Rashid, Abdul; Rauf, Rashid; Imran, Muhammad

Article

Do macroeconomic volatilities affect stock price volatility in Pakistan? : an empirical assessment using firm-level data

Pakistan journal of applied economics

Provided in Cooperation with:
ZBW OAS

Reference: Rashid, Abdul/Rauf, Rashid et. al. (2022). Do macroeconomic volatilities affect stock price volatility in Pakistan? : an empirical assessment using firm-level data. In: Pakistan journal of applied economics 32 (2), S. 145 - 168.
http://www.aerc.edu.pk/wp-content/uploads/2023/01/Paper-990-RASHID-ALI-III-1.pdf.

This Version is available at:
http://hdl.handle.net/11159/652868

Pakistan Journal of Applied Economics, Vol.32 No.2, (145-168), Winter 2022

DO MACROECONOMIC VOLATILITIES AFFECT STOCK PRICE VOLATILITY IN PAKISTAN? AN EMPIRICAL ASSESSMENT USING FIRM-LEVEL DATA

Abdul RASHID*, Rashid RAUF and Muhammad IMRAN*****

Abstract

This study empirically explores the influence of macroeconomic volatilities, such as oil-price volatility, real effective exchange rate volatility and manufacturing output volatility, on stock-price volatility by using annual firm-level unbalanced panel data over the period 1988-2017. The empirical results indicate that the impact of macroeconomic volatilities on stock-price volatility is positive. Firm age and cash holdings significantly positively impact stock-price volatility. In addition, an index is constructed based on the macroeconomic volatilities using principal component analysis. The macroeconomic volatility index also has a positive effect on stock-price volatility. Finally, the results reveal that the impact of macroeconomic volatility on stock price volatility has a positive effect in the pre-and post-2007 Global Financial Crisis period. However, the influence is stronger during the pre-crisis period.

Keywords: Stock Prices, Oil Prices, Exchange Rates, Volatility, Global Financial Crisis.
JEL Classification: C23, D22, D80, F62, G01, Q43.

I. Introduction

The growing importance of the relationship between macroeconomics and stock-price volatility has recently opened a new debate among practitioners, policymakers, and scholars. In principle, macroeconomic volatility significantly impacts the growth and stabilisation of an economy [Qiang, et al., (2019)]. Financial crises cause sharp fluctuations in the financial and real sectors in both developed and emerging economies [Sui and Sun (2016)]. Particularly in emerging economies, market capitalisation and equity returns increased recently. On the other hand, in these economies, macroeconomic conditions have recently improved [Wang and Guo (2020)].

* Professor, **Lecturer, ***Research Scholar, International Institute of Islamic Economics, International Islamic University, Islamabad, Pakistan.

Further, during the financial crisis periods,[1] several economies across the globe faced turmoil in financial markets [Chkili and Nguyen (2014) and Muhammad and Rasheed (2002)]. Investigating the impact of macro-level volatilities on stock-price volatility is imperative for academicians and policymakers to design appropriate and effective policy frameworks. The main research question in this study is whether, when, and how unexpected macroeconomic conditions influence stock price volatility in Pakistan.

The arbitrage pricing theory provides a sound theoretical foundation to determine the stock price and volatility determined in stock prices. The theory predicts that both micro and macro level factors are the determination of stock prices. On the contrary, the dividend discount model predicts stock prices by discounting expected dividends, which are affected by expected macroeconomic conditions.

In principle, fluctuations in international oil prices affect oil-importing countries via many channels. These channels include the real balance, the allocative, and the income transfer channel [Fang and You (2014)]. In this context, Hamilton (1983) highlighted that a sharp surge in oil prices was the major factor for most of the US recessions after the Second World War. Major oil price shocks that occurred in 1973 were not only responsible for recessions occurring but also deepened the recession [Burbidge and Harrison (1984)]. In addition, oil-exporting (importing) economies are positively (adversely) affected by higher (lower) oil prices. Further, differences in the industrial structure of a country are also responsible for influencing stock prices.

Fang and You (2014) pointed out that a surge in oil prices inevitably leads to lower stock prices. However, conventional wisdom suggests that an emerging economy like Pakistan faces prompt urbanisation and infrastructure development. Due to this, the economy faces a gradual and persistent surge in oil demand. The negative oil price shocks, particularly driven by supply shocks, are harmful to stock returns because they result in an uncertain future. In contrast, the oil price shocks driven by expansion in the global economies may positively affect global stock returns [Moore and Wang (2014)].

The theoretical underpinning of the association between the exchange rate (ER) and stock prices is discussed in two different strands of literature. The first strand consists of the 'flow-oriented' ER model, whereas the second strand originated from the 'portfolio balance approach'. In principle, the linkages between financial markets and the real sector economy are of paramount importance. The traditional flow-oriented approach of ER is based on goods markets, which asserts that the real ER affects the export competitiveness of an economy and the trade balance position, which, in turn, affects the output and hence, it affects stock prices in an economy [Dornbusch and Fischer (1980)]. An alternative view is provided by the portfolio balance approach on the association of ER and stock prices posits that advancements in the stock market

[1] The East Asian Crisis (1997-98) and the Global Financial Crisis (2007).

will affect ER through a country's capital account [Branson (1981)]. The demand for money affects the performance of stock markets, followed by interest rate fluctuations, which results in ER movements. Muhammad and Rasheed (2002) argued that the probability of occurring financial crisis might be minimised by designing policies and hedging strategies based on the relationship between exchange rates and stock prices.

Similarly, we cannot ignore the impact of manufacturing output on stock prices. Higher manufacturing output levels will result in higher incomes and, ultimately, higher stock prices in the country. The empirical examination of the influence of output shocks on stock prices would be useful for stock-market participants as they may decide on future investments by considering manufacturing output volatility in the economy. Researchers and policymakers are always curious to know the channel through which manufacturing output asserts its impacts on the stock price. The expected cash flows and interest rates are considered very important channels with respect to the output effects on stock price [Campbell and Shiller (1988)].

The effect of macroeconomic volatilities on stock-price volatility is still a subject of intense debate. Equity markets of emerging markets are more volatile in nature [Farooq, et al., (2004)]. The pertinent literature has theoretically and empirically established the association between several macroeconomic variables, such as ER, oil price, manufacturing output, and stock price. However, the extant literature on the association between macro-level volatilities and stock-price volatility remained silent, particularly in the case of Pakistan. Therefore, this study aims to bridge the gap in the existing literature by investigating the impact of macroeconomic volatilities, namely oil-price, real effective exchange rate and manufacturing output, on stock-price volatility. Further, this study also compares the impact of macroeconomic volatility on stock-price volatility in both the pre and post-crisis periods of the 2007 GFC.

The empirical analysis uses firm-level data for a large sample of 412 firms listed at the Pakistan Stock Exchange (PSX) over the period of 1988 to 2017. The study in hand significantly differs from the previous empirical literature in several dimensions. First, it uses a firm-level panel dataset, whereas most prior studies have utilised time series aggregated data. The use of firm-level panel data yields more robust and unbiased estimates of the effects of macroeconomic volatility on stock-price volatility. Second, three different types of macroeconomic volatilities (oil price, real effective exchange rate, and manufacturing output) are considered proxies for macroeconomic volatility using GARCH models. The annual average of the monthly series of conditional variance is obtained to match the firm-level annual data. Third, a composite volatility index is constructed using the principal component analysis (PCA) along with the effects of each underlying type of macroeconomic volatility. Finally, the impact of macro-level volatilities on stock-price volatility is examined after and before the 2007 GFC.

Our empirical findings show that the impacts of all types of macroeconomic volatilities on stock-prices volatility are positive and highly significant. This finding suggests that the stock price becomes more volatile during periods when macroeconomic conditions are vulnerable. The results indicate the stock prices of mature firms and firms holding more cash are more volatile. These variations may be attributed to the frequent trading of stocks of firms as investors consider that the stocks of such firms are more liquid and tradable. Finally, this study report that the impact of macroeconomic volatility on stock-price volatility has considerably decreased after the 2007 GFC.

The study proceeds in the following way: Section II consists of a review of relevant literature; Section III consists of data and an empirical framework. Section IV presents the results and discussions, and finally, Section V presents the conclusion and policy recommendations.

II. Literature Review

The empirical literature analyses the impact of oil price changes on the stock price. Subsequently, the section highlights the impact of volatility on stock price, followed by a relatively less explored impact of change in manufacturing output on stock prices and volatilities. The theoretical and empirical literature also highlights various channels for the impact of various macroeconomic volatilities on firm-specific volatility.

Oil-price volatility is a driver of real economic vulnerabilities [Yasmin (2020)]. Oil is an essential energy source; theoretically, fluctuations in the oil price are considered a vital factor in understanding the variations in stock prices [Koh (2015)]. Association between oil price and stock price can be explained through several channels. The increase directly influences stock prices in oil prices because it results in a decline in future cash flows and dividends of firms. Stock prices are also indirectly affected by oil prices because investors consider the increased oil price as an inflationary phenomenon, which may lead to an increase in discount rates.

Furthermore, manufacturing firms mostly rely on oil for production purposes; it is considered a major input in the production process. In the presence of imperfect substitution between the factors of production, any increase in oil price will result in higher costs of doing business, resulting in a decline in profits. Moreover, if the management decides to pass on the rise in the oil price to end users, it may affect firm sales and profitability. Several researchers documented the significant influence of oil prices on the stock price based on this argument [Basher, et al., (2012) and Yun and Yoon (2019)]. Nevertheless, the main focus of these studies is to explore the effect of oil price changes on stock price rather than on the influence of oil-price volatility on stock-price volatility. Therefore, the prevailing literature on the link between oil-price volatility and stock-price volatility is minimal.

The finding of the existing literature examining the impact of ER on stock price is conflicting. Caporale, et al., (2014), Inci and Lee (2014), Lin (2012), Mitra (2017), and Sui and Sun (2016) find a positive relationship between ER volatility and stock price. The studies of Bahmani-Oskooee and Saha (2016), Tsai (2012), and Wong (2017), the second strand of literature, report the adverse impact of ER on stock price and stock returns. The studies of Alagidede, et al., (2011), and Pan, et al., (2007) find mixed results. However, the existing empirical studies on the association between ER volatility and stock price suffer several shortcomings. Most researchers used co-integration techniques that did not consider the instantaneous links. Most previous studies do not consider any possible structural break in the data that may influence the relationship between the underlying variables.

The earlier research on exploring the association between manufacturing output and stock price volatility is mainly focused on how the level of economic growth and its volatility explain stock price or variation in stock prices [McMillan and Kumar Tiwari (2016), Rashid (2008), Tiwari, et al., (2018)]. McMillan and Kumar Tiwari (2016) analysed the time-varying connection between industrial output and stock prices using time series data for 200 years. They concluded that most fluctuations in stock prices are determined by industrial output and their results are in line with McMillan and Wohar (2012).

In Pakistan, there is limited research on the interaction of macroeconomics and stock-price volatility. However, the limited existing literature highlights the influence of macroeconomic variables, for example, exchange rates, interest rates, prices, output and oil prices on stock prices. The findings of these studies are mixed. Ahmad, et al., (2010), Bagh, et al., (2017), and Siddiqui and Nabeel (2013) found a positive association between ER and stock prices. On the other hand, several other studies Jawaid and Haq (2012), Mushtaq, et al., (2012), and Sarwar, et al., (2014) reported a negative association between ER and stock price volatilities. However, Muhammad and Rasheed (2002) and Zia and Rahman (2011) concluded that a significant association between ER and stock price did not exist.

The existing studies also explored the impact of oil price change on stock prices and found mixed findings. Sarwar, et al., (2014) and Siddiqui and Nabeel (2013) found positive, whereas Fatima and Bashir (2014) reported a negative impact of oil stock prices. Khan and Ali (2015) and Qayyum and Kemal (2007) found real effective exchange rate volatility affects stock-price volatility significantly. Similarly, Ahmad, et al., (2010) and Jawaid and Haq (2012) found a significant impact of macroeconomic volatility on stock-price volatility. There is a strong association between real effective exchange rate volatility and stock price.

Although the studies provided some evidence regarding the role of different macroeconomic variables and their volatilities in determining the variation in stock price, they left several gaps in the literature. These studies have utilised aggregated data on the stock price. These studies have focused on one type of macroeconomic volatility, ER or interest rates. However, to get an in-depth understanding, it would be worthwhile to examine the interconnection between macroeconomic volatility and stock price volatility in a multivariate framework.

The existing literature applied co-integration and Granger causality methods while examining the interconnections between macroeconomic variables and stock prices. One disadvantage of such methodology is that these empirical techniques fail to provide evidence on the nature of the relationship (positive or negative). Thus, the study examines the influence of macroeconomic volatilities on stock-price volatility by utilising a firm-level panel dataset and applying panel estimation methods, namely the fixed effects estimator.

The interlinkages between macroeconomic volatilities and firm-specific volatilities are open for debate. A review of prior literature highlights mixed results regarding the influence of macroeconomic volatilities on firm-specific volatility. Furthermore, to argue that the relationship between macroeconomic volatilities and stock-price volatility is less known, particularly in the case of emerging economies. Therefore, the study not only complements the existing relevant literature but also offers new empirical insights into the underlying issue of the emerging economy of Pakistan. The study contributes to the literature in many ways. First, investigate the influence of macroeconomic volatilities on stock-price volatility. Second, this study explores the role of the 2007 GFC in establishing the impact of macro-level volatilities on stock-price volatility.

III. Data and Empirical Framework

1. Data and Sample

The data used in this study is extracted from the Pakistan Bureau of Statistics (PBS), the International Financial Statistics (IFS), the World Bank, and the State Bank of Pakistan (SBP). The macroeconomic variables are taken from PBS and IFS. Firm-level variables such as firm size, age, cash, tangibility, and leverage are taken from the 'Financial Statements Analysis of Companies Listed at Pakistan Stock Exchange' published by the SBP. Using a large firm-level dataset comprising a panel of 412 listed manufacturing firms for 30 years (1988-2017). Pakistan stock market provides an ideal setting to empirically test our hypotheses and bridge the main gaps in the existing literature.

2. Measuring Macroeconomic Volatility

The existing literature identifies different methods to quantify the macroeconomic volatility; for example, it is obtained by utilising standard 'Autoregressive Conditional Heteroscedasticity' (ARCH) developed by Engle (1982) and 'Generalised Autoregressive Conditional Heteroscedasticity' (GARCH) proposed by Bollerslev (1986). Researchers widely use ARCH/GARCH techniques to measure volatilities. However, in contrast to ordinary least squares (OLS), the ARCH/GARCH techniques are based on the assumption of heteroscedasticity. Following Rahman, et al., (2018), Rauf and Rashid (2019), the study employ the ARCH/GARCH model to measure macroeconomic volatilities by utilising monthly oil price, ER, and industrial output data. To match frequency with annual firm-level data, average out the monthly volatility series of the macroeconomic variables. This study measures the macroeconomic series' volatilities using the following models in Equations (1) and (2).

$$A(L)\,\Delta Y_t = \omega + \beta\,(L)\,\varepsilon_t \tag{1}$$

$$\sigma_t^2 = \alpha + \sum_{i=1}^{q} \gamma_i\,\varepsilon_{t-i}^2 + \sum_{i=1}^{p} \lambda_i\,\sigma_{t-1}^2 \tag{2}$$

where (Y) represents the underlying macroeconomic variables, (Δ) is the first difference operator. Similarly, (ω) and (α) are constants, (β) is moving-average (MA) parameters, and (L) is lag polynomial operator. Calculated conditional variance, (σ_t^2), is the one-period ahead forecast variance based on past information and (ε_t) is the error term. Further, used the ARCH-LM test to check any remaining ARCH effects in the specification.

3. *Measuring Firm-Specific Volatility*

Following Morgan, et al., (2004) and Rashid (2011), the study measure idiosyncratic (firm-level) volatility. In the literature, numerous proxies are utilised to quantify firm-specific volatilities; for example, wage as well as material costs Huizinga (1993), number of workers Bo and Lenin (2005), and stock prices Baum, et al., (2009). According to Caglayan and Rashid (2014), the aforementioned proxies for firm-specific volatilities are appropriate for large public firms. However, regardless of firm size, Morgan, et al., (2004) provided more suitable measures of time-varying firm-specific volatilities [Caglayan and Rashid (2014)]. To estimate the following model as follows in Equation (3):

$$SP_{it} = f_i + f_t + \omega_{it} \tag{3}$$

where, (SP_{it}) represents stock price, (f_i) and (f_t) are firm and year fixed-effects, respectively, and (ω_{it}) represents an error term. Subscript (i) and (t) represent firm and (t) time, respectively. From Equation (3), obtain the absolute values of the residuals as a proxy for stock-price volatility.

4. *Empirical Models*

a) ***Impacts of Macroeconomic Volatilities on Firm Specific-Volatility***

This study examines the impacts of macroeconomic volatilities on firm-specific volatility and extends the empirical framework proposed by Caglayan and Rashid

(2014) and Baum, et al., (2009) in different dimensions by incorporating macroeconomic volatility and by considering stock-price volatility as a dependent variable. The effect of each macroeconomic volatility on stock-price volatility is given by the following Equation (4):

$$\begin{aligned} SPV_{it} = \alpha_0 + \beta_1 MV_t + \beta_2 Size_{it} + \beta_3 Age_{it} + \beta_4 Cash_{it} + \beta_5 Tangibility_{it} \\ + \beta_6 Leverage_{it} + f_i + Y_t + \varepsilon_{it} \end{aligned} \tag{4}$$

In Equation (4), (SPV_{it}) represents stock-price volatility and (MV_t) represents the macroeconomic volatilities comprised of the oil-price volatility, the real effective exchange rate volatility and the manufacturing output volatility. As suggested by the existing literature, the authors consider several control variables that may affect the stock price volatility, such as firm size, age, cash, tangibility and leverage that may affect stock-price volatility. In addition, (f_i) and (Y_t) denotes firm-fixed effects and year-fixed effects, respectively (ε_{it}) is the error term.

b) *Joint Impact of Macroeconomic Volatilities on Firm-Specific Volatility*

We estimate the impact of macroeconomic volatility on stock-price volatility by constructing a composite index of oil-price volatility, real effective exchange rate volatility, and manufacturing output volatility. The results of the Bartlett test for the appropriateness of PCA suggest that the variables are highly correlated. Issah and Antwi (2017) argued that most macroeconomic variables are correlated. Therefore, under such circumstances, it is valuable to use the PCA. The PCA carries useful attributes of the larger set of variables in the form of a unique index. To test our hypothesis empirically, this study incorporate the macroeconomic volatility index in the following regression Equation (5).

$$\begin{aligned} SPV_{it} = \alpha_0 + \beta_1 MVI_t + \beta_2 Size_{it} + \beta_3 Age_{it} + \beta_4 Cash_{it} \\ + \beta_5 Tangibility_{it} + \beta_6 Leverage_{it} + f_i + Y_t + \varepsilon_{it} \end{aligned} \tag{5}$$

In Equation (5), the (SPV_{it}) represent stock-price volatility, (MVI_t) is the index of macroeconomic volatilities. Firm size, firm age, firm cash holdings, firm leverage, and the tangibility of assets and leverage are incorporated as control variables in the model.

To explore the role of the 2007 GFC in establishing the impact of macroeconomic volatilities on firm-specific volatility. We introduce pre- and post-crisis dummies in our model as presented in Equation (6). The dummy for the pre-crisis period takes the value of 1 for the period before 2007 and otherwise 0. Similarly, the dummy for the post-crisis period takes the value of 1 for the period 2007 onwards and otherwise 0.

$$SPV_{it} = \alpha_0 + \beta_1 MVI_t \times Dum\_pre_t + \beta_2 MVI_t \times Dum\_post_t + \beta_3 Size_{it} + \beta_4 Age_{it} + \beta_5 Cash_{it} + \beta_6 Tangibility_{it} + \beta_7 Leverage_{it} + f_i + Y_t + \varepsilon_{it} \quad (6)$$

In Equation (6), the dependent variable (SPV_{it}) represents stock-price volatility. The impact of macroeconomic volatilities in pre-crisis periods is captured through the interaction term ($MVI_t \times Dum\_pre_t$), whereas the term ($MVI_t \times Dum\_post_t$) captures the effect of the macroeconomic volatility index on stock-price volatility in post-crisis periods.

5. Estimation Techniques

In our empirical analysis, we considered all the 412 manufacturing firms listed at the PSX. Following the relevant literature, this study utilised the fixed effects model, which is more appropriate in the case of a large sample, particularly for investigating firm-specific effects. Further, random effects models are more appropriate in the case of a small sample out of a large population.

To capture firm-specific effects, fixed effects model is preferred over random effects models, as suggested by the pertinent literature [Fogli and Perri (2015) and Vannoorenberghe (2012)]. For a more in-depth analysis on the underlying issue, construct macroeconomic volatility index using the PCA, as PCA can carry valuable attributes of a larger set of variables in the form of a unique index. Furthermore, it can squeeze the dataset by limiting the number of variables and convey only important information from data sets that contribute most to its variance without any loss of the information. In addition, for the validity of PCA, the Bartlet test is reported in Table A-2. (Appendix).

IV. Results and Discussion

Summary statistics of monthly macroeconomic variables series and their respective volatilities from 1988 to 2017 are reported in Tables 1 and 2, respectively. Similarly, Table 3 shows summary statistics of firm-specific variables and volatility.

In Table 1, the exchange rate has a higher mean value of 108.260, while LOIL mean value is 3.552. Similarly, LOIL and ER are positively skewed, whereas LMOP is negatively skewed. Further kurtosis of all the macroeconomic series is less than three, reflecting that these macroeconomic series are platykurtic with fewer less extreme outliers than the normal distribution. Moreover, the Jarque-Bera statistic also rejects the null hypothesis of normality.

All the volatility series are highly positively skewed. The estimated values of Kurtosis for all macroeconomic series are greater than 3. Therefore, these distributions are leptokurtic with more extreme outliers than the normal distribution. The Jarque-Bera statistics also reject the null hypothesis of normality.

TABLE 1

Summary Statistics of Macroeconomic Variables

	LOIL[a]	ER[b]	LMOP[c]
Mean	3.552	108.260	4.307
Median	3.382	107.327	4.264
Maximum	4.489	141.543	5.157
Minimum	2.343	89.472	3.405
Std. Dev.	0.701	11.499	0.451
Skewness	0.287	0.467	-0.118
Kurtosis	1.688	2.414	1.616
Jarque-Bera	30.794	18.266	29.577
Probability	0.000	0.0001	0.000

Source: Authors' estimation.
[a]LOIL is log of oil prices.
[b]ER is the real effective exchange rate.
[c]LMOP is log of manufacturing output.

TABLE 2

Summary Statistics of Macroeconomic Volatilities

	OLPV[a]	RERV[b]	MOPV[c]
Mean	0.007	2.897	0.008
Median	0.005	2.53	0.007
Maximum	0.045	9.079	0.023
Minimum	0.002	2.05	0.005
Std. Dev.	0.005	1.055	0.003
Skewness	3.136	2.759	2.009
Kurtosis	16.596	11.894	8.039
Jarque-Bera	3343.856	1634.236	619.586
Probability	0.000	0.000	0.000

Source: Authors' estimation.
[a]OLPV is oil-price volatility.
[b]RERV is real effective exchange rate volatility.
[c]MOPV is manufacturing output volatility.

In Table 3, we report summary statistics of firm-specific volatility and control variables, namely firm size, age, cash holding, firm leverage, and the tangibility of assets. The stock-price volatility mean value is 9.794 with a standard deviation of 272.035. Further, among the control variables, leverage has the lowest mean value of 0.632 with a standard deviation of 0.0409.

TABLE 3

Summary Statistics of Firm-Specific Variables and Volatilities

Variable	Obs.	Mean	Std. Dev.
SPV[a]	4797	81.857	282.520
Size	4797	14.537	1.662
Age	4797	30.802	18.155
Cash	4797	0.046	0.085
Tangibility	4797	0.784	0.383
Leverage	4797	0.584	0.241

Source: Authors' estimation.
[a]SPV is stock price volatility.

1. Stationary Analysis

To test the presence of a unit root, employ the Augmented Dickey-Fuller (ADF) test at levels and at first differences. The results are reported in Table 4.

The estimation of ARCH models requires stationarity of the series [Rauf and Rashid (2019)]. Therefore, to check the order of integration of the underlying macro-economic series. The results reported in Table 4 indicate that the null hypothesis of unit root at levels is not rejected for all the underlying series. Therefore, all macro-economic series, namely LOIL, ER, and LMOP, have a unit root at their levels. The unit root test for the first differences of the series is also presented in Table 4. The results provide strong evidence that all the underlying series appear stationary at their first differences. Thus, utilise the first difference of the aforementioned macro-economic series in the estimation of the ARCH/GARCH models.

TABLE 4

Results of Unit Root Tests

	ADF-Statistics		ADF- Statistics		ADF- Statistics	
	(At level) with Constant		(At level) with Constant and Linear Trend		(At First Difference) with Constant	
Variables	t-stat.	Prob.	t-stat.	Prob.	t-stat.	Prob.
LOIL	-1.685	0.438	-2.802	0.198	-13.727	0.000
ER	-2.182	0.213	-1.645	0.769	-8.892	0.000
LMOP	-0.718	0.839	-1.278	0.892	-6.099	0.000

Source: Authors' estimation.

2. *Model for Measuring Macroeconomic Volatilities*

The estimation of ARCH/GARCH models requires the presence of the ARCH effect. It can be observed by visual inspection through graphs and utilising a more reliable ARCH LM test. The null of the ARCH LM test is that 'there is no ARCH effect'. The ARCH LM test confirms the presence of ARCH effects in all macro-economic series. Hence, the study proceeds further to estimate GARCH models. The results of the models are given in Table 5.

To check the remaining ARCH effect in the underlying series, apply the standard ARCH LM test again. The findings suggest that there is no leftover ARCH effect. Therefore, the study obtain the GARCH variance (volatility) series of all three macro-economic variables. The annual average of the monthly volatility series is finally used as a proxy for macroeconomic volatility in the empirical analysis. In addition, all the macroeconomic volatilities, namely oil-price volatility, real effective exchange rate volatility, manufacturing output volatility and macroeconomic volatility index, are

TABLE 5

ARCH/GARCH Estimates for Macroeconomic Variables

Regressors	ΔER Coefficient	ΔOIL Coefficient	ΔLSM Coefficient
Constant	-0.043	0.004	0.003
	(0.114)	(0.005)	(0.006)
AR(1)	-0.177	0.085	0.383
	(0.144)	(0.230)	(0.537)
MA(1)	0.523***	0.178	-0.285
	(0.124)	(0.218)	(0.543)
Constant	1.161*	0.0007*	0.002**
	(0.615)	(0.0004)	(0.001)
ARCH(1)	0.173***	0.248***	0.147**
	(0.064)	(0.53)	(0.064)
GARCH(1)	0.431*	0.664***	0.597***
	(0.241)	(0.074)	(0.145)
Diagnostic Tests for Remaining GARCH Effects			
Log-likelihood	-689.977	411.751	348.015
Observations	358	358	358
LM-test	0.037	0.188	0.054
P Value	0.847	0.665	0.816

Source: Authors' estimation.*** $p<0.01$, ** $p<0.05$,* $p<0.1$. The standard errors are given in ( ).

found stationary at level. Furthermore, the firm-specific variables stock price volatility, size, age, cash, tangibility and leverage are also stationary at the level as shown in Table A-1 (Appendix).

Use daily stock price data of non-financial firms listed at the PSX to measure stock-price volatility. Morgan, et al., (2004), to obtain the time-varying stock-price volatilities as depicted in Equation (3). Specifically, the absolute value of the residuals from Equation (3) is used as a proxy for firm-specific volatility. Further, the study takes an annual average of the daily residuals to match the frequency.

3. Macroeconomic Volatility Effects on Firm-Specific Volatility

To explore the impacts of all macroeconomic volatility on stock-price volatility, we regressed stock-price volatility on each macroeconomic volatility series separately, along with firm-specific control variables as presented in Equation (4). The results are given in Table 6.

We estimate three different models to examine the effect of each type of macroeconomic volatility. The estimated values of the coefficients of macro-level volatilities show that macroeconomic volatility has a significant and positive impact on stock-price volatility. It implies that the stock-price volatility increases with unexpected variations in the underlying macroeconomic indicators. This finding holds in all estimated models, suggesting that the positive effect of macroeconomic volatility on stock-price volatility is robust to different measures of macroeconomic volatility. The estimated value of the coefficient of oil-price volatility is 2.68, which is statistically significant. Although both real effective exchange rate volatility and manufacturing output volatility are positively related to stock-price volatility, the effects of exchange rate volatility are higher.

Further, to detect multi-co-linearity, VIF is reported in Table 6. The average VIF lies in a range of 1.13 to 1.16. The positive effects of macroeconomic volatility on stock-price volatility suggest that unexpected variations in macroeconomic variables (oil price, ER, and manufacturing output) significantly transmit to firm-level volatility. These results also suggest that during periods of macroeconomic turmoil, investors may buy or sell stocks frequently. Another possible explanation is that during periods of volatile macroeconomic conditions, business firms become pessimistic about their future cash flow stream and thus, they design their financial policies (investment and dividend payout) accordingly. The cut in investments and dividends adversely affects investors' trading activities, causing abrupt variations in stock prices. These findings are consistent with our explanation of the positive impact of macroeconomic volatility on stock-price volatility. Similarly, these findings complement the prior literature, reporting the positive link between macroeconomic volatilities on stock-price volatility [Khan and Ali (2015) and Qayyum and Kemal (2007)].

The positive impact of size, age and cash holding on stock-price volatility indicates that the stock prices of large firms, mature firms, and firms with more cash reserves are more volatile. The possible explanation can be that investors may consider the stocks of large, mature and cash-rich firms more profitable; thus, they do more sales and purchases, which, in turn, results in higher volatility.

TABLE 6

Macroeconomic Volatility Effects on Stock-Price Volatility

	Model 1		Model 2		Model 3	
Regressors	Coefficient	VIF[a]	Coefficient	VIF	Coefficient	VIF
OLPV	2.680***	1.01	---		---	
	(0.748)					
RERV	---		3.791***	1.06	---	
			(0.575)			
MOPV	---		---		1.292***	1.11
					(0.186)	
Size	1.056*	1.31	1.012*	1.35	1.189**	1.39
	(0.596)		(0.594)		(0.594)	
Age	0.281***	1.08	0.446**	1.09	0.506***	1.1
	(0.075)		(0.795)		(0.082)	
Cash	0.424**	1.24	0.431**	1.24	0.398**	1.24
	(0.190)		(0.190)		(0.189)	
Tangibility	0.667	1.11	0.94	1.11	0.912	1.11
	(1.167)		(1.163)		(1.162)	
Leverage	-0.113	1.04	-0.389	1.04	-0.208	1.04
	(1.617)		(1.609)		(1.609)	
Constant	-18.458**		-31.627***		-35.339***	
	(7.507)		(7.814)		(7.944)	
Average VIF		1.13		1.15		1.16
Diagnostic Tests						
R^2-Within	0.020		0.027		0.028	
Between	0.010		0.007		0.007	
Overall	0.013		0.012		0.012	
Observations	4797		4797		4797	
Groups	412		412		412	
F-Statistics	21.420		14.400		22.270	
Probability	0.000		0.000		0.000	

Source: Authors' estimation.*** p<0.01, ** p<0.05,* p<0.1. The standard errors are given in ( ).
[a]VIF is variance inflation factor.

4. Joint Impact of Macroeconomic Volatilities on Firm-Specific Volatility

The study incorporates the macroeconomic volatility index in our model to examine the influence of macroeconomic volatility on stock-price volatility as presented in Equation (5). The estimation results are provided in Table 7. To get a clearer picture and better understanding, the study incorporates the 2007 GFC pre- and post-crisis dummies in the specification as presented in Equation (6).

In the above table results are reported on the basis of Equations (5) and (6). The empirical results reveal that the joint impact of macro-level volatilities on stock-price volatility is positive. The coefficient of the macroeconomic volatility index with a positive sign indicates that increased (decreased) macroeconomic volatility will result in increased (decreased) stock-price volatility. The positive effect of the macroeconomic volatility index on stock-price volatility is consistent with our earlier results in Table 6. These results suggest that each type of macroeconomic volatility amplifies stock-price volatility and different macroeconomic volatilities jointly affect stock-price volatility. To ensure whether the positive association between macroeconomic volatility is robust to any structural change in the data, examine the relationship for the pre-and post-financial crisis periods. In particular, define two dummy variables for pre- and post-financial crisis periods and interact them with the macroeconomic volatility index. Findings suggest that macroeconomic volatility is positively related to stock-price volatility in both periods, and the relationship is stronger in the pre-crisis period.

In Table 7, the estimated coefficients of (MVI×Dum_pre) and (MVI×Dum_post) suggest that when macroeconomic volatility increases by one unit, firm-specific volatility increases by 1.50 units in the pre-financial crisis period, whereas it increases by 0.64 units in the post-crisis period. This differential effect may be attributed to the precautionary behaviour of firms after the 2007 GFC. It can also be attributed to more effective and prudent macroeconomic policies adopted by the government after the 2007 GFC. The implication of a more effective regulatory framework and appropriate strategies may hinder spillover from macro-level volatilities to stock-price volatility. Our results are in line with the existing literature Chaudhary, et al., (2018) and Jebran, et al., (2017). In Table 7, all the reported coefficients are positive and significant. Moreover, for robustness check, the empirical results of all the models using pooled OLS are reported in Appendix (Table A-3 to Table A-4).

V. Conclusion and Policy Recommendations

The volatility in oil prices, exchange rates, and manufacturing output have considerable consequences on stock-price volatility. All economic agents are affected by macroeconomic volatility because any macroeconomic shock influences both the real and financial sectors of the economy. Therefore, this study explores the im-

TABLE 7

Joint Effect of Macroeconomic Volatilities on Stock-Price Volatility: Pre- and Post-Financial Crisis

	Model 4		Model 5	
Regressors	Coefficient	VIF	Coefficient	VIF
MVI × Dum_pre			1.499***	8.99
			(0.138)	
MVI × Dum_post			0.636***	8.72
			(0.121)	
MVI[a]	8.028***	1.06		
	(1.214)			
Size	1.013*	1.35	1.622*	1.48
	(0.593)		(0.590)	
Age	0.447***	1.09	1.308	1.13
	(0.080)		(1.152)	
Cash	0.431**	1.24	0.332*	1.24
	(0.190)		(0.188)	
Tangibility	0.940	1.11	0.799	1.11
	(1.163)		(1.150)	
Leverage	0.041	1.04	0.361	1.04
	(1.609)		(1.591)	
Constant	-31.695***		-70.121***	
	(7.815)		(8.590)	
Average VIF		1.15		3.39
Diagnostic Tests				
R^2-Within	0.027		0.050	
Between	0.007		0.006	
Overall	0.012		0.010	
Observations	4797		4797	
Groups	412		412	
F-Statistics	14.420		15.910	
Probability	0.000		0.000	

Source: Authors' estimation.*** p<0.01, ** p<0.05,* p<0.1. The standard errors are given in ( ).
[a]MVI is manufacturing output volatility.

pact of macroeconomic volatility on stock-price volatility, using firm-level volatility with special reference to Pakistan. The study uses a panel of 412 manufacturing firms listed at the PSX for the period of 1988 to 2017 to carry out an empirical analysis. The fixed effects model results show that all three types of macroeconomic volatilities, namely the oil-price volatility, the real effective exchange rate volatility, and the manufacturing output volatility, have a positive and significant impact on stock-price volatility.

This finding implies that macroeconomic volatility increases stock-price volatility. In other words, firms face higher stock-price volatility during periods of higher macroeconomic volatility. The results suggest that the macroeconomic volatility index is positively related to stock-price volatility. This evidence indicates that the joint impact of all three macroeconomic volatility is positive and also suggests that investors consider different macroeconomic variations while making investment decisions. Finally, the study results reveal that the positive impact of macroeconomic volatility on stock-price volatility is higher during the pre-crisis period than the post-crisis period. Further, firm size, age, and cash holding positively influence underlying stock-price volatility.

The findings presented in this study suggest some important and useful policy implications for manufacturing firms and policymakers. Higher macroeconomic and firm-specific volatilities have negative implications on economic activities. Thus, it has a higher economic cost as all macroeconomic volatilities positively impact stock-price volatility. Therefore, it is recommended that to limit stock-price volatility, policymakers have to control macroeconomic volatilities. In addition, excessive cash holdings by manufacturing firms also result in higher stock-price volatility. The positive relationship between cash holdings and stock-price volatility can also be explained as firms that hold more cash in their reserves do less investment and other R & D expenditures. Thus, their stock prices become more volatile. Therefore, firm managers are advised not to hold idle cash.

The empirical findings and policy recommendations provided above may be helpful to policymakers, academicians, and management of firms to overcome the adverse effects on stock-price volatility of macroeconomic volatilities. This study can be further extended by exploring the impacts of macroeconomic volatilities on firm-specific volatilities for a panel of emerging countries, especially oil-importing countries. One can also explore the impacts of unexpected variations in cash flow and sales volatility using firm-level data.

References

Ahmad, M. I., R. Rehman, and A. Raoof, 2010, Do interest rate, exchange rate effect stock returns?, A Pakistani perspective, International Research Journal of Finance and Economics, 50(1): 146-150.

Alagidede, P., T. Panagiotidis, and X. Zhang, 2011, Causal relationship between stock prices and exchange rates, The Journal of International Trade and Economic Development, 20(1): 67-86.

Bagh, T., T. Azad, S. Razzaq, I. Liaqat, and M. A. Khan, 2017, The impact of exchange rate volatility on stock index: Evidence from Pakistan stock exchange (PSX), International Journal of Academic Research in Accounting, Finance and Management Sciences, 7(3): 70-86.

Bahmani-Oskooee, M., and S. Saha, 2016, Do exchange rate changes have symmetric or asymmetric effects on stock prices?, Global Finance Journal, 31(3): 57-72.

Basher, S. A., A. A. Haug, and P. Sadorsky, 2012, Oil prices, exchange rates and emerging stock markets, Energy Economics, 34(1): 227-240.

Baum, C. F., M. Caglayan, and O. Talavera, 2009, On the sensitivity of firms' investment to cash flow and uncertainty, Oxford Economic Papers, 62(2): 286-306.

Bo, H., and R. Lensin, 2005, Is the investment–uncertainty relationship nonlinear?, An empirical analysis for the Netherlands, Economica, 72(286): 307-331.

Bollerslev, T., 1986, Generalised autoregressive conditional heteroskedasticity, Journal of Econometrics, 31(3): 307-327.

Branson, W. H., 1981, Macroeconomic determinants of real exchange rates, National Bureau of Economic Research, Working Paper, 0801.

Burbidge, J., and A. Harrison, 1984, Testing for the effects of oil price rises using vector autoregressions, International Economic Review, 25(2): 459-484.

Caglayan, M., and A. Rashid, 2014, The response of firms' leverage to risk: Evidence from UK public versus nonpublic manufacturing firms, Economic Inquiry, 52(1): 341-363.

Campbell, J. Y., and R. J. Shiller, 1988, The dividend-price ratio and expectations of future dividends and discount factors, The Review of Financial Studies, 1(3): 195-228.

Caporale, G. M., J. Hunter, and F. M. Ali, 2014, On the linkages between stock prices and exchange rates: Evidence from the banking crisis of 2007–2010, International Review of Financial Analysis, 33(3): 87-103.

Chaudhary, G. M., I. Hussain, and I. Shaheen, 2018, Global financial crisis and stock markets volatility: A comparison of diverse financial structure countries, Journal of Contemporary Research in Management, 13(1): 23-40.

Chkili, W., and D. K, Nguyen, 2014, Exchange rate movements and stock market returns in a regime-switching environment: Evidence for BRICS countries, Research in International Business and Finance, 31: 46-56.

Dornbusch, R., and S. Fischer, 1980, Exchange rates and the current account, The American Economic Review, 70(5): 960-971.

Engle, R. F., 1982, Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation, Econometrica, 50(4): 987-1007.

Fang, C. R., and S. Y. You, 2014, The impact of oil price shocks on the large emerging countries' stock prices: Evidence from China, India and Russia, International Review of Economics and Finance, 29(1): 330-338.

Farooq, M. T., W. W. Keung, and A. A. Kazmi, 2004, Linkage between stock market prices and exchange rate: A causality analysis for Pakistan, The Pakistan Development Review, 43(3): 639-649.

Fatima, T., and A. Bashir, 2014, Oil price and stock market fluctuations: Emerging markets, A comparative study of Pakistan and China, International Review of Management and Business Research, 3(4): 1958-1976.

Fogli, A., and F. Perri, 2015, Macroeconomic volatility and external imbalances, Journal of Monetary Economics, 69(1): 1-15.

Hamilton, J. D., 1983, Oil and the macroeconomy since world war II, Journal of Political Economy, 91(2): 228-248.

Huizinga, J., 1993, Inflation uncertainty, relative price uncertainty, and investment in US manufacturing, Journal of Money, Credit and Banking, 25(3): 521-549.

Inci, A. C., and B. S. Lee, 2014, Dynamic relations between stock returns and exchange rate changes. European Financial Management, 20(1): 71-106.

Issah, M., and S. Antwi, 2017, Role of macroeconomic variables on firms' performance: Evidence from the UK, Cogent Economics and Finance, 5(1): 1405581-140.

Jawaid, S. T., and A. U. Haq, 2012, Effects of interest rate, exchange rate and their volatilities on stock prices: Evidence from banking industry of Pakistan, Theoretical and Applied Economics, 19(8): 153-166.

Jebran, K., S. Chen, G. Saeed, and A. Zeb, 2017, Dynamics of oil price shocks and stock market behavior in Pakistan: Evidence from the 2007 financial crisis period, Financial Innovation, 3(1): 1-12.

Khan, R. E. A., and R. Ali, 2015, Causality analysis of volatility in exchange rate and stock market prices: A case study of Pakistan, Asian Economic and Financial Review, 5(5): 805-815.

Koh, W. C., 2015, Oil price shocks and stock markets in ASEAN-5, Southeast Asian Journal of Economics, 3(1): 143-164.

Lin, C. H., 2012, The comovement between exchange rates and stock prices in the Asian emerging markets, International Review of Economics and Finance, 22(1): 161-172.

McMillan, D. G., and A. Kumar Tiwari, 2016, Spillovers between output and stock prices: A wavelet approach, Studies in Economics and Finance, 33(4): 625-637.

McMillan, D. G., and M. E. Wohar, 2012, Output and stock prices: An examination of the relationship over 200 years, Applied Financial Economics, 22(19): 1615-1629.

Mitra, R., 2017, Stock market and foreign exchange market integration in South Africa, World Development Perspectives, 6(2): 32-34.

Moore, T., and P. Wang, 2014, Dynamic linkage between real exchange rates and stock prices: Evidence from developed and emerging Asian markets, International Review of Economics and Finance, 29(1): 1-11.

Morgan, D. P., B. Rime, and P. E. Strahan, 2004, Bank integration and state business cycles, The Quarterly Journal of Economics, 119(4): 1555-1584.

Muhammad, N., and A. Rasheed, 2002, Stock prices and exchange rates: Are they related?, Evidence from South Asian countries, The Pakistan Development Review, 41(4): 535-550.

Pan, M. S., R. C. W. Fok, and Y. A. Liu, 2007, Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets, International Review of Economics and Finance, 16(4): 503-520.

Qayyum, A., and A. Kemal, 2007, Volatility spillover between the stock market and the foreign exchange market in Pakistan, Pakistan Institute of Development Economics, Working Paper, 2006/7: 1-18.

Qiang, W., A. Lin, C. Zhao, Z. Liu, M. Liu, and X. Wang, 2019, The impact of international crude oil price fluctuation on the exchange rate of petroleum-importing countries: A summary of recent studies, Natural Hazards, 95(1): 227-239.

Rahman, S. U., A. Rashid, and Muhammad Ilyas, 2018, Returns volatility in stock market and performance of banks: Evidence from Pakistan, Pakistan Journal of Applied Economics, (Special Edition), 28(1): 389-410.

Rashid, A., 2008, Macroeconomic variables and stock market performance: Testing for dynamic linkages with a known structural break, Savings and Development, 32(1): 77-102.

Rashid, A., 2011, How does private firms' investment respond to uncertainty? Some evidence from the United Kingdom, The Journal of Risk Finance, 12(4): 339-347.

Rauf, R., and A. Rashid, 2019, Interlinkages among exchange rate, interest rate, consumer price index, and output volatilities, Forman Journal of Economic Studies, 15(1): 115-136.

Sarwar, A., M. H. Aftab, R. A. Khan, and H. A. Qureshi, 2014, Impact of macroeconomic factors on the stock index: A case study of Pakistan, The Science International, 26(5): 2595-2601.

Siddiqui, M. M., and Muhammad Nabeel, 2013, Oil price fluctuation and stock market performance: The case of Pakistan, Middle-East Journal of Scientific Research, 18(2): 177-182.

Sui, L., and L. Sun, 2016, Spillover effects between exchange rates and stock prices: Evidence from BRICS around the recent global financial crisis, Research in International Business and Finance, 36(1): 459-471.

Tiwari, A. K., M. Bhattacharyya, D. Das, and Muhammad Shahbaz, 2018, Output and stock prices: New evidence from the robust wavelet approach, Finance Research Letters, 27: 154-160.

Tsai, I. C., 2012, The relationship between stock price index and exchange rate in Asian markets: A quantile regression approach, Journal of International Financial Markets, Institutions and Money, 22(3): 609-621.

Vannoorenberghe, G., 2012, Firm-level volatility and exports, Journal of International Economics, 86(1): 57-67.

Wang, S., and Z. Guo, 2020, A study on the co-movement and influencing factors of stock markets between China and the other G20 members, International Journal of Finance and Economics, 25(1): 43-62.

Wong, H. T., 2017, Real exchange rate returns and real stock price returns, International Review of Economics and Finance, 49(3): 340-352.

Yasmin, B., 2020, Industrial sector and global oil price fluctuations: A case study of Pakistan. Pakistan Journal of Applied Economics, 30(1): 1-25.

Yun, X., and S. M. Yoon, 2019, Impact of oil price change on airline's stock price and volatility: Evidence from China and South Korea, Energy Economics, 78(2): 668-679.

APPENDIX

TABLE A-1

Results of Panel Unit Root Tests

Variables	ADF- Statistics (At level)	
	Chi^2-stat.	Prob.
OLPV	4859.440	0.000
RERV	3073.736	0.000
MOPV	2760.075	0.000
MVI	301.227	0.000
SPV	1104.607	0.000
Size	1534.566	0.000
Age	15300.000	0.000
Cash	2713.541	0.000
Tangibility	1708.185	0.000
Leverage	1268.682	0.000

Source: Authors' estimation.

TABLE A-2

Results of Bartlett Test for PCA

Degrees of Freedom	Chi^2-stat.	Prob.
3	8318.916	0.000

Source: Authors' estimation.

TABLE A-3

Macroeconomic Volatility Effects on Stock-Price Volatility

	Model 1	Model 2	Model 3
Regressors	Coefficient	Coefficient	Coefficient
OLPV	2.673***		
	(0.857)		
RERV		2.958***	
		(0.624)	
MOPV			9.306***
			(1.940)
Size	1.584***	1.923***	2.109***
	(0.429)	(0.437)	(0.446)
Age	1.637***	2.162**	2.307***
	(0.478)	(4.940)	(0.502)
Cash	0.036*	0.036*	0.034
	(0.021)	(0.021)	(0.021)
Tangibility	0.780	0.123	0.123
	(1.214)	(0.121)	(0.121)
Leverage	-0.627	-0.522	-0.650
	(1.746)	(0.174)	(1.743)
Constant	-22.002***	-35.250***	-37.316***
	(7.507)	(6.947)	(7.944)
Average VIF			
Observations	4797	4797	4797
Groups	412	412	412
Wald-Statistics	70.880	83.730	84.280
Probability	0.000	0.000	0.000

Source: Authors' estimation.*** p<0.01, ** p<0.05,* p<0.1. The standard errors are given in ( ).

TABLE A-4

Joint Effect of Macroeconomic Volatilities on Stock-Price Volatility:
Pre- and Post-Financial Crisis

	Model 4	Model 5
Regressors	Coefficient	Coefficient
MVI × Dum_pre		7.198***
		(1.338)
MVI × Dum_post		4.622***
		(1.389)
MVI[a]	6.261***	
	(1.317)	
Size	1.925***	2.676***
	(0.437)	(0.483)
Age	0.216***	3.188***
	(0.049)	(0.565)
Cash	0.363*	0.329
	(0.213)	(0.213)
Tangibility	0.123	0.153
	(0.121)	(0.122)
Leverage	-5.237	-4.050
	(1.426)	(17.421)
Constant	-35.309***	-48.985***
	(6.951)	(7.855)
Average VIF		
Observations	4797	4797
Groups	412	412
Wald-Statistics	83.810	98.290
Probability	0.000	0.000

Source: Authors' estimation.*** $p<0.01$. The standard errors are given in ( ).

[a] MVI is manufacturing output volatility.