock exchange. But it is the first attempt to explore the relationship of volatilities using vector auto regressive method in Pakistan. It is argued in this study that there exists a relationship among volatility of stock returns and volatility of macroeconomic fundamentals in developing market of Pakistan.

LITERATURE REVIEW

Many researchers have examined the relationship of stock market volatility and volatility of macroeconomic variables in different perspectives. It is argued that these studies have conducted in different economies and cultures. However, still there is no consensus about how volatility in macroeconomic variables influences stock market volatility.

Literature Review

Volatility is a process of change in behavior, value or investment over the time and cumulative persistence of that change to the next phase. An extensive work has been done upon volatility in different types such as modeling, measuring and forecasting the volatilities. Quite huge work has been done upon measuring and modeling the stock market volatilities. Year after year, finance literature is enriched with broad discussions about the volatility in markets which represents that emerging and emerged stock markets are responsive to macroeconomic updates and market players are likely to adhere with the significance of any declaration of changes in policy and economic figures.

The existing literature on macroeconomic uncertainty and stock market variability is of mixed nature. Initially the work upon stock market volatility has been done years ago; Officer (1973) evidently explained the relationship of stock market volatility with business cycle with uncertainty in industrial production. After that, Black (1976) explained the theoretical linkages for stock market volatility with financial leverage and explored that uncertainty of stock returns is linked with many of other variables not only with the financial leverages.

Christie (1982) examined the relationship between volatility in equity returns and many other descriptive variables and found that equity variances have a significant link with both financial and interest rate, unlikely to the options literature. To a relative degree it was explained the variance of equity moves in association with the variability of macroeconomic fundamentals.

Fraser and Power (1997) conducted a cross-country study to analyze the impact of news disbursement on stock market volatility. It was suggested that in Japan, Malaysia and UK conditions prevailing in the market reacted in similar way as price changes in the market. Future volatility is mostly inclined towards upward when the bearish trend is prevailing in the market. It is in favor to the view that there may be news in previous weekly returns from those markets which could be used to predict future volatility. Whereas analysis of Malaysia and Singapore equity data provides slightly different results, it supports evidence that information has greater influence on the volatility of Malaysian market than that of Singapore market. Their study concluded that information is one the major factors that have direct impact upon stock markets.

Bekaert and Harvey (1997) studied the market forces that cause capital market to fluctuate in different countries of varied economies. They found that markets which are fully integrated are affected by international macroeconomic fundamentals at several times and periods whereas markets which are segmented and operate at local levels are merely affected by local market forces. These market forces cause the variance in stock returns and a volatile condition is emerged. By analyzing the sources of variability in volatility separately; their study highlights how each capital market operated at local level is affected by world capital markets and how it influence changes with the passage of time.

Liljeblom and Stenius (1997) explained the relationship of stock market variability and variance in macroeconomic factors by analyzing te data for Finland from 1920-1991, by employing generalized auto regressive conditional heteroscedastic (GARCH) and vector auto regression (VAR) methods and it was found that there was a significant relationship between stock market

But Mitchell and Mulherin (1994) found significant and strong relationship of publically available information and activities being done in the stock market, it was reported that the existing relationship is as weak as reported in previous researches and therefore the difficulty of linking volume and volatility to calculated measures of information has been confirmed. But the economic situation also affect the predicting process; especially during the economic depression period it is difficult to predict stock return volatility using macroeconomic volatility, the magnitude of the fluctuations in combined stock volatility is hard to explain using simple models of stock valuation (Schwert, 1989). Kurz et., al (2004) present a study which gave a new integrated pattern accoding to which market expectations are the basic derivers of market volatility.

Errunza and Hogan (1998) explored the macroeconomic fundamentals affecting European capital market volatility. They studied whether variations in macroeconomic fundamentals can elaborate time variability of European stock market. They found that unlike the previous studies upon USA, in many cases, time variability of European stock market was found to be more significantly influenced by the previous variations in either monetary or real macroeconomic fundamentals. They proposed that approximations of capital market volatility are of significant importance for the decisions relating to capital budgeting and also for the elaboration of optimal portfolios. The of results of this presented that for many of capital markets in Europe, forecasting about return variations can be increased by including the information about the macroeconomic fundamentals. They found in this study that volatility in capital market fluctuates to economic variations with a 1 or 2 lag.

Bekaert and Harvey (2003) considered the movement of capital uncertainty and investment performance in emerged markets and impact of liberalization on exchange rate. They proposed paradoxical results that capital markets are less volatile in emerged economies than that of emerging economies. They also contradict with argument that foreign inflows enhance exchange rate fluctuations which ultimately has effect upon host country money depreciation. They also mentioned that capital market is also affected by price fluctuations and causes variance in return of securities. It a significant study that linked macroeconomic fundamentals with stock market movements and also explains its effect upon foreign portfolio volatility.

METHODOLOGY

Macroeconomic variables are interconnected. Change in one variable also affects others and these overall affect the economy of a country. These have impact over working of equity market. Their linkage is mostly short in nature and get volatile early. So analyze the volatility of macroeconomic factors and that of equity market GARCH model is used. After having the volatility values, their relationship is found through VAR model. In order to analyze the different dynamics of VAR system impulse response function and vector decomposition is also carried out.

Variables Description

This study uses daily data from 2000-2014 of Karachi stock index and macroeconomic variables. Stock indices are chosen from Karachi stock market and data of macroeconomic variables is taken from different data banks like as from World Bank, IMF and open doors for all. Data is chosen on daily basis because volatility is captured efficiently in short period rather than quarterly and annually in Pakistan.

In this study a comprehensive set of macroeconomic variables is used which have a deterministic role for returns in equity market. These variables are real interest rate, money supply M2, consumer price index as a measure of inflation, gross domestic production, and industrial production growth rate.

Industrial Production

Future cash flows and business capital structure of a corporate entity are directly related to the output growth rate of gross domestic production of a country as a whole or industrial production (Fama 1990; Ferson and Harvey 1998). Ross (1986). Industrial production growth is also used as a country specific factor by Mody, Taylor and Kim (2001), so this factor also affect on volatility of stock returns. Industrial production shows the overall economic activity and stock prices are affected by it. It is measured through industrial production index as it was in previous studies.

Real Interest Rate

Interest rate differential plays crucial role in fluctuation of returns of a market. Investors are interested to invest in those securities where high interest rate is offered than those where interest rate is low. This data is collected from WDI. The monthly real interest rate is calculated as: LN (RIRt/ RIRt-1) (Mushtaq et al., 2011). It is measured as RIR = NIR – Inflation

Inflation

The relationship between stock returns and inflation was theorized by Fisher (1930). Fisher suggested that it is hedging relationship as stock returns are hedged against inflation. When the price level rises up in general, market participants are given favor for rising price level by a relative increase in the nominal stock returns, whereas real returns remain unaffected. Fisher (1930) suggested that real stock returns should not be dependent of inflation. In contrast to this hypothesis, proxy suggested by Fama (1981) claimed a negative linkage among stock returns and inflation. It was critically explained by Fama that high inflation reduces the economic movement. In light of theoretical back ground and its affects inflation in this study is measured by consumer price index.

Money Supply M2

According to quantity theory of money, long term price level of economy is determined by the supply of money. If any change happens in supply of money then it creates relative change in the level of price either negatively or positively in the value of money through variation in the volatility of expected future cash flows and supply of credit by the monetary aggregates in the economy (Friedman and Schwartz 1970). So this study undertakes the broader level of money which can be easily liquefied, so M2 money supply is used.

Exchange Rate

To explain the theoretical relationship of exchange rate with stock returns there are two main approaches; one is flow oriented approach (Dornbush and Fisher 1980) and other is stock oriented approach (Branson 1983; Frankel 1983). The flow oriented approach asserts positive relationship among exchange rate and stock returns through the trade balance of a country. It supposes that international competitiveness and trade balance of a country are affected by exchange rates and ultimately it influences the income and output. When depreciation in currency of home country occurs, it generates opportunities for local firms as their products become cheaper in international market.

EMPIRICAL RESULTS AND DISCUSSION

Table1. *Descriptive Data*

	RI	M2	RCPI	REXP	RIGP	RRIR
Mean	0.00078	0.0096	0.0055	0.0027	0.0611	0.0124
Median	0.00094	0.0030	0.0070	0.0007	0.0211	0.0090
Maximum	0.0044	0.0593	0.0350	0.0054	0.6389	0.0965

Minimum	-0.0038	-0.0726	-0.0297	-0.0144	-0.7803	-0.0631
Std. Dev.	0.0025	0.0418	0.0174	0.0058	0.4056	0.0474
Skewness	0.3246	0.1144	-0.4461	-0.6016	-0.0605	0.1970
Kurtosis	2.0935	1.8979	2.9898	2.4917	2.4545	2.3672
Observations	3892	3892	3892	3892	3892	3892

Table 1 exhibits the statistical behavior of the data for the period of 2000-2014. The mean is range from 0.00078 of index returns to 0.0611 of industrial growth production. Standard deviation which is the measure of dispersion or deviation from mean is range from 0.0025 of index returns to 0.4056 industrial growth productions. Skewness indicates that most of the values are positively skewed whereas CPI, EXP and IGP are negatively skewed. In case of Kurtosis, if the value is equal to 3 then normal distribution and pattern is called mesokurtic. If the value is > 3 then pattern is called leptokurtic that are associated with simultaneously peaked and fat tail. But when value of kurtosis is less than 3 it is called platykurtic and is associated with simultaneously less peaked and have thinner tail. All the values in the table are showing the platykurtic behavior that is less that 3 with the maximum value of 2.9898 and minimum value of 1.8979. Furthermore, kurtosis shows that the data is flat and have thinner tail.

Table2. *Correlation Matrix*

	RI	RCPI	REXP	M2	RIGP	RRIR
RI	1.0000					
RCPI	0.0509	1.0000				
REXP	0.1145	-0.1117	1.0000			
M2	0.0151	0.1160	-0.1120	1.0000		
RIGP	0.0085	0.0502	-0.0220	-0.0333	1.0000	
RRIR	-0.0778	0.0247	-0.2455	0.2793	-0.0011	1.0000

Table 2 presents results of correlation analysis. Result indicates that volatility all macroeconomic variables are positively correlated with volatility of stock returns whereas volatility of real interest is negatively correlated with stock returns. Results are consistent with previous studies of Morelli (2002), Chinzara (2011) and Kumari and Mahakud (2014).

Table3. *Unit Root Test*

Variable	t-stat	p-value	Decision
M2	7.01251	0.000	I(0)
CPI	10.3906	0.000	I(0)
EXP	5.32571	00.000	I(0)
Index return	9.00551	00.000	I(0)
IGP	10.6379	00.000	I(0)
RIR	3.08405	0.0279	I(0)

In time series analysis stationary or non-stationary procedure is carried out to observe the integration level of the factors under observation. In the present study data set the Augmented Dickey Fuller (ADF) test is carried out. Above given table shows that all six variables are stationary at level with constant so linear trend, i.e. *I (0)* is existing here. It shows that the variables are having constant mean, variance and covariance and results are significant now. So it shows that all effects of the shocks are eradicated and now these are helpful in making an accurate decision for the future forecasting.

Table4. *Testing of ARCH effect*

Mean Equation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Index return(-1)	0.9590	0.0046	210.3969	0.0000
M2(-1)	0.9969	0.0013	772.0328	0.0000
CPI(-1)	0.9954	0.0016	626.5551	0.0000
EXP(-1)	0.9986	0.0009	1110.8010	0.0000
IGP(-1)	0.9964	0.0014	731.9030	0.0000
RIR(-1)	0.9994	0.0003	3093.7400	0.0000

Table5. *Variance Equation*

Variance Equation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Index return	0.4156	0.1051	25.4696	0.0000
M2	0.6621	0.0120	55.2304	0.0000

CPI	0.4072	0.0146	27.8698	0.0000
EXP	0.5993	0.0128	46.7951	0.0000
IGP	0.6227	0.0125	49.7555	0.0000
RIR	0.8904	0.0073	122.2878	0.0000

From above given both tables (4, 5) it is inferred that there exists auto regression and heteroskedasticity in the series. So it is evident from these results that ARCH family can be use to forecast volatility in the data.

CONCLUSION AND RECOMMENDATIONS

From above given discussion it is inferred that different macroeconomic fundamentals have different behavior and nature of relationship also differs from factor to factor. As arbitrage pricing theory mention that multiple factors are there to determine the stock returns and influence the movement of stock indices, it is find out how variations in different macroeconomic fundamentals affect the movement of stock indices and stock returns. This study analyzed the influence of volatility in macroeconomic factors upon volatility of stock market volatility and also showed the direction of relationship. This study is based upon different GARCH models and also vector auto regressive models. To analyze the GARCH models a dummy was also used to check the influence of abrupt happing in economy. This dummy was ranging from 2008 to 2013 encompassing the Zardari government era and results showed that volatility in stock market and in macroeconomic variables was different in this period as it was low from other periods. Results show the existence of relationship among the volatility of stock market and volatility of macroeconomic factors analyzed through vector auto regressive models. It is shown in the results that volatility of some macroeconomic factors has relationship with variations in stock returns. Some macroeconomic factors has deterministic role for future returns in stock market but some have not. Money supply have no direct effect with movements in stock market as it is also suggested in previous studies and analyzed in this study also. It is a settlement adjusted through central bank of any state so it does not have relationship with movement of stock indices. Similarly volatility in real interest rate does not have relationship with volatility in stock returns at any lag in vector auto regression model. But volatility in inflation measured through consumer price index proves to have significant relationship with volatility of stock returns. It shows that happening of any fluctuation in inflation also affects the movement of stock index and consequently it influence the variations of stock returns. Exports have significant relationship at some level with variations of stock indices and influence the stock returns. Exports increase the flow of money inward and improve the efficiency of central bank and consequently increase the business level in the state. So theoretically it does have relationship with movement of stock indices also. Industrial growth production measured through industrial production index also has relationship with variations in stock returns. So from this study it is inferred that volatility in different macroeconomic fundamentals exists and some of them also relationship with variations of stock returns.

This study is covering the span of fourteen years for Karachi stock market and five macroeconomic fundamentals only. It is a vast area for future research as there are many other macroeconomic variables which may be analyzed with a huge span of time to understand the nature of relationship among volatility of macroeconomic fundamentals with volatility of stock returns. There three stock exchanges in Pakistan so this study may be conducted while using stock returns from any other stock exchange other than Karachi stock exchange or it is also possible to analyze all these three stock exchanges at a time with different macroeconomic variables.

As mentioned above due to time constraint sample size is limited, it is a limited study consisted of only fourteen years data from Karachi stock exchange and from some macroeconomic variables. This study is only limited to one stock exchange but it may be extended to more ones. This study has undertaken only a few statistical techniques to analyze the data but many others may also used to more refine the results of study.

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