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Impact of Volatility on Firm Sales Growth Some Insights from Pakistan

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Abstract

This paper empirically investigates how firm level, industrial level, market level and macroeconomic volatilities influencePakistani non-financial firms' sales growth. It also examines how interactions between different kinds of volatilities affect sales growth. The empirical analysis is carried out using unbalanced annual panel data set covering the period 1988-2017.The results indicate that although all types of volatilities assert negative impacts, the intensity of the impact is quite different across different volatilities. Macroeconomic volatility has the highest adverse impact followed by firm volatility. Unexpectedly, the results provide evidence that one type of volatility significantly reduces the adverse impact of other type of volatility. These findings imply that firms may design and implement more effective sales growth strategies in periods when they face more than on type of volatility.

Keywords: *Firm growth; firm-specific volatility; market volatility; macroeconomic volatility*

JEL Classifications: *D22; D80*

1. Introduction

Firm growth plays an important role for the growth and development of a country (Farnoodi, Ghazinoory, Radfar & Tabatabaian, 2020).The determinant of firm growth is extensively explored in the literature (Arrighetti, Landini & Lasagni, 2021). Numerous theoretical models of volatility-firm growth have been proposed. However, these models reached with different results. For example, Abel (1983) and Hartman (1972) find a positive association between volatility and firm growth.On the other hand, Dixit and Pindyck (1994) and Ghosal and Loungani (2000) document a negative association between volatility and firm growth. Therefore, the impact of volatility on firm growth is still ambiguous and no consensus exists among the economists.Yet, the empirical findings are also inconclusive at best.Chong and Gradstein

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(2009) reported a negative impact of volatility on firm growth. In contrast,implications derived from Aghion, Angeletos, Banergee and Manova (2010) indicate that the link between volatility and firm growth is positive for developed and negative for the emerging economies.

The determinants of firm growth divided into qualitative and quantitative categories. Qualitative determinants are personality and technical entrepreneurial skills (Coad & Holzl, 2012). However, quantitative determinants are consist of all the other external and internal factors like size, age, profitability, productivity, research and development, resources, distinctive competencies, strategy, innovation, operational, marketing and financial capabilities (Coad & Holzl, 2012; Gupta, Guha & Krishnaswami, 2013). In addition to that, there are some other qualitative factors like economic, social, political, financial, technological, geographic, demographic, export, legal, and regulatory factors.

In principle, the determinants of firm growth into internal and external factors(Gupta *et al.,* 2013). All the factors which provide threats and profitable opportunities for an organization are considered as external factors for example growth in the economy, composition of age and gender, total population, and belief. However, the internal factors include resources, competencies of the firm and production capacity (Gupta *et al.,* 2013). Firm growth not only results in massive increase in production but also the utilization of unemployed workers of a country (Horbach & Rammer, 2020).

In the literature, the relationship between firm-level volatility and sales growth is less explored. There is lack of empirical evidence in the literature that how different types of volatilities affect firm growth. In particular, there is no empirical study is available on the impact of firm-level, industrial-level, and market-level volatilities on firm sales growth in case of Pakistani firms. The association between different types of volatilities and firm growth has been addressed extensively in case of developed economies (see Chong & Gradstein, 2009; Aghion *et al.*, 2010; Lee & Hwang, 2011). However, there is no consensus among the researchers on the underlying issue. Therefore, the complete understanding on the role of volatilities (firm-specific, industry-specific, market-specific and macroeconomic volatility) in determining firm growth is useful for the policy makers.

Patton and Sheppard (2015) are of the view that future volatility is strongly associated with the volatility of past adverse returns and that the influence of a price jump on volatility be contingent on the sign of the jump, with positive (negative) jumps leading to lower (higher) future volatility. Existing literature suggests that micro level volatility and macro level volatility are adversely related to economic growth and investment (Ramey & Ramey, 1995). In this study, we have explored the volatility effects of not only firm and industrial volatility but also market and macroeconomic volatility on firm growth in case of manufacturing firms in Pakistan. The empirical findings show that the impacts of macroeconomic, market, industrial and firm level volatilities have a negative relationship between volatilities and firm sales growth. Therefore, the policy makers may control extreme interest rate, exchange rate and consumer price index volatilities to limit adverse impact of macro level volatilities.

The paper is structured as follows. Section one covers the introduction. Section two documents the literature survey. Section three consists of empirical framework. Section four presents' descriptive statistics, unit root test results, estimation of GARCH models, results of volatility firm growth model and marginal effects of micro and macro level volatilities. Finally, Section five concludes the study.

2. Literature Survey

2.1. The impact of volatility on firm growth

There are multiple theoretical explanations for the existence of a negative or indirect association between macro and micro volatilities and growth of firms. However, the existing literature provides contradictory results regarding the volatility, investment, and growth relationship. This subsection is dedicated to the theories that focus on the volatility-growth relationship. There are number of theoretical channels that are described below.

1. **The degree of market competition.** In the presence of perfect competition, risk-neutral firms having linearly homogeneous production function want to maximize their net wealth because the basic intention of a business is to maximize wealth. Wealth maximization requires an optimum size of the firm. Optimum size minimizes the cost of production. Therefore, firm profitability increases. In order, to achieve that optimal position finance is needed. To overcome the shortage of funds faced by most of the firms managers have to borrow from the financial institutions. The financing raised by the managers is invested in profitable production processes. Therefore, volatility favors investment and ultimately firm growth (Hartman, 1972: Abel, 1983).

2. **The degree of returns to scale.** Caballero (1991) has explored that in the presence of perfect competition, constant returns to scale, convex in prices profit function, and symmetric adjustment cost volatility is positively related to investment expenditures that are suggested by Abel (1983) and Hartman (1972). He considered the case of risk averse firms, operating in an imperfect market and having decreasing returns to scale is responsible for the inverse relationship between volatility and in-

vestment. In determining the direction of investment volatility relationship we have to consider the market structure, risk aversion nature of the firm and the nature of adjustment cost (Caballero, 1991). If volatility is related to investment, then the higher investment results in the growth of the firms and vice versa. Therefore, volatility is indirectly related to the firm growth.

3. Investment irreversibility. Arrow (1968) is the first to present the idea of irreversibility of investment, the firms cannot disinvest. This means that with the rise in volatility investors realize that the investment expenditures are sunk cost. In addition, temporary hold of the investment by a firm has a number of advantages. For example, new information of the market conditions, tax structure, costs, prices and interest rate prior to the investment decision. Since the work of Kenneth Arrow this concept has remained neglected for almost two decades. Later on, the concept of irreversibility of the investment is flourished by Pindyck (1988).

Pindyck (1988) has related the volatility-investment relationship to irreversibility of investment. According to him the most of the investment expenditures are irreversible to an extinct; disinvestment is almost impossible. That is why investment expenditure is just like sunk cost. The reason behind this irreversibility is that firm-specific or industry-specific capital can only be used in a specific industry or firm. For example, investment in steel industry has nothing to do with the plastic industry. This means that the machines of steel industry can only be used for the production of the products made up of steel and cannot produce plastic. In the presence of high cost of reverting investment it is better for the investors to postpone their investment till better market conditions (Dixit &Pindyck, 1994). Therefore, volatility is negatively related to firm growth.

4. The possibility to obtain external credit. Financial constraints are the most important channel that highlights the adverse relationship between volatility and investment (Ghosal &Loungani, 2000). In the presence of extreme cash flow volatility and internal cash flow shortfall firms have to postpone discretionary investment (Minton & Schrand, 1999). Under such circumstances there is a difficult way out for the firms; firms can rely on the external financing to meet shortfall of the cash flow. However, external financing is relatively costly than the internal financing (Myers & Majluf, 1984). Such an expensive external finance results in lower net present value (NPV), hereafter NPV and internal rate of return (IRR), hereafter IRR. So, on the basis of NPV and IRR decision firms want to undergo lessor investment projects. Therefore, financial constraints and cash flow volatility is harmful for investment and firm growth.

5. The degree of risk aversion. Some theoretical studies explain that the inverse relationship between volatility and investment is based on risk averse nature of the firms (Zeira, 1990). Most of the firms are risk averse these firms do not want to invest under extreme micro and macro volatility. Furthermore, the risk averse firms want to invest under a known tax structure, interest rate, input costs and output prices. However, risk lover investors are supposed to invest more in the presence of a volatile environment. Therefore, the channel of investment cannot be neglected.

2.2. Volatility and firm growth

Knight (1921) has defined volatility as "uncertainty as peoples' inability to forecast the likelihood of events happening", in order to explain volatility, he explained the concept of risk for that he has used the example of flip of a coin. Volatility is the exposure to a hazard, a danger or the probability of loss (Rauf & Rashid, 2019).The existing literature suggests that internationally only a couple of studies on volatility and firm sales growth are available, however in case of Pakistan there are only a few studies. For example, age effects and volatility dynamics were explored by Khan, Khan and Khan (2016). Ahmed and Hamid (2011) have explored the determinants of firm growth in Pakistan and found that in Pakistan finance is the major restriction to the firm growth.

Kouser, Bano and Azeem (2012) have analyzed non-financial Pakistani firms and reported a strong positive connection between profitability and growth of the firm. They concluded that in case of Pakistan the research on volatility and firm sales growth is lacking; the existing empirical literature neglects the role of volatility in firm sales growth. Abbas, Faridi and Rahman (2020) have reported positive impact of firm internal financing and R & D on growth of the small Pakistani firms.

Volatility is part of life and cannot be avoided. In a volatile environment, firms invest and in return they earn potential profit (Naheed, Sarvar & Naheed, 2021). A fraction of the profit is saved and invested which result in firm growth (Yu, Dosi, Grazzi & Lei, 2014). Although, most of the empirical studies have highlighted negative association between volatility and growth but the arguments in favor of positive or even no relationship between volatility and growth are also convincing. Therefore the volatility firm growth literature is decomposed into the following three main groups in the context of the findings.

Theoretically positive link between volatility and firm growth is due to the fact that during a recession the revenues of all the firms will decline (Chee, Kwon & Pyun, 2017; Mills, 2018). Especially the decline in revenues of less productive firms will result in a sharp increase in losses and ultimately the businesses have to close down their business so that they may avoid losses. Mills (2000) has concluded positive impact of higher volatility on higher growth.

The second category of literature supports a negative theoretical link between volatility and growth. Highly volatile economies have lower growth. Further, the negative connection between volatility and growth persists even after controlling country- and time-fixed effects (Ramey & Ramey, 1995). Loayza and Hnatkovska (2004) have found a negative impact of volatility on growth. In addition there are many other studies which show a causal relationship between volatility and firm growth (Luo, Nie & Young, 2016). Minton and Schrand (1999) have found that cash flow volatility is a significant negative determinant of investment.

The last category of literature consists of mixed link between volatility and growth. For example, Lee and Hwang (2011) have analyzed the impact of volatility on growth in China, Japan, and Korea and presented mix evidence on volatility growth link. Volatility has a significant negative impact on growth of Korean firms but the said impact is positive for Chinese firms. However, no evidence of the impact of volatility on growth of Japanese firms is exist. Moreover, unexpected positive shocks have flourishing impact on growth of both Chinese and Korean firms although the cited impact is almost negligible for Japanese firms. Similarly, expected negative shocks have an adverse impact on growth in all the three economies under study, and the magnitude is small for Japanese firms and large for Korean firms. Jetter (2014) has analyzed 50 years balance panel data of 90 economies and found ambiguous impact of volatility on growth. Further, authors argued that volatility is harmful to growth under democratic regime but it is beneficial to growth under dictatorship. Moreover, the study highlights positive (negative) direct (indirect) effect of volatility on growth. Charles and Darne (2021) have examined 99 years IPI data of US and found no evidence of impact of volatility on growth.

The theoretical and empirical literature on the relationship between volatility and firm growth is inconclusive. Therefore, in this empirical study we investigate the exact relationship between volatility and firm sales growth.

2.3. Determinants of firm growth

Peric, Vitezic, and Peric (2020) have studied more than 7000 Croatian firms over the period of 2008 to 2013. Authors documented a positive relationship between size and firm growth. Yakubu (2020) has examined a sample of firms over the ten years period 2008 to 2010 and has found that the Gibrat's law[3] does not hold. Chung,

3 "Gibrat'sLaw"also knows as "law of proportionate effect" (1931) suggested that the growth of the firm is independent of the firm size (see Almsafir, Nassar, Al-Mahrouq & Hayajneh, 2015; Yadav, Pahi & Goyari, 2020).

Eumand Lee (2019) have explored the impact of size on the firm growth of the Korean firm over the period of 2007 to 2018. The authors have found that the young firms grow faster than the mature firms. Several other researchers during the recent past have also documented that Gibrat'slaw does not hold (Álvarez-Díaz, D'Hombres, Dijkstra, Ghisetti & Pontarollo, 2021).

Firm size is closely related to learning and age (Coad, 2018). Therefore, both age and learning are also considered as major determinants of firm growth. In other words the combination of age and size is the most essential component of the determinants of firm sales growth. Park, Shin and Kim (2010) have observed a negative link between age and growth of Korean manufacturing firms. Arouri, Ben-Yousaf, Quatraro and Vivarelli (2018) havedocumented that the impact of age on employment growth is positive. Age and firm growth are negatively related (Masila, 2019). Further, Evans (1987) hasconcluded that if age is considered then it supersede the impact of size if any Voulgaris, Asteriou and Agiomirgianakis (2003) have documented an inconclusive impact of age on firm growth.

On theoretical grounds firms with solid commitment to R&D grow faster than their counterparts. In few cases R&D significantly positively associated with firm sales growth. For example, Park *et al.* (2010) have documented that R&D is not only good for the firm growth but also it facilitates firm survival.

By ignoring personal and corporate taxes Modigliani and Miller (1958) have presented an idea of irrelevance of capital structure. Their idea raised many questions among the policymakers that either shareholder's wealth depends on the capital structure or not. Further, thecontroversial debt financing has drawn the attention of the researchers towards the impact of leverage on firm sales growth. Opler and Titman (1994) have reported slow sales growth for firms in the highest leverage decile, meaning adverse effects of leverage on firm sales growth. Therefore, during economic downturn leveraged firms lose their market share to less leveraged competitors. Voulgaris *et al.* (2003) have documented a positive association between leverage and firm growth.

Profitability is the most vital determinant of firm growth (Watson, 2006). A number of other scholars have reported a positive relationship between profitability and firm growth (Kachlami & Yazdanfar, 2016; Masila, 2019). Fuertes-Callen and Cuellar-Fernandez (2019), have found the positive impact of profitability on firm growth based on employees but not for sales growth. Lee, (2014) has reported a surprisingly negative impact of profit on firm growth. However, Mathew (2017) has reported an inconclusive effect of profitability on firm growth.

Tobin Q plays a vital role in determining growth of a firm. Bai, Fairhurst and

Serfling (2020) have reported significant positive association between Tobin Q and firm growth. Fu, Singhal and Parkash (2016) have reported that the Tobin's Q has a favorable impact on firm performance. Contrarily, Gurbuz, Ataunaland Aybars (2017) have reported a negative impact of Tobin Q on firm growth. Patel, Guedes, Soares and Conceicao (2018) have also reported an adverse impact of Tobin Q on firm growth.

A number of researchers reported a positive impact of investment on firm sales growth. For example, Chen and Ku (2000) have documented positive association between investment and firm sales growth.Tangible as well as intangible investments derive growth of the firm (Leoncini, Marzucchi, Montresor, Rentocchini & Rizzo, 2016). Abuhommous (2017) has found significant positive association between investment and firm growth. Oliveira and Fortunato (2017) have reported an increase in investment has a significant positive effect on firm growth. Mathew (2017) has presented a positive link between investment and firm growth. Esaku (2020) has also reported positive impact of firm level investment on firm growth. Investment has a significant positive impact on the firm growth (Pham, 2020).

Moore, Broome and Robinson (2009) have documented the positive impact of cash on firm growth. Simbana-Taipe, Mullo, Chuquin, Morales-Urrutia and Sanchez (2019) have reported that cash and firm growth are positively associated. Similarly, a number of researchers have reported a positive impact of cash on growth of the firm (Serrasqueiro & Nunes, 2016; Mbulawa & Ogbenna, 2019; Bai *et al.,* 2020). On the other hand, Thu and Khuong (2018) did not find any significant relationship between cash holdings and firm growth.

3. Econometric Model

3.1. Firm growth: the baseline model

In this section, we provide the specification and justification of the variables included in our baseline model. We chose the most appropriate control variables for the volatility firm salesgrowth investigation. Firm growth is dependent upon firm-specific, industry-specific and country-specific variables. The general form of the model is given as under.

$$\begin{aligned} FG_{it} &= \alpha_0 + \gamma_0 FG_{it-1} + \gamma_1 Size_{it} + \gamma_2 Age_{it} + \gamma_3 R\&D_{it} + \gamma_4 Leverage_{it} \\ &+ \gamma_5 TobinQ_{it} + \gamma_6 Investment_{it} + \gamma_7 Profitablity_{it} + \gamma_8 Cash_{it} \\ &+ f_i + Y_t + Dum^{ind} + \mu_{it} \end{aligned} \tag{1}$$

To quantify the impact of volatility on firm sales growth, we use the standard model used by Chong and Gradstein (2009) and others, where firms are represented by i, (FG_{it}) is the growth of the firm i at time period t. Firm growth is a percentage change in revenue (sale) of the firm. The explanatory variables are firm level control variables. (f_i) represents firm fixed effect,) Y_t represents year fixed effect, (Dum^{ind}) is the industrial (μ_{it}) dummy and is the error term. Size of the firm is the log of total assets of the firms. Firm growth is defined as sales growth. The number of years since the firm is in operation is age. R&D is the research and development expenditure for innovation. Leverage is defined as to what extent the firm is using debt financing, increase in capital stock, which is investment is measured by the fixed assets. Cash is the cash and bank balance. Profitability is the return on assets and Tobin Q is the ratio of market to book value of the firm. The selection of the control variables is motivated by the economic theory and existing literature.

3.2. Volatility and firm growth

Our analysis is based on firm, industrial, market and macroeconomic volatilities. Therefore, in the second stage we estimate the following baseline model of firm growth.

$$\begin{aligned} FG_{it} &= \alpha_0 + \gamma_0 FG_{it-1} + \gamma_1 Size_{it} + \gamma_2 Age_{it} + \gamma_3 R\&D_{it} + \gamma_4 Leverage_{it} \\ &+ \gamma_5 TobinQ_{it} + \gamma_6 Investment_{it} + \gamma_7 Profitablity_{it} + \gamma_8 Cash_{it} \\ &+ \gamma_9 \sigma_{it}^{Firm} + \gamma_{10} \sigma_{jt}^{Industry} + \gamma_{11} \sigma_t^{Market} + \gamma_{12} \sigma_t^{Macro} \\ &+ f_i + Y_t + Dum^{ind} + \mu_{it} \end{aligned} \quad (2)$$

In the above model, the dependent variable (is the firm growth i at time t. is the intercept, σ_{it}^{Firm} is the firm-specificvolatility, $\sigma_{jt}^{Industry}$ is the industry level volatility, σ_t^{Market} is the market volatility, $\sigma_t^{Macro}$is the macroeconomic volatility, u_{it} is the error term.

It is very likely that firm growth may be affected by the interaction of firm, industry, market and macroeconomic volatility so in the next equation, we introduce the interaction terms of firm, industry, market and macroeconomic volatility. Finally, in order to investigate the interaction among various volatility measures we estimate the following generalized model.

$$\begin{aligned} FG_{it} &= \alpha_0 + \gamma_0 FG_{it-1} + \gamma_1 Size_{it} + \gamma_2 Age_{it} + \gamma_3 R\&D_{it} + \gamma_4 Leverage_{it} \\ &+ \gamma_5 TobinQ_{it} + \gamma_6 Investment_{it} + \gamma_7 Profitablity_{it} + \gamma_8 Cash_{it} \\ &+ \gamma_9 \sigma_{it}^{Firm} + \gamma_{10} \sigma_{jt}^{Industry} + \gamma_{11} \sigma_t^{Market} + \gamma_{12} \sigma_t^{Macro} \\ &+ \beta_1 \left(\sigma_{it}^{Firm} \times \sigma_{jt}^{Industry} \right) + \beta_2 \left(\sigma_{it}^{Firm} \times \sigma_t^{Market} \right) + \beta_3 \left(\sigma_{it}^{Firm} \times \sigma_t^{Macro} \right) \\ &+ \beta_4 \left(\sigma_{jt}^{Industry} \times \sigma_t^{Market} \right) + \beta_5 \left(\sigma_{jt}^{Industry} \times \sigma_t^{Macro} \right) + \beta_6 \left(\sigma_t^{Market} \times \sigma_t^{Macro} \right) \\ &+ f_i + Y_t + Dum^{ind} + \mu_{it} \end{aligned} \quad (3)$$

3.3. Variable description

In this study, for firm-level volatility, we use sales volatility, cash flow volatility and stock price volatility. We use daily stock price to calculate stock returns which are useful for the computation of the firm level volatility. For macroeconomic volatility we use industrial production index (IPI), interest rate (IR), exchange rate (ER), and consumer price index (CPI). For industrial volatility we use total sales of all the industries. In the similar fashion for market volatility is based on KSE100 index.We use an unbalanced panel data set for all the manufacturing firms listed on the PSX during the period of 1988 to 2017 is collected from the "balance sheet analysis of non-financial firms", published by the State Bank of Pakistan (SBP). The data on macroeconomic variables is collected from International Financial Statistics (IFS), published by the International Monetary Fund (IMF) and World Development Indicators (WDI), published by the World Bank. We allow entry as well as exit of the firms from data during the study period to mitigate the problem of survival bias. To estimate the macroeconomic volatility we utilize monthly data after estimating the volatility series, we average out monthly volatility series to match frequencies with firm level and annual data.

3.4. Measuring volatility

In this study, we use ARCH models for IPI, IR, ER andCPI to capture the macroeconomic volatility. In order, to derive volatility of IPI, IR, ER and CPIwe use (G) ARCH technique for thirty-year monthly data of all the said macroeconomic series. An index of macroeconomic volatility is derived from these macro level volatilities. In a similar manner we use ARCH models for KSE 100 Index to compute market volatility.

$$\Delta IPI_t = \omega + \beta(L) IPI_t + \delta(L)\varepsilon_t + \varepsilon_t$$
$$\sigma_t^2 = \alpha + \gamma(L)\varepsilon_t^2$$

Where (ω) and (α) are the constant terms, (δ) and (β) are moving average and autoregressive parameters, respectively and (L) is lag polynomial operator. The estimated conditional variance, (σ_t^2) is the one period ahead forecast variance based on the prior informationand) is the error term.

In order, to calculate time varying measure of firm-specific volatility we use the estimation technique of Morgan, Rime and Strahan (2004). Caglayan and Rashid (2014) have also used the same technique. These studies are based on the following model.

$$S_{it} = f_i + f_t + \omega_{it}$$

where (S_{it}) represents total sales, (f_i) is firm fixed-effects, (f_t) is year fixed-effects, ω_{it} represents error term, t represents time and i represents i^{th} firm.

We use estimation technique proposed by Morgan *et al.* (2004) for sales, cash flow and stock price to capture firm level volatility. The micro level volatility series of all the said variables is based on the concept that the deviations from the firm mean and the mean of overall mean of all the firm in a given period is the respective volatility of a series. Furthermore, firm volatility is obtained by using the principle component analysis (PCA). The application of PCA on volatility series of sales, cash flow and stock price suggests that the Eigen values of the first principle component is greater than one. Therefore, we obtained firm level volatility series by multiplying the squares of the loadings on the first component with the respective variables. The sum of all the said products is the firm level volatility. Similarly, industrial sales are used to capture industrial volatility by using estimation technique of Morgan *et al.* (2004).

4. Results and Discussion

In this subsection, the results of the impact of different types ofvolatilities on firm sales growth of manufacturing firms listed at thePakistan Stock Exchange (PSX) during the period 1988-2017 is presented. First of all, the descriptive statistics of the data followed by the firm growth: the baseline model, impact of volatility on firm growth and volatility and firm growth: generalized model are presented.

4.1. Descriptive statistics

In this section, the descriptive statistics of the variables used in empirical analysisare presented. To measure macroeconomic volatility, the monthly data of ER and CPI from IFS have been taken. However, the data of industrial production index and interest rate are taken from SBP. Appendix A1, documents the descriptive statistics of the said macroeconomic variables.

The Appendix A1 shows the minimum value of LCPI and ER is 2.66 and 89.47 respectively. The comparison of mean and standard deviation of all the macroeconomic series shows that the IR series is the most volatile among all the macroeconomic variables. In developing economies, like Pakistan, the interest rate has been remained volatile in recent past (Rauf & Rashid, 2019).The ADF test suggests all the macroeconomic series are stationary at first difference but the level of significance varies (see Appendix A2). The IR, LIPI and ER are stationary at the 1% level of significance; however, LCPI series is stationary at the 5% significance level. Further, Autoregressive Conditional Heteroskedasticity-Lagrange Multiplier (ARCH-LM) test and Q-stats confirms the presence of (Autoregressive Conditional Heteroskedasticity) ARCH effect. Therefore, following Rauf and Rashid (2019) we use (G)ARCH[4] models to acquire the (G) ARCH variance series.

In light of the results of ARCH-LM test and Q-stats we estimate GARCH models to get the GARCH variance series of all the macroeconomic variables. The results

4 *Generalized autoregressive conditional heteroscedasticity.*

presented in Appendix A3 shows that all the macroeconomic series are stable.

In light of the results of ARCH-LM test and Q-stats we estimate GARCH models to attain the GARCH variance series of all the macroeconomic variables. The results presented in Appendix A4 shows that all the macroeconomic series are stable. Appendix A4 shows that, the minimum, maximum, mean, and standard deviation of GER is the highest and the minimum, maximum, mean and standard deviation of GCPI are the least. The comparison among the macroeconomic volatility series on the basis of mean and standard deviation shows that the GIR series is the most volatile series followed by GCPI. However, the volatility series of GIPI and GER are relatively stable. Furthermore, at level all the macroeconomic volatility series are stationary.

Table1 depicts the summary statistics of the full sample of micro level variables. The mean value of firm size is 11.899 with a low standard deviation of 4.183. This shows that the deviations among the firm size are relatively lower than all other micro level variables. Similarly, among the explanatory variables, firm age mean value is 26.577 with SD 18.624. In our data, most of firms do not spend on R&D. Mean value of R&D is 0.0041.The reason behind low investment in R&D is that the Pakistani firms normally do not invest in R&D activities. Tang, Gao and Ma (2019) have also documented that most of firms do not incur R&D expenditures. Mean value of the leverage is 0.632 with SD of 0.409 a similar finding is also reported for Pakistani firm level data by Mahmud and Qayyum (2003).

Table 1: Descriptive Statistics of Firm Level Variables

Variable	Mean	Std. Dev.	P25	P50	P75
Firm Growth	38.52	203.29	-0.034	0.115	0.298
Firm Size	11.899	4.183	7.010	13.368	14.934
Firm Age	26.577	18.624	13	24	38
R&D Expenditures	0.0041	0.0292	0.001	0.002	0.004
Leverage	0.632	0.409	0.470	0.631	0.758
Tobin Q	0.882	6.445	0.582	0.756	0.938
Investment	0.1170	0.5460	0.039	0.078	0.146
Profitability	0.1539	0.165	0.069	0.136	0.224
Cash	0.0443	0.0868	0.004	0.013	0.043

Table 2 documents the descriptive statistics of firm, industrial, market and macroeconomic volatilities. SD and range suggest that firm volatility is less volatile than the industrial volatility. Mean of firm (industrial) level volatility is 0.41297 (0.55278) respectively. SD of industrial volatility 0.7212 is also larger than SD of firm volatility 0.4746. Similarly, maximum and minimum values of industrial volatility are also much more extreme than all the other volatility series. Therefore, we can conclude that the industrial volatility is most extreme followed by firm-specific volatility.

Table2: Descriptive Statistics of Micro and Macro Volatilities

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Firm level volatility(σ^{firm})	4826	0.41297	0.47476	0.00155	12.276
Industry level volatility ($\sigma^{Industry}$)	9316	0.55278	0.7212	0.00023	18.998
Market level volatility (σ^{Market})	9278	0.00025	0.00017	0.00008	0.0008
Macro level volatility (σ^{Macro})	360	0.77198	0.13818	0.58280	1.2732

4.2. Volatility and firm growth

In this section, we report empirical findings based on models presented in equations (1), (2), and (3). Table 3 consists of three models. Col.(1) dedicated to our baseline model. Similarly, col.(2) is the extended form of baseline model in which we incorporate four different volatility measures. Finally, in col.(3) we include six different interaction terms of the volatilities. The dependent variable firm growth is regressed on its own lag other explanatory variables are size, age, R&D, leverage, Tobin Q, investment, profitability, cash and the industrial dummy. The AR(1) and AR(2) statistics indicates the presence (absence) of first (second) order serial correlation in the residuals. Similarly, Hansen J statistics validates the validity of instruments used in the estimation.

The coefficient of lagged dependent variable in all the three models is positive and statistically significant at the 1% significance level. Therefore, it is confirmed that the estimated models are dynamic in nature. Statistically significant positive coefficients of the lagged firm sales growth is in accordance with other studies (Gurbuz *et al.,* 2017; Behrens &Trunschke, 2020). The impact of size on firm growth is negative and highly significant in all of the three models. It shows that, as the size of the firm reaches to a particular threshold level, then growth may decline. That is the significant negative coefficient of size indicates that the Pakistani manufacturing firms are on average larger than the optimal size suggested by the classical theory. Therefore, the size is negatively related with the firm growth. The classical theory of optimal size suggests that there is an optimal size of a firm. Firms' initially grow to achieve an optimal size. Furthermore, at the optimal point firms minimize average cost of production. The possible explanation can be that the smaller firms tend to grow quickly as compare to their counterparts. The negative impact of size on firm sales growth is consistent with (Quader, 2017; Oliveira & Fortunato, 2017; Abuhommous, 2017; Hedija, 2017; Krasniqi & Lajgi, 2018; Arouri et al., 2018; Fiala & Hedija, 2019; Yang &Tsou, 2019; Mbulawa & Ogbenna, 2019; Bai *et al.,* 2020; Lin & Wu, 2020).

The association between age and firm sales growth is positive. It can be explain as the age of the firm increases it reflects in the better and prudent policies adopted by the firm. Therefore, firm with high experience (number of years) in the business have high sales growth. These findings are in line with (Leoncini*et al.,* 2016; Arouri *et al.,* 2018). Particularly, the learning theory on one hand postulates that experience results in better practices adopted by the firm therefore firms grow overtime. On the other hand, learning theory confirms that overtime the productivity of the workers increases. The reason behind the increase is workers' productivity is the fact that the repetition of the similar tasks by the workers requires lessor and lessor energy and effort.

The impact of R&D on firm sales growth is positive in all three models. Surprisingly, the level of significance for this positive relationship has a unique similarity although the magnitude of the coefficient varies. The positive association between R&D and firm sales growth in all the models is consistent with the existing literature (Ahn, Yoon & Kim, 2018; Zhu *et al.,* 2021). In all the cases, the association between leverage and firm growth is positive and statistically significant. It shows that highly leveraged firms grow faster than their counterparts (Masila, 2019). The reason behind the flouring impact of leverage on growth of the firm is the fact that in the 21st century the most important managerial resource is the recruitment of young managers. Hiring of new young managers require monetary spending and these spending are financed by the debt financing. The new recruits well equipped with the latest knowledge and technologies are not only good for the firm, but they may also transfer their latest knowledge to the existing experienced managers. The result is in accordance with the Penrose's (2009) theory that the firm growth requires managerial recourses.

The association between Tobin Q and firm sales growth is also positive in the underlying models. The positive coefficient of Tobin Q imply that an increase in Tobin Q have a flourishing impact on firm growth. The positive link between Tobin Q and firm sales growth is in line with the standard economic theory (Fu *et al.,* 2016). Similarly, the impact of investment on firm sales growth is also positive in all of the cases. The investment by firm results in enhancing productive capacity of the firm and ultimately firm grows. The finding is in line with (Mathew, 2017). Further, the significant positive coefficient of Tobin Q is consistent with the theoretical expectation. Impact of profitability on firm growth is also positive for all the estimated models. Profitable firm will grow faster than their counterparts because profitable firms with higher return on assets are in an excellent position to grow (Kachlami & Yazdanfar, 2016). However, less profitable firms tend to suffer. We also find a positive connection between cash and firms'sales growth in all the models. Numerous researchers have reported positive impact of cash on firm growth (Moore *et al.,* 2009; Serrasqueiro &

Nunes, 2016; Mbulawa & Ogbenna, 2019; Bai *et al.*, 2020).

4.2.1. Direct and indirect effects of volatility

To explore the impact of volatilities on firm sales growth we have incorporated four additional volatilities in our second model col.(2) it is found that the impact of macroeconomic volatility and industrial volatility on firm sales growth is negative and highly significant as presented in col.(2). However, the impact of market volatility and firm level volatility on firm sales growth is positive as presented in col.(2). The theoretical positive association between volatility and firm growth is also reported by Abel (1983). Consistent with the first hypothesis the impact of all the micro and macro level volatilities is negative as presented in col.(3).

For more insight and in depth analysis to understand the determinants of firm growth, we incorporate six volatilities, namely firm-industry, firm-market, firm-macro, industry-market, industry-macro, market-macro.The effects of interactive volatility terms are positive. The interactive effects of firm level volatility with industrial and market volatility are positive and highly significant. This shows that a rise in firm level volatility deteriorate the negative impact of industrial and market volatility on firm growth. Similarly, the coefficients of industry-market, industry-macro, and market-macro interaction terms are statistically significant positive at 1% significance level. This confirms that the increase in industrial volatility decreases the negative impact of market and macroeconomic volatility on firm growth. In a similar fashion, higher market volatility reduces strong negative effects of macroeconomic volatility on firm growth.

Table 3: Two-Step System-GMM Estimates for Effects of Volatility on Firm Growth based on Sales

	(1) Firm Sales Growth	(2) Firm Sales Growth	(3) Firm Sales Growth
Lagged Firm Growth	0.0031***	0.1675***	0.0021***
	(0.0000)	(0.0001)	(0.0001)
Size	-0.1253***	-0.160***	-0.2376***
	(0.0001)	(0.0003)	(0.0023)
Age	0.0025***	0.0009***	0.3107***
	(0.0000)	(0.0001)	(0.0038)
R&D	0.0009***	0.0010***	0.0238***
	(0.0000)	(0.0001)	(0.0009)
Leverage	0.5008***	0.3625***	0.2832***
	(0.0002)	(0.0026)	(0.0073)

TobinQ	0.0025***	0.0282***	0.0315***
	(0.0000)	(0.0018)	(0.0019)
Investment	3.000***	2.2200***	0.0423***
	(0.0008)	(0.0049)	(0.0023)
Profitability	1.6005***	0.9852***	1.4257***
	(0.0001)	(0.0009)	(0.0580)
Cash	0.2800***	0.4270***	0.0299***
	(0.0005)	(0.0549)	(0.0036)
Macro volatility		-0.9011***	-8.0498***
		(0.0009)	(0.2103)
Market volatility		5.2767***	-2.3043***
		(0.0078)	(0.2331)
Industrial volatility		-0.1800**	-1.1533***
		(0.0035)	(0.0186)
Firm volatility		2.9612***	-3.4067***
		(0.0008)	(0.3027)
Firm volatility × Industry volatility			3.1431***
			(0.0450)
Industry volatility × Market volatility			7.1392***
			(1.0886)
Industry volatility × Macro volatility			1.7111***
			(0.0270)
Market volatility × Macro volatility			2.5739***
			(0.3211)
Constant	1.3886***	1.2924***	0.4395
	(0.0084)	(0.0170)	(15.8007)
Obs.	5270	3175	3377
Firms	414	364	372
Instruments	405	353	355
Industrial Dummy	YES	YES	YES
Validity Tests			
AR(1)	-8.08 [0.000]	-5.16 [0.000]	-4.62 [0.000]
AR(2)	-1.41 [0.158]	-1.35 [0.176]	-0.01 [0.996]
Sargan	8269.02 [0.000]	1064.07 [0.000]	708.82 [0.000]

Hansen	393.16 [0.167]	296.70 [0.711]	270.02 [0.937]
Standard errors are in parenthesis. Probability values are in square brackets. *** p<0.01, ** p<0.05, * p<0.1			

4.3. Marginal effects of volatility on firm sales growth

4.3.1. Marginaleffects of firm volatility

In order, to get a clear picture of the marginal effects of micro and macro volatilities,various percentiles of each volatility are constructed. Figure 1 shows the marginal effect of firm volatility on firm growth at different percentiles of industrial volatility. We find that at the higher level of industrial volatility the marginal impact of firm volatility on firm growth seems to approach zero. Therefore, a rise in industrial volatility strengthens the association between firm volatility and firm growth. It is worth mentioning to note that at all levels of industrial volatility the marginal impact of firm volatility on firm growth remains a negative.

Figure 2 highlights the positive association between marginal effect of firm volatility and market volatility. Market volatility supports overall impact of firm volatility on firm growth. For example, at 10^{th} percentile, the positive marginal impact of firm volatility on firm growth is approximately 0.16. At 20^{th} percentile marginal impact of firm volatility is 0.16. The said impact becomes 0.24 at 90^{th} percentile.

However, contrary to Figures 1 and 2, Figure 3 indicates the weaken effect of firm volatility on firm growth with rise in macroeconomic volatility. Therefore, at the initial level of macro volatility the marginal effect of firm volatility on the dependent variable is a negative and low but later on it becomes high and negative. It indicates that the rise in macroeconomic volatility is responsible for the diminishing impact of firm level volatility on firm growth.

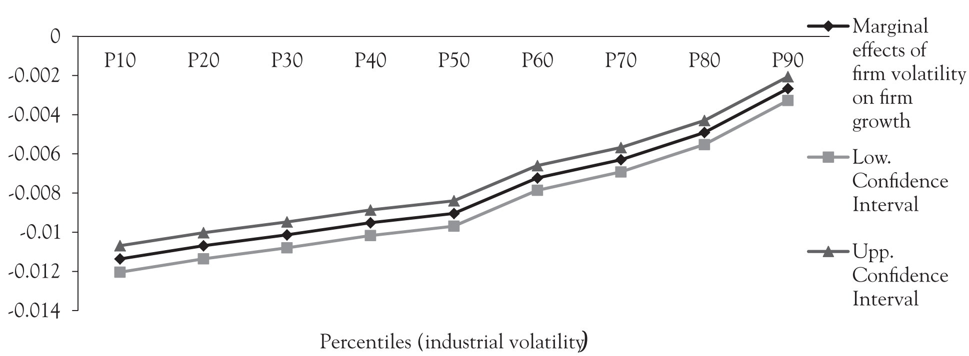

Figure 1: Marginal Effects of FirmVolatility on Firm Sales Growth across Industrial Volatility

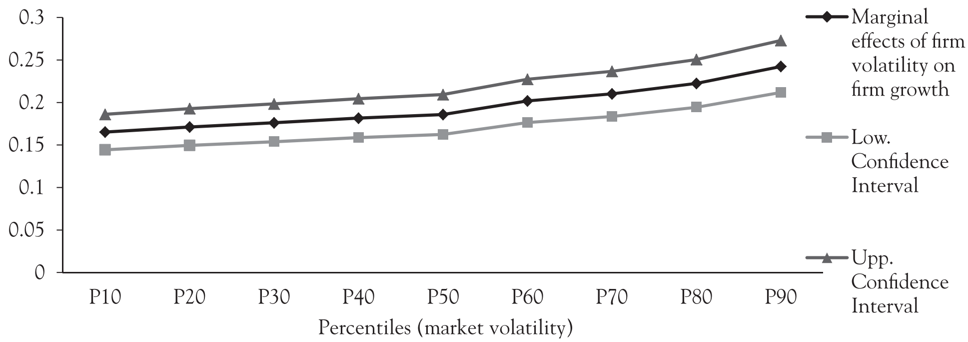

Figure 2: Marginal Effects of Firm Volatility on Firm Sales Growth across Market Volatility

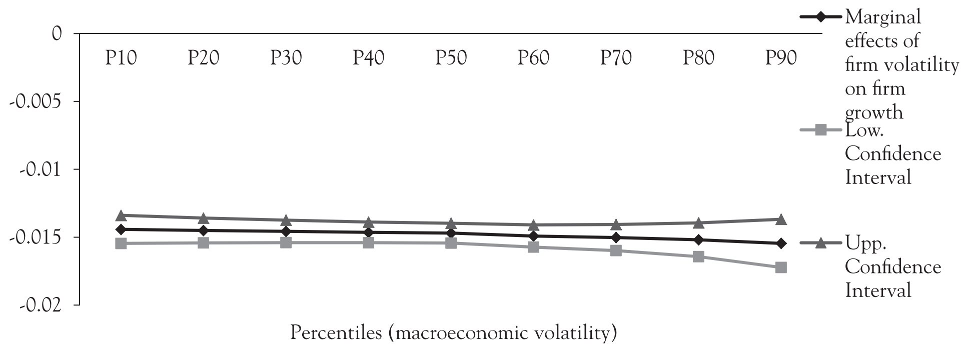

Figure 3: Marginal Effects of Firm Volatility on Firm Sales Growth across Macroeconomic Volatility

4.3.2. Marginal effects of industrial volatility

In all the figures specific level of volatilities which have been computed at 10^{th}, 20^{th}, 30^{th},40^{th},50^{th},60^{th}, 70^{th},80^{th} and 90^{th} percentiles are presented on the horizontal axis. Just like the initial three graphs the next three figures represent the graphs of marginal effects of industrial volatility on firm sales growth. Figure 4 shows that market volatility modifies the positive relationship between industrial volatility and firm growth. That is, at 10^{th} percentile the marginal effect of industrial volatility is smaller than, the marginal effect of industrial volatility at 20^{th} percentile. Similarly, the marginal effect of industrial volatility keeps on increasing with a rise in market volatility. The rise in graph of marginal impact of industrial volatility on firm growth indicate that the role of market volatility for the impact of industrial volatility on firm growth remains the same whatever the level of market volatility is.

Figure 5 shows that macroeconomic volatility tend to favor the marginal impact if industrial volatility on firm growth. For example, 10^{th} percentile the marginal effect of industrial volatility is negative, and its magnitude continuously increases. For example, at 20th percentile marginal impact of industrial volatility on firm growth becomes positive. Similarly, graph shows consistent uninterrupted increase in the marginal impact of industrial volatility on firm growth as the line of marginal effect of industrial volatility move from left to right. Therefore, graph indicates that higher and higher macroeconomic volatility strengthens the association between industrial volatility and firm growth.

The last graph of the marginal impact of industrial volatility also shows the strong positive link between firm volatility and marginal effect of industrial volatility on firm sales growth. The graphs presented in Figures 4, 5 and 6 shows increasing trend. These graphs confirm the positive interactive effects of industrial volatility with firm, market and macroeconomic volatilities respectively. These graphs show that unwanted variations at both micro and macro level modify the association between industrial volatility and firm sales growth individually as well as collectively.

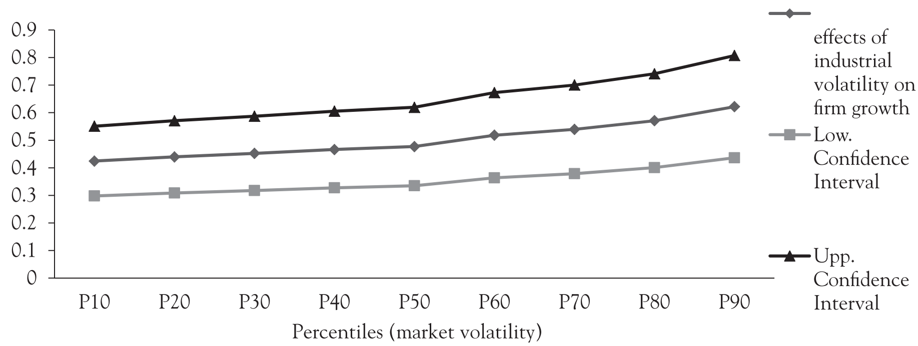

Figure 4: Marginal Effects of Industrial Volatility on Firm Sales Growth across Market Volatility

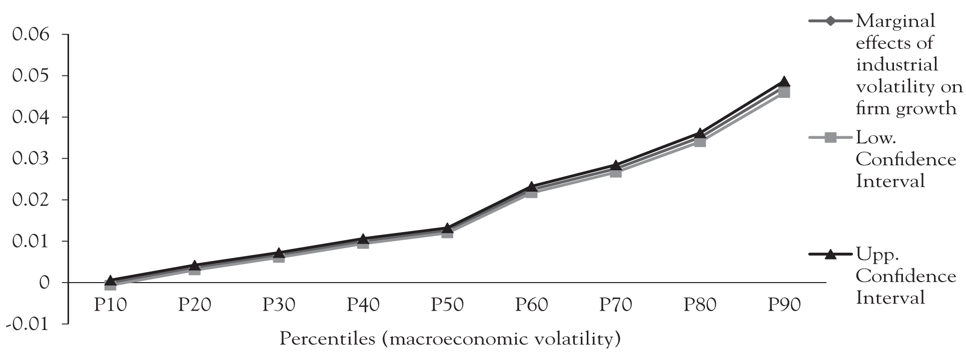

Figure 5: Marginal Effects of Industrial Volatility on Firm Sales Growth across Macroeconomic Volatility

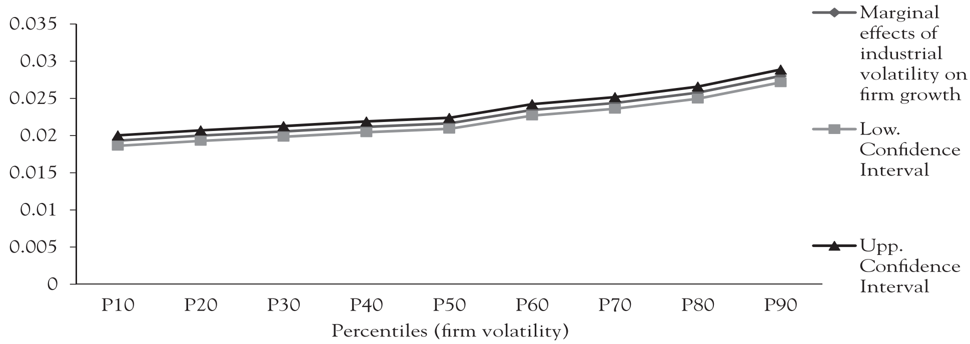

Figure 6: Marginal Effects of Industrial Volatility on Firm sales Growth across Firm Volatility

4.3.3. Marginal effects of market volatility

Similarly, Figure 7 shows that the marginal effect of market volatility on firm growth is positive and increasing with increase in macroeconomic volatility. At 10th percentile the coefficient of marginal effect of market volatility on firm growth is approximately 0.63 ultimately it rises to approximately 1.37 at the 90th percentile. Therefore, it can be concluded thatmacroeconomic volatility strengthens the positive association between market volatility and firm sales growth.Furthermore, the line of marginal effects of market volatility on firm sales growth is relatively flatter in the first half as compared to the second half. This indicates the association among macroeconomic volatility and the impact of market volatility on firm growth is weaker in the first half as compared to the second half.

Figure 8 shows marginal effect of market volatility on firm sales growth at various levels of firm volatility. Graph in Figure 8 depicts throughout positive marginal impact of market volatility on firm sales growth. It can be observed that the marginal effect of market volatility on firm sales growth rises as the line of marginal impact moves from the 10th percentile (extreme left of graph) to the 90th percentile (extreme right of graph). Therefore, the interaction between market and firm volatility is positive and strong.

Figure 9 also presents a positive marginal effect of market volatility on firm growth but contrary to the previous graph the line depicting marginal effects of market volatility on firm growth is flatter. Otherwise, the case is same as presented in the previous graph. Here, the only difference found is the magnitude of the effect is relatively smaller in the present case than the previous case. On the whole, the increasing functions presented inFigures 7 to 9 shows the positive link between micro as well as macro volatilities and the impact of market volatility on firm sales growth.

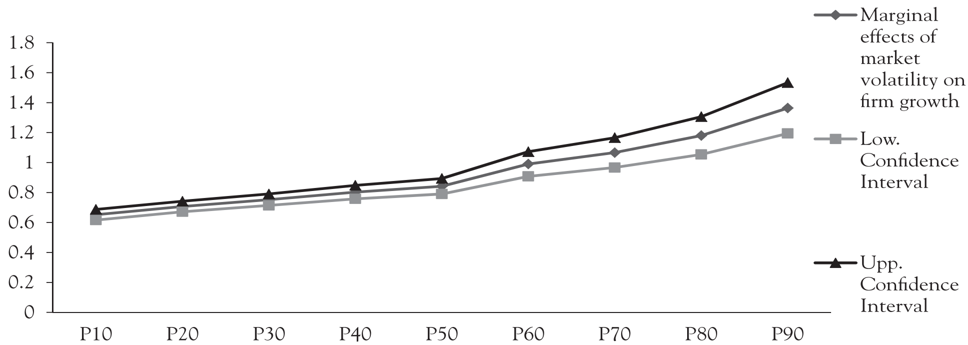

Figure 7: Marginal Effects of Market Volatility on Firm Sales Growth across Macroeconomic Volatility

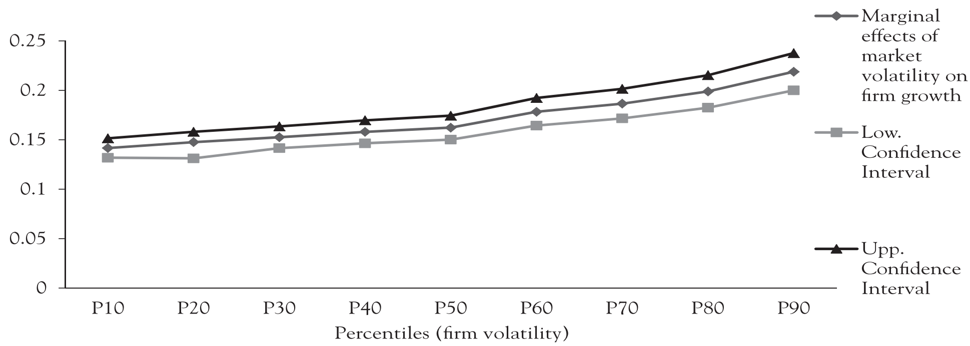

Figure 8: Marginal Effects of Market Volatility on Firm Sales Growth across Firm Volatility

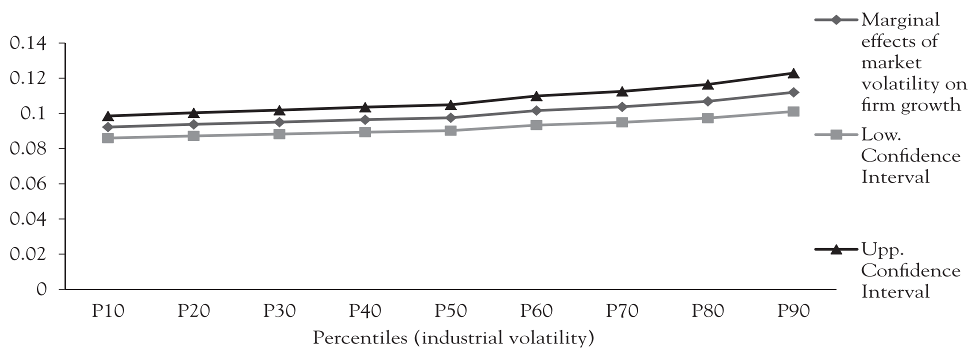

Figure 9: Marginal Effects of Market Volatility on Firm Sales Growth across Industrial Volatility

4.3.4. Marginal effects of macroeconomic volatility

In this subsection, we portray the marginal effects of macroeconomic volatility on firm growth graphically and its interpretation. For instance, Figure 10 shows the marginal impact of macroeconomic volatility on firm growth. Throughout the figure the marginal impact of macroeconomic volatility on firm growth remains positiveregardless the level of firm volatility. Further, the magnitude of the positive coefficient of macroeconomic volatility diminishes with an increase in firm level volatility. Therefore, higher and higher firm volatility reduces the magnitude of the positive association between macroeconomic volatility and firm growth.

Figure 11 shows the positive association of macroeconomic volatility on firm growth at various percentiles of industrial volatility. The marginal effect of macroeconomic volatility on firm growth is low at 10th percentile of industrial volatility than the 90th percentile of the industrial volatility. Therefore, it can be concluded the higher level of industrial volatility enhances the positive impact of macroeconomic volatility on firm growth.

Figure 12 shows that the marginal effect of macroeconomic volatility on firm growth remains positive regardless the level of market volatility. Further, increase in market volatility results in an increased coefficient of marginal effect of macroeconomic volatility. Therefore, market and industrial volatility individually and collectively strengthens the marginal impact of macroeconomic volatility on firm growth. Contrarily, the rise in firm level volatility weakens the impact of macroeconomic volatility on firm sales growth.

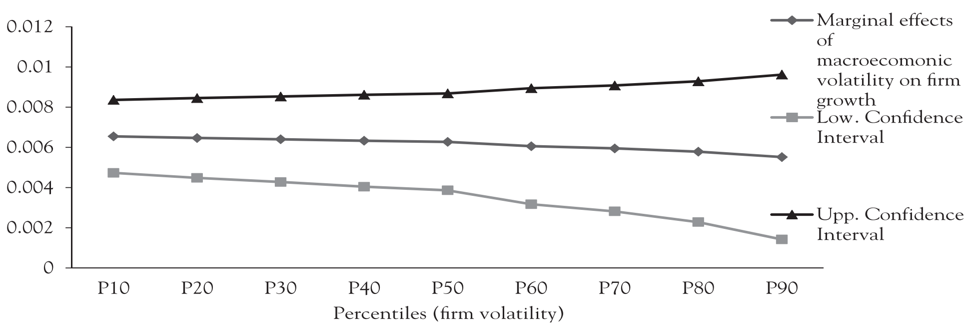

Figure 10: Marginal Effects of Macroeconomic Volatility on Firm Sales Growth across Firm Volatility

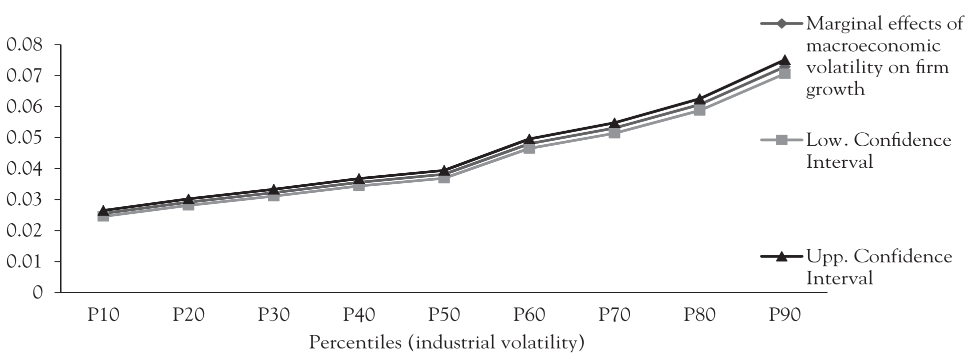

Figure 11: Marginal Effects of Macroeconomic Volatility on Firm Sales Growth across Industrial Volatility

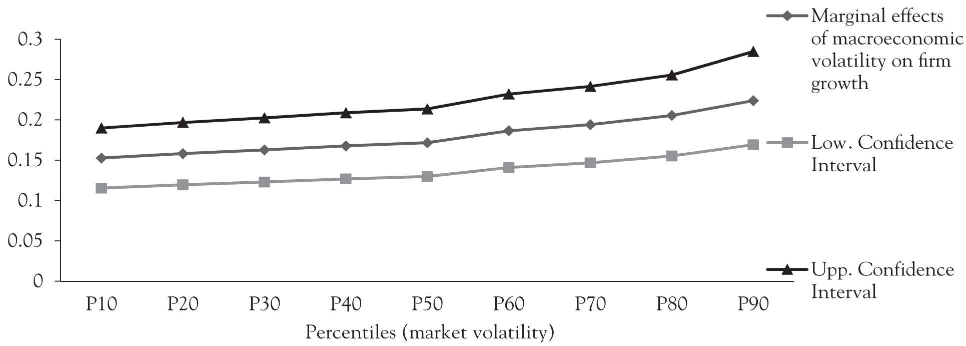

Figure 12: Marginal Effects of Macroeconomic Volatility on Firm Sales Growth across Market Volatility

5. Conclusions and Policy Implications

In this study, we empirically investigate the impact of various volatilities (firm level, industrial level, market level and macroeconomic) on firm sales growth of all the non-financial firms of Pakistan over the period of 1988-2017using two-step system GMM. Firm level volatility is based on three volatilities namely sales, cash flow, and stock price volatilities.On the other hand, macroeconomic volatility is based on CPI, ER, IR and IPI volatilities. Furthermore, we also considered the pair wise interactive effects of these volatilities and depict the marginal effects through graphical presentation.

The impact of size on firm growth is negative, indicating that the large firms tend to grow slower than the small firms.The empirical findings suggest that industrial and market volatilities weaken the negative impact of firm level volatility on firm sales growth. Similarly, the market and industrial volatilities reduce the negative impact of macroeconomic volatility on firm sales growth. Furthermore, firm, market, and macroeconomic volatilities diminish the negative impact of industrial volatility on firm sales growth. Furthermore, the impact of industrial volatility on the coefficient of interest is comparatively stronger than firm and macroeconomic volatilities.Volatility is integral part of decision making particularly in financial matters. Therefore, it is essential for the policy makers to design prudent policies and take necessary steps to tackle these volatilities.

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Appendix A

Appendix A1

Descriptive Statistics of Macroeconomic Variables				
Variables	**IR**	**LCPI**	**LIPI**	**ER**
Mean	11.01317	3.938175	4.307356	108.2596
Maximum	15.64000	5.074829	5.157445	141.5430
Minimum	3.940000	2.657870	3.405039	89.47218
Std. Dev.	3.218365	0.709621	0.450563	11.49910
Observations	360	360	360	360
IR is interest rate, LCPI is log of consumer price index, LIPI is log of industrial production index ER is exchange rate.				

Appendix A2

Unit Root Results						
Variables	**ADF- Stats (at level) with Constant**		**ADF- Stats (At level) with Constant and Linear Trend**		**ADF- Stats (At First Difference) with Constant**	
	t-stat.	**Probability**	**t-stat.**	**Probability**	**t-stat.**	**Probability**
IR	-2.640	0.086	-2.706	0.235	-3.850	0.003
LCPI	-0.954	0.770	-2.195	0.491	-2.899	0.046
LIPI	-0.718	0.839	-1.278	0.892	-6.099	0.000
ER	-2.182	0.213	-1.654	0.769	-8.892	0.000
IR is interest rate, LCPI is log of consumer price index, LIPI is log of industrial production index ER is exchange rate.						

Appendix A3

ARCH/GARCH Estimates for Macroeconomic Risk				
Regressors	ΔLCPI	ΔLIPI	ΔER	ΔIR
Constant	0.005*** (0.0004)	0.003 (0.004)	-0.042 (0.114)	-0.010 (0.055)
AR(1)	-0.541*** (0.130)	0.329 (1.389)	-0.176 (0.143)	-0.138 (1.505)
MA(1)	0.749*** (0.110)	-0.293 (1.391)	0.522 (0.124)	0.074 (1.462)
Constant	0.000003* (0.00001)	0.00006 (0.00005)	1.161* (0.615)	0.162*** (0.053)
ARCH(1)	0.072** (0.029)	0.021** (0.010)	0.172*** (0.063)	0.114*** (0.036)

GARCH(1)	0.865*** (0.053)	0.968*** (0.014)	0.431* (0.240)	0.564*** (0.118)
Diagnostic Tests for Remaining GARCH Effects				
Log-likelihood	1259.252	360.027	-689.971	-262.287
Observations	358	358	358	358
LM-test	0.021	0.008	0.037	0.576
P Value	0.883	0.926	0.847	0.448
Q-stat	0.022	0.009	0.037	0.585
P Value	0.883	0.926	0.848	0.444
Note: ***, ** and * represents significant at the 1%, 5%, and 10% level, respectively.				