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Volatility and Firm Growth: Do Firm Size and Age Matter?

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ABSTRACT

The impact of different types of volatility on the growth of Pakistani-listed non-financial firms is examined by using annual unbalanced panel data over the period 1988–2017. The differential effects of volatility conditional on firm size and age are also explored. The results indicate that the influence of firm volatility on firm growth is positive for small firms and negative for medium, large, young, and mature firms. The impact of market volatility is positive (negative) for small, young, and mature (large) firms. Industrial volatility has a negative impact on mature firms' growth, but the impact on young, small, medium, and large firms is positive. Finally, the results indicate that the impact of macroeconomic volatility is positive for small firms but negative for large, young, and mature firms.

Keywords

Firm growth; industrial volatility; firm volatility; macroeconomic volatility; market volatility; firm age; firm size

JEL Classification

D22; D80; L25

1. Introduction

Firm growth plays a vital role in the growth and development of an economy (Farnoodi *et al.*, 2020). Firm growth is important because growing firms generate more employment opportunities for the masses (Horbach and Rammer, 2020). Hence, it reduces unemployment and improves the wellbeing of the masses (Wadho *et al.*, 2019). The existing literature on firm growth advocates that all firms go through different stages of growth, usually called lifecycles (Kolesa, 2021). Each firm has to start, grow, and finally mature while facing different challenges and crises (Perkins and Khoo-Lattimore, 2020). The history of the enterprise, age, size, and location are some of the important factors that influence firm growth.

An important dimension of empirical research on firm growth is to study how firm, market, industrial, and macroeconomic volatilities affect the growth of firms' assets and sales. Nevertheless, the theoretical link between volatility and growth is ambiguous (Imbs, 2007).

Similarly, the existing empirical studies also provide mixed results. For example, Hung *et al.* (2019), Dhasmana (2021), Dincer *et al.* (2022), and Ekanayake and Dissanayake (2022) report a negative link between volatility and firm growth. In contrast, Black (2009) and Fountas and Karanasos (2006) find a positive relationship. However, there are some studies, including Blackburn and Pelloni (2004), Wong (2019), and Tarasenko (2021), that also report mixed relationships between volatility and firm growth. One of the recent studies by Baris-Tuzemen and Tuzemen (2021) also finds no significant impact of volatility on firms' growth.

Knight (1921) has defined volatility as "uncertainty as people's inability to forecast the likelihood of events happening". Volatility is the exposure to a hazard, a danger, or the probability of loss (Rauf and Rashid, 2019). The theories on the relationship between volatility and firms' growth suggest that the impact of volatility on firms' growth may differ for firms with different firm-specific characteristics. For example, firms that are large and mature are considered to have a higher capacity to absorb external and internal shocks. Thus, it is likely that their growth will be affected by volatility very differently than that of their other counterparts. The positive theoretical connection between volatility and the growth of firms is presented by Abel (1983) and Hartman (1972). Duru *et al.* (2022) document the mixed impact of volatility on firm growth. Similarly, Ghosal and Loungani (2000) highlight the negative link between volatility and firms' growth. A literature survey suggests that volatility may affect firm growth because of the irreversibility of investment and the risk-averse nature of firms. In addition, the differential impact of volatility on firms' growth is dependent on several firm-specific characteristics. Firm size significantly affects firms' ability and performance (Tho, 2018; Shahrin and Ibrahim, 2021). In a competitive market, firm size plays an important role. Large firms usually have an abundance of financial as well as human resources (Castriota and Delmastro, 2008) that allow them to grow faster and to absorb any negative internal as well as external shock. Economies of scale are also a factor that helps large firms absorb negative shocks by minimising production costs through bulk production (Rashid *et al.,* 2021). Large firms are also likely to face less risk due to foreign operations than small firms. Large firms generally produce a number of different goods (Sahay, 2014). More than half of world production is produced by large firms (Wakabayashi and Arimura, 2020). Therefore, these firms benefit from economies of scale through joint production and marketing at home as well as in foreign markets. Thus, the growth of large firms is likely to be less affected by firm, industrial, market, and macroeconomic variables.

Firm age is also an essential determinant of firm growth (Brummund and Connolly, 2019; Tsaedu and Chen, 2021). Firm age significantly affects the ability and performance of firms (Angelidou *et al.,* 2022). Over a period of time, firms learn, and hence, mature firms can tackle volatility more efficiently than their young counterparts (Henrekson and Sanandaji, 2018). For example, mature firms are more likely to produce the most desired products among consumers. Young firms may not be in a position to accurately forecast the demand. Hence, they are reluctant to produce on a larger scale. Costs of production may remain high for young firms and low for mature firms. In a similar manner, the anticipation of variations in market demand also requires

experience. Furthermore, mature firms generally produce a number of different goods for domestic and foreign markets. Empirical evidence also shows that economies of scope are positively linked with the growth of US firms (Choi, 2010). Therefore, the age of a firm may also affect the impact of volatility on firms' growth.

The empirical literature indicates that limited research work is available on the impact of volatility on firms' growth. Further, the existing literature does not provide adequate information on the underlying topic. By reviewing the literature, we observe four main gaps. First, limited empirical work is available on how volatility affects firm growth. A few existing studies have focused on developed countries, and therefore, we do not have any empirical evidence for emerging and developing economies on this topic. Second, prior studies (see, for example, Chong and Gradstein, 2009; Patel *et al.*, 2012; Bloom *et al.*, 2022) have just considered either firm volatility or macroeconomic volatility while examining the impact of volatility on firm growth. However, for an in-depth and complete understanding of how volatility determines firm growth, it is vital to examine whether different types of volatility, namely firm, industrial, market, and macroeconomic volatility, affect firm growth differently. Third, the available literature (see, for instance, Chong and Gradstein, 2009; Rauf and Rashid, 2021) is completely silent about the moderating role of firm-specific characteristics such as firm age and firm size in formulating the impact of different types of volatilities on firms' growth. Fourth, none of the studies has so far examined whether one type of volatility increases or decreases the influence of another type of volatility on firms' growth. Yet, from the point of view of risk management, it is very important to know that firms face simultaneously different types of volatility in their operations and decision-making processes.

This study addresses these limitations in the literature by providing an empirical investigation on the role of firm size and age in explaining the impact of industrial, firm, market, and macroeconomic volatilities on the growth of non-financial firms in Pakistan. Specifically, to check the impact of volatility on the growth of different-size firms, we categorise firms into small, medium, and large firms based on their total assets. The categorization of firms (small, medium, and large) is not taken into account in the previous literature, particularly in the case of Pakistan. Furthermore, in this study, we empirically investigate whether young and mature firms respond differently to volatility. Finally, for a better understanding of the nexus between volatility and the growth of the firm, we also incorporate the interactions between firm volatility, industry volatility, market volatility, and macroeconomic volatility into the empirical model.

The impact of industrial, firm, macroeconomic, and market volatility on small firms' growth is positive. However, the impact of firm, market, and macroeconomic volatility on large firms' growth is negative. Similarly, the impact of firm and macroeconomic (market) volatility on firm growth of young and mature firms is negative (positive). Further, the interaction terms indicate that the positive impact of firm volatility on small firms' growth diminishes with the increase in industrial and macroeconomic volatility. Macroeconomic volatility diminishes the positive impact of market volatility on small firms' growth. However, industrial volatility

increases the positive impact of market volatility on small firms' growth. In a similar manner, firm, industrial, and market volatility also limit the positive impact of macroeconomic volatility on small firms' growth. In the next section, we cover a literature survey followed by the heterogeneous effects of volatility on firms' growth. In Section 3 of the empirical model, variable descriptions and measurements of industrial, firm, market, and macroeconomic volatilities are presented. In Section 4, we present descriptive statistics and the empirical findings. The last section is based on conclusions.

2. Literature Review

2.1 Volatility and Firm Growth

The first strand of the literature supports a positive connection between volatility and firm growth. The positive relationship is based on the idea of creative destruction introduced by Schumpeter (1939). Later on, Rayan (2016) and Begovic (2021) also supported his view. Evolutionary firm growth theory has its roots in the concept of "creative destruction" presented by Schumpeter. The theory states that only the most efficient and profitable firms survive and capture market share, while the least efficient firms cannot do so and are forced to exit the market. Fitter firms may reinvest their profits, and reinvestment of their earnings is responsible for firm growth (Downie, 1958). Fast-growing firms have been found to reinvest profits (Connell *et al.*, 2021). The competitive advantage postulates that all firms compete with one another by adopting industry best practices and innovations. In addition, Hartman (1972) and Abel (1983) presented a theory that, in a perfectly competitive market in the presence of volatility and risk, firms want to maximize their net worth. In addition to this, risk-loving investors want to invest more under uncertain circumstances, while risk-neutral investors are not affected by higher or lower volatility. These firms have to borrow to finance investment. Therefore, volatility favours investment and, ultimately, firm growth.

The second strand of the literature reports a negative theoretical relationship between volatility and growth. Lower growth rates are associated with highly volatile countries (Rauf and Rashid, 2021). Furthermore, a negative relationship between growth and volatility persists even after controlling time- and country-fixed effects (Ramey and Ramey, 1995). Bidirectional causality exists between volatility and output growth (Tsouma, 2014). Trypsteen (2017) documents a negative link between growth and volatility. A negative theoretical link is presented by Caballero (1991) and Nakamura (1999). That is, risk-averse firms are reluctant to invest in a volatile environment; therefore, volatility is negatively related to firm growth. Bloom *et al.* (2022) documented a negative impact of volatility on employment and sales growth at the firm. Furthermore, Aroow (1968) presented the idea that most investments are irreversible; hence, a rise in volatility reduces investment and firm growth.

The third strand of the literature comprises a mixed relationship between volatility and growth. Contrary to Ramey and Ramey (1995), Dawson and Stephenson (1997), and Iyortsuun and Shakpande (2022), there is no significant relationship between volatility and growth. A similar

finding is reported by Grier and Perry (2000). A mixed theoretical link between volatility and firm growth through the channel of investment is presented by Zeira (1990) and Aizenman and Marion (1999). Their theoretical explanation for the mixed link between volatility and firm growth is based on the degree of risk aversion. The growth of risk-neutral firms is not affected by volatility.

2.2 Heterogeneous Effects of Volatility on Firm Growth

2.2.1 The Role of Firm Size

Classical theory suggests that there must be an ideal size for the firm, which is based on the concept of minimization of the average cost. The behaviourist theory suggests firms' greater than optimal size can also exist in the economy. In the recent past, the association between size and firm growth has gained the attention of researchers (Eklund, 2020). Larger firms grow faster than smaller firms (Canarella and Miller, 2018; Lefebvre, 2021). Further, the growth of the larger (smaller) firms remains stable (unstable) (Schimke and Brenner, 2011).

A number of researchers' documents show that large firms grow more quickly than small firms. For example, Peric and Vitezic (2016) analyse the manufacturing and hospital industries and find a positive influence of size on firm growth. Canarella and Miller (2018) document that large firms grow faster than small firms. McKenzie and Woodruff (2015) highlight that large firms hire specialized labour force. Therefore, large firms are more productive. Size is positively linked with firms' growth (Kusuma *et al.,* 2021). However, Chung *et al.* (2019) find a mixed relationship between size and firm growth. Large firms have more financial resources; hence, they are in a better position to handle volatility (Becchetti and Trovato, 2002). Based on the existing empirical literature, we empirically test the following hypothesis:

Hypothesis 1: The impact of volatility is higher for small and medium firms than larger firms.

2.2.2 The Role of Firm Age

Young and new firms need relatively more capital to grow than their counterparts (Westhead, 1995), making the transition to get strong resources the process to achieve firm growth (Zhao and Aram, 1995). Further, a lack of financial capital is more harmful to the growth of young firms (Cooley and Quadrini, 2001; Cabral and Mata, 2003). However, Spescha (2019) is of the view that the need for capital R&D is relatively more important for mature firms than for young firms. Furthermore, the analysis of the manufacturing and service industries reveals that young firms generate more employment opportunities than mature firms (Arouri *et al.,* 2020). Coad (2018) documents that firm age contributes towards learning and experience; therefore, mature firms are in an advantageous position in terms of handling the negative impact of volatility on firm growth compared to their counterparts. Models of learning and selection predict that mature firms are more productive as compared to their younger counterparts because the productivity of the firm is affected by its past practices. Hence, mature and experienced firms are least affected by the volatility. Based on the existing empirical literature, we empirically test the following hypothesis:

Hypothesis 2: The impact of volatility on growth is higher for young firms than mature firms.

3. Econometric Model

3.1 Volatility and Firm Growth

We follow Chong and Gradstein (2009) to empirically explore the impact of volatility on Pakistani non-financial firms' growth during 1988-2017. Further, we also investigate the impact of industrial, firm, market, and macroeconomic volatilities on firms' growth. The baseline model is presented in equation (1).

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

where, the dependent variable FG_{it} is the firm sales growth, FG_{it-1} is the lagged firm growth, $Size_{it}$ denotes the size of the firm based on total assets. $R\&D_{it}$ are the research and development expenditures, Age_{it} is the number of years since the firm is operating, $Leverage_{it}$ denotes debt to equity ratio. Tobin Q is the market to book value of the assets, fixed assets are used as a proxy of $Investment_{it}$, $Cash_{it}$ represents the cash holding, $Profitablity_{it}$ denotes the return on assets. σ_{it}^{Firm} is the firm volatility, $\sigma_{jt}^{Industry}$represents the industrial volatility, σ_t^{Macro} is the macroeconomic volatility and σ_t^{Market} denotes the market volatility. (Y_t) represents year fixed effect, (f_i) represents firm fixed effect, (μ_{it}) is the error term and (Dum^{ind}) is the industrial dummy. In the next step, to capture interactive effects of the volatilities, we incorporate volatility interaction terms. The empirical model is presented in equation (2).

$$\begin{aligned} FG_{it} \;=\; & \alpha_0 + \gamma_0 FG_{it-1} \;+\; \gamma_1 Size_{it} + \gamma_2 Age_{it} + \gamma_3 R\&D_{it} + \gamma_4 Leverage_{it} \\ & + \gamma_5 TobinQ_{it} + \gamma_6 Investment_{it} + \gamma_7 Profitablity_{it} \;+\; \gamma_8 Cash_{it} \\ & + \gamma_9 \sigma_{it}^{Firm} + \gamma_{10} \sigma_{jt}^{Industry} \;+\; \gamma_{11} \sigma_t^{Market} \;+\; \gamma_{12} \sigma_t^{Macro} \\ & + \beta_1 \left(\sigma_{it}^{Firm} \times \sigma_{jt}^{Industry}\right) + \beta_2 \left(\sigma_{it}^{Firm} \times \sigma_t^{Market}\right) + \beta_3 \left(\sigma_{it}^{Firm} \times \sigma_t^{Macro}\right) \\ & + \beta_4 \left(\sigma_{jt}^{Industry} \times \sigma_t^{Market}\right) + \beta_5 \left(\sigma_{jt}^{Industry} \times \sigma_t^{Macro}\right) \;+\; \beta_6 \left(\sigma_t^{Market} \times \sigma_t^{Macro}\right) \\ & + f_i + Y_t + Dum^{ind} + \mu_{it} \end{aligned} \tag{2}$$

where $\sigma_{it}^{Firm} \times \sigma_{jt}^{Industry}$is the firm-industrial volatility interaction term, $\sigma_{it}^{Firm} \times \sigma_t^{Market}$ is the firm-market volatility interaction term, $\sigma_{it}^{Firm} \times \sigma_t^{Macro}$ denotes firm-macroeconomic volatility interaction term. Similarly, $\sigma_{jt}^{Industry} \times \sigma_t^{Market}$ represents industrial-market volatility interaction term, $\sigma_{jt}^{Industry} \times \sigma_t^{Macro}$ is the industrial-macroeconomic volatility interaction term and $\sigma_t^{Market} \times \sigma_t^{Macro}$ denotes interaction of market-macroeconomic volatility.

3.2 Variable Description

Firm-level volatility is obtained from stock price volatility (based on daily stock price data), sales volatility, and cash flow volatility. Macroeconomic volatility is calculated from interest rate (IR), industrial production index (IPI), consumer price index (CPI), and exchange rate (ER) volatilities. Industrial volatility is based on total industrial sales. Similarly, the KSE 100 index is used for market volatility. An unbalanced panel data set (for a period of 1988 to 2017) of all the non-financial firms listed on the PSX is collected from the "balance sheet analysis of non-financial firms". The data sources for macro-level variables are the State Bank of Pakistan (SBP) and International Financial Statistics (IFS). In order to mitigate the problem of survival bias, entry and exit of firms are allowed.

3.3 Measuring Volatility

Time varying firm level volatility is based on the estimation technique suggested by Morgan *et al.* (2004). Caglayan and Rashid (2014) and Rauf and Rashid (2021) also used the same technique. Morgan *et al.* (2004) proposed the following model for the estimation of the firm volatility.

$$S_{it} = f_i + f_t + \omega_{it} \quad (3)$$

where (S_{it}) is total sales, $(f_i \; and \; f_t)$ are firm and year fixed-effects, *t* and *i* represents time and firm respectively and ω_{it} is the error term. Following Morgan *et al.* (2004) we estimate cash flow, sales and stock price volatilities to measure firm volatility. Similarly, Industrial volatility is also derived by using the same estimation technique and is based on industrial sales. Following Rashid *et al.* (2022) to measure volatility of IR, IPI, ER and CPI we use GARCH technique. Moreover, macroeconomic volatility is calculated by using the principle component analysis. Similarly, we derive market volatility by utilizing (G)ARCH model for KSE 100 index.

$$\Delta IPI_t = \omega + \beta\,(L)\, IPI_t + \delta\,(L)\varepsilon_t + \varepsilon_t \quad (4)$$

$$\sigma_t^2 = \alpha + \gamma\,(L)\varepsilon_t^2 \quad (5)$$

where (α and ω) are the constants, (β and δ) are autoregressive and moving average parameters. (L) represents lag. The estimated conditional variance (σ_t^2), is a single period ahead forecast variance and (ε_t) is the error.

3.4 Estimation Methods

We utilize dynamic panel model including one period lag value of firm growth (dependent variable). In this study we use the System Generalized Method of Moments (GMM). It gives consistent and relevant estimates. This technique is developed by Arellano and Bond in (1991) and it is considered as the best technique for the dynamic nature of the panel data. Later on this technique was improved by Bover and Arellano (1997) and Blundell Bond (1998). In our study, the total number of firms is greater than the time period, thus under such conditions it is appropriate to use system GMM.

4. Results and Discussion

4.1 Descriptive Statistics

Appendix A1 shows the summary statistics of all the macroeconomic series. In Appendix A1, the least value of ER and LCPI is 89.4 and 2.66, respectively. The standard deviation and average of the macroeconomic series indicate that the IR is the most volatile series. In countries like Pakistan, the IR has been found to be volatile over the past few years (Rauf and Rashid, 2019).

The results of the ADF test show that at first, the macroeconomic series are stationary but at different significance levels (see Appendix A2). IR, ER, and LIPI are stationary at the 1% significance level; however, the LCPI series is stationary at the 5% level of significance. Furthermore, the ARCH-Lagrange multiplier test and Q-stats validate the presence of the ARCH effect. Therefore, we use GARCH[1] models to measure the GARCH variance series as recommended by Rauf and Rashid (2021). Moreover, Appendix A3 shows a stable macroeconomic series.

Table 1 describes the descriptive statistics of the firm-level variables. The average value of firm sales growth is 0.202. Similarly, the standard deviation (SD) of firm sales growth is 0.946. The mean value of R&D is 0.004, which is comparatively closer to the minimum value. The data validates the argument presented by Rauf and Rashid (2021) that Pakistani firms' investment in R&D is the least. Tang *et al.* (2019) also document similar findings. The average value of the leverage is 0.576, with a SD of 0.202. The mean value of Tobin Q is 1.409 with SD of 6.058. Among the explanatory variables, the variable R&D has the lowest mean value of 0.004 with SD of 0.03. Rauf and Rashid (2021) also documented that the R&D expenditures of Pakistani firms are very low.

Table 1: Summary Statistics of Firm-Specific Variables

Variables	Average	Std. Dev.	P25	P50	P75
Firm Growth	0.202	0.946	-0.034	0.117	0.290
Firm Size	14.370	1.557	13.264	14.217	15.323
Firm Age	18.573	6.143	14	18	23
Investment	0.101	0.157	0.042	0.075	0.135
Leverage	0.576	0.202	0.444	0.594	0.723
R&D Expenditure	0.004	0.030	0.001	0.002	0.004
Tobin Q	1.409	6.058	0.718	0.866	1.073
Cash	0.050	0.094	0.005	0.014	0.048
Profitability	0.135	0.136	0.072	0.126	0.192

[1] Generalized autoregressive conditional heteroskedasticity

Table 2 documents the summary statistics of all the variables. Macroeconomic volatility is the most stable series; it has a mean of 0.77198, a SD of 0.13818, and an interquartile range of 0.161. However, the market volatility series with a mean value of 0.00025, a SD of 0.0001, and an interquartile range of 0.0039 is the second most stable volatility series.

Table 2: Summary Statistics of Firm, Industrial, Market and Macroeconomic Volatilities

Variables	Mean	Std. Dev.	P25	P50	P75
Firm level volatility (σ^{firm})	0.41297	0.47476	0.168	0.304	0.520
Industry level volatility ($\sigma^{Industry}$)	0.55278	0.7212	0.1888	0.402	0.706
Market level volatility (σ^{Market})	0.00025	0.00017	0.0001	0.002	0.004
Macro level volatility (σ^{Macro})	0.77198	0.13818	0.630	0.667	0.791

Table 3 documents the correlation among the volatility series. The correlation among all the volatilities is low.

Table 3: Correlation among Volatility Series

	Firm level volatility (σ^{firm})	Industry level volatility ($\sigma^{Industry}$)	Market level volatility (σ^{Market})
Industry level volatility ($\sigma^{Industry}$)	0.177		
Market level volatility (σ^{Market})	-0.048	-0.029	
Macro level volatility (σ^{Macro})	0.024	0.011	0.115

4.2 Firm Size and Volatility Effects

In this section, the results are provided on the basis of firm sales growth. Now we turn to our objective of the study. The possible differences in the results are investigated on the basis of difference in the firm characteristics such as firm size. We categorize firms into small, medium and large size firms to examine the differential impact of volatilities on growth.

We incorporate the lag of firm growth in all the three models and find that the firm growth is dependent on its lagged value. Size of the firm is the most important factor which affects the growth of the firms because, large firms have more resources as compare to small firms. We may expect that the level of human capital and financial resources are relatively more in larger firms than the smaller counterparts. Furthermore, the availability of funds as well as a big team of

managers is essential for large scale operations. Therefore, all these available resources enable the large firms to cope with the harmful effects of the volatilities. These findings are consistent with the economic theory such as theory of returns to scale suggests that only large firms can enjoy economies of the scale. Moreover, smaller firms are exposed to a higher level of risk from the foreign operations. Therefore, smaller firms seem to be in jeopardy.

In addition, McKenzie and Woodruff (2015) documents that more than half of the labor force of emerging economies is comprised of the labor force of small firms. Therefore, small firms significantly contribute towards the economic development of an emerging economy and a separate analysis of small firm growth is essential for a developing economy. Rehman (2016) document that small firms are financially constrained. Therefore, these small firms may start joint ventures to cope with the problem of funds constraint. Furthermore, large firms are in a better position to produce a large number of well diversified products. Such variety of the products enables them to fulfill the needs of the customers. Therefore, they can easily capture the big market share. These larger firms normally enjoy the benefits of joint production and marketing. Furthermore, large firms may handle adverse impact of volatility in a better way than their counterparts.

4.2.1 Direct and Indirect Effects of Volatility

The influence of firm volatility on medium size firms' growth is a negative. However, the effect of industrial volatility on medium size firms' growth is a positive. Further, for large firms the impact of macroeconomic, market and firm volatility is negative while, the impact of industrial volatility on firms' growth is positive. Similarly, the positive and statistically significant impact of macroeconomic, market, industrial and firm volatility on small firms' growth rejects the Hypothesis 1 of the study. For small firms the interaction between firm-industry, firm-macro industry-macro and market-macro volatility have a negative impact on firm growth. Col.(3) of Table 4 also shows the mix effects of interaction terms for large firms. For example, the firm-industry, firm-macro, industry-market and market-macro volatility favors firm sales growth. Similarly, firm-market, and industry-macro volatility have a negative influence on firm growth.

The significant negative coefficient of small firm firm-industry interaction term points that the flourishing impact of industrial volatility on firm growth deteriorates with higher level of firm volatility and vice versa. Similarly, the three other significant negative interaction terms, firm-macro, industry-macro, and market-macro indicate, that impact firm volatility on growth of the firm diminishes with an increase in macroeconomic volatility. The rise in firm, industry and market volatilities weakens the positive relationship between macroeconomic volatility and growth of small firm. Similarly, rise in macroeconomic volatility is also not good for the positive impacts of both market and industrial volatilities on small firm growth. The interaction terms presented in col.(2) represent the interactive effects of volatilities on firm growth of medium size firms. The negative coefficient of firm-market interaction term indicates the rise in market volatility is positively related with the degree of the association between firm volatility and growth of medium size firms. The positive industry-market interaction term highlights the booming impact of rise in market volatility on the degree of association between industrial volatility medium size firms' growth. Similarly, impact of industrial volatility on medium size firms' growth declines with higher level of macroeconomic volatility.

Col.(3) presents the interactive effects of volatilities on firm growth of large firms. The positive firm-industry interaction term implies that rise in firm volatility magnifies the positive

impact of industrial volatility on sales growth of large firms. In a similar manner the rise in industrial volatility diminishes a negative influence of firm volatility on large firms' growth. The significant negative firm-market interaction term suggests that both firm and market volatilities strengthen the desired negative effects of each other on firm growth. The coefficient of firm-macro interaction term is positive and significant. The said positive coefficient proposes that the inverse relationship between firm volatility and large firm growth becomes weaker and weaker with higher and higher macroeconomic volatility. Industry-macro volatility term is significant and negative at 1% level of significance. This implies that higher industrial (macroeconomic) volatility magnifies (reduces) the impact of macroeconomic (industrial) volatility on firms' growth. At higher level of market (macroeconomic) volatility the negative association of macroeconomics (market) volatility on large firm growth diminishes as reported by the significant positive coefficient of market-macro interaction term.

4.2.2 Effects of Control Variables

The coefficients of lagged dependent variable are positive indicating that the model is dynamic in nature. The coefficients of size for both medium and small firms is significant and negative indicates that small as well as medium size firms do not have the capacity to expand and compete with the large firms. In other words, the small and medium size firms are unable to capture the market share of the large counterparts. Negative coefficient of the size is consistent with the overall generalized robust model displayed in Table 4. This represents that, the impact of size is different for the smaller and medium firms than the larger firms. The reason behind this negative association between size of small firms and firm growth is that normally smaller firms supply their output in a nearby local market and enjoy normal profit. Due to smaller scale of operations these small and medium size firms are not in a position to occupy country wide markets. These findings are in line with (Lotti *et al.*, 2003; Serrasqueiro and Nunes, 2016). Managerialism theory postulates that the small firms are normally controlled by the owners whereas large firms are controlled by the managers. Furthermore, the theory predicts that managers' controlled large firms grow faster than the owner controlled firms.

The influence of age on firm growth for extreme cases that is small as well as large firms is positive showing that with the passage of time the firm adopt better practices that is, "learning by doing". The coefficient of R&D for small firms is positive and significant. The possible explanation of the positive coefficient of R&D for small firms is that, the small size firms spend on R&D to develop new products and services for potential future sales growth. The coefficient of leverage is highly significant and positively associated with the firm growth only for the medium size firms. This relationship can be explained as debt financing causes expansion in operations of the medium size firms. However, the impact of debt financing is found to be negative for large firms.

We find positive significant association between Tobin Q and firm growth for small as well as medium size firms. As anticipated the investment and firm growth is positively related irrespective of firm size. This means that more and more investment by non-financial firms enhances sales growth of the firms. The coefficient of profitability is positive in all the cases but the positive coefficient is significant only for smaller and larger firms. Therefore, the influence of profitability on firms' growth is statistically significant positive for both small and large firms but not for medium size firms. In a similar manner, the impact of cash on firms' growth is a positive for medium as well as large firms. The possible explanation can be that the relatively large firms

are in a better position to utilize sufficient amount cash to enhance their production and sales. However, the negative coefficient of cash for the small firms shows that these small firms cannot utilize their cash efficiently. The reason behind the negative association is that the small firms generally face a number of obstacles and challenges. Therefore, these firms cannot exploit benefits of cash holdings.

Table 4: Two-Step System-GMM Estimates for Differential Effects of Volatility on Firm Growth of Small, Medium and Large Firms

	(1) Small size Firm Growth	(2) Medium size Firm Growth	(3) Large size Firm Growth
Lag of Firm Growth	0.0016***	0.0096	0.1051***
	(0.0004)	(0.0293)	(0.0098)
Size	-0.0451**	-0.1162***	-0.0668
	(0.01773)	(0.0168)	(0.0460
Age	0.0012***	-0.0032***	0.0197***
	(0.0001)	(0.0011)	(0.0053)
R&D	0.0059***	-0.0016	-0.0831
	(0.0019)	(0.0018)	(0.0667)
Leverage	0.0367	0.9037***	-0.4497**
	(0.0817)	(0.0771)	(0.2087)
Tobin Q	0.0186*	0.0040***	-0.0041
	(0.0111)	(0.0008)	(0.0041)
Investment	0.0255***	0.0089***	0.0252***
	(0.0024)	(0.0006)	(0.0087)
Profitability	1.2198***	0.0570	0.8835***
	(0.0989)	(0.0597)	(0.2353)
Cash	-0.0103**	0.0373***	0.0145***
	(0.0050)	(0.0056)	(0.0025)
Macro volatility	5.6694***	2.4337	-1.6987***
	(0.4338)	(0.4892)	(0.3805)

Market volatility	9.5198***	5.5887	-2.4728***
	(1.0291)	(4.6735)	(0.5041)
Industrial volatility	1.0962***	3.5245***	0.8197**
	(0.3107)	(0.3578)	(0.3767)
Firm volatility	2.9241***	-1.2593**	- 2.1454***
	(0.3602)	(0.5549)	(0.4614)

Cont...

Firm volatility × Industry volatility	-0.2390***	0.6550***	0.6127**
	(0.0728)	(0.0720)	(0.2550)
Firm volatility × Market volatility	-6.1875	-2.3242***	-3.8366***
	(4.6780)	(0.3930)	(0.7037)
Firm volatility × Macro volatility	-4.0125***	0.2902	4.1113***
	(0.4939)	(0.8979)	(0.7397)
Industry volatility × Market volatility	2.8603***	5.3162***	1.9500***
	(0.0409)	(0.4785)	(0.5051)
Industry volatility × Macro volatility	-2.0481***	-6.0731***	-2.3794***
	(0.5033)	(0.5568)	(0.5621)
Market volatility × Macro volatility	-1.5628***	-3.6004***	4.8024***
	(0.1473)	(0.7449)	(0.8777)
Constant	0.0791	0.7651**	0.8999
	(1.2732)	(0.3692)	(0.5946)
Obs.	586	1177	1052
Firms	108	118	114

Instruments	105	116	98
Industrial Dummy	YES	YES	YES
Validity Tests			
AR(1)	-1.84	-2.50	-2.82
	[0.066]	[0.012]	[0.005]
AR(2)	-1.16	-1.58	-0.88
	[0.244]	[0.115]	[0.377]
Sargan	222.12	128.31	96.19
	[0.000]	[0.000]	[0.000]
Hansen	64.76	80.69	58.64
	[0.224]	[0.139]	[0.188]

Probability values are in square brackets (*** *p<0.01,* ** *p<0.05,* * *p<0.1*) and standard errors are in parenthesis.

4.3 Firm Age and Volatility Effects

Firm age is also an important firm-specific determinant of firm growth. Firm age significantly affects the firm's ability and performance. It is obvious that over the period of time firms learn and hence mature firms are in a better position to tackle volatility than their counterparts. For instance, mature firms are more likely tend to produce the most desired products of the consumers. Due to a lack of experience young firms may not be in a position to accurately forecast the consumer demand as well. Hence, they may be reluctant to produce at a larger scale. Due to economies of scale cost of production may remain low for mature firms and high for young firms. In addition, mature firms have a team of experienced managers and relatively more financial resources. Furthermore, mature firms generally produce a number of different goods for domestic and foreign market. Therefore, they can harvest benefits from economies of scope through the joint production and marketing at home and foreign markets. Therefore, the age of a firm may have effect on the influence of volatility on the firm growth. Young firms are those that are new in business. Therefore, these firms are not well aware of the market and the potential customers.

4.3.1 Direct and Indirect Effects of Volatility

Macroeconomic and firm-level volatility are harmful for both young and mature firms. The influence of industrial volatility is significant and negative on mature firms' growth. However, market volatility has a positive impact on both young and mature firms' growth. The effect of firm-industry and firm-macro is positive for all firms. However, the effect of firm-market and market-macro volatility is negative on firms' growth. Moreover, both the coefficients of industry-market volatility terms are positive, but only the coefficient of young firms is significant. Similarly, the impact of industry-macro volatility is positive (negative) for mature (young) firms, respectively.

The significant negative coefficient of the firm-market relationship shows that a rise in firm (market) volatility is related to a decrease (increase) in the impact of market (firm) volatility on young firms' growth. The positive coefficient of firm-macro interaction term highlights the diminishing impact of firm (macroeconomic) volatility on young firms' growth with an increase in macroeconomic (firm) volatility, respectively. The positive coefficient of industry-market points out the flourishing influence of market volatility on young firms' growth with a surge in industrial volatility. The significant negative coefficient of the industry-macro interaction term highlights the increasing impact of macroeconomic volatility on young firms' growth with a rise in industrial volatility. The negative market-macro volatility term proposes increasing (or decreasing) impacts of macroeconomic (market) volatility on young firms' growth.

In col. (2), the significant positive coefficient of the firm-industry interactive term represents the diminishing inverse impact of firm (industrial) volatility on mature firms' growth with an increase in industrial (firm) volatility, respectively. The firm-market interaction term is found to be negative. This implies that a rise in market volatility is associated with an amplifying impact of firm volatility on mature firms' growth, and an increase in firm volatility reduces the positive impact of market volatility on firms' growth. The positive firm-macro coefficient indicates a fading impact of firm (macroeconomic) volatility on firm growth of mature firms with increased macroeconomic (firm) volatility, respectively. The significant positive coefficient of the industry-macro interaction term highlights the diminishing impact of macroeconomic (industrial) volatility on mature firms' growth with an increase in industrial (macroeconomic) volatility. Similarly, a significant negative market-macro interaction term indicates that a rise in market volatility

intensifies the influence of macroeconomic volatility on mature firms' growth. While higher macroeconomic volatility results in reducing the positive influence of market volatility on the growth of mature firms.

4.3.2 Effects of Control Variables

For the young firms, lagged firm growth is significantly positive, indicating that the firm growth model is dynamic in nature. In the case of young firms, the effect of size is negative, highlighting that the association between size and young firms' growth is an inverse because, due to a lack of knowledge, younger firms are not in a position to enjoy the benefits of large-scale operations. In fact, with limited knowledge of the market, they can operate efficiently at a smaller scale of operation. Contrarily, the relationship between size and growth of the firm is positive for mature firms, indicating that mature firms are well-experienced and aware of market conditions and customers' needs. Therefore, they are in a position to perform large-scale operations in a perfect manner. Normally, the managers of mature firms have plenty of experience and expertise to easily handle the operations of the new plant. For young firms, the coefficient of age is highly significant, demonstrating that with the passage of time, young firms learn and grow. Our result shows that the learning theory holds. The aim of spending on R&D is to produce better and newer products to meet the demand prevailing in the market. Mature firms are in a better position to derive benefits from R&D activities. Therefore, the coefficient of R&D is positive for mature firms. The impact of leverage is significant and positive at the 1% level for both young and mature firms. It shows that debt financing is good for all firms, irrespective of their experience.

As expected, the coefficient of Tobin Q is positive for both young and mature firms. Investment by mature firms favours growth. Hence, spending for the purpose of investment by mature firms results in firm sales growth. We report a significant and positive association between profitability and firm growth for both young and mature firms. Similar findings are reported by Voulgaris *et al.* (2003). Similarly, the cash held by mature firms also has a strong positive effect on firm sales (growth).

Table 5: Two-Step System-GMM Estimates for Differential Effects of Volatility on Firm Growth of Young and Mature Firms

	(1) Young Firms' Growth	(2) Mature Firms' Growth
Lag of Firm Growth	0.0267*	0.0011
	(0.0149)	(0.0008)
Size	-0.2263***	0.2093*
	(0.0321)	(0.1161)
Age	0.0113***	-0.0010
	(0.0038)	(0.0008)
R&D	0.0837	0.0690**
	(0.058)	(0.0305)
Leverage	1.5628***	0.6581***
	(0.0604)	(0.0650)

Tobin Q	0.0145***	0.0850*
	(0.0019)	(0.0436)
Investment	-0.0016	0.0718***
	(0.0024)	(0.0186)
Profitability	1.7704***	3.1318***
	(0.0761)	(0.6567)
Cash	-0.0013*	0.0219***
	(0.0008)	(0.0083)
Macro volatility	-1.5030***	-2.6446*
	(0.2417)	(1.4175)
Market volatility	1.4608***	1.1651***
	(0.2239)	(0.1692)
Industrial volatility	0.3894	-3.1429***
	(0.2701)	(0.9649)
Firm volatility	-3.4364***	-7.2126***
	(0.2676)	(0.6838)
Firm volatility × Industry volatility	0.2774***	2.2067***
	(0.0676)	(0.3278)
Firm volatility × Market volatility	-1.7207***	-1.0257***
	(0.1900)	(0.1830)
Firm volatility × Macro volatility	5.5016***	5.4900**
	(0.4454)	(1.3914)
Industry volatility × Market volatility	1.0876***	8.2860
	(0.2670)	(10.9726)
Industry volatility × Macro volatility	-1.2066***	8.7041***
	(0.4114)	(1.8134)
Market volatility × Macro volatility	-1.9574***	-1.2373***
	(0.3688)	(0.2618)
Constant	2.7196***	5.5399
	(0.8076)	(7.4284)
Obs.	1771	1643
Firms	193	182
Instruments	168	136
Dummy for Industry	YES	YES

Cont...

Validity Tests		
AR(1)	-6.70	-3.37
	[0.000]	[0.001]
AR(2)	-1.30	-1.65
	[0.194]	[0.100]
Sargan	470.72	134.81
	[0.000]	[0.001]
Hansen	131.52	82.09
	[0.222]	[0.657]

Probability values are in square brackets (*** *p<0.01,* ** *p<0.05,* * *p<0.1*) and standard errors are in parenthesis.

5. Conclusions

We empirically investigate the effects of firm, industrial, market, and macroeconomic volatilities on firm sales growth in the context of Pakistan. Firm sales growth is not only essential for the existence and survival of the firm in the long run but also for the growth of the economy. The study contributes to existing knowledge in different ways. First, contribution of the study is volatility effects on firm growth under three distinguishing categories: small, medium, and large firms. The second contribution is the analysis of volatility and firm growth relationships for young and mature firms.

The classification of the firms into small, medium, and large categories indicates that the harmful influence of micro-and macro-level volatility are more extreme for large and medium-size firms than their smaller counterparts. Similarly, the interaction terms of volatility confirm that young firms are more prone to the adverse effects of volatility than their mature counterparts. Moreover, we find that the association between firm size and growth is significant negative for smaller firms as well as medium-size firms but not for larger firms. We find that mature firms get benefits from expansion, while young firms are less likely to get benefits from expansion.

Two major policy implications arise from the findings of the study. First, the study reveals the possible differences in results between small, medium, and large firms. The study highlights the differences in the effects of volatility on different size firms. Therefore, different policy measures are required for different size firms. For example, although the connection between cash holdings and firm growth is positive for medium- and large-size firms, for small firms' cash holdings, it has a negative effect on firm growth. Similarly, the effect of leverage is positive for medium-sized firms, but the influence is negative for large firms. The effect of volatilities also varies for large, small, and medium-size firms. Secondly, the study discloses the possible differences in results between young and mature firms. Contrary to the negative effect of firm size on young firms' growth, the effects of size are flourishing for mature firms. In the same manner, cash holding is harmful for young, new firms, but it is beneficial for

mature firms. Hence, the study provides different guidelines for policy purposes for young and mature firms.

The study opens multiple directions for future research. For example, the study is based on a linear model. The study can be extended by incorporating the possible non-linear impact of control variables. In the future, researchers may explore the effects of volatility on firm performance based on profitability. The study is based on secondary data. Researchers are encouraged to conduct a similar study by utilising the primary data of the firms listed at PSX. Researchers may extend the study by identifying and quantifying the impact of volatilities on firm growth across countries in general and across developing countries in particular. For example, an analysis conducted by considering major Asian countries may provide better insight into the volatility-firm growth phenomenon in the context of Asian firms.

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Appendix A

Appendix A1

Descriptive Statistics of Macroeconomic Variables

Variables	IR	LCPI	LIPI	ER
Std. Dev.	3.218365	0.709621	0.450563	11.49910
Mean	11.01317	3.938175	4.307356	108.2596
Min.	3.940000	2.657870	3.405039	89.47218
Max.	15.64000	5.074829	5.157445	141.5430
Obs.	360	360	360	360

LCPI is log of consumer price index, IR is interest rate, ER is exchange rate and LIPI is log of industrial production ind

Appendix A2

Unit Root Results

	ADF- Stats with Constant (At level)		ADF- Stats with Constant and Linear Trend (At level)		ADF- Stats with Constant (At First Difference)	
Variables	**t-stat.**	**Prob.**	**t-stat.**	**Prob.**	**t-stat.**	**Prob.**
LCPI	-0.954	0.770	-2.195	0.491	-2.899	0.046
IR	-2.640	0.086	-2.706	0.235	-3.850	0.003
ER	-2.182	0.213	-1.654	0.769	-8.892	0.000
LIPI	-0.718	0.839	-1.278	0.892	-6.099	0.000

LCPI is log of consumer price index, IR is interest rate, ER is exchange rate and LIPI is log of industrial productio index.

Appendix A3

ARCH/GARCH Estimates for Macroeconomic Risk

Regressors	ΔLCPI	**ΔLIPI**	**ΔER**	**ΔIR**
MA(1)	0.749***	-0.293	0.522	0.074
	(0.110)	(1.391)	(0.124)	(1.462)
AR(1)	-0.541***	0.329	-0.176	-0.138
	(0.130)	(1.389)	(0.143)	(1.505)
Constant	0.005***	0.003	-0.042	-0.010
	(0.0004)	(0.004)	(0.114)	(0.055)
GARCH(1)	0.865***	0.968***	0.431*	0.564***
	(0.053)	(0.014)	(0.240)	(0.118)

ARCH(1)	0.072**	0.021**	0.172***	0.114***
	(0.029)	(0.010)	(0.063)	(0.036)
Constant	0.000003*	0.00006	1.161*	0.162***
	(0.00001)	(0.00005)	(0.615)	(0.053)
Diagnostic Tests for Remaining GARCH Effects				
Observations	358	358	358	358
Log-likelihood	1259.252	360.027	-689.971	-262.287
Q-stat	0.022	0.009	0.037	0.585
P Value	0.883	0.926	0.848	0.444
LM-test	0.021	0.008	0.037	0.576
P Value	0.883	0.926	0.847	0.448

Note: ***, ** and *** represents significant at the 10%, 5%, and 1% level, respectively.**