

**THE IMPACT OF MACROECONOMIC VOLATILITY ON  
STOCK RETURN VOLATILITY: EVIDENCE FROM PAKISTANI  
STOCK MARKET**



**Submitted By**

**Zulfiqar Ali Mir**

Registration No. 03/M.Phil-EAF/PIDE/2014

**Supervised By**

**Dr. Attiya Yasmin Javid**

Professor/Head

Department of Economics

A thesis submitted to the Department of Economics and Finance of the Pakistan Institute of Development Economics in partial fulfillment for the requirements for the degree of Master of Philosophy in Economics and Finance.

**Department of Economics and Finance**

**Pakistan Institute of Development Economics,  
Islamabad  
2016**



PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS, ISLAMABAD

CERTIFICATE

This is to certify that this thesis entitled “**The Impact of Macroeconomic Volatility on Stock Return Volatility: Evidence from Pakistani Stock Market**” submitted by **Mr. Zulfiqar Ali Mir** is accepted in its present form by the Department of Economics and Finance, Pakistan Institute of Development Economics (PIDE) Islamabad as satisfying the requirements for partial fulfillment of the Degree of Master of Philosophy in Economics and Finance.

Supervisor:

Dr. Attiya Yasmin Javid  
Professor,  
PIDE,  
Islamabad.

Internal Examiner:

Dr. Abdul Qayyum  
Joint Director,  
PIDE,  
Islamabad.

External Examiner:

Dr. Abdul Rashid,  
Associate Professor,  
IIUI,  
Islamabad.

Head, Department of Economics and Finance:

Dr. Hasan Muhammad Mohsin  
PIDE,  
Islamabad.

## Table of Contents

LIST OF FIGURES	V
LIST OF TABLES	VI
ABSTRACT	VII
CHAPTER 1	1
INTRODUCTION	1
1.1: A SYNOPSIS OF PAKISTAN STOCK EXCHANGE	1
1.2 VOLATILITY IN PAKISTAN STOCK EXCHANGE AND ITS CONSEQUENCES	2
1.3 GOALS OF THE STUDY	6
1.4 GAP AND SIGNIFICANT OF STUDY	7
1.5 ORGANIZATION OF THESIS	7
CHAPTER 2	8
LITERATURE REVIEW:	8
CHAPTER 3	15
DATA AND METHODOLOGY	15
3.1 THEORETICAL FRAMEWORK	15
3.2 EMPIRICAL SPECIFICATION OF THE MODEL	18
3.3 ESTIMATION TECHNIQUE	18
3.4 MACROECONOMIC AND STOCK RETURNS VOLATILITY ESTIMATION	19
3.5 THE EMPIRICAL MODEL	19
3.6 PANEL DATA MODELS	20
3.7 FIXED-EFFECTS PANEL	20
3.8 RANDOM EFFECTS (FEASIBLE GENERALIZED LEAST SQUARES) ESTIMATOR	20

3.9	THE GMM APPROACH	21
3.10	DATA	22
3.11	CONSTRUCTION OF VARIABLES	23
3.12	MACROECONOMIC VARIABLES	23
3.12.1	<i>Discount Rate</i>	23
3.12.2	<i>Inflation</i>	24
3.12.3	<i>Exchange Rate</i>	24
3.12.4	<i>Index of Industrial Production</i>	25
3.12.5	<i>Money Supply</i>	26
3.12.6	<i>Gold Prices</i>	26
3.12.7	<i>Sectorial Indices</i>	28
3.12.8	<i>Crude Oil Prices</i>	29
CHAPTER 4		30
EMPIRICAL RESULTS		30
4.1	DESCRIPTIVE STATISTICS	30
4.2	CORRELATION MATRIX	31
4.3	PANEL UNIT ROOT TEST ON THE VOLATILITY ESTIMATES	32
4.4	TEST OF SERIAL CORRELATION	33
4.5	TESTING FOR HETEROSKEDASTICITY	34
4.6	HAUSMAN TEST (FIXED VS. RANDOM EFFECT)	34
4.7	RESULTS OF PANEL DATA MODELS	35
4.8	RANDOM EFFECT MODEL WITH ROBUST STANDARD ERROR	36
CHAPTER 5		38
CONCLUSION		38

REFERENCES	40
APPENDIX	42
A1 GRAPHS	42
A2 POOLED OLS ESTIMATORS	43
A3 POPULATION AVERAGED ESTIMATORS	43
A4 BETWEEN ESTIMATORS	44
A5 FIXED EFFECT (WITHIN) REGRESSION	44
A6 FIRST DIFFERENCE ESTIMATORS	45
(RANDOM-EFFECTS GLS REGRESSION)	45
A7 RANDOM-EFFECTS MODEL	46
A8 HAUSMAN TEST (FIXED VS. RANDOM EFFECT)	47
A9 BREUSCH-PAGAN LAGRANGE MULTIPLIER (LM)	47
A10 TESTING FOR CROSS-SECTIONAL DEPENDENCE/CONTEMPORANEOUS CORRELATION	48
A11 TEST OF SERIAL CORRELATION	48
A12 TESTING FOR HETEROSKEDASTICITY	48
FIGURE A.2 CLUSTERING, DATA IS HETERO	50

## List of Figures

FIGURE 1.1 HISTORICAL MOVEMENT OF KSE-100 INDEX .....	3
FIGURE 3.1 GOLD PRICES HISTORY.....	27
FIGURE A.1 GRAPHS OF VOLATILITY OF VARIABLES .....	42
FIGURE A.2 CLUSTERING, DATA IS HETERO .....	50

## List of Tables

TABLE	4.1	Descriptive Statistics of all Independent Variables	32
TABLE	4.2	Correlation Matrix	32
TABLE	4.3	Results of Panel Unit Root Test	33
TABLE	4.4	Result of Random Effect Model with Robust Least Squares	37
TABLE	A1	Pooled OLS Estimations	44
TABLE	A2	Population Average Estimators	44
TABLE	A3	Between Estimators	45
TABLE	A4	Fixed Effect (within) Regression	45
TABLE	A5	First Difference Estimators	46
TABLE	A6	Random Effect Model	47
TABLE	A7	Regression after solving Hetero	50
TABLE	A8	Robust Least Squares	52
TABLE	A9	Dynamic Least Squares	52
TABLE	A10	Description of Variables	53

## ABSTRACT

This thesis examines whether macroeconomic disturbance that is volatility of macroeconomic variables can affect different sectors of stock market volatility by applying Random Effect Model on panel data over 8 sectors of Pakistan Stock Exchange. The panel estimation is used because there was both time effect and cross-sectional effect. The time frame is used in monthly data from January 2004 to December 2014. The macro-economic variables comprised in the analysis are Industrial Production Index, Interest Rate, Gold Prices, Crude Oil Prices, Money Supply M2, Exchange Rate and CPI. To account for the effects volatility of fundamentals, ARCH/GARCH model is employed to evaluate the volatility of stock returns and macroeconomic variables. The result of random effect model suggests existence of volatility persistence. The industrial production volatility has surprisingly negative effect on stock market volatility and the volatility of exchange rate captures the external sector volatility and has positive effect on the stock return volatility. Gold prices has negative whereas crude oil price volatility has positive effect on share market return volatility. The increased variation in money supply and inflation make stock returns more volatile in opposite way. This leads to conclusion that the stock prices variations in Pakistan are influenced by financial and economic variables' uncertainty included in the study but only the two variables. Subsequently stockholders, consultants and policy makers must take into attention the economic volatility of above two variables like crude oil prices and interest rate in their analysis of risk management of portfolio investment.

**Keywords:** *Stock Return Volatility, Macroeconomic Volatility, GARCH Model, Random Effect Model*



## **Chapter 1**

### **INTRODUCTION**

Deb, S. G., & Mukherjee, J. (2008), the growing reputation of stock markets in developing countries around the globe over the last few decades has shifted the focus of researchers to explore the relationship between stock market development and economic growth. The inspiration is derived chiefly from the obvious policy implications of the findings of such studies for the developing economies.

The performance of the stock market is measured to be a chief reason for the flourishing monetary settings of a nation. Bourses show a character of a tie among the purchasers and the merchants for purchasing and selling of securities. Investments are equipped by the bourses that show a significant part in channelizing altogether these protected funds into extensive diversity of productive investment ventures. The autonomous powers of demand and supply vibrant the marketplace and planned bazaar processes match the likings of purchasers and traders.

In Pakistan there is one stock exchange titled as Pakistan Stock Exchange (PSX).

#### **1.1: A Synopsis of Pakistan Stock Exchange**

In the year 1949 Karachi Stock Exchange was established and was the principal bourse of Pakistan. The supervisory power of bourse is SECP (Securities and Exchange Commission of Pakistan). At the outset the transaction was happening in Karachi Stock Exchange on physical method termed outcry method but then again well ahead on this structure was swapped by the novel electronic structure which is famous to be Karachi Automatized Trading System (KATS) and the Central Depository System in 1998. This scheme has attested to be crystal clear and has

improved the presentation and effectiveness of the bazaar. Karachi Stock Exchange developed noticeable by reason of this arrangement expansion in contrast to other stock bazaars of the globe. In the time 2002 Karachi Stock Exchange exhibited its top show that was accredited by the Global Magazine “Business Week” and USA Daily “USA Today” as “The Best Performing Stock Market of the World”.

(Chen, Roll, & Ross, 1986), No satisfactory theory would argue that the relation between financial markets and the macro-economy is wholly in on direction. However, stock prices are usually considered as responding to external forces (even though they may have a feedback on the other variables). It is apparent that all economic variables are endogenous in some ultimate sense. Only natural forces, such as supernovas, earthquakes, and the like, are truly exogenous to the world economy.

## **1.2 Volatility in Pakistan Stock Exchange and its Consequences**

Numerous investors comprehend that the stock market is a volatile place to invest their cash. The daily, quarterly and annual moves can be dramatic, but it is this volatility that too produces the market returns investors experience. In this thesis it is explained how volatility disturbs investors' returns and how to take benefit of it.

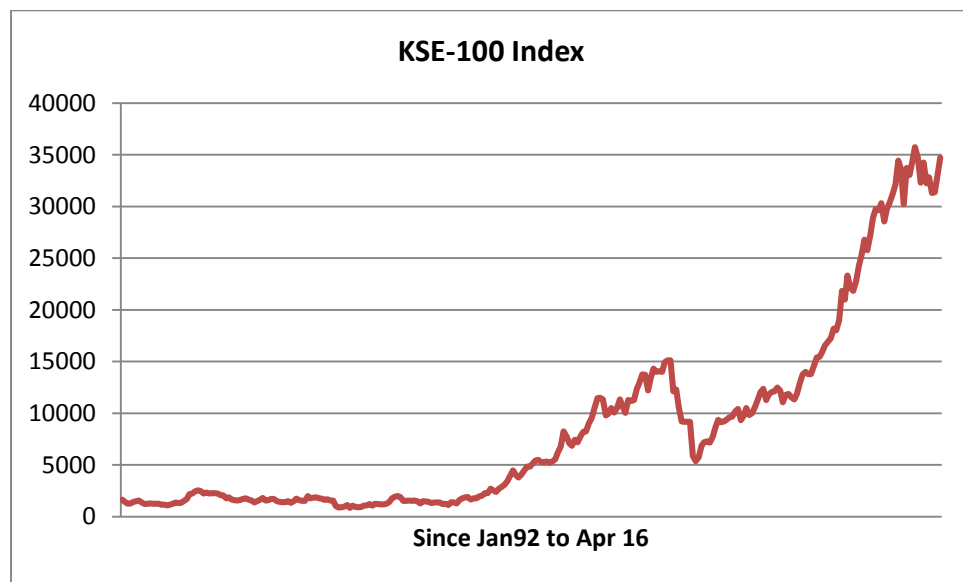
There is a robust connection between volatility and market show. Volatility tends to weakening as the stock market rises and increase as the stock market falls. When volatility increases, risk increases and returns decrease. Risk is represented by the dispersion of returns around the mean. The greater the dispersion of returns around the mean, the larger the drop in the compound return.

Pakistan Stock Exchange is volatile marketplace and has confronted grave disasters in which the market crashed in March 2005, second quarter of 2006, May 2008 - January 2009 that lead to in decrease of bazaar capitalization.

The main crash of Pakistan Stock Exchange was in 2008 where nose dive of

market was because of the “Worldwide Financial Crunch” in which the credit marketplace and particularly the banking area confronted a severe difficulty of liquidity. It was taken place in the USA when the physical assets taking place down worth owing to unnecessary liquidity offered to the persons and business segment as banks and other loaning establishments offered advances on very relaxed positions. This unnecessary liability level twisted into international monetary disasters and triggered manifold hostile effects on the universal economy. Growth percentage of the emerging states ongoing reduction, exports underway diminishing and resident money taking place devaluing. The enormous flight of wealth and reduction in foreign transfers caused bourse to nose dive.

Figure 1.1 Historical Trend of KSE-100 Index



In the similar era Pakistan was furthermore fronting short progression ratio and its coinage was devaluing. Capitals were getting short and both the budget shortfall plus the fiscal shortage were spreading. The fear of terrorism and insecure political management give rise to a deteriorating economy. Consequently, the economy of Pakistan was previously opposite deprived condition beforehand the international financial crunches of 2008.

Volatility is focal units of finance and its extent and estimate have been an evolving matter every time ever since the idea advanced equal with the risk of a financial tool. When inspecting reasons of stock marketplace randomness, one ponders the newsflash, capitalization or the number of listed corporations, but barely think about GDP, inflation or additional variables for an economy's fundamentals.

There are inconsistent significances from prevalent educations: Schwert (1988) high spot the meager outcome of macro variables on the US stock marketplace unpredictability, while Diebold and Yilmaz (2008) select a section of both advanced and developing markets and determine an important connecting between GDP and shares yields. Before this, Fama (1977) specified that stock proceeds and inflation are unfavorably connected, suggesting that stocks would be used as hedge against inflation. But the notable effect is made by Engle, both through the formation of the conditional volatility models and the overview of the GARCH-MIDAS and Spline-GARCH extensions. The latter break volatility into a short-time and a long-period segment and formed that the stock marketplace volatility trend is motivated by the fundamentals.

This study focus on a collection of 9 stock markets industrial sectors (Automobile index, Cement Index, Chemical Index, Food Index, Oil & Gas Development Index, sugar index, telecom index and textile index). The chief variables are stock market indexes and macroeconomic variables i.e. industrial production, CPI, Crude, Gold price, Money Supply M2, Interest rates and exchange rates. The period length covers 10 years, from January 2004 to December 2014.

Methodology used is to get returns through log difference and then extracting volatility through ARCH/GARCH models. The next step was an analysis with modified conditional volatility models for each sector, followed by dynamic panel

estimation. The panel revealed that the sole significant determinant of the stock market volatility is exchange rate volatility and the relationship is a positive one.

The outcome put forward that as fundamentals volatility is caused by stock market variance, these variables would be displayed together. A comprehensive method like the integration of the macroeconomic variables in modeling the stock marketplace volatility might improve the current approaches which device and estimate market unpredictability founded on stocks' past figures. Furthermore, the study has suggestions for stakeholders, who might practice the association between macroeconomic variance and market unpredictability to hedge correctly and likewise for the policymakers who can compute the residual effect their results have on stock bazaar. The learning is organized as follows: the first unit contains of a literature appraisal followed by a portrayal of data and the methodology employed. The closing two units display the outcomes and for the complete panel and the following inferences.

In the 2008 KSE 100 index confronted an enormous deterioration of almost 6000 points in three months i.e. KSE -100 index fell from 15,000 level to 9,200 level. The huge decay in KSE-100 index was as a result of waning in stakeholder's buoyancy owing to fears about universal financial crunches. This mammoth decay was startling for the regime. Hence the regime employed a floor and its involvement was revealed when a bailout strategy was wished-for.

In 2008 the State Bank of Pakistan valued that roughly \$500 million as a replacement for FDI came in Karachi Stock Exchange which was measured at about 20 percent of the total free float in contrast to fiscal year 2006-2007 when KSE was quite appealing for overseas investment and savers were taking keen attention for participating in KSE-listed havens. The KSE 100 index displayed a nonstop downhill drift and touched the lowermost level at 5,865 points after a noticeable loss of 58.3 %

in Dec 2008 as related to Dec 2007.

Accompanied by these factors like administrative and Political discontent, deprived economic and financial state, climbing food inflation, broadening budget shortfall and trade shortfall, reduction of FOREX funds, devaluation of currency etc. as most of the trading of securities was proceeding on speculation; the KSE was manipulated when the speculation bubble spurt.

The understanding of the association amongst stock rates and economic development is currently fetching extra significant about emerging states considering the numerous economic restructurings happening around. Beginning in the 1990s there has been many methods in use for economic liberalization, privatization, easing of foreign exchange controls, and especially the opening of the stock marketplaces to global financiers. These procedures caused in substantial enhancements in the scope and gravity of stock bazaars in evolving states and they are starting to show their part.

About causative relation amongst stock rates and economic action Mookerjee (1988) discovers indication that GDP leads stock values in India however Nishat and Saghir (1991) discover the contradictory sign in Pakistan. In contrast, (Ahmed, 1999) catches the proof that IIP leads stock values in Bangladesh.

(Husain, Mahmood, & Azid, 1999) discover a uni steering causation Money Stock to Stock Values in Pakistan. Namely, whether variation in stock values changes or is altered by variability in currency stock.

### **1.3 Goals of the Study**

The objective of this thesis is to find the following:

Firstly, the purpose is to find the new findings on research and to locate the connection between volatility of macro-economic variables and return volatility of Pakistan Stock Market with data from January 2004 to December 2014.

Secondly, to find the impact of volatility of macro-variables at the volatility of Pakistan Stock Market at the same span of time as stated above.

#### **1.4 Gap and Significant of Study**

Much enquiry has been done on the impact of stock market volatility because of volatility of macroeconomic indicators for developed markets; however, there is scarcity of research work in developing markets

#### **1.5 Organization of Thesis**

Chapter 1 is for introduction, purpose and organization of thesis. Next chapter is reserved for literature review that offers abundant literature qualifying the liaison amongst unlike variables and stock rates and on pragmatic proof allied to causal bond (bi-directional and uni-directional) among diverse variables and stock values. After that next chapter talk about data and methodology used in reading. Last chapter closes and proposes policy suggestions.

## Chapter 2

### LITERATURE REVIEW:

This chapter reviews the relevant literature in this area. Macroeconomic variables are the right representatives of the financial overall performance of a country. Those variables have stimulus at the economic sustainability of the financial system. Economic sustainability of an economic system reflects the financial sustainability of the capital markets. Hazard is the key thing that is usually prevailing within the capital markets and risk management could be very vital for the monetary sustainability of the capital markets. Risk managers recall both macro and micro monetary indicators by using the use of the risk management models to control the chance. (Ross, 1976) presented a theory named as “The Arbitrage Pricing Model” which states that adversity premium is a generous component and return on securities is inclined by the risk premium that's linked with various factors and performs a huge position within the determinations of the asset prices. So you can enforce systematically the risk management policies the affiliation among economic variables and stock prices have to be considered and analyzed deeply with the aid of the risk managers. The findings of (Chen, Roll, & Ross, 1986) concluded that economic variables have influence on discount rate which in turn affects future dividend payments and therefore affects the cash flow generation competence of the organizations. Their study serves as the basis to rely on that there is a massive link among macro-economic variables and stock prices.

In order to analyze the affiliation among macro-financial variables and stock prices a look at became performed through (Maysami & Koh, 2000) in which they analyzed the long run affiliation between one-of-a-kind stock markets like Singapore, Japan and USA. The outcomes concluded that “interest charge” and “exchange price”



were relatively noteworthy and the three of the markets were substantially co-integrated to every other.

(Arnold & Vrugt, 2006) examined empirical evidence on the association between stock market volatility and macroeconomic uncertainty. They used the time period from 1969 to 1996. It showed that US stock market volatility is significant related to the dispersion in economic forecasts from survey participants. It also revealed that link is much stronger than that between stock market volatility and the more traditional time-series measures of macroeconomic volatility, but disappears after 1996.

(Attari, Safdar, & Student, 2013) endeavored to analyze the power of macroeconomic variable on returns of Pakistan Stock Market, using monthly time series data (1991-2012). They used the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH), ADF and ARCH (Stationarity & Homoskedasticity). Variable included were interest rate, inflation, GDP and KSE-100 Index.

They determined that there is important influence of macro variables on share prices. This clues the outcomes that stock prices have abundant stimulus on the economy of the country, and are best barometer for economy and futuristic approach. KSE is highly volatile; therefore, regulatory bodies must put consideration to it. probed the consequence of macroeconomic vagueness by using 19 commodity marketplaces grouped into four classes: energy, precious metals, agriculture and industry. They used monthly macroeconomic and financial pointers. Using Structural threshold VAR (TVAR) program to define the outcome of macro ambiguity on commodity price returns on degree of improbability, the data was taken from 1980 and transformed into first logarithmic differences (i.e., price returns). The verdicts are

that gold is good hedge against inflation, and there is huge effect on agricultural and industrial marketplaces of macroeconomic sharps and uneven amplitudes.

The relationship between macroeconomic variables and stock changes was tested with the aid of (Maysami & Sim, 2002) in Hong Kong and Singapore, (Maysami and Sims, 2001a) in Malaysia and Thailand, (Maysami and Sims, 2001b), in Japan and Korea. They carried out Hendry's (1986) technique so that one can examine the convergence closer to equilibrium route and additionally to take a look at the long-run equilibrium courting among the macro monetary variables and stock prices. The outcomes found out that there exists short run link in addition to long run affiliation between the said variables and stock prices in all of the chosen countries relying upon their length of financial system and monetary shape.

(Muhammad, Rasheed, & Husain, 2002) carried out a studies so as to check the affiliation between prices of stocks and rate of exchange via taking into consideration the information from South Asian international countries and found no connotation between prices of stocks and rate of exchange in case of Pakistan and India, where as there occur bi-directional long term causal link between prices of shares and variables of macroeconomics in case of Sri Lanka and Bangladesh however no short run friendship turned into determined in each the international locations.

(HERVE, Chanmalai, & Shen, 2011) made a studies in case of Malaysia in order to discover the long-run bond among the prices of shares and other explanatory variables like IPI "index of business manufacturing", i "interest charge" and MS "money supply" and discovered a massive lengthy-run link between the prices of shares and all of the variables.

In case of Pakistan (Sohail & Hussain, 2009) attempted to discover the

bivariate connection between prices of stocks and variables of macroeconomics and located an advantageous solution. It was portrayed from the consequences that industrial production index is the most massive definitely related variable with the stock costs on the other hand inflation is the main massive however negatively connected variable with the shares prices and determined that motion within the stock price are affected by the macroeconomic indicators. Some other look at concerning causal relationship between financial variables and shares prices became performed via Imran Ali, et al., (2010) and discovered that there was neither any affiliation nor any causal affiliation between the macroeconomic indicators and prices of shares.

Inside the equal manner an examine in India via (Chakravarty, 2005) who determined after investigation that IIP changed into big and definitely associated with the prices of shares and there exist single directional causal dating from IIP to stock prices. Nevertheless, balance of trade demonstrated to be unimportant which became against the results of Bhattacharya (2002) who decided balance of trade to be great and negatively associated with shares charges.

One have a look at become performed through (Qayyum and Kamal, 2007) on the way to inspect the impact of volatility in forex market on stock exchange marketplace and effect of volatility in stock alternate marketplace on forex market. The studies found out a few exciting final results that no long term courting was located among the two markets however the manner both the markets behave discovered to be associated. Stock prices determined to be sensitive to the volatility of forex market and vice n versa. The study concluded that the volatility of forex marketplace and volatility of stock prices are quite interweaved.

One more examine about connotation of monetary variables and shares prices became carried out by using (Sohail and Hussain, 2009) deliberating the index of Lahore Stock Exchange i.e. LSE 25 index. The effects of the look at confirmed that

CPI turned into meaningfully negatively associated with stock prices wherein IIP, ER and MS had been sizeable and definitely related to the prices of shares in the long term. In case of short term, the outcomes confirmed convergence closer to the equilibrium direction.

(Kanasro et al, 2009) performed a look at to recognize that whether or not attention of shares impacts the capitalization of marketplace or not. After research massive concentration of stocks of Cotton and textile industry, Chemical and prescribed drugs enterprise, gasoline and power sector, delivery and communication zone and banking region turned into determined in KSE and those 5 areas of corporations performed a dominant role in capitalization of the market. The research settled that traders are usually seeking out negatively correlated securities so one can provide hedge to their funding and to take most benefit however if the marketplace is pretty concentrated it's miles very hard for the traders to choose choicest aggregate of negatively correlated securities for portfolio funding.

Another thrilling investigation work executed through Hussain et al., (2011) was to explore the effect of day of the week on the returns of the shares with the aid of deliberating the KSE 100 index. The research turned into performed inside the mild of efficient marketplace hypothesis and it was observed that KSE is green in susceptible shape and bears a whole lot of anomalies. The effects of the look at confirmed the presence of day of the week effect and it turned into determined that returns on Tuesday were relatively substantial and fantastic than other days of the week.

(Kiymaz, 2001) performed a studies to research the effects of rumors regarding shares trade market on returns of the shares. 355 rumors relating to stock exchange marketplace have been taken from Weekly magazine the contents of which had been;

expectancies concerning profits (128), sales of corporations or exports (6), Undervalued stocks (23), Purchases with the aid of foreigners (22), Unclassified (108), Rumors without any content (sixty-eight). It was determined that that the effect of rumors is excessive before and after the announcement of the rumors and demonstrated a giant influence of rumors on the share prices.

Some of studies regarding the association between the variables of macroeconomics and prices of shares in exclusive nations of the world had been performed. (Riely and Brown, 2000) showed a poor dating between Discount rate charge and Shares prices. Fama & (Shwert, 1977), (Chen, Roll and Ross, 1986), (Nelson, 1976), (Jaffe and Mandelkar, 1976) indicated that there occurs a courting among inflation and shares prices and inflation is adversely correlated with the shares prices.

In keeping with Mukherjee and (Naka, 1995) there happens a high quality affiliation among the forex rate and prices of shares whereas the affiliation between the prices of shares and money supply is an empirical query. (Tainer, 1993), (Fama, 1990), (Geske and Roll, 1983) has view that index of business production has a positive affiliation with the shares prices.

This have a look at is likewise going to check out the connection both long-run and brief-term among unique variables of macroeconomics and prices of shares so as to deal with the enquiry that stock prices may be forecasted through the macroeconomic variables or now not. Furthermore this take a look at can even bear in mind the impact of market crash by using a dummy variable with the intention to understand that extended crises notably have an effect on the stock prices and overall performance of the shares market.

(Yaya & Shittu, 2010) attentive on the effects of exchange rate and inflation using the QGARCH model and recognized that these variables have a weighty affiliation to stock profits volatility in the Nigerian Stock Exchange. This is maintained by (Ouma and Muriu, 2014) who also found similar results on the Kenyan stock market. Through OLS technique, they documented the robust linking with optimistic association between money supply M2 and stock marketplace volatility.

(Nazir et. Al, 2010) bring into being the effect of interest rate, where they scrutinized the influence of interest rate together with other macro-economic features, i.e. inflation, income per capita, exchange rate and stock performance index plus political stability indicators towards stock return and volatility afterwards Pakistani equity markets liberalization. Grounded on the EGARCH estimation technique, they establish that interest rate has lowering effects in the direction of stock yield. This is controverted with the conclusions of (Zulkarnain and Sofian, 2012), who revealed an affirmative association between Base Lending Rate, a proxy to interest rates and stock returns volatility; even though, the connection is not significant.

## Chapter 3

### DATA AND METHODOLOGY

This chapter discussed the theoretical framework, methodology, data, variable construction and estimation technique

#### 3.1 Theoretical Framework

The clue of using macroeconomic variables as proxies for pervasive risk factors is very instinctive, as some co-movements are commonly observed between stock returns and macroeconomic such as inflation, interest rate, etc. It is well documented that macroeconomic variables influence the stock returns in developed markets [Lintner (1975), Modigliani and Cohn (1979), Chen, Roll and Ross (1986), Fama (1981), Antoniou et al (1998), Ferson and Harvey (1991, 1993, 1999) and other studies]. Chen, Roll and Ross (1986) are the first who implement this idea for US stock returns. Then, the researchers have specified, a set of economic variables as proxies for macroeconomic risks. In order to specify macroeconomic variables that impact the stock returns the motivation comes from the Rational Valuation Formula (RVF) also called stock valuation formula, where the current price is function of all expected dividends and expectation of discount rate. Poterba and Summers (1988) linearize the rational valuation formula to the following approximation,

$$P_{it} = E_t(\delta_{t+1} D_{t+1}) + E_t(\delta_{t+1} \delta_{t+2} D_{t+2}) + E_t(\delta_{t+1} \delta_{t+2} \delta_{t+3} D_{t+3}) + \dots \dots \dots (4.1)$$

Here  $P_{it}$  is the price of asset i,  $E_t$  denotes conditional expectations based on the information available at time t,  $D_t$  is dividend,  $\delta_t = 1/(1+r_f+r_p)$ ,  $r_f$  is risk free rate and  $r_p$  is risk premium. According to this representation, stock price will change

if the future expected dividends are revised or if discount factor changes. Therefore, macroeconomic variables that influence stock price are those that changes expected cash flow and the discount rate. The choice of these macroeconomic variables is guided by general economic theory, but in practice the identification of these variables is provided by empirical literature.

In this study several macroeconomic variables are considered that investors are likely to count as risk factors for investment and need compensation in the emerging market of Pakistan. This study goes a step further and sees whether the volatilities of these macroeconomic variables affect the volatility of the stock market. The Arbitrage Pricing model is used for this purpose in the spirit of Chen, Roll and Ross (1986).

The macroeconomic variables for which the validities are estimated Industrial Production Index, exchange rate (PKRs. /USD), Consumer Price Index (a proxy for inflation), interest rate, money supply (measured by M2)  $M2 = M1 + \text{Time Deposit} + \text{Residents Foreign Currency Deposit}$ , where  $M1 = \text{Currency in Circulation} + \text{Demand Deposits} + \text{other Deposits}$ , and Gold and Crude Oil prices.

In literature interest rate is used for capturing the state of economic opportunities. Merton (1973) Cox, Ingersoll and Ross (1985), Chen, Roll and Ross (1986) and Ferson (1989) and many recent studies have used interest rate as macroeconomic variable. In this study, call money rate is used as proxy for the short-term interest rate and its volatility is estimated

The inflation could be the sources of economic risk because these variables affect expected aggregate marginal utility. Thus in this study the inflation is also used as a measure of risk following Chen, Roll and Ross (1986). Inflation rate is based on wholesale price index and its volatility is estimated.



The level of activity, as measured by growth in industrial sector capture real sector of the economy. They serve as indicators of current health of the economy and hence influence the earning expectations of the investors. The volatility is measured for PPI index.

The spot exchange rate, which is defined as domestic currency price of foreign currency is one of the factors that captures the effect of foreign sector on the stock returns. It is well known that investment decision in the foreign asset is dependent on investment performance of foreign asset and performance of domestic currency relative to foreign currency [De Santis and Gerard (1998)]. Thus variation in exchange rate effect cash flows because when purchasing power parity (PPP)<sup>1</sup> is violated, this variation in exchange rate reflects currency risk to shareholders who want to maximize return and minimize risk. The volatility of exchange rate is estimated

Another macroeconomic variable that affects stock price volatility prices is the oil prices volatility. Chen, Roll and Ross (1986) and other studies used this risk factor. Gold price volatility also effect stock return volatility

Thus above-mentioned set of macroeconomic variables is selected based on data availability. The macroeconomic that are found to influence the stock return in the empirical literature, the general economic and financial theoretical give guidance.

Returns are calculated taking the log first difference. The volatility is captured by the ARCH/GARCH model.

---

<sup>1</sup> The doctrine, according to which goods must sell for same price in every country, implies that the nominal exchange rate affects difference in price level [Mankiw (1994)].

### 3.2 Empirical Specification of the Model

It is assumed that the stock return volatility of sector  $i$  follows a linear factor model with  $j$  macroeconomic variables volatilities following Roll, Ross and Chen (1986) Therefore,

$$E(r_{it}^\sigma) = E\left(\sum_{j=1}^J \beta_{jt} f_j^\sigma\right) \dots\dots\dots(4.1)$$

Or,

$$r_{it}^\sigma = \beta_{0t} + \sum_{j=1}^J \beta_{jt} f_j^\sigma + \varepsilon_{it} \dots\dots\dots(4.2)$$

Where  $\beta_{0t}$  is the constant,  $\beta_{jt}$  are factor sensitivities on the macroeconomic volatilities and  $\varepsilon_{it}$  is idiosyncratic error term The set of macroeconomic volatilities used as risk factors include interest rate, inflation, industrial production growth rate, foreign exchange rate, money, oil prices and gold prices.

The volatility is measured by GARCH (1,1) model

$$r_{it} = \beta_{0t} + \sum_{i=1}^p \alpha_i r_{t-i} + \sum_{s=0}^q \beta_s \varepsilon_{t-s} + \varepsilon_{it} \dots\dots\dots(4.3)$$

$$\varepsilon_{it} = v_t \sqrt{h_t} \dots\dots\dots(4.4)$$

$$h_t = \varphi_0 + \varphi_1 \varepsilon_{t-1}^2 + \varphi_2 h_{t-1}$$

Where the stock returns follow ARMA process and other variables are same as above. The coefficient  $\varphi_1$  is called ARCH coefficient of order 1 and  $\varphi_2$  the GARCH coefficient of order 1.

### 3.3 Estimation Technique

Monthly time series data from January 2004 to December 2014 is used to assess the relationship between the macroeconomic volatilities and stock market volatility. A

panel analysis is appropriate for our paper because the dataset has both a time-based measurement given by 292 monthly observations and a cross-sectional measurement well-defined by the sample of 8 Sectorial Indices. This study estimates the stock market and macroeconomic volatilities first for each sector and then use the APT model to estimate the impact of macroeconomic volatilities on stock return volatilities and panel data estimation technique is used for this purpose

### **3.4 Macroeconomic Volatility and Stock Returns Volatility Estimation**

Stock return and the appraisal of volatility depend on generally on static standard deviation or variance of earlier time. On the other hand, it covers a main weakness in estimating financial volatility since financial data is identified to have variances which constantly are variation. In future years, Engle (1982) shaped a method to estimate volatility of inflation through Autoregressive Conditional Heteroscedasticity (ARCH) and put the foundation of the beginning of dynamic volatility estimation process. ARCH models have been recognized by its capability to arrest formal structures of actual world volatility, and in keeping with Wong and Kok (2005), it is superior to capture the stock bazaar volatility. The GARCH (1,1) model is more parsimonious and take account of autoregressive and heteroscedasticity in the data in estimating the volatility. To take account of asymmetry in the volatility indicating that bad shocks have more impact than good shocks this study applies Exponential Generalized Autoregressive Conditional Heteroscedasticity EGARCH (1,1) to estimate volatility of macroeconomic and stock market volatility.

### **3.5 The Empirical Model**

$$V_{sr} = \alpha_0 + \beta_1 V_{ind\ prod} + \beta_2 V_{exch} + \beta_3 V_{inf} + \beta_4 V_{ms} + \beta_5 V_{gold} + \beta_6 V_{oil} + \varepsilon$$

### **3.6 Panel Data Models**

Panel data models can be common effect models, fixed effect models and random effect models

### **3.7 Fixed-Effects Panel**

Let equation for the fixed-effects model:

$$y_{it} = \beta x_{it} + \alpha_i + \varepsilon_{it}$$

Where  $y_{it}$  is the dependent variable,  $\beta$  is the coefficient of the independent variable,  $x_{it}$  is the independent variable,  $\alpha_i$  is the specific intercept for each entity (time invariant), and it is the error term.

A fixed-effects model undertakes that every unit has its individual distinctive features that may or may not condition the explained variable. It is thought that this unfairness happens because the separate errors are correlated with the explanatory variable. It is assumed that every country (sector) is exceptional, it is obligatory for units' time invariant types and error term not to be connected amongst cross-sections. If this correlation occurs, the random-effects model is more suitable.

### **3.8 Random Effects (Feasible Generalized Least Squares) Estimator**

Fixed effects and random effects estimations are normally utilized in panel data study. According to Verbeek (2012), the fixed effects model is built on least squares estimation. Meanwhile, random effects model is constructed on generalized least squares or GLS. Depending on the Hausman Test, generalized least squares regression is better in this analysis compared to fixed effects model because it empowers this study to measure the impacts of time in-variant distinct variables. In addition to that, GLS estimator moreover yields reduced variance that is desirable when equated to least squares estimation (Hills et. al., 2008).

A random-effects model would be engaged if it is considered that the variances crossways objects have an influence upon the explained variable. One of the benefits of said model is that, without being integrated in the intercept, it permits time invariant features to exercise a substantial impact on the explained variable.

The equation of a random-effects model:

$$y_{it} = \beta X_{it} + \alpha + u_{it} + \varepsilon_{it}$$

Where  $u_{it}$  is the within-entity error term and  $\varepsilon_{it}$  is the between-error term.

Even though the random-effects models are taken to be more effectual as they lose less degree of freedom, one would check if the errors are interconnected with the autonomous variables using the Hausman test. The null hypothesis is that errors are not correlated and consequently the random-effect model is more appropriate than the fixed-effect model.

### **3.9 The GMM Approach**

A fundamental assumption when estimating an econometric model is that the independent variables must not be correlated with the error term. The violation of this principle means the estimators will be biased. Therefore, if the Hausman test signals that our panel exhibits fixed effects, these should be eliminated. Furthermore, we will have to account for the additional cross-sectional heterogeneity: heteroscedasticity and error autocorrelation.

Arellano and Bond's GMM model offers a facile solution to deal with these problems. First of all, it introduces instrumental variables which are correlated with the independent variables and also uncorrelated with the errors, eliminating the dependence between regressor and error term.

Let be the equation of a dynamic panel:

$$y_{it} = \beta_1 y_{i,(t-1)} + \beta_2 X_{it} + \varepsilon_{it} + \alpha_i$$

Where  $X_{it}$  pools the independent variables,  $\varepsilon$  is the error term and  $\alpha_i$  account for the fixed-effects.

We can notice that  $\alpha_i$  is time-invariant. By differentiating the equation, GMM eliminates the fixed-effects.

$$\Delta y_{it} = \beta_1 \Delta y_{i,t-1} + \beta_2 \Delta X_{it} + \Delta \varepsilon_{it}$$

As  $(y_{i,t-2} - y_{i,t-3})$  are correlated with  $(y_{i,t-1} - y_{i,t-2})$ , but uncorrelated with  $(X_{i,t-1} - X_{i,t-2})$ , they can be used as instruments for  $(y_{i,t-1} - y_{i,t-2})$ . This justifies why lagged variables will be considered instruments. Identified and over-identified GMM will be estimated and the Sargan test will signal if the proper exogenous instruments have been selected.

Macroeconomic volatilities as independent variables utilized in this investigation are a selection on realistic lessons completed by former investigators and bearing in mind the readiness of data for Pakistan. Macroeconomic volatility comprised in this enquiry are the volatility for Industrial Production Index, exchange rate (PKR. /USD), Consumer Price Index (a proxy for inflation), interest rate, money supply (measured by M2)  $M2 = M1 + \text{Time Deposit} + \text{Residents Foreign Currency Deposit}$ , where  $M1 = \text{Currency in Circulation} + \text{Demand Deposits} + \text{other Deposits}$ , and Gold and Crude Oil prices.

### **3.10 Data**

The research collects macro-economic variables' and index of Pakistan Stock Market's monthly data from State Bank of Pakistan monthly bulletin together with Pakistan Stock Exchange website, WB Development Indicators and Yahoo Finance. The sectorial indices are created using value weighted method. Weights are the volume of stock. The time frame is from January 2004 to December 2014. The raw data was converted returns using log difference and then converted to volatility data

using ARMA ARCH/GARCH method and later into panel data.

As a first step, descriptive statistics is found with the intention of to get averages of volatility of indices and independent variables. A fast method to recognize the association amongst stock returns and macroeconomic variables is to discover the correlations amongst them. As an introductory investigation, hence, the correlation coefficients are considered

The explanatory variables used on this reading are CPI (Consumer Price Index) as substitution of inflation, Money supply M2, Exchange Rate, Index of commercial manufacturing, Discount Rate, Gold rate, Crude oil rate whereas sectorial indices of stock market are used as an explained variable. The information is accumulated from printed resources of IFS, SBP, Router and KSE. The rate of returns is calculated as follows:

$$R_t = \ln(P_t) - \ln(P_{t-1})$$

Where P is the stock price index, R is the rate of return, ln denotes the natural logarithm and t refers to time.

The little sense and projected symbols of macroeconomic variables with stock prices are given as follows:

### **3.11 Construction of Variables**

### **3.12 Macroeconomic Variables**

#### **3.12.1 Interest Rate**

Interest rate is capture by discount rate. This is the rate of interest, charged by way of nation financial institution of Pakistan to banks and other economic institutions on loans which they take from SBP known as discount fee. This is the fee that banks are charged for borrowing money from State bank.

The effect of discount rate charge is negatively associated with the share

prices (Reilly and Brown 2000). The causal argument for that is as given follows:

The straight consequence of increase or lower in discount rates is on the earnings of the corporations that sequentially have an effect on the dividends and as a consequence prices of the shares are affected. Boom in discount charge increases the borrowing charge of the firms and vice versa and accordingly serves as a purpose for enlargement and pointers to boom the anticipated returns for the firm in the future and consequences in share prices to rise.

Most of the purchases either capital assets or current assets are made through borrowing by the corporations. With an increase in the discount rate the dealings for purchasing the stock becomes costly and these costly trades will trap the demand and results in stock prices to depreciate.

Most of the acquisitions both capital assets and Current Assets unit are created through borrowing by the commercial organizations. With an upward thrust inside the discount rate price, the dealings for buying the shares will become luxurious and those high priced trades can trap the demand and marks in share prices to devalue

### **3.12.2 Inflation**

There happens an adverse association between the inflation and prices of shares which is warranted by the readings of (Fama and Schwert, 1977), (Chen, Roll and Ross 1986), (Nelson, 1976) and (Jaffe and Mandelker, 1976) that inflation is adversely linked to stock prices. When the inflation upsurges it forces the establishments to regulator this by assuming a contractionary monetary strategy which eventually indicates to escalation the rate of interest and henceforward the discount rate rises.

### **3.12.3 Exchange Rate**

The equilibrium rate of demand and supply of foreign currency is known as



Forex rate. The Forex rate is confidently related to stock prices and the fundamental row for this liaison is as given follows:

The devaluation of local currency brings the upsurge of export. This upsurge in export directs to the cash inflows for that country to escalate. As the demand for exports is supposed to be adequately flexible and hence advances the income for the export concerned with businesses that eventually upshots in a optimistic temperament in the stock exchange market and hints the stock prices to upturn. Conversely the increase of an indigenous money imitates economic firmness which eventually outcomes in enlarged investment both in the real as well as in the monetary segment. The improved demand for native registered securities will thrust up the level of index of stock exchange market. Consequently, there exists an up connection between the rate of Forex and prices of shares (Mukherjee and Naka 1995).

#### **3.12.4 Index of Industrial Production**

Industrial production Index is a proxy of industrial performance and indicates economic bustle. The rise in industrial production index imitates progress of economy. In expansionary period of economy, the index increases and in recessionary period of economy the index tumbles, Tainer (1993). Index is positively correlated to the prices of stocks that result was found by the Fama (1990) and Geske and Roll (1983).

It is the economic occurrences that the buildup of real assets upsets the manufacture competence of an economy which eventually shakes the cash flow generation capability of the businesses. An escalation in production marks in a rise in cash arrivals of the companies however cut in production outcomes in a lessening in cash flows of the firm. Enlarged incomes tips to upsurge in earnings outcomes in the dividends to upturn which leads the stock prices to escalate and vice n versa. It is

portrayed by the lessons shown by Chen, Roll & Ross (1986) and Fama (1981) which found the importance of index and its positive relationship with the stock prices.

### **3.12.5 Money Supply**

Friedman and Schwartz (1963) supported that money is the core part in economics and finance and contended that it is the monetary area which marks the whole economy in cumulative. Improved money supply means rise in liquidity in the hands of individuals and business sector and vice n versa which ultimately upsets the anticipated yields of the stocks. Henceforth as long as the basis for belief that a connotation occurs between the money supply and stock prices

Additional liquidness will aid to bargain more securities, therefore leads to a growth in the demand for securities and the improved demand shifts the prices of the securities to upsurge. Consequently, an affirmative and major relationship was established by Hamburger and Kochin (1972) and Kraft (1977). Rise in money supply is the reason for inflation, that transform to squeezing monetary strategy and it results in discount rate to surge. The enlarged discount rates shift the shares prices to devalue (Fama, 1981). Alternatively, the economic spur made by a rise in money stock may melt the harmful properties of inflation results in a growth in the cash streams and stock prices of the corporations which are caused by the effect of commercial earnings. Maysami and Koh (2000) in case of Singapore similarly institute that cash stock is absolutely allied with the stock rates.

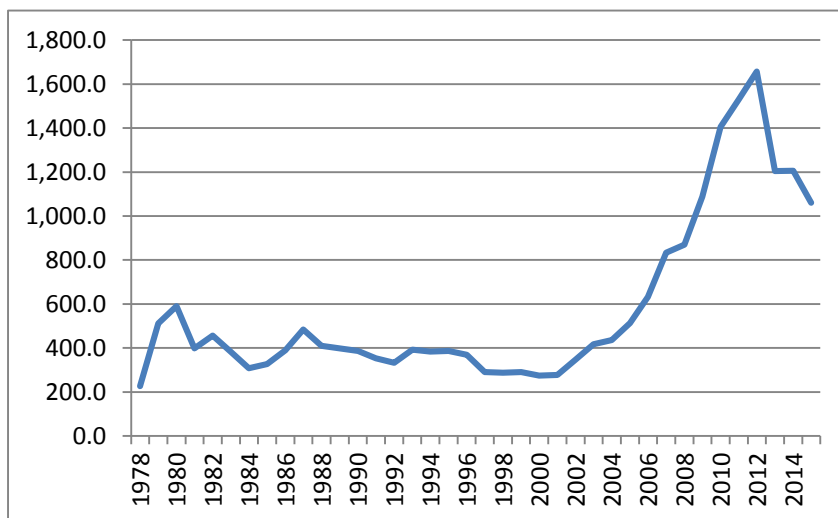
### **3.12.6 Gold Prices**

Gold is a treasurable mineral that is mined in partial amounts. It is not originate effortlessly in nature and consequently has an inadequate resource. A substantial lot of global people have used gold as an investment hedge against inflation and uncertainty for centuries. Gold is a mark of fortune. Its supreme

gorgeous features are its effective worth everywhere the world, its ability to yield profits on investments, to shield investors from risks rising from counterparties and its liquidity.

In spite of current unproductivity, the demand for gold has improved by reason of improved risk factors in marketplaces caused by the disasters happening in the world economy. The graph below illustrates the change in the world's total gold demand between 1978 and 2014. As the graph shows world gold demand is on the rise.

Figure 3.1 Gold Prices History from 1978 to 2014



Source: World Gold Council

A research on gold prices by Bali and Cinel (2011) finds the influence of gold prices on the Istanbul Stock Exchange (ISE). By means of panel data investigation the study endeavors to conclude whether gold prices had some influence on the ISE 100 Index, its path and degree and to define this constant effect models and random effect models were used. The analyses done make it obvious that gold prices do not have a straight effect on KSE 100 Index but it is a feature elucidating the changes in the KSE 100 Index.

In a 2001, Graham Smith establishes a slight negative relation between the price of gold and stock prices by means of data from between January 1991 and October 2001 for the United States. Another reading by Smith (2002) tried to decide the short and long term relationships between gold prices and stock market prices. The reading used three changed gold prices from the London exchange (at 10:30, at 15:00 and closing time) and 18 dissimilar stock marketplace indexes. It was found that in the short term there were a negative kith and kin between gold prices and the stock market, but that there was no significant relation in the long run.

One more study by Kaliyamoorthy and Parithi (2012) examined the association between gold prices and stock market for the age from June 2009 to June 2010 by means of the Chi Square test. It was found nothing relation between stock prices and gold rates. It calls for that the upsurge in the stock market index was not triggered by an upsurge in the gold price.

### **3.12.7 Sectorial Indices**

The purpose of a stock market index is to size variations in the worth of definite collections of stocks and aid amount ups and downs in the whole market. Indexes can offer a rapid picture to understand how an exact collection of stocks performs related to other collections of stocks. As performance differs significantly from one sector to the other, it's very valuable to distinguish the major Indexes. Agents use Market Indexes as vital gears when trying to anticipate future measure in stock price. For example, it is not accurate to imagine stock ABCD to do momentarily outside of space of index it is part of. It is thus vital to recognize what index is symbolic of stock one is dealing.

All main stock market hubs everywhere the world have strategic indices by which the economic presentation of the area is assessed. In the United Kingdom we

have the FTSE 100 whereas in the USA the utmost usually mentioned standards are the Dow Jones and the S&P 500. The situation is similar in Pakistan where different indices are used to gauge the market. These include, KSE 100 Index, All Share Index, KSE 30 Index, KMI 30 Index, and PSX-KMI All Shares Index. All these indices track the act of great, blue chip corporations - some of whom are domestic names and leaders in their field. Corporations are added on the list and withdrawn from the list founded on their reputation and impact in the precise sector.

The indices of 8 sectors are calculated using the value weighted index. The eight sector indexes include, Textile Index, Cement index, Chemical Index, Food Index, Oil and Gas Index, Sugar Index, Telecom Index, and KSE 100 index. In each of the above sector, companies listed in the Pakistan Stock Market in that sector are included. The sectorial Indices are calculated to imitate the behavior and performance of sectors. The index comprises companies listed on stock market. The base date of the index is January 01, 2004 and base value of 1000 points.

### **3.12.8 Crude Oil Prices**

Crude oil prices have influence on stock index. The outcomes advocate that (1) crude oil prices have a positive significant outcome on stock exchange index of studied countries. (2) The volatility of crude oil prices has little positive effect on stock bazaars of nominated country. Li and Chiu (2011) got a single variant GARCH model to test S&P 500 index and WTI crude oil prices association. They decided that significant volatilities in crude oil prices would have negative impact on S&P500 yield but their outcomes has not been permitted in low price volatilities.

## Chapter 4

### EMPIRICAL RESULTS

This chapter presents the empirical results and interpretation of these results. Data of 8 indices of stock market is used as dependent variable in Panel data. The macroeconomic variables such as Industrial Production Index, Interest Rate, and gold prices, Crude Oil Price, Exchange Rate, Money Supply and CPI is taken to check the impact on stock returns volatility owing to volatility of macro variables on stock return volatility. Before applying, ARCH/GARCH test to discover the volatility data. The log difference is calculated. After achieving this, panel data is generated to examine the impact of macroeconomic volatilities on stock return volatility using monthly data from January 2004 to December 2014.

The prime focus of this thesis is exploring of macro variables' volatility impact on stock market return volatility. In the process of finding volatility by Autoregressive Conditional Heteroscedasticity ARCH, conditional variance is varying owing to info of previous period and past forecast errors and it shows variable volatility<sup>2</sup>. The analysis begins with summary statistics of the data.

#### 4.1 Descriptive Statistics

From the table mentioned below, all variables have positive skewnesses and their kurtoses are greater than normal distribution. By Tarque- Bera statistics (1980) they are not in all of normal standard significant level.

---

<sup>2</sup> The figure A1 in appendix shows the graph of volatilities

**Table 4.1 Descriptive Statistics of all Independent Variables**

	IND_IDX	I_RATE	GOLD	CRUD	EXCH	M2	CPI
Mean	0.0007	0.0541	0.0026	0.0062	0.0003	0.0005	0.0002
Median	0.0002	0.0159	0.0012	0.0020	0.0000	0.0002	0.0002
Maximum	0.0154	0.9804	0.0332	0.1097	0.0063	0.0043	0.0018
Minimum	0.000038	0.013960	0.000319	0.000000	-0.000002	-0.000001	0.000000
Std. Dev.	0.0016	0.1233	0.0039	0.0140	0.0009	0.0008	0.0003
Skewness	6.8	4.7	4.6	5.0	4.8	2.2	2.5
Kurtosis	57.6	29.5	31.8	31.6	27.2	8.3	10.8
Sum	0.090	7.147	0.349	0.824	0.037	0.071	0.032
Sum Sq. Dev.	0.00034	1.99265	0.00201	0.02562	0.00011	0.00008	0.00001
Observations	132	132	132	132	132	132	132

#### 4.2 Correlation Matrix

The results reported in table 5.2 show that the coefficient of correlation is not very high. So there is no problem of multi-co-linearity in the data

**Table 4.2 Correlation Matrix**

Variable	Industrial Production	Interest Rate	Gold	Crude Oil	Exchange	M2	CPI
Industrial Production	1						
Interest Rate	0.0151	1					
Gold	-0.0118	-0.0002	1				
Crude Oil	-0.0495	0.0161	0.5004	1			
Exchange	-0.0792	-0.0683	0.1382	0.2204	1		
M2	0.0057	-0.1115	-0.0112	-0.0021	-0.0212	1	
CPI	0.1062	-0.0776	0.1494	0.044	0.3563	-0.103	1

### 4.3 Panel Unit Root Test on the Volatility Estimates

Fisher-type unit-root test based on augmented Dickey-Fuller test is applied to check the stationarity of the volatility series used for analysis.

$H_0$ : All panels contain unit roots

$H_a$ : At least one panel is stationary

**Table 4.3 Results of Panel Unit Root Test**

Variable	P-value	Result
Volatility Stock Returns	0.0000	Stationary at Level
Volatility IIP	0.0000	Stationary at Level
Volatility Interest Rate	0.0000	Stationary at Level
Volatility Gold	0.0000	Stationary at Level
Volatility Crude	0.0000	Stationary at Level
Volatility Exchange Rate	0.0000	Stationary at Level
Volatility Money Supply	0.0001	Stationary at Level
Volatility Inflation	0.0000	Stationary at Level

The results of panel unit root test results presented in table 5.3 indicate that the volatilities measured by GARCH variance are stationary at level. This suggests that the panel data regression is appropriate estimation techniques for analysis to investigate how the macroeconomic volatilities affect the stock market volatility. In the panel data there is common effect model (pooled model), fixed effect model and random effect model. The Breusch-Pagan Lagrange multiplier (LM) test is used to check between pooled model and panel model.



For serial correlation Wooldridge Test was utilized that showed no serial correlation exists in the data<sup>3</sup>. To find whether to use simple OLS or Panel Effect, Breusch-Pagan Lagrange multiplier (LM) test was applied. This test concluded in favor of Panel Tests<sup>4</sup>.

#### 4.4 Test of Serial Correlation

Wooldridge test is used to detect the problem of serial correlation. The results are as follows:

$$F(1, 8) = 1.277$$

$$\text{Prob} > F = 0.2912$$

Conclusion: No serial correlation exists

After the decision in favour of Panel effect test, the Hausman Test is used to decide between Random Effect vs. Fixed Effect. Before applying this test, both Fixed and Random Effect models are run and stored their results. The final conclusion was in favour of Random Effect Model.

To apply random effect, there are different options:

1. If serial correlation is noticed and substantial (p-value of the test < 0.05): use the cluster standard error.
2. If serial correlation is NOT discovered: use **robust standard error** (it will get rid of the problem of heteroskedasticity)

---

<sup>3</sup> Table A7 in appendix shows the results

<sup>4</sup> Table A8 in appendix shows the results

#### 4.5 Testing for Heteroskedasticity

The compute a modified Wald statistic for group-wise Heteroskedasticity

H<sub>0</sub>: Homoskedasticity (constant variance)

For detection of Heteroskedasticity, Wald test is used. The results are given below:

Chi2 (9) = 1.1e+06                      Prob > chi2 = 0.0000

There is Heteroskedasticity in model

If hetero exists, then we use robust errors to get some adjustment for the hetero problem. As there is no serial correlation in the data set, robust standard errors model is checked. This method brought near reliable result, as per our conclusion.

#### 4.6 Hausman Test (Fixed vs. Random Effect)

The Hausman test is used to compare the fixed effect model with the random effect model.

H<sub>0</sub>: Random Effect Model is Appropriate

H<sub>a</sub>: Fixed Effect Model is Appropriate

The results of Hausman test is as follow:

Prob>chi2 = 1.0000

Conclusion: We accept H<sub>0</sub>: Random Effect Model is Appropriate

Random effects undertake that the entity's error term is not connected with the predictors which permit for time-invariant variables to show a role by means of explanatory variables.

In random-effects you want to require those separate features that may or may not impact the predictor variables. The tricky with this is that certain variables may not be obtainable thus leading to lost variable prejudice in the model. RE allows generalizing the inferences beyond the sample used in the model.

#### **4.7 Results of Panel Data Models**

The prime focus of this thesis is exploring of macro variables' volatility impact on stock market return volatility. In the process of finding volatility by Auto Regressive Conditional Heteroskedasticity ARCH, conditional variance is varying owing to info of previous period and past forecast errors and it shows variable volatility.

In this section for exploring macro variables volatilities effect on stock returns volatility, panel data method has been applied. Benefits of using this data are sample broadening, lessening serial correlation, rise of effectiveness, dropping estimation bias, limited Heteroskedasticity, likelihood of economic effects parting and so on (Heshiao,2003), as a result of larger quantity of observations and data, this technique is extra liked and it permits to exam more models.

The results of pooled model, fixed effect model and random effect model, with population average, by removing Heteroskedasticity, with difference and with dynamic least square are presented in Appendix Table A1 to A12. The results are showing comparison of different estimation techniques used but the objective is to reach to most appropriate model.

The Hausman supports that random effect model best fits the data. There are also symptoms of Heteroskedasticity, there random effect model using OLS and with Heteroskedasticity adjusted errors are presented in this chapter.

#### 4.8 Random Effect Model with Robust Standard Error

To find whether to use simple OLS or Panel Effect, Breusch-Pagan Lagrange multiplier (LM) test was applied. This test concluded in favour of Panel Tests.

After the decision in favour of Panel effect test, the Hausman Test is used to decide between Random Effect vs. Fixed Effect. Before applying this test, both Fixed and Random Effect models were run and stored their results. The final conclusion was in favour of Random Effect Model.

To apply random effect, there are different options:

1. If serial correlation is noticed and substantial (p-value of the test < 0.05): use the cluster standard error.
2. If serial correlation is NOT discovered: use **robust standard error** (it will get rid of the problem of Heteroskedasticity)

As there is no serial correlation in the data set, robust standard errors model is checked. This method brought near reliable results. These results are as follow:

**Table 4.4 Result of Random Effect Model with Robust Least Squares**

Volatility Stock Returns	Coefficient	Std. Error	z-Statistic	Prob.
Volatility IIP	-0.07	0.19	-0.39	0.69
Volatility Interest Rate	0.0053	0.0021	2.58	0.0099
Volatility Gold	0.17	0.12	1.66	0.098
Volatility Crude	-0.04	0.02	-1.57	0.11
Volatility Exchange Rate	0.20	0.47	0.42	0.68
Volatility Money Supply	0.066	0.34	1.91	0.057
Volatility Inflation	2.45	1.39	1.76	0.078
Constant	-0.0059	0.0029	-2.00	0.048

## Robust Statistics

$R_n$ -squared statistic 31.77

The results reported in Table 5.4 indicate that almost all macroeconomic volatilities have significant effect on stock return volatilities captured by eight sectors: textile, food, sugar, oil and gas, cement, chemicals, telecom and engineering. The inflation volatility and money supply volatility are evident to be the major factors in determining the volatility of stocks in all sectors. The findings also show that crude Oil Price volatility are positively related to stock returns volatility suggesting that an increase in any of the determinants will elevate volatility of stocks returns. The industrial production volatility and exchange rate volatility are not significant in affecting stock returns volatility. Nonetheless; the values of the coefficients of explanatory variables are different across different sectors and shows that macroeconomic factors will bring different magnitudes of impact in the stock returns volatility for different sectors.

## Chapter 5

### CONCLUSION

The aim of this thesis has been to give the literature on Pakistan Stock Market the exposure of Stock Market and its indices to economic and financial factors. The performance of stock market has been monitored by the behavior of its returns and the volatility of these returns.

This study explores the impact of volatility of macroeconomic variables viz. Industrial Production Index, Interest rate, gold prices, crude oil prices, exchange rate, money supply and CPI with volatility of indices of stock market returns in 8 monetary sectors.

Results from Robust Least Squares regressions imply that all selected macroeconomic volatilities except Industrial Production volatility and Exchange Rate volatility are significant in affecting stock returns volatility where inflation volatility and money supply volatility are proved to be the major factors in determining the volatility of stocks in all sectors. The investigation also shows that all macroeconomic volatility except for Industrial Production Index volatility and Crude Oil Price volatility are positively related to stock returns volatility suggesting that an increase in any of the determinants will elevate volatility of stocks returns. Nonetheless, the values of the coefficients of explanatory variables are different across economic sectors and shows that macroeconomic factors will bring different magnitudes of impact in the stock returns volatility for different economic sectors.

As these eight sector indices will carry on growth with respect to trade value and number of contributing companies, this endeavor is vital to support mutually policymakers and corporations. It is recommended that any strategies executed by watchdogs that will make these macroeconomic aspects to swing should be

measured in profundity so that it will help to mitigate the risk of portfolio and risk management a better tool, which will ultimately benefit the financial market of Pakistan.

Robust standard errors can treat with a group of minor worries about disaster to encounter suppositions, such as trivial hitches about normality, Heteroskedasticity, or certain observations that display great residuals, leverage or effect. For such minor glitches, the robust possibility could efficiently transact with these fears.

With the **robust** route, the point estimates of the coefficients are precisely the similar as in ordinary OLS, but the standard errors make allowances for matters regarding heterogeneity and absence of normality. Using robust standard errors do not change any of the decisions from the unusual OLS regression.

This thesis promotes the result that the advanced level of volatility has a direct impact on portfolios. It also adds to the level of concern and worry on the part of investors as they watch the value of their portfolios move more violently and decrease in value. This causes irrational responses which can increase investors' losses. As an investor's portfolio of stocks declines, it will likely cause them to "rebalance" the weighting between stocks and bonds by buying more stocks as the price falls. Investors can use volatility to help them buy lower than they might have otherwise.

## REFERENCES

- Ahmed, M. F. (1999). Stock market, macroeconomic variables, and causality: The Bangladesh case/Bourse des valeurs, variables macroeconomiques et causalite: Le cas du Bangladesh. *Savings and Development*, 109-130.
- Arnold, I. J., & Vrugt, E. B. (2006). Stock market volatility and macroeconomic uncertainty: Evidence from survey data. *Available at SSRN 896720*.
- Attari, M. I. J., Safdar, L., & Student, M. (2013). The relationship between macroeconomic volatility and the stock market volatility: Empirical evidence from Pakistan. *Pakistan Journal of Commerce and Social Sciences*, 7(2), 309-320.
- Chen, N.-F., Roll, R., & Ross, S. A. (1986). Economic forces and the stock market. *Journal of business*, 383-403.
- HERVE, D. B. G. H., Chanmalai, B., & Shen, Y. (2011). The study of causal relationship between stock market indices and macroeconomic variables in Cote d'Ivoire: Evidence from error-correction models and Granger causality test. *International Journal of Business and Management*, 6(12), 146.
- Husain, F., Mahmood, T., & Azid, T. (1999). Monetary Expansion and Stock Returns in Pakistan [with Comments]. *The Pakistan Development Review*, 769-776.
- Maysami, R. C., & Koh, T. S. (2000). A vector error correction model of the Singapore stock market. *International Review of Economics & Finance*, 9(1), 79-96.
- Maysami, R. C., & Sim, H. H. (2002). Macroeconomics variables and their relationship with stock returns: error correction evidence from Hong Kong and Singapore. *The Asian Economic Review*, 44(1), 69-85.

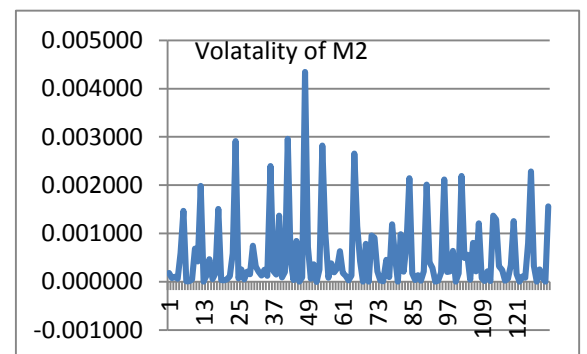
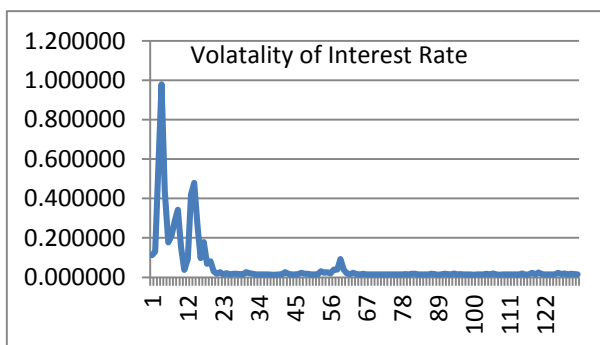
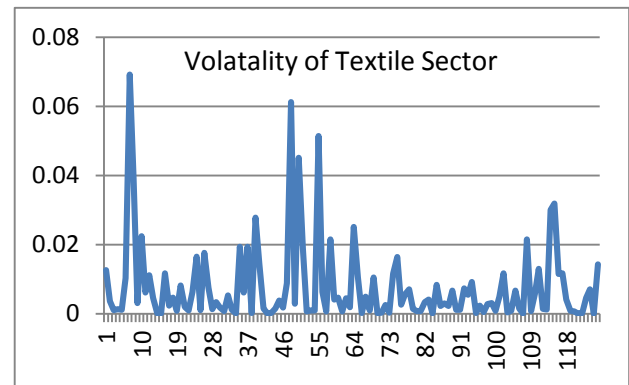
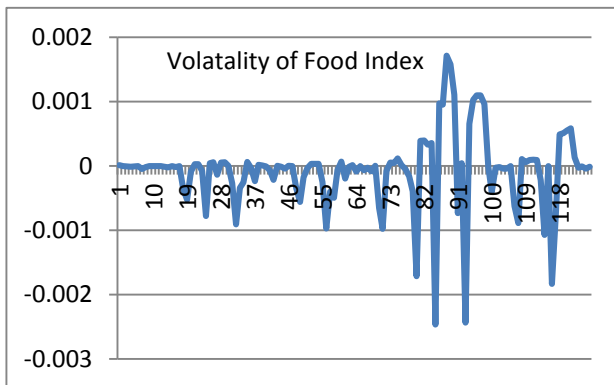
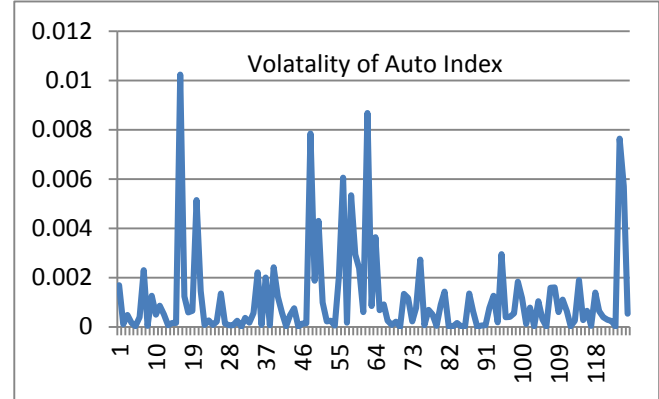
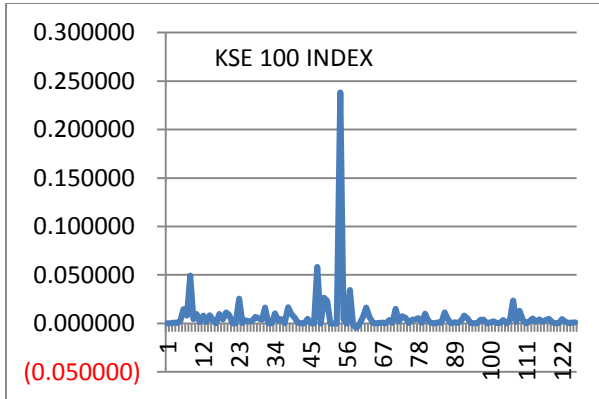


- Muhammad, N., Rasheed, A., & Husain, F. (2002). Stock Prices and Exchange Rates: Are they Related? Evidence from South Asian Countries [with Comments]. *The Pakistan Development Review*, 535-550.
- Sohail, N., & Hussain, Z. (2009). Long-run and short-run relationship between macroeconomic variables and stock prices in Pakistan: The case of Lahore Stock Exchange. *Pakistan Economic and Social Review*, 183-198.
- Yaya, O. S., & Shittu, O. I. (2010). On the Impact of inflation and exchange rate on conditional stock market volatility: A re-assessment. *American Journal of Scientific and Industrial Research*. DOI, 10.
- Deb, S. G., & Mukherjee, J. (2008). Does stock market development cause economic growth? A time series analysis for Indian economy. *International Research Journal of Finance and Economics*, 21(3), 142-149.

# APPENDIX

## A1 Graphs

Figure A.0.1 GRAPHS OF VOLATILITY OF RETURNS



## A2 Pooled OLS Estimators

Prob > F = 0.3778

R<sup>2</sup>=0.36

Adj R<sup>2</sup> = 0.0005

**Table A1 Pooled OLS Estimations**

Variable	Coef.	Std. Err.	T	P
Volatility Stock Returns	-0.103	0.31	-0.33	0.74
Volatility IIP	0.0104	0.006	1.65	0.099
Volatility Interest Rate	-0.081	0.15	-0.55	0.586
Volatility Gold	0.064	0.04	1.53	0.126
Volatility Crude	0.17	0.59	0.28	0.779
Volatility Exchange Rate	-0.49	0.65	-0.76	0.45
Volatility Money Supply	-0.85	1.71	-0.50	0.62
Volatility Inflation	0.005	0.0009	5.2	0.000

## A3 Population Averaged Estimators

GEE population-averaged model

Wald Chi2 (7) = 7.54

Prob > chi2 = 0.37

**Table A2 Population Averaged Estimators**

Variables	Coef.	Std. Err.	z	P
Volatility Stock Returns	-0.104	0.31	-0.34	0.73
Volatility IIP	0.01	0.006	1.6	0.12
Volatility Interest Rate	-0.082	0.15	-0.56	0.57
Volatility Gold	0.065	0.04	1.57	0.117
Volatility Crude	0.17	0.58	0.28	0.776
Volatility Exchange Rate	-0.50	0.64	-0.77	0.44
Volatility Money Supply	-0.85	1.68	-0.51	0.61

Volatility Inflation	0.005	0.001	3.6	0.000
----------------------	-------	-------	-----	-------

#### A4 Between Estimators

F (1, 7) = 0.38

Prob > F = 0.56

**TABLE A3 Between Estimators**

	Coef.	Std. Err.	t	P> t
Volatility Stock Returns	0 (omitted)			
Volatility IIP	0.14	0.23	0.61	0.559
Volatility Interest Rate	0 (omitted)			
Volatility Gold	0 (omitted)			
Volatility Crude	0 (omitted)			
Volatility Exchange Rate	0 (omitted)			
Volatility Money Supply	0 (omitted)			
Volatility Inflation	-0.00081	-0.00899	0.93	-0.022

#### A5 Fixed Effect (within) Regression

R2 (overall) = 0.007

F (7, 1124) = 1.06

Prob > F = 0.39

**Table A4 Fixed Effect (within) Regression**

Variables	Coef.	Std. Err.	t	P
Volatility Stock Returns	-0.104	0.31	-0.34	0.73
Volatility IIP	0.01	0.006	1.6	0.11
Volatility Interest Rate	-0.083	0.15	-0.56	0.57
Volatility Gold	0.065	0.04	1.57	0.117
Volatility Crude	0.16	0.58	0.28	0.776

Volatility Exchange Rate	-0.50	0.64	-0.77	0.44
Volatility Money Supply	-0.85	1.68	-0.50	0.61
Volatility Inflation	0.005	0.001	5.28	0.000

Rho = 0.039 (Very small, not good thing)

F test that all  $u_i = 0$ : F (8, 1124) = 5.12 Prob > F = 0.0000

Prob > F = 0.39 shows that result is not a good fit. Only Interest Rate, Crude oil shows the significance of results.

## A6 First Difference Estimators

(Random-effects GLS Regression)

$R^2$  : within = 0.0304

Between = 0.0333

Overall = 0.0304

Walid chi2 (7) = 32.09

Prob > = 0.0000

## Table A5 FIRST DIFFERENCE ESTIMATORS

D.sector	Coeff.	Std. Err.	Z	P >   z
Ind_idx D1	-0.61	0.33	-1.82	0.069
Interest Rate D1	0.017	0.0093	1.83	0.067
Gold Prices D1	-0.042	0.145	-0.29	0.77
Crude Oil D1	0.033	0.043	0.77	0.44
Exchange D1	0.698	0.68	1.02	0.306
M2 D1	-3.56	1.08	-3.30	0.001
CPI D1	-4.96	1.89	-2.63	0.009

_cons	-0.00008	0.007	-0.11	0.914
Sigma_u	0			
Sigma_e	0.024			
Rho	0	(fraction of variance due to u_i)		

### A7 Random-Effects Model

(Random Intercept, Partial Pooling Model)

$R^2$ : within = 0.00066

Between = 0.0511

Overall = 0.0066

Valid chi2 (7) = 7.49

Prob > = 0.3799

### Table A6 RANDOM-EFFECTS MODEL

	Coeff.	Std. Err.	Z	P >  z
Volatility Stock Returns	-0.104	0.30	-0.34	0.74
Volatility IIP	0.0099	0.0063	1.60	0.11
Volatility Interest Rate	-0.083	0.15	-0.56	0.573
Volatility Gold	0.065	0.041	1.57	0.117
Volatility Crude	0.165	0.58	0.28	0.777
Volatility Exchange Rate	-0.85	0.64	-0.77	0.441
Volatility Money Supply	-0.85	1.69	-0.50	0.614
Volatility Inflation	0.0046	0.001	3.34	0.001
Sigma_u	0.003			

Sigma_e	0.017	
Rho	0.035	(fraction of variance due to u_i)

### A8 Hausman Test (Fixed vs. Random Effect)

H<sub>0</sub>: Random Effect Model is Appropriate

H<sub>a</sub>: Fixed Effect Model is Appropriate

Prob>chi2 = 1.0000

Accept H<sub>0</sub>: Random Effect Model is Appropriate

### A9 Breusch-Pagan Lagrange multiplier (LM)

#### Testing for random effects:

The LM test helps you decide between a random effects regression and a simple OLS regression.

H<sub>0</sub>: Variances across entities = 0

(No significant difference across units / No panel effect)

-

H<sub>0</sub>: There is no Panel Effect

The Breusch-Pagan statistic investigate the null that  $\text{var}(v_{it})=0$ , consequently under the null OLS is consistent.

If one agrees the null that means that one cannot evaluate the model using Random Effects.

The results of Breusch-Pagan Lagrange Multiplier (LM) are as follow:

There is Panel Effect. Random effect model is appropriate

## **A10 Testing for cross-sectional dependence/contemporaneous correlation**

Using Pasaran CD test for serial correlation

Cross-sectional dependence is mainly an issue in macro panels with long time series (over 20-30 years) than in micro panels. Serial correlation causes the standard errors of the coefficients to be smaller than they actually are and higher R-square.

Pasaran CD (cross-sectional dependence) test is used to test that the residuals are correlated across entities. Cross-sectional dependence can cause prejudice in test outcomes (also called contemporaneous correlation).

H<sub>0</sub>: Residuals are not correlated.

A Lagrang-Multiplier test for serial correlation

## **A11 Test of Serial Correlation**

Results of Wooldridge test are given below:

$$F(1, 8) = 1.277 \quad \text{Prob} > F = 0.2912$$

Conclusion: No serial correlation exists

## **A12 TESTING FOR HETEROSKEDASTICITY**

The compute a modified Wald statistics for group-wise Heteroskedasticity

H<sub>0</sub>: Homoskedasticity (constant variance)



In line with Baltagi, cross-sectional dependence is a difficulty in macro panels with elongated time series (over 20-30 years). This is not mainly a problem in micro panels (few years and large number of cases).

Test of Wald Test for Heteroskedasticity results are follow:

. xttest3

Chi2 (9) = 1.1e+06

Prob > chi2 = 0.0000

There is Heteroskedasticity in FE model

. regress sector ind\_idx i\_rate gold crud exch m2 cpi i.month

F (131, 1008) = 1.96

Prob > F = 0.0000

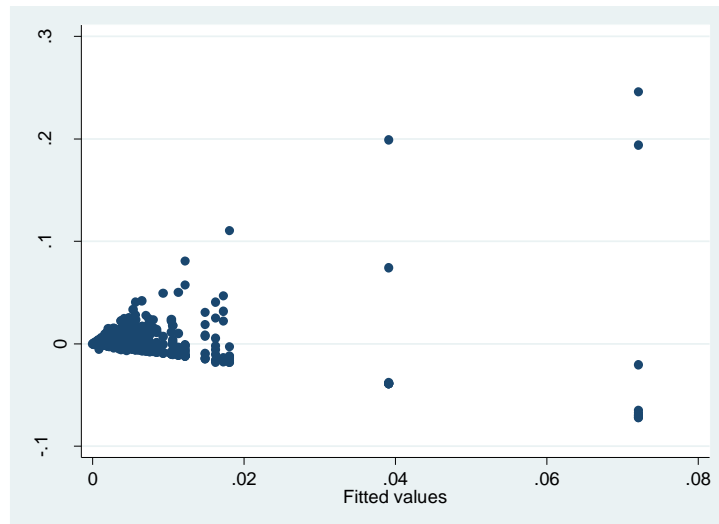
R2 = 0.20

Adj R2 = 0.02

### Table A7 REGRESSION AFTER SLOVING HETERO

	Coeff.	Std. Err.	T	P > t
Volatility Stock Returns	26.0	9	2.89	0.004
Volatility IIP	-0.025	0.19	0.14	0.892
Volatility Interest Rate	2.93	3.21	0.93	0.353
Volatility Gold	0.34	0.127	2.68	0.008
Volatility Crude	-3.36	16.7	-0.20	0.84
Volatility Exchange Rate	-10.42	5.24	-1.99	0.047
Volatility Money Supply	-7.82	69.91	-0.11	0.911
Volatility Inflation				

Figure A.2 Clustering, Data is Hetero



If hetero exists then we use robust errors to get some adjustment for the hetero problem

Hetero is normal problem of cross section data not time series.

For random effect: we want to run the test to check the presence (and harshness) of serial correlation difficulty.

1. If serial correlation is noticed and substantial ( $p$ -value of the test  $< 0.05$ ): use the cluster standard error.
2. If serial correlation is NOT discovered: use **robust standard error** (it will get rid of the problem of Heteroskedasticity)

**Table A8 ROBUST LEAST SQUARES**

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Volatility Stock Returns	-0.07	0.19	-0.39	0.69
Volatility IIP	0.0053	0.0021	2.58	0.0099
Volatility Interest Rate	0.17	0.12	1.66	0.098
Volatility Gold	-0.04	0.02	-1.57	0.11
Volatility Crude	0.20	0.47	0.42	0.68
Volatility Exchange Rate	0.066	0.34	1.91	0.057
Volatility Money Supply	2.45	1.39	1.76	0.078
Volatility Inflation				

R<sub>n</sub> –squared statistic 31.77Prob (R<sub>n</sub> –squared stat.)

0.000045

**Table A9 DYNAMIC LEAST SQUARES**

Variable	Coefficient	Std. Error	t-Statistic	Prob
Volatility Stock Returns	-0.048	1.15	-0.042	0.97
Volatility IIP	0.011	0.01	0.99	0.3239
Volatility Interest Rate	1.61	0.59	2.72	0.0077
Volatility Gold	0.63	0.14	4.41	0.0000
Volatility Crude	-0.19	2.64	-0.07	0.94
Volatility Exchange Rate	2.79	3.38	0.830	0.41
Volatility Money Supply	12.26	6.53	1.88	0.06
Volatility Inflation	-0.0059	0.0029	-2.00	0.048

R <sup>2</sup>	0.59	Mean Dependent Var	0.007
Adjusted R <sup>2</sup>	0.48	S.D. dependent Var.	0.022
S.E. of regression	0.02	Sum squared resid	0.03
Durbin-Watson Stat	2.48	Long-run variance	0.00013

### **Table A10 DESCRIPTION OF VARIABLES**

<b>Abbreviation</b>	<b>Full Name</b>
<b>P</b>	Prices of Stock Indices
<b>IIP</b>	Index of Industrial Production
<b>M2</b>	Money Supply
<b>CPI</b>	Consumer Price Index
<b>KSE</b>	Karachi Stock Exchange
<b>PSX</b>	Pakistan Stock Exchange