Evaluating the Friedman-Ball and Cukierman-Meltzer hypothesis: A GARCH application on Pakistan and Neighboring Economies

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IN THE NAME OF ALLAH

THE MOST BENEFICENT

THE MOST MERCIFUL

Verily We have Created Man into Toil and Struggle… Have We not made for Him a Pair of Eyes, and a Tongue, and a Pair of Lips, and Shown him the Two Ways (Obedience and Disobedience) … ?

Qur'an, Al-Balad (90:4-10)

Pakistan Institute of Development Economics

CERTIFICATE

This is to certify that this thesis entitled: **"Evaluating the Friedman-Ball and Cukierman–Meltzer Hypotheses: A GARCH Application on Pakistan and Neighboring Economies"** submitted by Mr. Zahid Yaqoob is accepted in its present form by the Department of Econometrics and Statistics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Econometrics**.

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GOLDEN SAYING OF

THE HOLY PROPHET

[PEACE AND BLESSINGS OF ALLAH BE UPON HIM]

"Knowledge from which no Benefit is Derived is Like a Treasure out of Which Nothing is Spent in the Cause of God".

Al-Hadith, Al-Tirmidi (108)

DEDICATED

TO

MY BELOVED PARENTS

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Zahid Yaqoob

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List of Acronyms

PICRI	Pakistan, India, China, Russia and Iran
DLP	return series describing inflation of Pakistan
DLC	return series describing inflation of China
DLR	return series describing inflation of Russia
DLIR	return series describing inflation of Iran
DLIN	return series describing inflation of India
ACF	Autocorrelation Function
PACF	Partial Autocorrelation Function
ADF test	Augmented Dickey Fuller Test
ARCH	Autoregressive Conditional Hetroscedasticity
GARCH	Generalized Autoregressive Conditional Hetroscedasticity
GJR	Glosten, Jagannathan and Runkle
EGARCH	Exponential Generalized Autoregressive Conditional Hetroscedasticity
IMF	International Monetary Fund
IFS	International Financial Statistics
LM test	Lagrange Multiplier Test

ABSTRACT

Inflation is a very burning issue of every economy and also the most widely observed and addressed economic variable and its overall costs to the economy are well known. Economists developed consensus that uncertainty of inflation rather inflation itself, distorts price mechanism, trespass purchasing power, hinders investment decisions and makes welfare losses on an economy. This notion was informally addressed by Milton Friedman (1977) and then formally by Lawrence Ball (1992) arguing the positive relationship between inflation and inflation uncertainty whereas the inflation causes inflation uncertainty, the proposition opposite to Cukierman-Meltzer hypothesis. However this study analyses the relationship between inflation and inflation uncertainty using monthly data set of Pakistan and neighboring economies as China, Russia, Iran and India for the period of 2000:M1-20015:M6.GARCH-type Models are used to generate the measure of inflation uncertainty. We used GARCH-L(1) and GARCH-M, GARCH-M(1) models to describe the relation between inflation and inflation uncertainty. The model GARCH-L(1) has lag of inflation in the conditional variance equation and in all economies of under study inflation significantly raises inflation uncertainty as predicted by Milton Friedman. The model GARCH in Mean has the conditional variance in the mean equation and only in case of Pakistan, India, China and Russia inflation uncertainty causes inflation as predicted by Cukierman-Meltzer and no evidence is found about direction from inflation uncertainty to inflation in case of Iran. However, the model GARCH-M(1) has lag of the inflation uncertainty in conditional mean equation. The results suggest that in case of Pakistan and China inflation uncertainty cause inflation and are in line with Cukierman-Meltzer Hypothesis but we have found no evidence in case of India, Russia and Iran. However, the global financial crises 2005 is found to be empirically insignificant in case of all the economies whereas global financial crises 2008 found be empirically significant in case of Pakistan, India and China but found empirically insignificant in case of Russia and Iran. The results of our study justify that monetary authority need to maintain inflation at lower rates.

Key Words: *Inflation, Inflation Uncertainty, GARCH, Global Financial Crises 2005, Global Financial Crises 2008*

CHAPTER 1

INTRODUCTION

Rising rates of inflation distorts price mechanism and makes inflation less stable causes more uncertainty about future inflation. Economists become less predictive to understand the future course of inflation therefore encompasses with the delayed decisions of investment. Fall in purchasing power are also some of the costs of inflation. Therefore such relationship became much contentious issue and Milton Friedman (1977) became the first and highlighted such issue in his Nobel lecture. The literature is full of regarding the association between inflation and inflation uncertainty but the area remains untouched with reference to Pakistan and neighboring economies as India, China, Russia and Iran (PICRI). This study adds to existing literature by addressing such issue in two directions. Instead of survey of expectation approach and moving standard deviation approach, modern Generalized Autoregressive Conditional Hetroscedasticy GARCH family is been employed for conditional variance used for inflation uncertainty. The nexus between inflation and inflation uncertainty is recognized through two famous hypotheses namely Freidman (1977) Ball (1992) Hypothesis and Cukierman-Meltzer (1986) Hypothesis. Freidman-Ball hypothesis postulates that inflation causes inflation uncertainty while Cukierman-Meltzer hypothesis pointes out the inverse causal relationship.

This study follows conventional and non-conventional methods to trace relation between inflation and inflation uncertainty. At first we estimate the inflation uncertainty by employing GRACH-type models. However to check the directional relationship between inflation and inflation uncertainty we employed GARCH-L (1) model *i.e.*, proposed by Fountas *et al.*, (2000) and GARCH-M model instead of the conventional Granger causality test. Secondly we estimate the inflation uncertainty by employing GRACH-type models in the presence of global financial crises 2005 and global financial crises 2008 by introducing the dummy variable to capture the significance on PICRI empirically. We used GARCH-L(1)-D1-D2 and GARCH-M-D1-D2 model. Where D1 and D2 represents the dummies for global financial crises 2005 and global financial crises 2008 respectively. Thirdly in contrast to the majority of the existing literature we test for the inflation uncertainty and inflation by estimating a proposed model 2-GARCH-M(1) in two steps, for conditional mean and conditional variance, where GARCH mean generalize autoregressive conditional heteroskedastic, M(1) mean lag of conditional variance (inflation uncertainty) in the mean equation and prefix 2 shows the two steps , in first step we have estimated conditional variance by a GARCH-type model and in second step we have used the lag of this conditional variance as a proxy for the inflation uncertainty in the mean equation. In this approach we estimate distinct GARCH-type models to verify the hypotheses. To trace effect of inflation on inflation uncertainty we employ the technique by Fountas *et al.,* (2000). In this technique in a frame work of GARCH-type model a lag term of inflation is introduced in the conditional variance equation of inflation (inflation uncertainty). A positive significant parameter of lagged inflation term validates Freidman-Ball hypothesis. To trace the effect of inflation uncertainty on inflation this study proposes a technique and introduces a lagged term of inflation uncertainty in the inflation equation in a frame work of GARCH-type model.

A positive significant parameter of lagged inflation uncertainty term validates the Cukierman-Meltzer hypothesis. Our newly proposed GARCH-type model is kind of GRACH-L(1) model. These technical models are presented in methodology. GARCH-type models present conditional mean and conditional variance equations simultaneously. Due to this pair of entwine conditional equations, parameter convergence is a serious problem in GARCH-type modeling. Consequently we expect divergence issues in our newly proposed approach. The impact of inflation on inflation uncertainty is well documented in literature. However, the previous empirical studies report mixed results. One of the reasons for mixed outcomes is distinct sample periods and frequencies. This indicates the dynamic nature of data generating process of inflation series. Enough amount of literature postulated that the association between inflation and its associated uncertainty is neither linear nor stable over time. However Baillie *et al.,* (1996) discussed long memory process of inflation dynamics for ten countries by employing ARFIMA (autoregressive fractionally integrated moving average) specification. They ratified that there is an insignificant liaison between inflation and its associated uncertainty for the countries which have low rate of inflation including Canada, France, Germany, Italy, Japan and the USA. Whereas the strong and positive nexus was found among the countries where there is high rate of inflation including Argentina, Brazil, Israel and the UK. Chen *et al.,* (2008) have worked on asymmetric behavior of inflation and confirmed that the relevant importance of the dynamics of inflation and its associated uncertainty.

The intuition to carry out this analysis is to check the effect of inflation on inflation uncertainty in GARCH modeling framework. Since the evident of ARCH process by Engle (1982) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) by Bollerslev (1986); GARCH-type models are used to measure inflation uncertainty. We have applied such type of models to the monthly time series covering the period from 2000:M1-2015:M6 for PICRI countries. We have utilize the technique proposed by Fountas *et al.,* (2000) to find the casual relationship between inflation and inflation uncertainty in case of PICRI countries.

The study is relevant in perspective of CPEC. We investigate important Macro phenomena in Pakistan and neighboring BRICS economies having stake on CPEC (positive or negative).Since China is a major partner of CPEC , In line with the macro global change in the region Russia ,Iran and middle east states shows their deep interest in the project and looking forward to invest in Pakistan. On the contrary India is not taking interest in CPEC but India tries to creates hurdles by different means. More over following the emerging economy status, Pakistan is supposed to be included in BRICS.

1.1) Objective of the Study

- 1. Propose a new GARCH type model.
- 2. To Investigate the relation between inflation and inflation uncertainty in the case of Pakistan, Iran and neighboring BRICS economies (Russia, India, China) 2000:1—2015:6.
- 3. To check the effect of global financial crises (GFC) 2005 and global financial crises (GFC) 2008 (intercept dummy approach) in case of Pakistan , India , China , Russia and Iran (PICRI).

1.2) Significance of the Study

This study specifically discusses the nexus between inflation and inflation uncertainty by employing Log-GARCH specifications in case of Pakistan and neighboring economies, which has not been discussed yet. So, this study particularly puts forward that inflation uncertainty becomes the cost of higher inflation that may justify the equal billing with inflation uncertainty. We carried out our analysis by observing the global financial crises 2005 and global financial crises 2008. For this purpose we introduced dummies for both crises and found the empirically insignificance of global financial crises 2005 in our all under discussion economies. While significant relationship of global financial crises 2008 is been evident through our estimation in case of Pakistan, India and China but insignificant in case of Russia and Iran. However, the study found mixed type of results in case of direction of inflation and inflation uncertainty.

1.3) Organization of the Study

Further study will be stated in 5 frameworks such as; an overview theoretical framework concerning the nexus between inflation and inflation uncertainty will be discussed in Chapter 2. Chapter 3 includes literature review. Chapter 4 contains the source of data and methodology. Chapter 5 will conclude the study along with some policy implications.

CHAPTER 2

THE THEORETICAL FRAMEWORK

2.1) Inflation-Inflation Uncertainty Nexus: The Theoretical Background

Rising rate of inflation creates uncertainty about inflation which mechanism of price levels therefore trespasses the overall level of the economy as suggested by Milton Friedman (1977). According to Friedman (1997) and Ball (1992) rising rates of inflation raises greater inflation uncertainty about the future policy. Ungar and Zilberfarb (1993) argued that inflation uncertainty in presence of high inflation decreases expected inflation uncertainty. Barro and Gordon (1983) and Cukierman and Meltzer (1986), stated that inflation uncertainty can increase inflation level. Therefore Barro and Gordon (1983) stated that due to indexation of wage rates uprising inflation uncertainty increases the rate of inflation. It was argued that the reason of rising of inflation rates is that the wage contracts has to be made after forecasting the level of inflation in an economy, so higher inflation uncertainty leads to higher wage contracts. Whereas Holland (1995) postulated that when uncertainty about inflation happens then government announces stabilization policies then and there under stabilization policy inflation and its associated uncertainty is negatively linked with each other. Preliminary objective of this study is to focus on the direction of inflation and inflation uncertainty in line with Friedman-Ball hypothesis and Cukierman and Meltzer hypothesis in Pakistan and neighboring economies.

Figure 2.1: Friedman-Ball Hypothesis

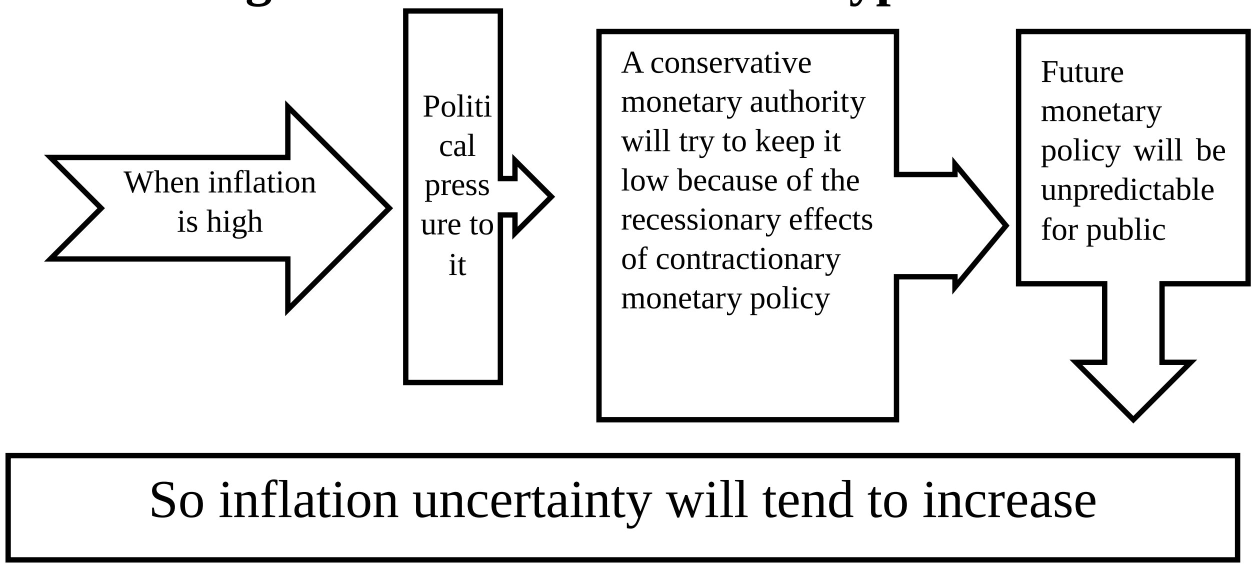
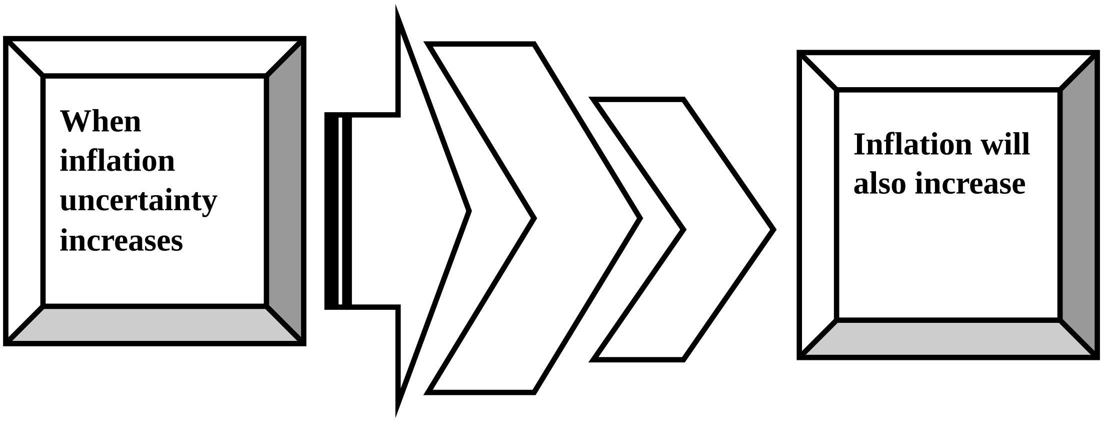


Figure 2.2 : Cukierman-Meltzer Hypothesis



CHAPTER 3

LITERATURE REVIEW

Sarkar and Chowdhury (2014) analyzed the relation of inflation and its associated uncertainty for G7 countries and the monthly data was taken for the period between 1970 and 2013. Since the data follows two different regimes therefore the relationship was checked under such different regimes. However these two regimes follow GRACH specifications. The analysis supported Friedman-Ball hypothesis stating that inflation affects uncertainty of inflation.

The analysis of inflation and inflation uncertainty was also checked by Rizvi and Naqvi (2014) using ARCH/GARCH model. The analysis was based on ten Asian Economies including China, Pakistan, Philippines, Hong Kong, Philippines, Malaysia, Singapore, South Korea, India, Indonesia and Thailand. They took quarterly data of CPI and the dataset was covered from 1987Q1 to 2008Q02. The results confirmed Friedman-Ball Hypothesis for Pakistan, India, Indonesia and Thailand and aforementioned that higher inflation brings uncertainty about inflation. while there was bi-directional causality between inflation and inflation uncertainty in other countries.

The nexus of inflation and its associated uncertainty for SAARC countries was examined by Asghar *et al.*, (2011). They carried out their analysis after allowing their dataset to be ranged between 1980Q1 and 2009Q4. The findings of the studies were the evident of positive Bi-directional Granger Causality between inflation and its associated uncertainty among all countries.

Fountas and Karanasos (2007) took the data from 1960 to 1999 and examined the relationship between inflation and its associated uncertainty for six European countries (Spain, France, Germany, Netherlands and Italy) by employing Exponential GARCH specification. The study forwarded that inflation positively increases its associated uncertainty in all European economies except Netherlands and Germany. Whereas the negative link of inflation and inflation uncertainty was ratified in case of Germany and Netherlands.

Rizvi and Naqvi (2010) tested the theory and liaison between inflation and its associated uncertainty. They took quarterly data from 1976:01 to 2008:02 and employed Exponential GARCH and GJR-GARCH. The study confirmed the strong, significant and positive evidence of Friedman and Ball hypothesis.

Thornton (2007) took monthly data from 1957 to 2005 and confirmed the Friedman and Ball hypothesis mentioning the strong and positive nexus between inflation and its associated uncertainty in India using GARCH specification.

Nas and Perry (2000) took the data of Turkey from 1960 to 1998 and examined the nexus between uncertainty of inflation and inflation by employing GARCH specification. The study supported the strong and positive link between inflation and its associated uncertainty.

Fountas *et al.,* (2000) took monthly dataset of CPI of United States over the period of 1960 to 1999. The study however confirmed the strong positive but one way direction from inflation to its associated uncertainty.

Baillie *et al.,* (1996) analyzed inflation by fractionally integrated ARFIMA-GARCH MODEL and justified the empirical evidence which was in line to Friedman Hypothesis.

Bollerslev (1986) has taken the quarterly data from 1848Q2-1983Q4 for USA GDP Deflator and confirmed that there is an insignificant association between inflation and its associated uncertainty.

CHAPTER 4

METHODOLOGY AND MODEL SPECIFICATION

4.1) Description of Data Source

Inflation can be calculated using underlying four different types of price indicators namely: wholesale price index (WPI), consumer price index (CPI), sensitive price index SPI), and GDP deflator. For our analysis, we go for the country's specific measure of inflation which they follow for their level of living standard. For Pakistan, China, Russia, Iran and India CPI is available. Hence with above lines we have used consumer price index (CPI) for Pakistan and neighboring economies. The data have been taken from International Financial Statistics (IFS).We collected the monthly data on consumer price index (CPI) of Pakistan and neighboring economies from 2000-2015 as under.

Table 4.1 Data on the Return Series

Country	**Dataset**
Pakistan	2000:M1—2015M5
China	2000:M1—2015M5
Russia	2000:M1—2015M4
Iran	2000:M1—2015M6
India	2000:M1—2015M4

4.2) Econometric Methodology and Model Specification

In this section, Autoregressive Conditional Heteroscedasticity (ARCH) model and its advanced version Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model are used to detect the ARCH effects in Pakistan and neighboring economies. These models better explains time varying behavior of inflation series. ARCH models are specially designed to model and forecast conditional variance. The ARCH model was first worked out by Engle (1982). The model suggests that the variance of the residuals at time, t depends on the squared error terms from past periods.

4.2.1) ARCH (q) Model

Robert F. Engle in (1982) introduced the Autoregressive conditional Hetroscedasticity (ARCH) model. In this model Engle, introduced conditional mean and conditional variance equations. Empirically the conditional mean equation follows ARMA (p, q) process and the conditional variance depends upon the square of past values of error process ε_t.

The general description of ARCH model is

Conditional mean equation

$$R_t = c_0 + \beta X_t + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.1)$$

Where $\varepsilon_t \sim D(0, \sigma_t^2)$

Conditional variance equation

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-i}^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.2)$$

Where, $\alpha_0 > 0, \alpha_i \geq 0$ $\quad i = 1, 2, \dots\dots, q$

Where $\varepsilon_t = z_t \sigma_t \sim N(0,1)$

In conditional mean equation R_t represents the return series which is linear function of X_t. *where* β shows the vector of parameters. Empirically βX_t illustrates ARMA (m, n) process with different specifications. In some cases it may be ARMA (0, 0). In conditional variance equation the restriction on coefficients is that they must be non-negative. σ_t^2 represents conditional variance which depends upon lags of ε_t^2 squared past value of ε_t process.

4.2.2) GARCH (p, q) Model

Linear ARCH (q) model has some problems first, sometime takes long lag length ‘q’ due to this number of parameters are going to increase as result loss of degree of freedom. Secondly, non-negativity condition of parameters of conditional variance equation. Bollerslev (1986) proposed generalized extension of ARCH (q) model named as Generalized autoregressive conditional hetroscedasticy model i.e. GARCH (p,q) model, such that ,

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i \, \sigma_{t-i}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (4.3)$$

Where $\varepsilon_t = z_t \sigma_t \sim N(0,1)$

Where $\alpha_0 > 0, \alpha_i \geq 0, \beta_i \geq 0$

In GARCH (p, q) model the conditional variance depends upon square of past values of process ε_t and lag of conditional varianceσ_{t-1}^2. The condition of non-negativity of parameter also applied in this model.

4.2.3) GARCH (1, 1)

GARCH (1, 1) is frequently used in financial econometric literature for volatility modeling. Sajid *et al.*, (2012) employed ARMA-GARCH for measurement of inflation and inflation uncertainty. Faisal et al. (2012) used GARCH to explore the dynamics of exchange rate in case of Pakistan. Jabeen and Saud (2014) employed GARCH model to find out “Exchange rate volatility by macroeconomic fundamentals in Pakistan”. Ghouse *et al.*, (2015) employed GARCH modeling the time varying volatility of leading stock markets. The GARCH (1, 1) is the modest form in dispersion models family. The GARCH (1, 1) provide most robust estimations than other volatility models. GARCH (p, q) mostly use when data is very large and require higher lags.

The general representation of GARCH (1, 1) is

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-i}^2 + \beta_1 \sigma_{t-i}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.4)$$

Where $\alpha_0 > 0$, $\alpha_i \geq 0$, $\beta_i \geq 0$

Where $\varepsilon_t = z_t \sigma_t \sim N(0,1)$

These are the restrictions $\alpha_0 > 0,\ \alpha_i \geq 0,\ \beta_i \geq 0$of non-negativity on coefficients of conditional variance equation. GARCH (1, 1) model (Bollerslev, 1986) established statistical properties for unconditional moment of residual (ε_t). ($\alpha_i + \beta_i$< 1) is sufficient and necessary condition represents the persistence of shock to volatility, it satisfies the wide sense stationary condition.

4.2.4) EGARCH (Exponential GARCH)

The exponential GARCH or EGARCH model was first developed by Nelson (1991), and the variance equation for this model is given by :

$$\boldsymbol{log\sigma_t^2 = \gamma + \sum_{j=1}^{q} \alpha_j \left(\left| \frac{\varepsilon_{t-j}}{\sqrt{\sigma^2{}_{t-j}}} \right| \right) + \sum_{j=1}^{q} \beta_j \left(\frac{\varepsilon_{t-j}}{\sqrt{\sigma^2{}_{t-j}}} \right) + \sum_{i=1}^{q} \delta_i\ log\ \sigma^2_{(t-i)}} \dots \dots \dots .. (\mathbf{4.5})(\boldsymbol{a})$$

where , the$\alpha's, \beta's\ and\ \delta's$ are the parameters to be estimated. Note that the left-hand is the log of the variance series. This makes the leverage effect exponential instead of quadratic , and therefore the estimates of the conditional variance are guaranteed to be non-negative. The EGARCH Model allows for the testing of asymmetric as well as the TARCH. To test for asymmetries the parameters of impotence are$\beta's$. If β_1=β_2 = … = 0, then the model is symmetric. Whenβ_j<0, then positive shocks (good news) generate less volatility than negative shocks (bad news).

4.2.5) APARCH (Asymmetric Power ARCH)

Ding *et al.,* (1993) observed that absolute return series with powers near 1 exhibit long memory as compare to raw return or squared return series (squared return series impersonates 2nd moment). They enhanced the GARCH model and allow for asymmetric shock, the model is as under.

$$\varepsilon_t = z_t \sigma_t \sim N(0,1)$$

$$\sigma_t^{\delta} = \alpha_0 + \sum_{i=i}^{q} \alpha_i(|\varepsilon_{t-1}| - \gamma_i\varepsilon_{t-i})^{\delta} + \sum_{j=1}^{p} \beta_j\, \sigma_{t-1}^{\delta} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.6)$$

Where ,$\alpha_0 > 0$,$\gamma > 0$, $\alpha_i \geq 0$, $i = 1, 2, \ldots, q$,, $\beta_j \geq 0$, $j = 1, 2, \ldots, p$, $-1 \leq \gamma_i \leq 1$

Where $\delta \geq 0$ represents the Box-Cox transformation of conditional standard deviationσ_t. The parameter capture the leverage effect; if the standard leverage effect is present then becomes positive and previous negative shock causes greater impact on current volatility than the previous positive shock of same magnitude.

4.2.6) GARCH -L

The general representation of GARCH (1, 1) –L(1) is

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2 + \ l_1R_{t-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.7)$$

Where $\alpha_0 > 0$, $\alpha_1 \geq 0$, $\beta_1 \geq 0$

These are the restrictions $\alpha_0 > 0$, $\alpha_1 \geq 0, \beta_1 \geq 0$, of non-negativity on coefficients of conditional variance equation. Here R_{t-1} represents the lag of the return series of inflation in conditional variance equation. Also in equation 4.7 l_1 represents the coefficient of lag of the return series in conditional variance equation and the significance of the term describes the direction of inflation on inflation uncertainty.

4.2.7) GARCH –L-D1-D2

The general representation of GARCH (1, 1) –L(1)-D1-D2 is

$$R_t = c_0 + \beta X_t + +d_1D_{1(t)} + d_2D_{2(t)} + \varepsilon_t \dots\dots\dots .. (4.8a)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-}^2 + \beta_1\sigma_{t-1}^2 + \ l_1R_{t-1} \dots\dots\dots\dots\dots\dots (\ 4.8\ )$$

Where $\alpha_0 > 0$, $\alpha_1 \geq 0$, $\beta_1 \geq 0$

These are the restrictions $\alpha_0 > 0,\ \alpha_1 \geq 0, \beta_1 \geq 0,$ of non-negativity on coefficients of conditional variance equation. Here $D_{1(t)}$ represents the dummy for the financial global crises for 2005, $D_{2(t)}$ represents the dummy for the financial global crises 2008 and R_{t-1} represents the lag of the return series of inflation. Also in equation 4.8 σ_t^2 represents the conditional variance and l_1 show the lag of the inflation in conditional variance equation. The significance of this term describes the direction of inflation on inflation uncertainty.

4.2.8) GARCH –M

GARCH in mean specification incorporates the term of conditional variance. Whereas conditional variance exhibits variability of inflation or inflation uncertainty The ARCH-in-mean model was first introduced by Engle, Lilien and Robins (1987). This model was used to investigate the existence of time varying term premium in the term structure of interest rates. Such time varying risk premium have been strongly supported by a huge body of empirical research, in interest rates including Hurn *et al.*, (1995), Moosa and Al-Loughani (1994), Caporale and McKierman (1996) and Campbell and Hentscel (1992).

The general representation of GARCH–M (1, 1) is;

Conditional mean equation

$$R_t = \alpha_0 + \beta X_t + m_1\sigma_t^2 + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.. (4.9)$$

Where $\varepsilon_t \sim D(0, \sigma_t^2)$

Conditional variance equation

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.\dots.\dots\dots\dots\dots (4.10)$$

Where $\alpha_0 > 0, \alpha_1 \geq 0, \beta_1 \geq 0$

These are the restrictions $\alpha_0 > 0,\ \alpha_1 \geq 0,\ \beta_1 \geq 0$ of non-negativity on coefficients of conditional variance equation. Here R_t represents the return series of inflation. Also in equation 4.9

m_1 represents the coefficient of the conditional variance. The significance of this term describes the direction of inflation uncertainty on inflation.

4.2.9) GARCH-M-D1-D2

The general form of the model GARCH-M (1, 1)-D1-D2 is given by

Conditional mean equation

$$R_t = c_0 + d_1 D_{1(t)} + d_2 D_{2(t)} + \beta X_t + m_1 \sigma_t^2 + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. (4.11)$$

Where $\varepsilon_t \sim N(0, \sigma_t^2)$

Conditional variance equation

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.12)$$

Where $\alpha_0 > 0, \alpha_1 \geq 0, \beta_1 \geq 0$

These are the restrictions $\alpha_0 > 0,\ \alpha_1 \geq 0,\ \beta_1 \geq 0$ of non-negativity on coefficients of conditional variance equation. R_t represents the return series of inflation. Also here in equation 4.11 $D_{1(t)}$ represents the dummy for the financial global crises for 2005; $D_{2(t)}$ represents the dummy for the financial global crises 2008 and m_1 represents the coefficient of the conditional variance. The significance of this term describes the direction of inflation uncertainty on inflation.

CHAPTER 5

EMPIRICAL RESULTS AND DISCUSSION

5.1 Graphical Analysis

In this section visual inspection of the inflation of the Pakistan and neighboring economies are explained and briefed. In case of financial data visual inspection is essential for GARCH-type modeling and is a pre-requisite. The visual inspection is not as reliable as diagnostic analysis for the validation of time series properties of the return series of inflation.

5.2 Actual Series

The actual graph represents the monthly consumer price index of the Pakistan and neighboringeconomies i.e., China, Russia, Iran and India. The returns are estimated. There are two specific methods to estimate the return series these are log and growth method both gives same results. The formulas for estimation of log return is $R_t = \log_e (Y_t / Y_{t-1})$ and growth return is $R_t = (Y_t - Y_{t-1})/Y_{t-1}$, here Y_t = consumer price index of each series. The log return series are employed in this study.

5.3 Volatility Clustering

Financial data are subject to Autoregressive Conditional Heteroscedasticity (ARCH) effect and volatility clustering. It's the result of good and bad news in the exchange rate and stock market. In inflation series there is huge amount of uncertainty that have been represented by the volatility of the return series. In such case the variances changes over time and tends to cluster. There is no specific pattern and have mean reversion behavior. The given figure 3 shows the volatility in the financial market regarding the return series of DLP, DLC, DLR, DLIR and DLIN. It can be observed that high volatilities are easily differentiated by low volatilities following the same pattern as high volatilities followed by high once and low volatilities followed by low once.

5.4Autocorrelation and Partial Autocorrelation

The Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) of the return series represent the short memory and dying out of return series. The autocorrelation are mostly removed by taking first lag. The spikes also represent the lags to be taken to tackle the problem of autocorrelation.

The Autocorrelation and Partial Autocorrelation helps to differentiate between AR and MA term in ARMA model and also tackle the problem of Autocorrelation by introducing the number of lags to resolve problem of autocorrelation. The spikes that go outside the 95% bands represent the AR and MA terms in the models. It can be seen that in figure 5 in case of return series of DLP, DLIN and DLIR shows the first and twelfths spikes are outside the band, showing monthly pattern, ensuring autocorrelation and numbers of lags to be introduced to solve the problem of autocorrelation. It also represent that the autocorrelation are not persistent and die out very fast by introducing the lags. It also explains their short memory property. The return series of DLR showing all the spikes out of the 95% band. The other return series of DLC showing all the spikes within the 95% band which in actual is not possible and exist, it’s the reason that visual inspection is considered not reliable and never show actual picture so prefer residual analysis for ensuring the real picture of financial series problems.

Figure 5.1: Graph of Actual Series

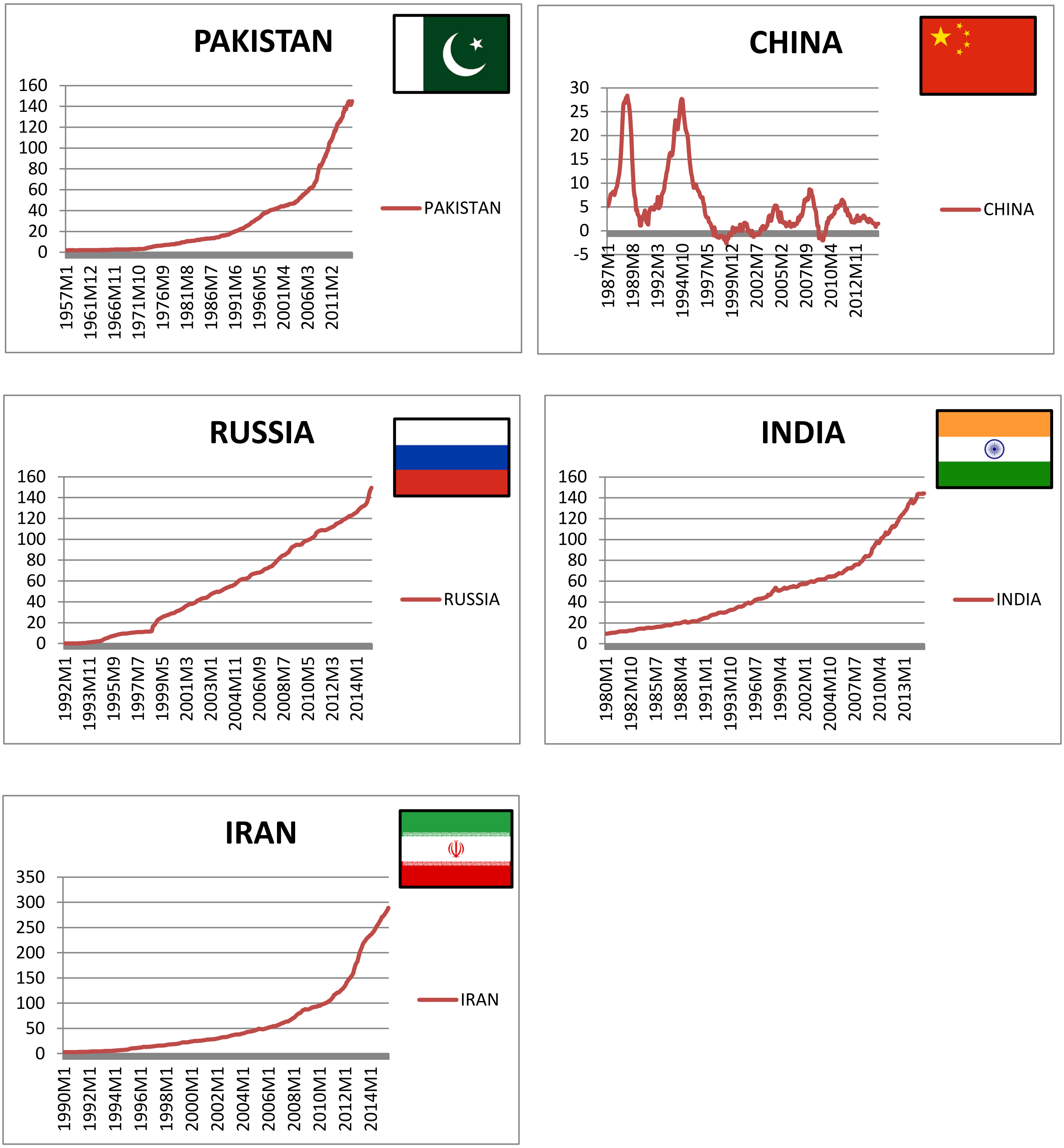


Figure 5.2: The Inflation Series (Return Series) Showing Volatility Clustering

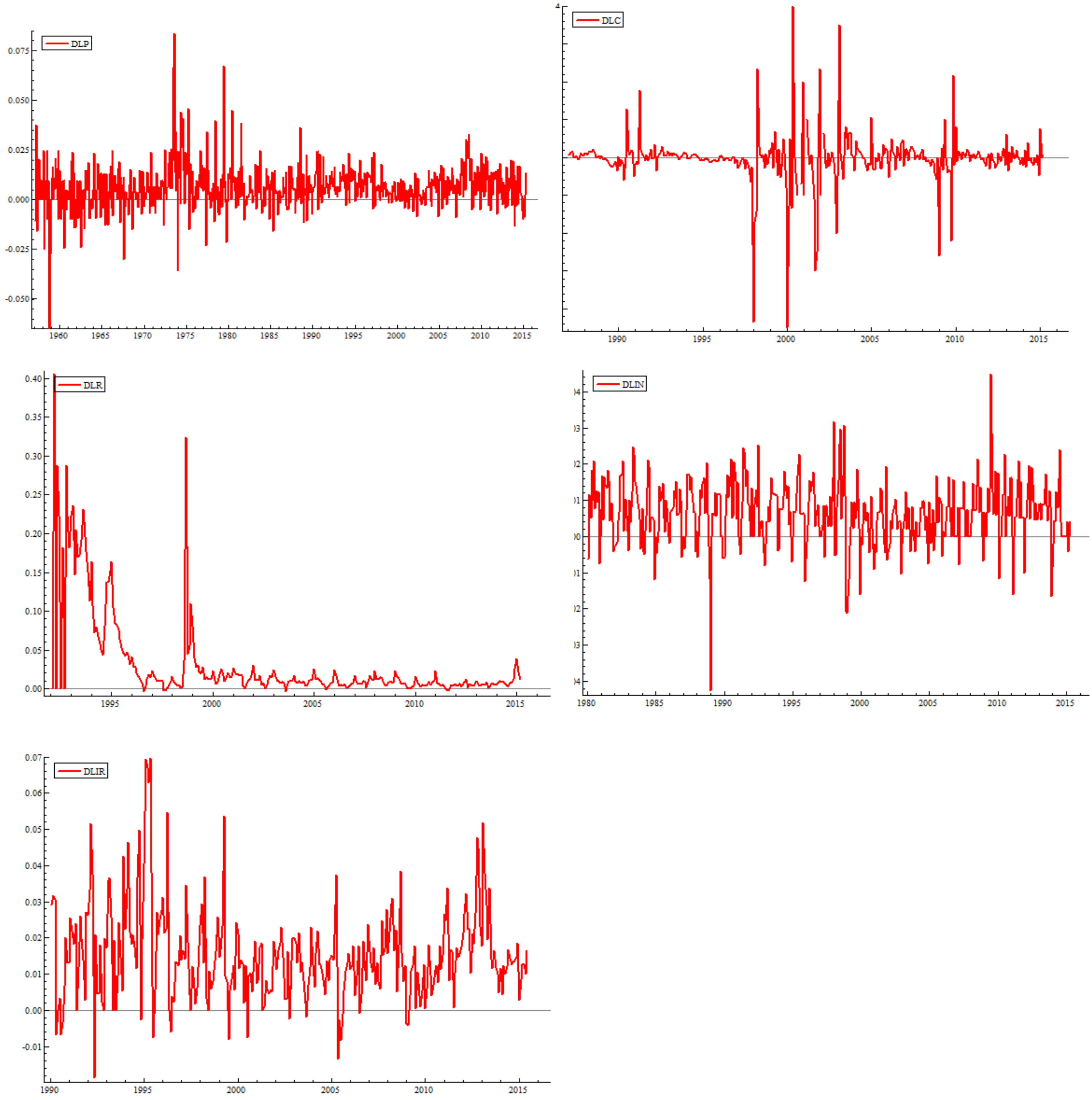
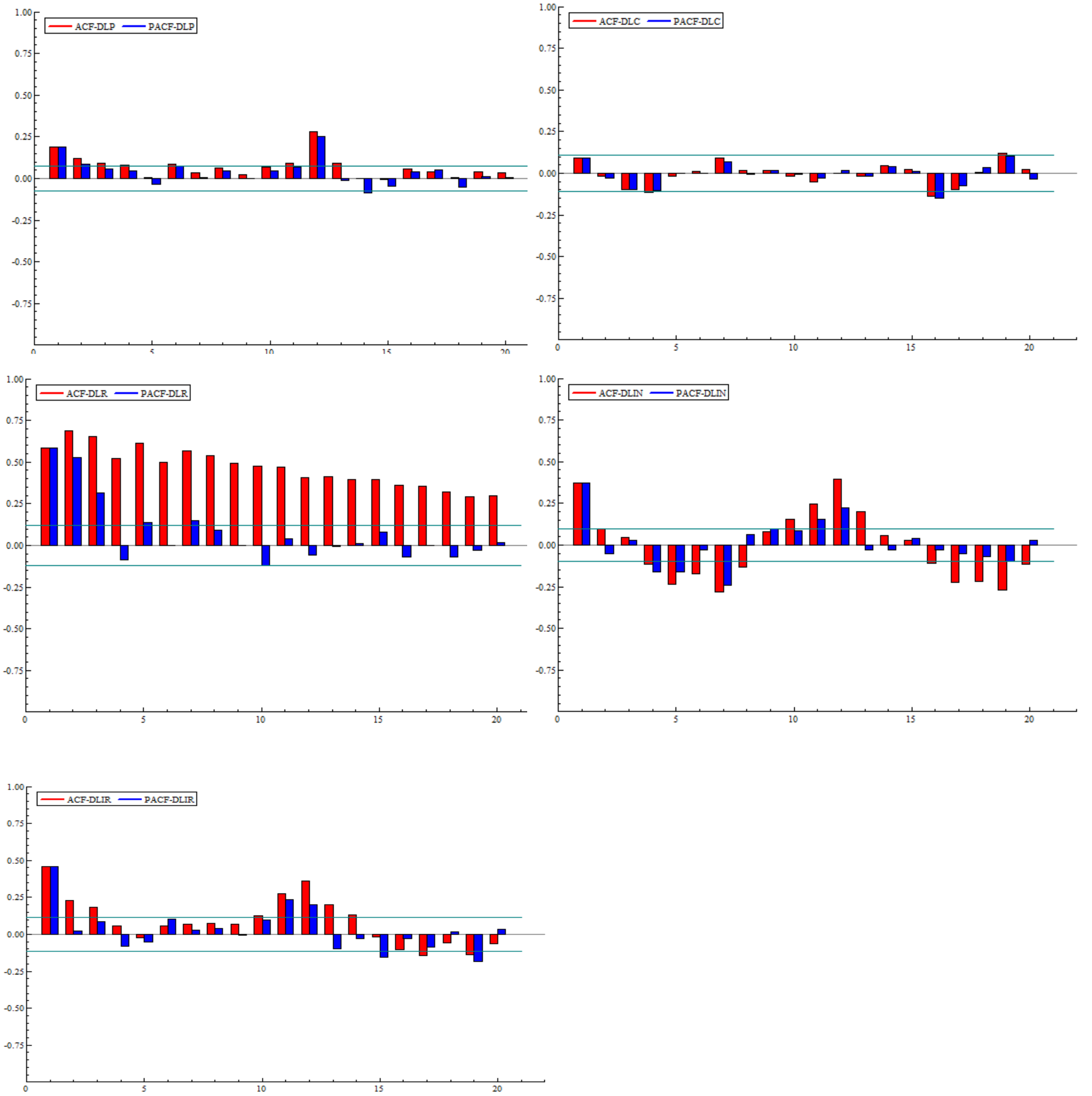


Figure 5.3: Graph of ACF and PACF of Return Series



5.5 Descriptive Analysis

The descriptive analysis for the CPI of Pakistan and neighboring economies are given in table. The mean values of all the return series are almost zero that indicates mean reverting behavior of the series. The excess kurtosis for the return of DLP, DLC, DLR, DLIR, DLIN is positive showing leptokurtosis depicting heavy tails and having clustering of data around mean value. The Jarque Bera depicts the characteristics of the distribution of the return series. All the return series of PICRI are significant showing non normality distribution of the series. Thus it can be analyzed that all the return series are skewed, leptokurtic and non-normal. The summary Stats is given in the following table. There are P-Values in the parentheses.

5.6 ARCH Test on the Return Series

Before applying GARCH-type model it should check ARCH effect in the data. If data has ARCH effect then goes for further analysis. ARCH effect can be check by using the Engle (1982) LM ARCH test and Q^2-Statistics test on the return series. ARCH effect means volatility clustering that data show small and large clustered. Period of low volatility tend to be followed by period of low volatility for the long time period and period of high volatility tend to be followed by the period of high volatility for the long period. Graphical representation of Return Series of Pakistan and neighboring economies has given in the figures 2. All graphs of return series depict that data has small and large volatility clustering. In the second step check ARCH effect by using the Engel's ARCH test and Q^2-Statistics test on the return series. Table 5.1.2 depicts all the five countries show ARCH effect in their return series. In graphical method it has been cleared that data on return series of Pakistan and its neighbouring economies have volatility clustering. In other words, data have ARCH Effect. Also for the return series of India shows ARCH effect through Q^2-Statitsics test. LM ARCH test follow the $\mathcal{X}^2$ value. The present study has return series of Pakistan and neighbouring economies. One condition is fulfilled before applying ARCH family test.

Table 5.1.1 Summary of Statistics

	Pakistan DLP	**China DLC**	**Russia DLR**	**Iran DLIR**	**India DLIN**
Mean	0.00673	0.00537	0.00907	0.01345	0.00551
S.D.	0.00812	0.3762	0.00662	0.00962	0.00769
C.V	1.2069	69.9680	0.72995	0.71575	1.39578
Obs.	184	185	183	185	182
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Skewness	0.38476 (0.032)	0.97009 (0.000)	1.23530 (0.000)	0.79362 (0.000)	0.53637 (0.000)
Excess Kurtosis	0.28455 (0.427)	4.4474 (0.000)	2.0678 (0.000)	2.1500 (0.000)	3.2586 (0.000)
JB test Stats:	5.1046 (0.077)	178.54 (0.000)	78.709 (0.000)	54.159 (0.000)	89.248 (0.000)
Q-stats(5)	34.929 (0.000)	2.69015 (0.747)	101.406 (0.000)	87.6816 (0.000)	20.4043 (0.000)
Q-Stats(10)	45.1422 (0.000)	4.59612 (0.916)	113.784 (0.000)	101.917 (0.000)	37.0583 (0.000)
Q^2-stats(5)	102.230 (0.000)	1.70588 (0.888)	50.7275 (0.000)	106.045 (0.000)	36.7725 (20) (0.012)
Q^2-stats(10)	116.854 (0.000)	9.34291 (0.499)	54.4537 (0.000)	118.577 (0.000)	87.6988(50) (0.000)
LM-ARCH test stats : Lag (2)	24.544 (0.000)	0.30214 (0.739)	25.549 (0.000)	25.416 (0.000)	0.63307 (0.5322)
LM-ARCH test stats : Lag (5)	13.992 (0.000)	0.6809 (0.638)	10.56 (0.000)	15.313 (0.000)	0.49524 (0.7795)

Table 5.1.2: Results of LM ARCH Test

Variable	LM-ARCH test : lag 2	LM-ARCH test : lag 4	Remarks
DLP	24.544 (0.000)	13.992 (0.000)	ARCH Effect.
DLC	0.3021 (0.000)	0.6809 (0.638)	ARCH Effect.
DLR	25.549 (0.000)	10.560 (0.000)	ARCH Effect.
DLIR	25.416 (0.000)	15.313 (0.000)	ARCH Effect.
DLIN	0.63307 (0.000)	0.49524 (0.780)	ARCH Effect.

Table 5.1.2: Apply Engel's LM ARCH test on the return series of Pakistan and neighbouring economies.

H_0 **= return series has no ARCH Effect**

H_A **= return series has ARCH Effect**

LM-ARCH test follow $\mathcal{X}^2$ Distribution. Except two return series all the return series have ARCH effect.

Table 5.1.3: Results of Q^2-statistics Test (ARCH Test)

Variable	Q^2-statistics (5)	Q^2-statistics (10)	Remarks
DLP	102.230 (0.000)	116.854 (0.000)	ARCH Effect.
DLC	1.7058 (0.0008)	9.3429 (0.001)	ARCH Effect.
DLR	50.727 (0.000)	54.453 (0.000)	ARCH Effect.
DLIR	118.577 (0.000)	25.416 (0.000)	ARCH Effect.
DLIN	36.7725 (0.012)	87.6988 (0.001)	ARCH Effect.

Table 5.1: Apply Q2-statistics test (ARCH) test on the return series of Pakistan and neighbouring economies.

H_0 **= return series has no ARCH Effect**

H_A **= return series has ARCH Effect**

Except China return series all the return series have ARCH effect.

5.7 Augmented Dickey Fuller Test

Augmented Dickey Fuller (1979) Unit Root Test is used to test the stationarity of the return series. Here uses return series of inflation of Pakistan and neighboring economies as a variable.

Table 5.1.4: Results of Augmented Dickey Fuller Test

Variable	**Constant(t)**	**Trend(t)**	**Lags**	$\boldsymbol{\rho(\tau)}$	**Remarks**
DLP	C	0	0	-5.051713	No unit root
DLC	C	0	0	-15.10209	No unit root
DLR	C	0	0	-3.308025	No unit root
DLIR	C	0	0	-8.224387	No unit root
DLIN	C	0	0	-10.74627	No unit root

ADF tabulated value for the sample size n < 250 is -1.95.

The return series of consumer price index for Pakistan and neighboring economies China, Russia, Iran and India are represented by DLP, DLC, DLR, DLIR and DLIN respectively. So we check stationarity of all the return series by applying Augmented Dickey Fuller Test of stationarity and also check autocorrelation in the retune series. C is intercept term, t is trend term, ρ is the coefficient value of the lag return series for each country, whose t-statistics called τ (tau) which follows the $\mathcal{X}^2$ distribution. τ Should compare with the critical value of ADF statistics. At 5% critical value is -1.95 for the n <250 .The results of the Augmented Dickey Fuller test are given in the above Table. These series are stationary at level.

5.8 Empirical Result

First take the ACF and PACF of the Return Series of the Pakistan in order to find out the order of AR and MA terms. Then estimate the GARCH-type models through Maximum Likelihood procedure**.**

1) Pakistan

1) Estimated GARCH-L(1) Model

Conditional Mean Equation

$$R_{DLP(t)} = 0.005723 + 0.245492DLP_{t-1} + 0.562354\varepsilon_{t-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.1(a))$$

(0.0000) (0.1161) (0.0000)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLP(t)} = 0.00000026 + 0.089579\varepsilon^2_{(t-1)} + 1.014540\sigma^2_{(t-1)} + 0.000678DLP_{(t-1)}} \dots\dots\dots\dots\dots\dots (\mathbf{5.2(a)})$$

(0.4938) (0.0000) (0.0000) (0.0000)

The above equations shows that the co-efficient of lag of return DLP(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty under our study in case of Pakistan. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.2(a) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.2(a)) is conditional variance equation for inflation of Pakistan which show that lag of inflation causes inflation uncertainty, is positive and significant.

2) Estimated GARCH-L(1)-D1-D2 Model

Conditional Mean Equation

$$R_{DLP(t)} = 0.004572 + 0.003484\, D_{1(t)} + 0.007551 D_{2(t)} + 0.357102\, DLP_{(t-1)} + 0.576642\, \varepsilon_{t-1} \ldots (5.1(b))$$

(0.0000) (0.1361) (0.0011) (0.0895) (0.0025)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLP(t)} = 0.0000000714 + 0.096747\varepsilon^2_{(t-1)} + 1.027488\sigma^2_{(t-1)} + 0.000599 DLP_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.2(b)})$$

(0.8100) (0.0010) (0.0000) (0.0031)

The above equations shows that the co-efficient of lag of return DLP(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of Pakistan. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.2(b) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.2(b)) is conditional variance equation for inflation of Pakistan which show that lag of inflation causes inflation uncertainty, is positive and significant.

3) Estimated GARCH-M Model

Conditional Mean Equation

$$\boldsymbol{R_{DLP(t)} = 0.003157 + 0.146653 DLP_{t-1} + 56.93142\, \sigma^2{}_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.1(c)})$$

(0.0000) (0.0239) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLP(t)} = 0.143008 + 0.185416\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.079793\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.969919\,\log\,(\sigma^2_{(t-1)})} \ldots (\mathbf{5.2(c)})$$

(0.0000) (0.0000) (0.0031) (0.0000)

The above equation (5.1(c)) shows that the co-efficient of inflation uncertainty *i.e.*, $\boldsymbol{\sigma^2{}_t}$ is significant, inflation uncertainty causes inflation which is in line with Cukierman-Meltzer Hypothesis under our study in case of Pakistan. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.2(c) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.1(c)) is conditional mean equation for inflation of Pakistan which shows that inflation uncertainty causes inflation, is significant and positive under our study in case of Pakistan.

4) Estimated GARCH-M-D1-D2 Model

Conditional Mean Equation

$$R_{DLP(t)} = 0.004572 + 0.002288D_{1(t)} + 0.003362D_{2(t)} + 0.103988\, DLP_{(t-1)} + 32.91316\, \sigma^2{}_{(t)} (5.1(d))$$

(0.0003) (0.2366) (0.0842) (0.1772) (0.1747)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLP(t)} = 0.263618 + 0.179088\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.090644\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.958152\, log\, (\sigma^2_{(t-1)})} \dots\dots (\mathbf{5.2}(\boldsymbol{d}))$$

(0.0000) (0.0000) (0.0053) (0.0000)

The above equations shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is insignificant , inflation uncertainty does not causes inflation, which means that Cukierman-Meltzer Hypothesis does not hold , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of Pakistan. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.2(d) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.1(d)) is conditional mean equation for inflation of Pakistan which show that inflation uncertainty does not causes inflation, is insignificant under our study in case of Pakistan.

5) Estimated GARCH-M(1) Model

STEP 1:

Conditional Mean Equation

$$DLP_{(t)} = 0.005793 + 0.493265DLP_{t-1} + \quad 0.710660\varepsilon^2_{(t-1)} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5.3)$$

(0.0000) (0.0016) (0.0000)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLP(t)} = 0.044225 + 0.092539\varepsilon^2_{(t-1)} + 0.838779\sigma^2_{(t-1)}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (\mathbf{5.4})$$

(0.7223) (0.3290) (0.0046)

Now we save the conditional variance series from the above model and use it as a proxy for inflation uncertainty. We introduce the lag of this conditional variance in the mean equation in order to check the relation between inflation uncertainty and inflation which is in line with Cukierman-Meltzer Hypothesis. The diagnostic tests are given in the table 5.4. The P-values are given in the parentheses.

STEP 2:

Conditional Mean Equation

$$DLP_{(t)} = 0.000615 + 0.565426DLP_{t-1} + \quad 0.756502\varepsilon_{t-1} + 91.748179\sigma^2_{(t-1)} \ldots \ldots \ldots \ldots \ldots \ldots . \ldots \ldots \ldots \ldots \ldots \ldots (5.5)$$

(0.8668) (0.0196) (0.0000) (0.1706)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLP(t)} = 0.017288 + 0.092539\varepsilon^2_{(t-1)} + 0.150120\ \varepsilon^2_{(t-1)}\ D_{(t-1)} + 0.937968\sigma^2_{(t-1)} +} \ \ldots \ldots \ldots \ldots \ldots \ldots (\mathbf{5.6})$$

(0.8425) (0.6937) (0.3032) (0.0074)

The above equation (5.5) shows that the co-efficient of lag of inflation uncertainty i.e.$\boldsymbol{\sigma^2_{(t-1)}}$ is insignificant, inflation uncertainty does not causes inflation and Cukierman-Meltzer Hypothesis does not hold under our study in case of Pakistan. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags, Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.6 of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.5) is conditional mean equation for inflation of Pakistan which show that lag of inflation uncertainty does not causes inflation , is insignificant.

2) China

First take the ACF and PACF of the return series of the China in order to find out the order of AR and MA terms. Then estimate the GARCH-type models through Maximum Likelihood procedure.

6) Estimated GARCH-L Model

Conditional Mean Equation

$$R_{DLC(t)} = 0.034768 + 0.216025\ DLC_{(t-1)} + 0.162799\ DLC_{(t-2)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.7(a))$$

(0.0044) (0.0001) (0.0009)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLC(t)} = 0.019031 + 1.123469\ \varepsilon^2_{(t-1)} + 0.304330\sigma^2_{(t-1)} + 0.249630\ DLC_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.8(a)})$$

(0.0003) (0.0000) (0.0000) (0.0000)

The above equation 5.8(a) shows that the co-efficient of lag of return series inflation of China DLC(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty under our study in case of China. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.8(a) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.8(a)) is conditional variance equation for inflation of China which show that lag of inflation causes inflation uncertainty, is negative and significant.

7) Estimated GARCH-L-D1-D2 Model

Conditional Mean Equation

$$R_{DLC(t)} = 0.110505 + 0.020538\ D_{1(t)} + 0.360388\ D_{2(t)} + 0.024165\ DLC_{t-1} + 0.089550\ DLC_{t-2} \ldots\ldots (5.7(b))$$

(0.0096) (0.7717) (0.0007) (0.7252) (0.1791)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLC(t)} = 0.188227 + 0.214058\varepsilon^2_{(t-1)} + 0.281936\ \sigma^2_{(t-1)} + 0.396852 DLC_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.8(b)})$$

(0.0000) (0.0001) (0.0000) (0.0000)

The above equation 5.8(b) shows that the co-efficient of lag of return series of inflation DLC(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of China. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1)-D1-D2 Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.8(b) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.8(b) is conditional variance equation for inflation of China which show that lag of inflation causes inflation uncertainty, is negative and significant.

8) Estimated GARCH-M Model

Conditional Mean Equation

$$R_{DLC(t)} = 0.044065 + 0.303270 DLC_{(t-1)} + 0.050176\,\sigma^2{}_{(t)} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5.7(c))$$

(0.0032) (0.0005) (0.0981)

Conditional Variance Equation

$$\sigma^2_{DLC(t)} = 0.009194 + 1.430914\,\varepsilon^2_{(t-1)} + 0.226302\,\sigma^2_{(t-1)} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5.8(c))$$

(0.0980) (0.0000) (0.0018)

The above equation (5.7(c)) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is significant, inflation uncertainty causes inflation which is in line with Cukierman-Meltzer Hypothesis under our study in case of China. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.8(c) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.7(c) is conditional mean equation for inflation of China which show that inflation uncertainty causes inflation, is significant and positive under our study in case of China .

9) Estimated GARCH-M-D1-D2 Model

Conditional Mean Equation

$$\boldsymbol{R_{DLC(t)} = 0.011731 + 0.011254 D_{1(t)} + 0.717631\, D_{2(t)} + 0.204348\, DLC_{(t-1)} + 0.072217\,\sigma^2{}_{(t)} \ldots \ldots (5.7(d))}$$

(0.5066) (0.8069) (0.0000) (0.0329) (0.0010)

Conditional Variance Equation

$$\sigma^2_{DLC(t)} = \mathbf{0.021292} + \mathbf{1.383807}\,\varepsilon^2_{(t-1)} + \mathbf{0.142661}\,\sigma^2_{(t-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.8(d)})$$

(0.0045) (0.0000) (0.0045)

The above equations shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2}_t$ is significant , inflation uncertainty causes inflation, which means that Cukierman-Meltzer Hypothesis hold , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of China. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.8(d) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.7(d) is conditional mean equation for inflation of China which shows that inflation uncertainty causes inflation, is significant under our study in case of China.

10) Estimated GARCH-M(1) Model (Two Step Model)

STEP 1:

Conditional Mean Equation

$$R_{DLC(t)} = \mathbf{0.014462} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.9})$$

(0.04411)

Conditional Variance Equation

$$\sigma^{1.469476}_{DLC(t)} = \mathbf{0.044622} + \mathbf{0.864668}\,(|\varepsilon_{t-1}| + \mathbf{0.335903}\varepsilon_{t-1})^{1.469476} + \mathbf{0.335903}\sigma^2_{(t-1)} \ldots\ldots\ldots (\mathbf{5.10})$$

(0.2107) (0.1672) (0.0001) (0.0471) (0.2159)

Now we save the conditional variance series from the above model and use it as a proxy for inflation uncertainty. We introduce the lag of this conditional variance in the mean equation in order to check the relation between inflation uncertainty and inflation which described Cukierman-Meltzer Hypothesis. The diagnostic tests are given in table 10. The P-values are given in the parentheses.

STEP 2:

Conditional Mean Equation

$$\boldsymbol{DLC = 0.004494 + 0.045602\sigma^2_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.11})$$

(0.8142) (0.0397)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLC(t)} = 0.034902 + 1.301781\varepsilon^2_{(t-1)} + 0.270921\,\sigma^2_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.12})$$

(0.0477) (0.0550) (0.0477)

The above equation (5.11) shows that the co-efficient of lag of inflation uncertainty i.e. $\sigma^2_{(t-1)}$ is significant and positive , inflation uncertainty causes inflation and is in line with Cukierman-Meltzer Hypothesis under our study in case of China. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 12 of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.11) is conditional mean equation for inflation of China which show that lag of inflation uncertainty causes inflation, significant and positive.

3) Russia

First take the ACF and PACF of the Return Series of the Russia in order to find out the order of AR and MA terms. Then estimate the GARCH-type models through Maximum Likelihood procedure.

11) Estimated GARCH-L(1) Model

Conditional Mean Equation

$$R_{DLR(t)} = 0.009301 + 0.707078DLR_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.13(a))$$

(0.0000) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLP(t)} = 6.05072 + 0.49749\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.41578\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.42245\log(\sigma^2_{(t-1)}) + 23.0420DLR_{t-1}}(\mathbf{5.14(a)})$$

(0.0000) (0.0000) (0.0020) (0.0000) (0.1606)

The above equations shows that the co-efficient of lag of return DLR(-1) is insignificant and does not describes the Friedman-Ball Hypothesis that inflation causes inflation uncertainty under our study in case of Russia. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.14(a) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.14(a)) is conditional variance equation for inflation of Russia which show that lag of inflation does not causes inflation uncertainty and insignificant.

12) Estimated GARCH-L(1)-D1-D2 Model

Conditional Mean Equation

$$R_{DLR(t)} = 0.009804 + 0.000751\, D_{1(t)} + 0.001507 D_{2(t)} + 0.754439\, DLR_{t-1} \dots\dots\dots\dots (5.13(b))$$

(0.0000) (0.5987) (0.3673) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLR(t)}} = \mathbf{4.117574 + 0.429899}\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}}\right|\right) + \mathbf{0.398333}\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}}\right) + \mathbf{0.603094}\, \boldsymbol{log}\, (\boldsymbol{\sigma^2_{(t-1)}}) + \mathbf{18.48525}\boldsymbol{DLR_{t-1}} \dots (\mathbf{5.14}(\boldsymbol{b}))$$

(0.0289) (0.0031) (0.0019) (0.0003) (0.0000)

The above equations shows that the co-efficient of lag of return DLR(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty , the global financial crises 2005 and global financial crises 2008 both are insignificant under our study in case of Russia. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.14(b) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.14(b)) is conditional variance equation for inflation of Russia which show that lag of inflation does not causes inflation uncertainty and insignificant.

13) Estimated GARCH-M Model

Conditional Mean Equation

$R_{DLR(t)} = 0.011001 + 0.672454 DLR_{t-1} + 38.20001\, \sigma^2{}_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.13(c))$

(0.0351) (0.0000) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLR(t)} = 1.655137 + 0.650802\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.330983\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.796830\, log\,(\sigma^2_{(t-1)}) \ldots\ldots (5.14(c))}$$

(0.0000) (0.0000) (0.0000) (0.0000)

The above equation (5.13(c)) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is significant, inflation uncertainty causes inflation which is in line with Cukierman-Meltzer Hypothesis under our study in case of Russia. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.14(c) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.13(c)) is conditional mean equation for inflation of Russia which shows that inflation uncertainty causes inflation, is significant and positive under our study in case of Russia.

14) Estimated GARCH-M-D1-D2 Model

Conditional Mean Equation

$R_{DLR(t)} = 0.010606 + 0.000859\ D_{1(t)} + 0.001578\, D_{2(t)} + 0.610511\, DLR_{(t-1)} + 69.86830\, \sigma^2{}_{(t)} \ldots\ldots (5.13(d))$

(0.0000) (0.4995) (0.3021) (0.0000) (0.1310)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLR(t)} = 3.242742 + 0.437548\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.439619\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.666269\, log\,(\sigma^2_{(t-1)}) \ldots\ldots (5.14(d))}$$

(0.0227) (0.0002) (0.0000) (0.0000)

The above equations shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_{(t)}}$ is insignificant , inflation uncertainty does not causes inflation, which means that Cukierman-Meltzer Hypothesis does not hold , the global financial crises 2005 and global financial crises 2008 both are insignificant under our study in case of Russia. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.14(d) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.13(d)) is conditional mean equation for inflation of Russia which show that inflation uncertainty does not causes inflation, is insignificant under our study in case Russia.

15) Estimated GARCH-M(1) Model

STEP 1:

Conditional Mean Equation

$$DLR_{(t)} = 0.007119 + 0.541695 DLR_{t-1} \ldots \ldots (5.15)$$

(0.0000) (0.0000)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLR(t)} = 100 + 1.000000\varepsilon^2_{(t-1)} + 0.412496\sigma^2_{(t-1)}} \ldots \ldots (\mathbf{5.16})$$

(0.0718) (0.9860) (0.0184)

Now we save the conditional variance series from the above model and use it as a proxy for inflation uncertainty. We introduce the lag of this conditional variance in the mean equation in order to check the relation between inflation uncertainty and inflation which describes Cukierman-Meltzer Hypothesis. The diagnostic tests are given in the table 5.16 of appendix, for the above model. The P-values are given in the parentheses.

STEP 2:

Conditional Mean Equation

$$DLR_{(t)} = 0.010961 + 0.640617 DLR_{t-1} + 1.154491\sigma^2_{t-1} \ldots \ldots (5.17)$$

(0.5116) (0.0000) (0.2306)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLR(t)} = 0.246941 + 0.099220\varepsilon^2_{(t-1)} + 0.000005\sigma^2_{(t-1)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5.18})$$

(0.3234) (0.2985) (1.0000)

The above equation (5.17) shows that the co-efficient of lag of inflation uncertainty i.e. $\boldsymbol{\sigma^2_{(t)}}$ is insignificant , inflation uncertainty does not causes inflation and Cukierman-Meltzer Hypothesis does not hold under our study in case of Russia. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.18 of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.17) is conditional mean equation for inflation of Russia which show that lag of inflation uncertainty does not causes inflation , is insignificant.

4) Iran

First take the ACF and PACF of the return series of the China in order to find out the order of AR and MA terms. Then estimate the GARCH-type models through Maximum Likelihood procedure.

16) Estimated GARCH-L(1) Model

Conditional Mean Equation

$$R_{DLIR(t)} = 0.014117 + 0.540296\, DLIR_{(t-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.19(a))$$

(0.0000) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLIR(t)} = 16.3165 + 0.08337\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.27542\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.53641\, log\,(\sigma^2_{(t-1)}) + 100.338\, DLIR_{(t-1)}}(\mathbf{5.20(a)})$$

(0.0000) (0.5188) (0.0798) (0.0010) (0.0000)

The above equation 5.20(a) shows that the co-efficient of lag of return series inflation of Iran

DLIR(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty under our study in case of Iran. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.20(a) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.20(a)) is conditional variance equation for inflation of Iran which show that lag of inflation causes inflation uncertainty, is positive and significant.

17) Estimated GARCH-L(1)-D1-D2 Model

Conditional Mean Equation

$$R_{DLIR(t)} = 0.014088 + 0.003719\, D_{1(t)} + 0.000394\, D_{2(t)} + 0.505682\, DLIR_{t-1} \dots\dots\dots (5.19(b))$$

(0.0000) (0.2859) (0.8764) (0.0000)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLIR(t)} = 16.6614 + 0.05901\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.32060\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.56053\, log\,(\sigma^2_{(t-1)}) + 109.203\, DLIR_{(t-1)}(5.20(b))}$$

(0.0000) (0.6209) (0.0439) (0.0002) (0.0000)

The above equation 5.20(b) shows that the co-efficient of lag of return series of inflation

DLIR(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty , the global financial crises 2005 and global financial crises 2008 both are insignificant under our study in case of Iran. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1)-D1-D2 Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.20b) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.20(b) is conditional variance equation for inflation of Iran which show that lag of inflation causes inflation uncertainty, is positive and significant.

18) Estimated GARCH-M Model

Conditional Mean Equation

$$R_{DLIR(t)} = 0.012441 + 0.378741 DLIR_{(t-1)} + 9.889256\ \sigma^2{}_{(t)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.19(c))$$

(0.0000) (0.0001) (0.6438)

Conditional Variance Equation

$$\sigma^2_{DLIR(t)} = 0.0000156 + 0.340649\ \varepsilon^2_{(t-1)} + 0.506448\ \sigma^2_{(t-1)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.20(c))$$

(0.0086) (0.0022) (0.0022)

The above equation (5.19(c)) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is insignificant, inflation uncertainty does not causes inflation which is not in line with Cukierman-Meltzer Hypothesis under our study in case of Iran. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.20(c) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.19(c) is conditional mean equation for inflation of Iran which shows that inflation uncertainty does not causes inflation, is insignificant under our study in case of Iran .

19) Estimated GARCH-M-D1-D2 Model

Conditional Mean Equation

$$R_{DLIR(t)} = 0.012261 + 0.000672 D_{1(t)} + 0.001606\ D_{2(t)} + 0.377289\ DLC_{(t-1)} + 8.630506\ \sigma^2{}_{(t)} \dots\dots (5.19(d))$$

(0.0000) (0.8739) (0.4495) (0.0001) (0.6281)

Conditional Variance Equation

$$\sigma^2_{DLIR(t)} = 0.000015 + 0.328036\ \varepsilon^2_{(t-1)} + 0.522537\ \sigma^2_{(t-1)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.20(d))$$

(0.0161) (0.0059) (0.0000)

The above equation 5.19(d) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is insignificant , inflation uncertainty does not causes inflation, which means that Cukierman-Meltzer Hypothesis does not hold , the global financial crises 2005 and global financial crises 2008 both are insignificant under our study in case of Iran. The P-values are given in the parentheses. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.20(d) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation 5.19(d) is conditional mean equation for inflation of China which shows that inflation uncertainty does not causes inflation, is insignificant under our study in case of Iran.

20) Estimated GARCH-M(1) Model (two step model)

STEP 1:

Conditional Mean Equation

$$DLIR_{(t)} = 0.012984 + 0.428352 DLIR_{t-1} \dots\dots\dots (5.21)$$

(0.0000) (0.0000)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLIR(t)} = 0.160136 + 0.674813\varepsilon^2_{(t-1)} + 0.518636\sigma^2_{(t-1)} \dots\dots\dots (5.22)}$$

(0.0002) (0.1180) (0.0001)

Now we save the conditional variance series from the above model and use it as a proxy for inflation uncertainty. We introduce the lag of this conditional variance in the mean equation in order to check the relation between inflation uncertainty and inflation which describes Cukierman-Meltzer Hypothesis. The diagnostic tests are given in the table 22 , of appendix , for the above model. The P-values are given in the parentheses.

STEP 2:

Conditional Mean Equation

$DLIR_{(t)} = 0.012679 + 0.415754 DLIR_{t-1} + 3.775264\sigma^2_{(t-1)}$ … … … … … … … … … … … … … … … … … … … (5.23)

(0.0000) (0.0000) (0.4644)

Conditional Variance Equation

$\boldsymbol{\sigma^2_{DLIR(t)} = 0.628509 + 0.134295\varepsilon^2_{(t-1)} + 0.8930\sigma^2_{(t-1)}}$ … (**5.24**)

(0.0713) (0.3492) (0.0025)

The above equation (5.23) shows that the co-efficient of lag of inflation uncertainty i.e. $\boldsymbol{\sigma^2_{(t-1)}}$ is insignificant , inflation uncertainty does not causes inflation and Cukierman-Meltzer Hypothesis does not hold under our study in case of Iran. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 24 of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.23) is conditional mean equation for inflation of Iran which show that lag of inflation uncertainty does not causes inflation , is insignificant.

5) India

First take the ACF and PACF of the Return Series of the India in order to find out the order of AR and MA terms. Then estimate the GARCH-type models through Maximum Likelihood procedure.

21) Estimated GARCH-L(1) Model

Conditional Mean Equation

$R_{DLIN(t)} = 0.007195 + 0.221271 DLIN_{t-1} + 0.476053\, DLIN_{t-12} + 0.030392\varepsilon_{t-1} + 0.149479\varepsilon_{t-12}$ … (5.25(*a*))

(0.0000) (0.0111) (0.0000) (0.8011) (0.1988)

Conditional Variance Equation

$\boldsymbol{\sigma^2_{DLIN(t)} = 0.00000114 + 0.078089\varepsilon^2_{(t-1)} + 0.872864\sigma^2_{(t-1)} + 0.001449 DLIN_{(t-1)}}$ … … … … … … … (**5.26(*a*)**)

(0.2465) (0.0005) (0.0000) (0.0000)

The above equations 5.26(a) shows that the co-efficient of lag of return DLIN(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty under our study in case of India. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.26(a) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.26(a)) is conditional variance equation for inflation of India which show that lag of inflation causes inflation uncertainty, is positive and significant.

22) Estimated GARCH-L(1)-D1-D2 Model

Conditional Mean Equation

$$R_{DLIN(t)} = 0.0134 + 0.0003D_{1(t)} + 0.0041D_{2(t)} + 0.0585DLIN_{t-1} + 0.9049DLIN_{t-12} + 0.0310\varepsilon_{t-1} + 0.773\varepsilon_{t-12} (5.25(b))$$

(0.1870) (0.7302) (0.0089) (0.1837) (0.0000) (0.5969) (0.0000)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLIN(t)} = 0.0000000652 + 0.084091\varepsilon^2_{(t-1)} + 0.918733\sigma^2_{(t-1)} + 0.001136DLIN_{(t-1)}} \dots\dots\dots\dots\dots (\mathbf{5.26(b)})$$

(0.8260) (0.0010) (0.0000) (0.0000)

The above equation 5.26(b) shows that the co-efficient of lag of return DLIN(-1) is significant and described the Friedman-Ball Hypothesis that inflation causes inflation uncertainty , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of India. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-L(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.26(b) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.26(b)) is conditional variance equation for inflation of India which show that lag of inflation causes inflation uncertainty, is positive and significant.

23) Estimated GARCH-M Model

Conditional Mean Equation

$$R_{DLIN(t)} = 0.014415 + 0.005677DLIN_{t-1} + 0.973407\ DLIN_{t-12} + 0.028872\varepsilon_{t-1} + 0.908282\varepsilon_{t-12} + 3.906311\ \sigma^2{}_{(t)}(5.25(c))$$

(0.0547) (0.7470) (0.0000) (0.1321) (0.0000) (0.7367)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLIN(t)} = 0.355902 + 0.216789\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right|\right) + 0.131418\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{t-1}}}\right) + 0.950366\ log\ (\sigma^2_{(t-1)}) \ldots\ldots\ldots (5.26(c))}$$

(0.0000) (0.0000) (0.0021) (0.0000)

The above equation (5.1(c)) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2{}_t}$ is insignificant, inflation uncertainty does not causes inflation which is not in line with Cukierman-Meltzer Hypothesis under our study in case of India. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.26(c) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.25(c)) is conditional mean equation for inflation of India which show that inflation uncertainty does not causes inflation, is insignificant under our study in case of India.

24) Estimated GARCH-M-D1-D2 Model

Conditional Mean Equation

$$R_{DLIN(t)} = 7.7351 + 0.0009D_{1(t)} + 0.0023D_{2(t)} + 0.0121DLIN_{t-1} + 0.9879DLIN_{t-12} + 0.0201\varepsilon_{t-1} + 0.9312\varepsilon_{t-12} + 32.492\ \sigma^2{}_{(t)}(5.25(d))$$

(0.9993) (0.1808) (0.0017) (0.4393) (0.0000) (0.1678) (0.0000)

(0.0079)

Conditional Variance Equation

$$\boldsymbol{log\sigma^2_{DLIN(t)} = 1.980430 + 0.408719\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}}\right|\right) + 0.314239\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}}\right) + 0.779768\, log\,(\sigma^2_{(t-1)})} \ldots (\boldsymbol{5.26(d)})$$

(0.0003) (0.0014) (0.0005) (0.0000)

The above equations 5.1(d) shows that the co-efficient of inflation uncertainty i.e. $\boldsymbol{\sigma^2_t}$ is significant , inflation uncertainty causes inflation, which means that Cukierman-Meltzer Hypothesis hold , the global financial crises 2005 is insignificant and global financial crises 2008 is significant under our study in case of India. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 5.26(d) of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.25(d)) is conditional mean equation for inflation of India which show that inflation uncertainty causes inflation, is significant and negative under our study in case of India.

25) Estimated GARCH-M(1) Model (two step model)

STEP 1:

Conditional Mean Equation

$$DLIN_{(t)} = 0.005470 + 0.116889DLIN_{t-1} + 0.352566\varepsilon_{t-6} \ldots \ldots (5.27)$$

(0.0000) (0.6028) (0.1101)

Conditional Variance Equation

$$\boldsymbol{\sigma^2_{DLIR(t)} = 0.005050 + 0.00000\varepsilon^2_{(t-1)} + 0.993706\sigma^2_{(t-1)}} \ldots \ldots (\boldsymbol{5.28})$$

(0.7288) (1.0000) (0.0000)

Now we save the conditional variance series from the above model and use it as a proxy for inflation uncertainty. We introduce the lag of this conditional variance in the mean equation in order to check the relation between inflation uncertainty and inflation which describes Cukierman-Meltzer Hypothesis. The diagnostic tests are given in the table 28 , of appendix , for the above model. The P-values are given in the parentheses.

STEP 2:

Conditional Mean Equation

$DLIN_{(t)} = 0.001056 + 0.229917\ \varepsilon_{(t-1)} + 100.000\sigma^2_{(t-1)}$ … … … … … … … … … … (5.29)

(0.8880) (0.0002) (0.3818)

Conditional Variance Equation

$\boldsymbol{\sigma^2_{DLIN(t)} = 0.002938 + 0.00000\varepsilon^2_{(t-1)} + 0.996411\sigma^2_{(t-1)}}$ … … … … … … … … … … … … … . … $(\mathbf{5.30})$

(0.8364) (1.0000) (0.0000)

The above equation (5.23) shows that the co-efficient of lag of inflation uncertainty i.e. ω_{t-1} is insignificant, inflation uncertainty does not causes inflation and Cukierman-Meltzer Hypothesis does not hold under our study in case of India. The P-values are given in the parentheses.

Diagnostic Test

Check that there is no ARCH effect and autocorrelation in the residual of GARCH-M(1) Model by using Engle et al (1982) LM ARCH test, up to 10 lags , Q-Statistic test and Q^2-statistics on residuals and squared residuals accepts the null of no serial correlation respectively as given in Table 28 of appendix. This also justifies that GARCH captures the ARCH effect effectively. Equation (5.29) is conditional mean equation for inflation of India which show that lag of inflation uncertainty does not causes inflation , is insignificant.

TABLE 5.1.5: Summary of Results of Different Models

MODEL	Coefficient	PAKISTAN	INDIA	CHINA	RUSSIA	IRAN
GARCH-L	l_1	YES	YES	YES	NO	YES
GARCH-L-D1-D2	l_1	YES	YES	YES	YES	YES
	d1	**N0**	**NO**	**NO**	**NO**	**NO**
	d2	**YES**	**YES**	**YES**	NO	NO
GARCH-M	m_1	YES	NO	YES	YES	NO
GARCH-M-D1-D2	m_1	NO	YES	YES	NO	NO
	d1	**NO**	**NO**	**NO**	**NO**	**NO**
	d2	**YES**	**YES**	**YES**	NO	NO
GARCH-M(1)	m_1	YES	NO	YES	NO	NO

MODEL

GARCH-L(1) : FRIDEMAN-BALL HYPOYHESIS

GARCH-L(1)-D1-D2 : FRIDEMAN-BALL HYPOTHESIS

GARCH-M : CUKIERMAN-MELTZER HYPOTHESIS

GARCH-M-D1-D2 : CUKIERMAN-MELTZER HYPOTHESIS

GARCH-M(1): CUKIERMAN-MELTZER HYPOTHESIS

d1: coefficient of global financial crises 2005

d2: coefficient of global financial crises 2008

YES: empirically significance N0: does not significance empirically

Conclusion

This study analyses the relationship between inflation and inflation uncertainty using monthly data set of Pakistan and neighboring economies including China, Russia, Iran and India employing GARCH-type Models. It is evident from the results of GARCH-L(1) specification that the hypothesis is in line with the argument of Friedman and Ball in case of all economies however the model GARCH-M and GARCH-M(1) Cukierman-Meltzer Hypothesis holds true in case of Pakistan, China and Russia but not in the case of India and Iran. However the global financial crises 2005 is found to be empirically insignificant in case of all the economies whereas global financial crises 2008 found be empirically significant in case of Pakistan, India and China however insignificant in case of Russia and Iran. This work will help the analysts and policy makers to formulate policies to control inflation so that uncertainty can be minimized. Moreover, based on our findings we conclude that a stable inflation will result in degradation of inflation uncertainty which can improve economic performance of the Pakistan, India, China, Russia and Iran. The results of our study justify that monetary authority need to maintain inflation at lower rates.

APPENDICES

Table 5.1(a) Pakistan inflation series Model GARCH-L(1)

Mean Equation (Equation 5.1(a))			**Variance Equation (Equation 5.2(a))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.005723	(0.0000)	C(V)	0.000000269	(0.4938)
AR(1)	0.245492	(0.1161)	α_1	0.089579	(0.0000)
MA(1)	0.562354	(0.0000)	β_1	1.014540	(0.0000)
			l_1	**0.000678**	**(0.0000)**
Log likelihood			***639.7629***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.2(a): Residuals Analysis of equation 5.1(a) and 5.2(a)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.097	(0.018)*
Q-Stats(10)	16.262	(0.032)*
Q-Stats(20)	37.688	(0.014)*
Q^2-Stats(5)	4.1405	(0.247)
Q^2-Stats(10)	10.728	(0.218)
Q^2-Stats(20)	22.191	(0.224)
LM-ARCH Test (2) F-stats	1.547644	(0.2156)
LM-ARCH Test (5) F-stats	0.847859	(0.4967)
LM-ARCH Test (10) F-stats	0.951788	(0.4757)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.1(b) Pakistan Inflation return series Model GARCH-L(1)-D1-D2

Mean Equation (Equation 5.1(b))			**Variance Equation (Equation 5.2(b))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.004572	(0.0000)	C(V)	0.0000000714	(0.8100)
d_1	0.003484	(0.1361)	α_1	0.096747	(0.0010)
d_2	0.007551	(0.0011)	β_1	1.027488	(0.0000)
AR(1)	0.357102	(0.0895)***	l_1	**0.000599**	**(0.0031)**
MA(1)	0.576642	(0.0025)			
Log likelihood			***647.8809***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.2(b): Residuals Analysis of equation 5.1(b) and 5.2(b)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	5.3764	(0.146)
Q-Stats(10)	6.1280	(0.633)
Q-Stats(20)	19.876	(0.340)
Q^2-Stats(5)	3.7991	(0.284)
Q^2-Stats(10)	8.2593	(0.409)
Q^2-Stats(20)	29.176	(0.046)
LM-ARCH Test (2) F-stats	0.010128	(0.9899)
LM-ARCH Test (5) F-stats	0.188346	(0.9442)
LM-ARCH Test (10) F-stats	0.639461	(0.7437)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.1(c) Pakistan Inflation returns series Model GARCH-M

Mean Equation (Equation 5.1(c))			**Variance Equation (Equation 5.2(c))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0003157	(0.0000)	C(V)	0.143008	(0.0000)
AR(1)	0.146653	(0.0000)	α_1	0.185416	(0.0000)
m_1	56.93142	(0.0239)	β_1	0.079793	(0.0031)
			$\boldsymbol{\delta_1}$	0.969919	(0.0000)
Log likelihood			***643.9274***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.2(c): Residuals Analysis of equation 5.1(c) and 5.2(c)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.502	(0.033)*
Q-Stats(10)	15.171	(0.086)**
Q-Stats(20)	41.794	(0.002)*
Q^2-Stats(5)	27.917	(0.000)
Q^2-Stats(10)	35.561	(0.000)
Q^2-Stats(20)	51.264	(0.000)
LM-ARCH Test (2) F-stats	14.31148	(0.0000)
LM-ARCH Test (5) F-stats	7.646301	(0.0000)
LM-ARCH Test (10) F-stats	5.78126	(0.0000)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.1(d) Pakistan Inflation return series Model GARCH-M-D1-D2

Mean Equation (Equation 5.1 (d))			**Variance Equation (Equation 5.2(d))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.004060	(0.0003)	C(V)	0.263618	(0.0000)
d_1	0.002288	(0.2366)	α_1	0.179088	(0.0000)
d_2	0.003362	(0.0842)***	β_1	0.090644	(0.0053)
AR(1)	0.103988	(0.1772)	$\boldsymbol{\delta_1}$	0.958152	(0.0000)
m_1	32.91326	(0.1747)			
Log likelihood			***645.9913***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.2(d): Residuals Analysis of equation 5.1(d) and 5.2(d)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	8.6647	(0.070)**
Q-Stats(10)	10.780	(0.291)
Q-Stats(20)	30.140	(0.050)**
Q^2-Stats(5)	3.0566	(0.548)
Q^2-Stats(10)	9.0688	(0.431)
Q^2-Stats(20)	21.846	(0.292)
LM-ARCH Test (2) F-stats	0.244423	(0.7834)
LM-ARCH Test (5) F-stats	0.314231	(0.8682)
LM-ARCH Test (10) F-stats	0.900537	(0.5175)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.3 Pakistan Inflation return series Model GARCH-M(1) step I

Mean Equation (Equation 5.3)			**Variance Equation (Equation 5.4)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.005793	(0.0000)	C(V)	0.044225	(0.7223)
AR(1)	0.493265	(0.0016)	α_1	0.092539	(0.3290)
MA(1)	0.710660	(0.0000)	β_1	0.838779	(0.0046)
Log likelihood			***632.531***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.4 : Residuals Analysis of equation 5.3 and 5.4

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.1727	(0.0171538)*
Q-Stats(10)	18.0686	(0.0207180)*
Q-Stats(20)	35.0204	(0.0093967)
Q^2-Stats(5)	4.51917	(0.2105867)
Q^2-Stats(10)	11.1712	(0.1921888)
Q^2-Stats(20)	20.1980	(0.3217855)
LM-ARCH Test (2) F-stats	1.8026	(0.1679)
LM-ARCH Test (5) F-stats	0.84058	(0.5226)
LM-ARCH Test (10) F-stats	0.99684	(0.4485)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.5 Pakistan Inflation return series Model GARCH-M(1) step II

Mean Equation (Equation 5.5)			**Variance Equation (Equation 5.6)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.000615	(0.8668)	C(V)	0.017288	(0.8425)
m_1	**91.748179**	**(0.1706)**	α_1	0.103846	(0.6937)
AR(1)	-0.565426	(0.0196)	β_1	0.937968	(0.0074)
MA(1)	0.756502	(0.0000)	$\boldsymbol{\gamma_1}$	0.150120	(0.3032)
Log likelihood			**637.206**		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.6: Residuals Analysis of Equation 5.5 and 5.6

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	5.69274	(0.0860759)***
Q-Stats(10)	9.41636	(0.3083984)
Q-Stats(20)	23.0311	(0.1893972)
Q^2-Stats(5)	6.64044	(0.0842856)***
Q^2-Stats(10)	8.95061	(0.3464798)
Q^2-Stats(20)	27.4894	(0.0702620)***
LM-ARCH Test (2) F-stats	1.8485	(0.1605)
LM-ARCH Test (5) F-stats	1.4856	(0.1970)
LM-ARCH Test (10) F-stats	0.99636	(0.4489)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.7(a) China inflation return series Model GARCH-L(1)

Mean Equation (Equation 5.7(a))			Variance Equation (Equation 5.8(a))		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.034768	(0.0044)	C(V)	0.019031	(0.0003)
AR(1)	0.216025	(0.0001)	α_1	1.123469	(0.0000)
AR(2)	0.162799	(0.0009)	β_1	0.304330	(0.0000)
			l_1	0.249630	(0.0000)
Log likelihood			***-96.48569***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.8(a): Residuals Analysis of equation 5.7(a) and 5.8(a)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	9.8235	(0.020)*
Q-Stats(10)	16.163	(0.040)*
Q-Stats(20)	44.949	(0.000)
Q^2-Stats(5)	3.1706	(0.366)
Q^2-Stats(10)	11.049	(0.199)
Q^2-Stats(20)	17.393	(0.496)
LM-ARCH Test (2) F-stats	0.034488	(0.9661)
LM-ARCH Test (5) F-stats	0.553318	(0.6969)
LM-ARCH Test (10) F-stats	0.594430	(0.7816)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.7(b) China inflation return series Model GARCH-L(1)-D1-D2

Mean Equation (Equation 5.7(b))			**Variance Equation (Equation 5.8(b))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.110505	(0.0096)	C(V)	0.188227	(0.0000)
d_1	0.020538	(0.7717)	α_1	0.214058	(0.0001)
d_2	0.360388	(0.0007)	β_1	0.281936	(0.0000)
AR(1)	0.024165	(0.7252)	l_1	0.396852	(0.0000)
AR(2)	0.089550	(0.1791)			
Log likelihood			***-144.6223***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.8(b): Residuals Analysis of equation 5.7(b) and 5.8(b)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	4.1383	(0.247)
Q-Stats(10)	10.386	(0.239)
Q-Stats(20)	16.779	(0.538)
Q^2-Stats(5)	4.9744	(0.174)
Q^2-Stats(10)	18.153	(0.020)*
Q^2-Stats(20)	26.006	(0.101)**
LM-ARCH Test (2) F-stats	2.128142	(0.1221)
LM-ARCH Test (5) F-stats	0.925275	(0.4506)
LM-ARCH Test (10) F-stats	1.539237	(0.1472)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.7(c) China inflation returns series Model GARCH-M

Mean Equation (Equation 5.7(c))			**Variance Equation (Equation 5.7(c))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.044065	(0.0032)	C(V)	0.009194	(0.0980)
AR(1)	0.303270	(0.0005)	α_1	1.430914	(0.0000)
m_1	0.050176	(0.0981)***	β_1	0.226302	(0.0018)
Log likelihood			***-108.4595***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.8(c): Residuals Analysis of equation 5.7(c) and 5.8(c)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	11.993	(0.017)*
Q-Stats(10)	15.476	(0.079)**
Q-Stats(20)	39.399	(0.004)
Q^2-Stats(5)	2.3342	(0.675)
Q^2-Stats(10)	12.106	(0.207)
Q^2-Stats(20)	17.185	(0.577)
LM-ARCH Test (2) F-stats	0.360858	(0.6976)
LM-ARCH Test (5) F-stats	0.334023	(0.8548)
LM-ARCH Test (10) F-stats	0.360698	(0.9398)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.7(d) China inflation return series Model GARCH-M-D1-D2

Mean Equation (Equation 5.7(d))			**Variance Equation (Equation 5.8(d))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.072217	(0.0010)	C(V)	0.021292	(0.0045)
d_1	0.011254	(0.8069)	α_1	1.383807	(0.0000)
d_2	0.717631	(0.0000)	β_1	0.142661	(0.0045)
AR(1)	-0.204348	(0.0329)			
m_1	0.072217	(0.0010)			
Log likelihood			***-127.9448***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.8(d): Residuals Analysis of equation 5.7(d) and 5.8(d)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	13.474	(0.009)
Q-Stats(10)	25.732	(0.002)
Q-Stats(20)	45.067	(0.001)
Q^2-Stats(5)	7.9888	(0.092)***
Q^2-Stats(10)	10.994	(0.276)
Q^2-Stats(20)	18.544	(0.486)
LM-ARCH Test (2) F-stats	3.472629	(0.0332)
LM-ARCH Test (5) F-stats	1.894047	(0.1136)
LM-ARCH Test (10) F-stats	1.252407	(0.2719)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.9 China inflation return series Model GARCH-M step I

Mean Equation (Equation 5.9)			**Variance equation (Equation 5.10)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.014462	(0.4411)	C(V)	0.044622	(0.2107)
			α_1	0.864668	(0.1672)
			β_1	0.335903	(0.2159)
			γ_1	0.335903	(0.0001)**
			δ_1	1.469476	(0.0471)**
Log likelihood			**-83.982**		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.10 : Residuals Analysis of Equation 5.9 and 5.10

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	3.46894	(0.6280931)
Q-Stats(10)	10.8818	(0.3667991)
Q-Stats(20)	27.2462	(0.1284779)
Q^2-Stats(5)	1.15416	(0.7640186)
Q^2-Stats(10)	6.95009	(0.5420269)
Q^2-Stats(20)	10.9475	(0.8965692)
LM-ARCH Test (2) F-stats	0.33505	(0.7158)
LM-ARCH Test (5) F-stats	0.20797	(0.9588)
LM-ARCH Test (10) F-stats	0.63648	(0.7810)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.11 China inflation return series Model GARCH-M step II

Mean Equation (Equation 5.11)			Variance Equation (Equation 5.12)		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.004494	(0.8142)	C(V)	0.034902	(0.0477)
m_1	0.045602	(0.0397)	α_1	1.301781	(0.0550)
			β_1	0.270921	(0.0477)
Log likelihood			***-83.982***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.12 : Residuals Analysis of equation 5.11 and 5.12

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	2.96548	(0.7053083)
Q-Stats(10)	6.78884	(0.7452184)
Q-Stats(20)	12.2972	(0.9054663)
Q^2-Stats(5)	0.306563	(0.9587895)
Q^2-Stats(10)	6.45700	(0.5961805)
Q^2-Stats(20)	7.73003	(0.9823901)
LM-ARCH Test (2) F-stats	0.0034600	(0.9965)
LM-ARCH Test (5) F-stats	0.093106	(0.9932)
LM-ARCH Test (10) F-stats	1.3762	(0.1956)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.13(a) Russia inflation return series Model GARCH-L(1)

Mean Equation (Equation 5.13(a))			**Variance Equation (Equation 5.14(a))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.009301	(0.0000)	C(V)	6.050726	(0.0000)
AR(1)	0.707078	(0.0000)	α_1	0497493	(0.0000)
			β_1	0.415781	(0.0020)
			$\boldsymbol{\delta_1}$	0.422457	(0.0000)
			l_1	23.04207	(0.1606)
Log likelihood			***719.9508***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.14(a): Residuals Analysis of equation 5.13(a) and 5.14(a)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	11.102	(0.025)*
Q-Stats(10)	16.754	(0.059)**
Q-Stats(20)	69.618	(0.000)
Q^2-Stats(5)	5.1848	(0.269)
Q^2-Stats(10)	12.994	(0.163)
Q^2-Stats(20)	52.310	(0.000)
LM-ARCH Test (2) F-stats	2.103915	(0.1250)
LM-ARCH Test (5) F-stats	1.232604	(0.2988)
LM-ARCH Test (10) F-stats	1.312180	(0.2406)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.13(b) Russia inflation return series Model GARCH-L(1)-D1-D2

Mean Equation (Equation 5.13(b))			**Variance Equation (Equation 5.14(b))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.009804	(0.0000)	C(V)	4.117574	(0.0289)
d_1	0.000751	(0.5987)	α_1	0.429899	(0.0031)
d_2	0.001507	(0.3673)	β_1	0.398333	(0.0019)
AR(1)	0.754439	(0.0000)	$\boldsymbol{\delta_1}$	0.603094	(0.0003)
			l_1	18.48525	(0.4224)
Log likelihood			***721.4125***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.14(b): Residuals Analysis of equation 5.13(b) and 5.14(b)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	11.524	(0.021)*
Q-Stats(10)	18.229	(0.033)*
Q-Stats(20)	73.151	(0.000)
Q^2-Stats(5)	3.6105	(0.461)
Q^2-Stats(10)	9.9264	(0.356)
Q^2-Stats(20)	49.131	(0.000)
LM-ARCH Test (2) F-stats	1.228583	(0.2952)
LM-ARCH Test (5) F-stats	0.899960	(0.4653)
LM-ARCH Test (10) F-stats	0.963819	(0.4662)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.13(c) Russia inflation return series Model GARCH-M

Mean Equation (Equation 5.13(c))			**Variance Equation (Equation 5.14(c))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.011001	(0.0000)	C(V)	1.644137	(0.0000)
AR(1)	0.672454	(0.0000)	α_1	0.650802	(0.0000)
m_1	38.20001	(0.0351)	β_1	00.330983	(0.0000)
			$\boldsymbol{\delta_1}$	0.796830	(0.0000)
Log likelihood			***729.8301***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.14(c): Residuals Analysis of equation 5.13(c) and 5.14(c)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	0.1150	(0.998)
Q-Stats(10)	0.2142	(0.999)
Q-Stats(20)	34.815	(0.015)*
Q^2-Stats(5)	0.3706	(0.990)
Q^2-Stats(10)	0.6324	(0.999)
Q^2-Stats(20)	40.311	(0.003)
LM-ARCH Test (2) F-stats	0.053712	(0.9477)
LM-ARCH Test (5) F-stats	0.058901	(0.9935)
LM-ARCH Test (10) F-stats	0.066814	(0.9998)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.13(d) Russia inflation return series Model GARCH-M-D1-D2

Mean Equation (Equation 5.13(d))			**Variance Equation (Equation 5.14(d))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.010606	(0.0000)	C(V)	3.242742	(0.0227)
d_1	0.000859	(0.4995)	α_1	0.437548	(0.0002)
d_2	0.001578	(0.3021)	β_1	0.439619	(0.0000)
AR(1)	0.610511	(0.0000)	$\boldsymbol{\delta_1}$	0.666269	(0.0000)
m_1	69.86830	(0.1310)			
Log likelihood			***723.5428***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.14(d): Residuals Analysis of equation 5.13(d) and 5.14(d)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	0.0335	(0.998)
Q-Stats(10)	0.0756	(0.999)
Q-Stats(20)	0.1815	(0.999)
Q^2-Stats(5)	0.0301	(0.999)
Q^2-Stats(10)	0.0626	(0.999)
Q^2-Stats(20)	0.1354	(0.999)
LM-ARCH Test (2) F-stats	0.005661	(0.9944)
LM-ARCH Test (5) F-stats	0.005728	(0.9999)
LM-ARCH Test (10) F-stats	0.005863	(0.9999)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.15 Russia inflation return series Model GARCH-M step I

Mean Equation (Equation 5.15)			**Variance Equation (Equation 5.16)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.007119	(0.0000)	C(V)	100.0000	(0.0718)***
AR(1)	0.541695	(0.0000)	α_1	1.000000	(0.9860)
			β_1	0.412496	(0.0184)*
Log likelihood			***-83.982***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.16 : Residuals Analysis of equation 5.15 and 5.16

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.0715	(0.0392407)*
Q-Stats(10)	14.0935	(0.1190390)
Q-Stats(20)	72.5849	(0.0000000)
Q^2-Stats(5)	4.11715	(0.2490887)
Q^2-Stats(10)	6.84908	(0.5529998)
Q^2-Stats(20)	46.1249	(0.0002845)
LM-ARCH Test (2) F-stats	1.9460	(0.1459)
LM-ARCH Test (5) F-stats	0.75857	(0.5809)
LM-ARCH Test (10) F-stats	0.88792	(0.5459)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.17 Russia inflation return series Model GARCH-M step II

Mean Equation (Equation 5.17)			**Variance Equation (Equation 5.18)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.010961	(0.5116)	C(V)	0.246941	(0.3234)
m_1	1.154491	(0.2306)	α_1	0.099220	(0.2985)
AR(1)	0.640617	(0.0000)	β_1	0.000005	(1.0000)
Log likelihood			***699.557***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.18: Residuals Analysis of equation 5.17 and 5.18

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	11.9365	(0.0178296)*
Q-Stats(10)	16.3765	(0.0594231)***
Q-Stats(20)	86.9553	(0.0000000)
Q^2-Stats(5)	3.49334	(0.3216274)
Q^2-Stats(10)	9.85236	(0.2755418)
Q^2-Stats(20)	70.4130	(0.0000000)
LM-ARCH Test (2) F-stats	0.90812	(0.4052)
LM-ARCH Test (5) F-stats	0.65625	(0.6571)
LM-ARCH Test (10) F-stats	1.2060	(0.2909)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.19(a) Iran inflation return series Model GARCH-L(1)

Mean Equation (Equation 5.19(a))			**Variance Equation (Equation 5.20(a))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.014117	(0.0000)	C(V)	16.31654	(0.0000)
AR(1)	0.540296	(0.0000)	α_1	0.083369	(0.5188)
			β_1	0.275415	(0.0798)
			$\boldsymbol{\delta_1}$	0.536409	(0.0010)
			l_1	100.3378	(0.0000)
Log likelihood			***630.5499***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.20(a): Residuals Analysis of equation 5.19(a) and 5.20(a)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.833	(0.029)*
Q-Stats(10)	14.532	(0.105)
Q-Stats(20)	37.026	(0.010)*
Q^2-Stats(5)	6.1485	(0.188)
Q^2-Stats(10)	8.6935	(0.466)
Q^2-Stats(20)	15.348	(0.700)
LM-ARCH Test (2) F-stats	0.175413	(0.8393)
LM-ARCH Test (5) F-stats	1.456801	(0.2174)
LM-ARCH Test (10) F-stats	1.196017	(0.3042)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.19(b) Iran inflation return series Model GARCH-L(1)-D1-D2

Mean Equation (Equation 5.19(b))			**Variance Equation (Equation 5.20(b))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.014088	(0.0000)	C(V)	16.66137	(0.0000)
d_1	0.003719	(0.2859)	α_1	0.059013	(0.6209)
d_2	0.000394	(0.8764)	β_1	0.320600	(0.0439)
AR(1)	0.505682	(0.0000)	$\boldsymbol{\delta_1}$	0.560530	(0.0002)
			l_1	109.2031	(0.0000)
Log likelihood			***631.1845***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.20(b): Residuals Analysis of equation 5.19(b) and 5.20(b)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	9.8375	(0.043)*
Q-Stats(10)	13.388	(0.146)
Q-Stats(20)	35.682	(0.012)*
Q^2-Stats(5)	6.6961	(0.153)
Q^2-Stats(10)	8.9352	(0.443)
Q^2-Stats(20)	15.320	(0.702)
LM-ARCH Test (2) F-stats	0.287738	(0.7503)
LM-ARCH Test (5) F-stats	1.568028	(0.1849)
LM-ARCH Test (10) F-stats	1.197355	(0.3034)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.19(c) Iran inflation return series Model GARCH-M

Mean Equation (Equation 5.19(c))			**Variance Equation (Equation 5.20(c))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.012441	(0.0000)	C(V)	0.0000156	(0.0086)
AR(1)	0.378741	(0.00001)	α_1	0.340649	(0.0022)
m_1	9.889256	(0.6438)	β_1	0.506448	(0.0000)
Log likelihood			***618.9710***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.20(c): Residuals Analysis of equation 5.19(c) and 5.20(c)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.602	(0.031)*
Q-Stats(10)	15.240	(0.085)
Q-Stats(20)	39.924	(0.003)
Q^2-Stats(5)	6.7389	(0.150)
Q^2-Stats(10)	8.1416	(0.520)
Q^2-Stats(20)	16.461	(0.626)
LM-ARCH Test (2) F-stats	0.793209	(0.4540)
LM-ARCH Test (5) F-stats	1.530127	(0.1954)
LM-ARCH Test (10) F-stats	1.060916	(0.3930)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.19(d) Iran inflation return series Model GARCH-M-D1-D2

Mean Equation (Equation 5.19(d))			**Variance Equation (Equation 5.20(d))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.012261	(0.0000)	C(V)	0.000015	(0.0161)
d1	0.000672	(0.8739)	α_1	0.328036	(0.0059)
d2	0.001606	(0.4495)	β_1	0.522537	(0.0000)
AR(1)	0.377289	(0.0001)			
m_1	8.630506	(0.6821)			
Log likelihood			***619.1043***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.20(d): Residuals Analysis of equation 5.19(d) and 5.20(d)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.397	(0.034)*
Q-Stats(10)	15.232	(0.085)**
Q-Stats(20)	39.991	(0.003)
Q^2-Stats(5)	7.0396	(0.134)
Q^2-Stats(10)	8.4954	(0.485)
Q^2-Stats(20)	15.823	(0.669)
LM-ARCH Test (2) F-stats	0.673205	(0.5114)
LM-ARCH Test (5) F-stats	1.618524	(0.1716)
LM-ARCH Test (10) F-stats	1.089465	(0.3729)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.21 Iran inflation return series Model GARCH-M(1) step I

Mean Equation (Equation 5.21)			**Variance Equation (Equation 5.22)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.012984	(0.0000)	C(V)	0.160136	(0.0002)
AR(1)	0.428352	(0.0000)	α_1	0.674813	(0.1180)
			β_1	0.518636	(0.0001)
			STUDENT (DF)	0.735956	(0.0801)***
Log likelihood			***633.254***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.22 : Residuals Analysis of equation 5.21 and 5.22

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.1578	(0.0378514)*
Q-Stats(10)	13.1560	(0.1556716)
Q-Stats(20)	39.1184	(0.0042640)
Q^2-Stats(5)	1.03242	(0.7934080)
Q^2-Stats(10)	4.73837	(0.7851380)
Q^2-Stats(20)	18.4382	(0.4271531)
LM-ARCH Test (2) F-stats	0.49099	([0.6129)
LM-ARCH Test (5) F-stats	0.47273	(0.7962)
LM-ARCH Test (10) F-stats	0.80362	(0.6254)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.23 Iran inflation return series Model GARCH-M(1) step II

Mean Equation (Equation 5.23)			**Variance Equation (Equation 5.24)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.012679	(0.0000)	C(V)	0.628509	(0.0713)
m_1	3.775264	(0.4644)	α_1	0.134295	(0.3492)
AR(1)	0.415754	(0.0000)	β_1	0.053499	(0.8930)
			STUDENT (DF)	4.292581	(0.0025)
Log likelihood			***623.167***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.24 : Residuals Analysis of equation 5.23 and 5.24

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	10.2933	(0.0357667)*
Q-Stats(10)	14.4548	(0.1070428)
Q-Stats(20)	36.0599	(0.0103781)*
Q^2-Stats(5)	18.2874	(0.0003837)
Q^2-Stats(10)	20.0471	(0.0101594)*
Q^2-Stats(20)	24.2351	(0.1474760)
LM-ARCH Test (2) F-stats	0.14656	(0.8638)
LM-ARCH Test (5) F-stats	3.8457	(0.0025)*
LM-ARCH Test (10) F-stats	2.3189	(0.0142)*

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.25(a) India inflation return series Model GARCH-L(1)

Mean Equation (Equation 5.25(a))			**Variance Equation (Equation 5.26(a))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.007195	(0.0000)	C(V)	0.00000114	(0.2465)
AR(1)	0.221271	(0.0111)	α_1	0.078089	(0.0005)
MA(1)	0.476053	(0.8011)	β_1	0.872864	(0.0000)
MA(12)	0.149479	(0.1988)	l_1	0.001449	(0.0000)
Log likelihood			***623.4451***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.26(a): Residuals Analysis of equation 5.25(a) and 5.26(a)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	9.2964	(0.002)
Q-Stats(10)	14.108	(0.028)*
Q-Stats(20)	28.453	(0.028)*
Q^2-Stats(5)	1.5870	(0.208)
Q^2-Stats(10)	3.7672	(0.708)
Q^2-Stats(20)	11.219	(0.796)
LM-ARCH Test (2) F-stats	0.374550	(0.6882)
LM-ARCH Test (5) F-stats	0.325659	(0.8605)
LM-ARCH Test (10) F-stats	0.430881	(0.9011)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.25(b) India inflation return series Model GARCH-L(1)-D1-D2

Mean Equation (Equation 5.25(b))			**Variance Equation (Equation 5.26(b))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.013414	(0.1870)	C(V)	0.0000000652	(0.8260)
d_1	0.000316	(0.7302)	α_1	0.084091	(0.0000)
d_2	0.004081	(0.0089)	β_1	0.918733	(0.0000)
AR(1)	0.058561	(0.1837)	l_1	0.001136	(0.0000)
AR(12)	0.904926	(0.0000)			
MA(1)	0.030972	(0.5969)			
MA(12)	0.772466	(0.0000)			
Log likelihood			***643.8567***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.26(b): Residuals Analysis of equation 5.25(b) and 5.26(b)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	9.0834	(0.003)
Q-Stats(10)	15.333	(0.018)*
Q-Stats(20)	27.567	(0.036)*
Q^2-Stats(5)	1.6809	(0.195)
Q^2-Stats(10)	2.7816	(0.836)
Q^2-Stats(20)	5.7306	(0.995)
LM-ARCH Test (2) F-stats	0.326619	(0.7218)
LM-ARCH Test (5) F-stats	0.368871	(0.8306)
LM-ARCH Test (10) F-stats	0.298643	(0.9655)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.25(c) India inflation return series Model GARCH-M

Mean Equation (Equation 5.25(c))			**Variance Equation (Equation 5.26(c))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.014415	(0.0547)	C(V)	0.355902	(0.0000)
AR(1)	0.005677	(0.7470)	α_1	0.216789	(0.0000)
AR(12)	0.973407	(0.0000)	β_1	0.131418	(0.0012)
MA(1)	0.028872	(0.1321)	$\boldsymbol{\delta_1}$	0.950366	(0.0000)
MA(12)	0.90282	(0.0000)			
m_1	3.906311	(0.7367)			
Log likelihood			***649.2248***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.26(c): Residuals Analysis of equation 5.25(c) and 5.26(c)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	7.4306	(0.006)*
Q-Stats(10)	9.6445	(0.140)
Q-Stats(20)	20.721	(0.189)
Q^2-Stats(5)	5.2923	(0.021)
Q^2-Stats(10)	6.6022	(0.359)
Q^2-Stats(20)	8.6801	(0.926)
LM-ARCH Test (2) F-stats	1.632443	(0.1986)
LM-ARCH Test (5) F-stats	0.855548	(0.4921)
LM-ARCH Test (10) F-stats	0.747645	(0.6493)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.25(d) India inflation returns series Model GARCH-M-D1-D2

Mean Equation (Equation 5.25 (d))			**Variance Equation (Equation 5.26(d))**		
	Coefficient	P-value		Coefficient	P-value
C(M)	7.735096	(0.9993)	C(V)	1.980430	(0.0003)
d_1	0.000861	(0.1808)	α_1	0.408719	(0.0014)
d_2	0.002245	(0.0017)	β_1	0.314239	(0.0005)
AR(1)	0.012087	(0.4393)	$\boldsymbol{\delta_1}$	0.779768	(0.0000)
AR(12)	0.987899	(0.0000)			
MA(1)	0.020951	(0.1678)			
MA(12)	0.931218	(0.0000)			
m_1	32.49184	(0.0079)			
Log likelihood			***643.4051***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.26(d): Residuals Analysis of equation 5.25(d) and 5.26(d)

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	2.8679	(0.090)**
Q-Stats(10)	8.7153	(0.190)
Q-Stats(20)	23.529	(0.100)**
Q^2-Stats(5)	3.2650	(0.071)*
Q^2-Stats(10)	5.1211	(0.528)
Q^2-Stats(20)	21.976	(0.144)
LM-ARCH Test (2) F-stats	1.476152	(0.2315)
LM-ARCH Test (5) F-stats	0.776366	(0.5421)
LM-ARCH Test (10) F-stats	0.556943	(0.8117)

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.27 India inflation return series Model GARCH-M(1) step I

Mean Equation (Equation 5.27)			**Variance Equation (Equation 5.28)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.005470	(0.0000)	C(V)	0.005050	(0.7288)
AR(1)	0.116889	(0.6028)	α_1	0.000000	(1.0000)
MA(1)	0.352566	(0.1101)	β_1	0.993706	(0.0000)
Log likelihood			***646.776***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.28 : Residuals Analysis of equation 5.27 and 5.28

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	11.6439	(0.0087079)*
Q-Stats(10)	27.9792	(0.0004782)*
Q-Stats(20)	87.8590	(0.000000)
Q^2-Stats(5)	1.02273	(0.7957529)
Q^2-Stats(10)	13.4964	(0.0958738)**
Q^2-Stats(20)	39.4717	(0.0024618)*
LM-ARCH Test (2) F-stats	0.403380	(0.6684)
LM-ARCH Test (5) F-stats	0.22220	(0.9526)
LM-ARCH Test (10) F-stats	1.1853	(0.3044)

Level of significance 1%, 5%, 10% above the parentheses shown by *, **, *** respectively.

Table 5.29 India inflation return series Model GARCH-M(1) step II

Mean Equation (Equation 5.29)			**Variance Equation (Equation 5.30)**		
	Coefficient	P-value		Coefficient	P-value
C(M)	0.001056	(0.8880)	C(V)	0.002939	(0.8364)
m_1	**100.0000**	**(0.3818)**	α_1	0.00000	(1.0000)
MA(1)	0.229917	(0.0002)	β_1	0.996411	(0.0000)
Log likelihood			***643.701***		

Level of significance 1%, 5%,10% above the parentheses shown by * , ** , *** respectively .

Table 5.30 : Residuals Analysis of equation 5.29 and 5.30

Statistics	**Standard residuals**	**P-value**
Q-Stats(5)	13.4450	(0.0092943)*
Q-Stats(10)	30.3668	(0.0003799)*
Q-Stats(20)	91.2742	(0.000000)
Q^2-Stats(5)	1.25446	(0.3799747)
Q^2-Stats(10)	14.2147	(0.0763383)
Q^2-Stats(20)	39.8722	(0.0021725)*
LM-ARCH Test (2) F-stats	0.48676	(0.6154)
LM-ARCH Test (5) F-stats	0.26667	(0.9308)
LM-ARCH Test (10) F-stats	1.2864	(0.2423)

Level of significance 1%, 5%, 10% above the parentheses shown by *, **, *** respectively.

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