MACROECONOMIC NEWS ANNOUNCEMENTS EFFECTS ON FOREIGN EXCHANGE RETURNS AND VOLATILITY: EXPLORING THE ROLE OF ORDER FLOW

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Macroeconomic News Announcements Effects on Foreign Exchange Rate Returns and Volatility: Exploring the Role of Order Flow

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Dedication

This Dissertation is dedicated to my parents

Dr. Muhammad Hussain (Late)

And

Tahira Nasreen (Late)

Who had given me invaluable educational opportunities, guidance and support,

Whose affection, love, encouragement and prays of day and night made me able to succeed and to get honor to complete this work

To My Teacher

Professor Dr. Muhammad Hussain (Late)

Ex- Director General, International Institute of Islamic Economics,

International Islamic University, Islamabad.

Who had always been a great source of inspiration and motivation to me. His sincere guidance and support made possible in achieving this dissertation

To my daughter

Bareera Jabeen

Who has been my emotional anchor through my entire life and keeping my spirit up.

DECLARATION

I hereby declare that this thesis, neither as a whole nor as a part thereof, has been copied out from any source. It is further declared that I have carried out this research by myself and have completed this thesis on the basis of my personal efforts under the guidance and help of my supervisor.

Munazza Jabeen

ABSTRACT

This study examines the effects of macroeconomic news announcements and order flow on Pak rupee exchange rate returns and exchange rate volatility. It discovers the role of macroeconomic news and order flow in the process of price discovery in emerging economies' foreign exchange market. For this, this study employs univariate and multivariate GARCH models to analyze the joint reaction of exchange rate returns and exchange rate volatility of Pak rupee with macroeconomic news and order flow. It uses the daily data of Pak rupee exchange rates, foreign exchange transactions of Pak rupee between dealers in terms of traded contracts and monthly data on foreign and domestic news announcements from January, 2008 to December, 2018.

The analysis shows that macroeconomic news affect Pak rupee exchange rate returns and their volatilities during and after announcements periods. It shows that order flow drives movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. The findings also show that releases of macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rate returns and their volatilities indirectly during announcements periods. Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes foreign exchange market, it affects decisions of market makers, influencing order flow and then exchange rates.

Key words: Pak rupee exchange rates; Macroeconomic news announcements; Order Flow

JEL Classification: F31, F40, G14, C32

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CHAPTER 1
INTRODUCTION

1.1- Background

The exchange rate determination is a leading issue in international economics. In the 1970s, the researchers developed the traditional macroeconomic models of exchange rates within the asset market approach to analyze the behavior of exchange rates through macroeconomic fundamentals (Dornbusch, 1976; Frenkel, 1976). These models explained the link between exchange rates and macroeconomic fundamentals. However, Meese and Rogoff (1983) criticized these traditional macroeconomic models and provided empirical evidence for the poor performance of these models in predicting the short-run exchange rate movements. Therefore, some researchers attempted new approaches to explain and predict exchange rate movements.

In the early 1980s, the researchers developed new models of foreign exchange rates incorporating the role of information in analyzing the behavior of foreign exchange rates (Almeida, Goodhart, & Payne, 1998; Andersen, Bollerslev, Diebold, & Vega, 2003; Evans & Lyons, 2002a, 2002b; Glosten & Milgrom, 1985; Goodhart, Hall, Henry, & Pesaran, 1993; Kyle, 1985). The macro-information based models of exchange rates considered the role of macroeconomic news announcements in explaining exchange rate movements. Under the assumptions of rational expectations and efficient markets, these models stated that the macroeconomic news announcements directly and immediately incorporate public information into exchange rates (Almeida *et al.*, 1998; Andersen *et al.*, 2003). These

models showed the effects of macroeconomic news announcements on exchange rates and trading conveys no private information that affects exchange rates. On the other hand, the micro-information based models of exchange rates considered the role of trading in explaining exchange rate movements. These models stated that order flow incorporate private information into exchange rates (Glosten & Milgrom, 1985; Kyle, 1985). These models showed the effects of trading on exchange rates and trading conveys private information which affects exchange rates. The hybrid- information-based models of exchange rates considered the information-aggregation role of order flow linking macroeconomic fundamentals and exchange rates (Evans & Lyons, 2002a). These models stated that order flow induce private portfolio shift effects on exchange rates that are unrelated to macroeconomic information.

A considerable amount of research focused on the relative importance of the direct and indirect information channels during and after news announcement periods. If macroeconomic news announcements contain common knowledge information, then the direct channel accounts for most of the exchange rate movements and has the same effects on exchange rates. Conversely, if macroeconomic news announcements contain dispersed information, then the indirect channel dominates and has different effects on exchange rates. Therefore, the empirical studies analyzed the direct and indirect effects of macroeconomic news announcements on exchange rates, respectively (Evans & Lyons, 2008; Savaser, 2011).

One strand of studies found that macroeconomic news announcements directly and immediately incorporate public information into exchange rates (Almeida *et al.*, 1998; Andersen *et al.*, 2003; Ben Omrane, Welch, & Zhou, 2020; Boudt, Neely, Sercu, &

Wauters, 2019; Caporale, Spagnolo, & Spagnolo, 2018; Cheung, Fatum, & Yamamoto, 2019; Ehrmann & Fratzscher, 2005; Fatum, Hutchison, & Wu, 2012; Gau & Wu, 2017; May, Farrell, & Rossouw, 2018; Neely, 2011; Pearce & Solakoglu, 2007). These studies found that only common knowledge macroeconomic information matters and there are rational and homogeneous market participants, interpreting public information identically and thus, uniformly calculate changes in exchange rates. In contrast, other studies found that macroeconomic news announcements indirectly incorporate dispersed information into exchange rates via order flow (Evans & Lyons, 2005, 2008; Galati & Ho, 2003; Love & Payne, 2008; Savaser, 2011; Zhang, Marsh, & MacDonald, 2016). These studies found that macroeconomic news releases public information creating order flow that reveals private information and incorporating dispersed information into exchange rates. Hence, the trading conveys dispersed information which affects exchange rates. These studies integrated public macroeconomic information, agents' heterogeneous information, and dispersed information which induce market participants to revise their expectations, resulting in changes in exchange rates.

1.2- Research Issues and Research Gaps

For understanding the linkages among exchange rates and macroeconomic fundamentals, many researchers in the 1980s, instead of identifying the impacts of shocks to macroeconomic fundamentals on exchange rates, began considering the effects of announcements of macroeconomic news on foreign exchange rates. Such announcements allowed researchers to examine which of the announcement influences foreign exchange rates more significantly, how markets perceive and respond to new information, and how that information incorporate into exchange rates. Analyzing foreign exchange rates'

response to announcements of macroeconomic news can shed light on how market perceptions of fundamentals change and how markets form expectations of future fundamentals (Neely & Dey, 2010).

Early research used the efficient market hypothesis and uncovered interest rate parity hypothesis for testing news effects of macroeconomic fundamentals on exchange rates (Cornell, 1982; Dornbusch, 1982; Edwards, 1982; Engel & Frankel, 1984; Hakkio & Pearce, 1985; Hardouvelis, 1984, 1988). A considerable amount of research focused on examining foreign exchange rates response to macroeconomic news releases (Almeida *et al.*, 1998; Andersen *et al.*, 2003; Ben Omrane *et al.*, 2020; Boudt *et al.*, 2019; Caporale *et al.*, 2018; Cheung *et al.*, 2019; Ehrmann & Fratzscher, 2005; Fatum *et al.*, 2012; Gau & Wu, 2017; May *et al.*, 2018; Neely, 2011; Pearce & Solakoglu, 2007). These studies focused on price formation in foreign exchange markets and explained the price discovery process in these markets. These studies examined how news about fundamentals are incorporated into exchange rates. These studies assumed that markets react directly to the surprise component of any announcement. These studies analyzed foreign exchange rates' response to macroeconomic news announcements in many dimensions including analysis of the pattern and speed of adjustments, asymmetry effects according to the sign, news effects on exchange rates returns and volatility across countries, over time, and with the business cycle. These studies' most key finding is that the announcements of macroeconomic news directly and immediately affect exchange rates.

An extensive empirical literature explored macroeconomic news announcements' effects on exchange rate returns and volatility. It focused on examining how foreign exchange markets respond to various announcements of macroeconomic news. The main

finding is that a variety of macroeconomic news across several countries affects exchange rates. Most of the studies took into account the impact of regularly- quantitative scheduled news about macroeconomic fundamentals (Almeida *et al.*, 1998; Andersen *et al.*, 2003; Ehrmann & Fratzscher, 2005). These studies concluded that exchange rates react significantly to the surprise component of macroeconomic announcements. Most of the researchers found that US announcements, German announcements, and Japanese announcements are the most important and influential to the foreign exchange rates[1]. The literature also showed that domestic macroeconomic news announcements have no significant impact on exchange rates. Moreover, most of the existing studies were limited to major currencies exchange rates[2].

However, there exists no general consensus on which of macroeconomic surprise has the greatest effect on exchange rates and which currency is most elastic to macroeconomic surprises. The extent of fluctuations in exchange rates explained by the macroeconomic surprises and the direction and degree of the effect of various macroeconomic surprises on various exchange rates of the same currency is not explored in the literature. Similarly, the effects of the similar macroeconomic news release from different economies on different exchange rates of the same currency are still unexplored in the empirical literature. Furthermore, the link between foreign exchange markets and the reactions of market participants to public information originating from different economies is not explored in the literature. Moreover, the interdependencies of different exchange

[1] US Dollar exchange rates for British Pound, Euro, German Mark, , Japanese Yen, and Swiss Franc.
[2] US Dollar, British Pound, Euro, and Japanese Yen.

rates of the same currency on the same underlying fundamental economic influences on exchange rate returns and volatility are the dimensions that need to be investigated.

The existing studies mostly considered developed economies for examining the news effects on exchange rates in different contexts and dimensions. Few studies examined the effects of announcements of macroeconomic news on exchange rates in developing economies as well (Cai, Howorka, & Wongswan, 2008; Caporale *et al.*, 2018; Wong, Ariff, & Ahmad, 2014). The exchange rate dynamics with respect to the news on macroeconomic fundamentals in foreign exchange markets of developing economies need to be examined as they are characterized by market inefficiency and illiquidity (Caporale *et al.,* 2018). There is also a dire need to investigate whether the news about macroeconomic fundamentals interprets the process of price discovery in developing economies' foreign exchange markets as they become available to market participants and whether exchange rates are more reactive to foreign news announcements as compared to domestic news announcements (Gau & Wu, 2017). Further, it is also important to examine whether the direction of news effects on the exchange rate depends on "*the market's belief about both the exchange rate determination models and the response of the monetary authorities to new information*"(Almeida et al., 1998).

Several empirical studies showed the effects of macroeconomic news announcements on exchange rates via order flow (Evans & Lyons, 2005, 2008; Galati & Ho, 2003; Love & Payne, 2008; Savaser, 2011; Zhang *et al.*, 2016). These studies examined how news about fundamentals is incorporated into exchange rates via the trading process. These studies argued order flow is the medium by which macroeconomic information is incorporated into exchange rates. Evans and Lyons (2002 a) found exchange

rate fluctuations are caused by the order flow through private portfolio shift which is unrelated to macroeconomic information. The order flow induce portfolio-balance effects on exchange rates. Evans and Lyons (2005) described the average news effect as the direct effect of announcements of macroeconomic news on exchange rates, and the total news effect as the sum of the direct effect and the indirect effect of announcements of macroeconomic news. They concluded that the total news effect on exchange rates must include the immediate reaction to new as well as reaction to trades. Evans and Lyons (2008) and Love and Payne (2008) found the exchange rate reaction to macroeconomic news announcements is mediated by order flow. Savaser (2011) and Zhang *et al.* (2016) found the exchange rate reaction to macroeconomic news announcements is moderated by order flow. These empirical studies examined both the direct and indirect news effects on exchange rates. Their results revealed that real-time public and private information significantly influence exchange rates. However, the empirical studies considered only the contemporaneous effects of macroeconomic news and order flow on exchange rates and ignore the dynamic effects. Further, these studies on the direct and indirect effects of macroeconomic news examined the exchange rate dynamics of developed economies only.

Most of the existing studies on information-based models of exchange rate determination considered developed economies' foreign exchange markets to investigate the link among macroeconomic news announcements, order flow, and exchange rates. However, the exchange rate dynamics concerning macroeconomic news announcements and order flow for developing economies are still unexplored in literature. There is a need to investigate whether these models also hold for emerging foreign exchange markets as they are characterized by market inefficiencies and illiquidity. Further, there is a need to

explore the effects on exchange rates if the information is revealed to all market participants publicly and simultaneously and if the information is dispersed between heterogeneous market participants in an integrated framework. Moreover, the empirical work on joint dynamics of exchange rates (exchange rate returns and exchange rate volatility) with macroeconomic news announcements and order flow is missing in the existing literature.

In Pakistan, the empirical literature on exchange rates generally focused on examining the role of macroeconomic fundamentals in explaining the nominal exchange rates dynamics (Abbas, Khan, & Rizvi, 2011; Jabeen & Khan, 2014; Kemal, Haider, & Khalid, 2004; M. A. Khan & Qayyum, 2011; Zakaria, Ahmad, & Iqbal, 2007). There is no empirical study that analyzed the role of announcements of macroeconomic news and order flow in explaining Pak rupee exchange rates dynamics. There is a need to examine exchange rate dynamics with respect to the news on macroeconomic fundamentals in the foreign exchange market of Pakistan. It is essential to explore which of the macroeconomic news have the most impact on Pak rupee exchange rates during and after announcements, and how much of the movements and variations in Pak rupee exchange rates do macroeconomic 'surprises' account for (or explain)? There is also a need to discover in which direction similar macroeconomic news announcements impact the different exchange rates of the Pak rupee. Additionally, there is a need to identify the mechanisms that are related to the exchange rate determination, as well as the mechanisms that dominate and determine the sign of the response of the exchange rate to the news. Also, there is a need to investigate whether order flow drive movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. It is essential to examine whether trading signals and trading strategies of

currency traders affect exchange rates and whether releases of foreign and domestic macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rates indirectly during and after announcements periods.

1.3- Research Objectives

The core objective of the study is to examine the effects of macroeconomic news announcements on exchange rate returns and exchange rate volatility in the Pak rupee which includes a broad set of macroeconomic news announcements (both foreign and domestic) well-known in the economic literature. It analyzes three sources of exchange rate movements: i) macroeconomic news announcements which immediately and directly affect exchange rates, ii) order flow which affect exchange rates but is unrelated to macroeconomic news announcements, iii) an indirect effect of macroeconomic news announcements that operates via order flow. It also investigates the joint reaction of different exchange rates of the Pak rupee to news announcements in a multivariate framework. Specifically, the study intends:

1. To examine the direct impact of macroeconomic news announcements on exchange rate returns and exchange rate volatility. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.
2. To examine the direct impact of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.
3. To examine the indirect impact of macroeconomic news announcements on exchange rate returns and exchange rate volatility via order flow with

heterogeneous market participants and dispersed information. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.

4. To examine the interdependencies between different exchange rates of the same currency and their joint reaction to news announcements in a multivariate framework.

1.4- Research Questions

In this study, the following research questions are investigated.

1. How foreign exchange market reacts to various macroeconomic news announcements?
2. How information (both public and private) is incorporated into exchange rate returns and exchange rate volatility directly?
3. How public information affects exchange rate returns and exchange rate volatility through private information?
4. How do different exchange rates of the same currency respond jointly to macroeconomic news announcements?

1.5- Contributions

This study is a comprehensive analysis of examining the role of information in analyzing the behavior of foreign exchange rates. It considers the direct market as well as the indirect market of foreign exchange. It examines the link between macroeconomic news announcements, order flow, and exchange rates. The study makes several contributions, which are as follows:

This study tests different macro-based and hybrid-based models (Andersen *et al.*, 2003, Evans and Lyons, 2002; 2008) for the emerging economy in order to test their validity in developing economies. For this, the study modifies the information-based models for modeling exchange rates in the emerging economy by incorporating the dynamics of the emerging foreign exchange market. It develops models' specifications to examine the joint dynamic response of exchange rate returns and exchange rate volatility to macroeconomic news announcements in an integrated framework. These models take into account the features of market inefficiencies and illiquidity. Further, these models explain not the only response of exchange rates to public information and private information but also past information. Moreover, these models also capture the dynamics of the developing economies' foreign exchange market by considering the fact that macroeconomic news and order flow may not affect instantly but affect over a number of periods with lags. When trades are initiated, the time it takes to incorporate the information transmitted by trades into exchange rates may be quite delayed. This makes a major contribution to existing literature.

Unlike many empirical studies, it examines three sources of exchange rate movements, i) macroeconomic news announcements which immediately and directly affect exchange rates, ii) order flow which affects exchange rates but is unrelated to macroeconomic news announcements, iii) an indirect effect of macroeconomic news announcements that operates via order flow. It takes both direct and indirect information channels during and after news announcement periods to analyze news effects on exchange rates. Further, in contrast to other studies, it explores the dynamic nonlinear relationship

between macroeconomic news and order flow through interaction between macroeconomic news and order flow which identifies indirect channel by which macroeconomic news influences exchange rates. This makes another major contribution to existing literature.

Instead of examining the response of the exchange rates of different currencies of developed and developing countries against major currencies (US dollar, British pound, Euro, and Japanese yen) to macroeconomic news announcements, this study examines the response of the exchange rates of the same currency against major currencies. It examines the direction and degree of impact of the different or similar macroeconomic news announcements from different economies on the different exchange rates of the same currency. Further, it also examines the effects of the domestic macroeconomic news announcements along with foreign macroeconomic news announcements. Moreover, this study investigates dynamic dependencies between different exchange rates of the same currency and their joint response to macroeconomic news announcements in a multivariate framework. These also make major contributions to the existing literature.

In Pakistan, the empirical literature on exchange rates generally focuses on examining the role of macroeconomic fundamentals in explaining the nominal exchange rates dynamics. There is no empirical study that analyzes the role of announcements of macroeconomic news and order flow in explaining Pak rupee exchange rates dynamics against major currencies. Therefore, this study significantly contributes to the existing literature by investigating the effects of macroeconomic news announcements on Pak rupee exchange rate returns and their volatilities that are well-known in the economic literature. It also examines the price discovery process during and after the announcement in the foreign exchange market of Pakistan. Further, it explores the extent of movements and

variations in Pak-rupee exchange rates explained by the macroeconomic news. It discovers in which direction similar macroeconomic news announcements impact the different exchange rates of the Pak rupee, which of mechanisms are related to the Pak rupee exchange rate determination, and which mechanisms dominate and determine the sign of the response of the exchange rate to the news. Also, it investigates whether order flow drive movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. Moreover, it examines the role of trading signals and trading strategies of currency traders affecting Pak rupee exchange rates and releases of foreign and domestic macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rates indirectly during and after announcements periods.

This study investigates the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of the Pak rupee. It examines the joint dynamic response of exchange rate returns and exchange rate volatility to macroeconomic news announcements and order flow in an integrated framework. The foreign exchange rates of the Pak rupee exhibit the features of skewness, fat tails, volatility clustering, and serial correlation. Therefore, unlike other studies, it employs Autoregressive Moving Average (ARMA) with Univariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models and Multivariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models[3]. It is well-known that ARMA-GARCH models are able to capture stylized facts of the exchange rate dynamics.

[3] Ehrmann and Fratzscher (2005) stated that the estimation of news models in a GARCH framework would be superior due to the direct estimation of the conditional second moments in GARCH models.

1.6- Importance and Significance of the Study

According to the efficient market hypothesis (EMH), the exchange rate should directly and immediately respond to the surprise component of any announcement. Response to announcements shows market perceptions of policy and changes in these policies over time and across countries. Thus, the exchange rate response informs market participants about expectations of future fundamentals formed by markets.

The main weakness of traditional, fundamentals-based exchange rate models is that these models include fundamental macroeconomic indicators which do not exactly reveal the correct information the market participants get while taking trading decisions. In order to analyze the linkages between exchange rates and fundamentals, there is a need to investigate how market participants form expectations from macroeconomic announcements and extract the surprise or "news" component of announcement about fundamentals. Testing whether such news about fundamentals explain exchange rate behaviour, whether the news about fundamentals explain the price discovery process in foreign exchange markets as they become available to market participants and whether exchange rates are more reactive to foreign news announcements as compared to domestic news announcements are useful in trade analysis and decision making by market participants like investors, traders, managers, and businesses and for designing and evaluating policies by policymakers.

Macroeconomic news announcements create order flows which convey private information into exchange rates. Private market participants integrate macroeconomic news announcements with private information owned by them and thus, convey that private information through their publicly-observed decisions. Understanding how

macroeconomic news announcements affect exchange rates directly or indirectly through order flow is useful for making trading decisions and investment decisions.

Understanding and explaining the exchange rate behavior by macroeconomic news announcements is important for trade analysis and decision making by market participants like investors, traders, managers, and businesses and for designing and evaluating policies by policymakers. Estimating the volatility in the exchange rates is vital for currency pricing, allocating portfolios, and managing risk. The exchange rate volatility explains how news influences currency prices, what information is relevant, and how markets interpret that information. Exchange rate volatility is also essential for policy evaluation. Policymakers are involved in assessing the volatility of the exchange rates to learn about investor perceptions and policy uncertainty.

In developing countries like Pakistan, the exchange rate dynamics with macroeconomic news announcements are still unexplored. Therefore, this study focuses on explaining exchange rate behavior by macroeconomic news announcements which help in trade analysis and decision making by market participants and policymakers. Thus, the results of this study possibly help to provide guidance for traders and regulators so that they are expected to utilize the models.

1.7- Structure of Thesis

The thesis is structured as follows.

Chapter 1: Introduction. It briefly mentions an outline of the research study. It discusses the background, research issues and gaps, and research objectives. It also highlights the

importance, significance, and contribution of the study to existing literature. In the end, it provides the structure of the thesis.

Chapter 2: Review of Theoretical Literature. It provides theoretical concepts of macro information-based models, micro information-based models, and hybrid information-based models. It also provides various models used in different studies.

Chapter 3: Review of Empirical Literature. It consists of five sub-sections which are: a) macroeconomic news announcements and foreign exchange rate returns, b) macroeconomic news announcements and foreign exchange rate volatility, c) exchange rates, order flow, and fundamentals d) exchange rates, order flow, and macroeconomic news e) interdependencies between exchange rates and macroeconomic news.

Chapter 4: Empirical Models and Data. It presents the model specifications, the methodology for the joint dynamics of Pak rupee exchange rate returns and Pak rupee exchange rate volatility with macroeconomic news announcements and order flow.

Chapter 5: Empirical Analysis. It presents the descriptive analysis, and technical analysis of Pak rupee exchange rates, foreign and domestic macroeconomic news announcements and order flow, and estimated empirical results.

Chapter 6: Conclusion. It provides a summary of the findings of the research study and discusses the policy implication and recommendations.

CHAPTER 2
REVIEW OF THEORETICAL LITERATURE

In the early 1980s, the researchers developed new models of foreign exchange rates incorporating the role of information in explaining exchange rate movements. The macro-information based models of exchange rates considered the role of macroeconomic news announcements in explaining exchange rate movements. They showed only common knowledge public information matters and there are rational and homogeneous market participants, interpreting public information identically and thus, uniformly calculate changes in exchange rates. The micro-information based models of exchange rates considered the role of order flow (trading flows) in explaining exchange rate movements. They showed that non-common knowledge private information matters and there are heterogeneous market participants having different information sets who interpret private information differently and revise their expectations that result in changes in exchange rates. The hybrid- information based models of exchange rates considered information-aggregation role of order flow linking macroeconomic fundamentals and exchange rates. They showed order flow induce private portfolio shift effects on exchange rates which is unrelated to macroeconomic information. They integrated public macroeconomic information, agents' heterogeneous information, and dispersed information which induces market participants to revise their expectations that result in changes in exchange rates.

This chapter provides a review of theoretical literature consisting of macro-information based models and micro-information based models and hybrid-information based models.

2.1- Macro-Information Based Models of Exchange Rates

The efficient market hypothesis asserts that asset prices should reflect all available information to market participants so that it is should not be possible for a trader to gain profits on the basis of this information. The foreign exchange market efficiency concerns with the informational content of exchange rates. In the simplest form, the efficient market hypothesis reduces to a "*joint hypothesis*" that participants in the foreign exchange market are risk-neutral and have rational expectations. If the risk-neutral efficient market hypothesis holds, then the uncovered interest rate parity condition: the interest rate differential equals the expected change in the exchange rate, is the test for foreign exchange market efficiency (Taylor, 1995).

The theoretical macro-information based models of exchange rates are derived from "the *asset price approach of exchange rate theory*" which assumes that "*expectations are the dominant factor in foreign exchange markets*" (Bilson, 1978; Dornbusch, 1976; Frenkel, 1976; Mundell, 1964; Mussa, 1977). According to "*the asset price approach of exchange rate theory*", the exchange rate (s_t) may be defined as "*a weighted average of its fundamental value (f_t) and the expected exchange rate in the next period*"[4].

$$s_t = (1-b)E_t(f_t) + bE_t(s_{t+1}) \tag{2.1}$$

where b is the discount factor and $E_t(.)$ shows the expected value based on information available at a point in time *t*.

[4] See Engel and West (2004, 2005).

The equation (1) is iterated as

$$s_t = (1-b)\sum_{i=1}^{\infty} b^i E_t(f_{t+i}) \quad (2.2)$$

where the exchange rate is defined as the present value of the macroeconomic fundamentals' current and expected future conditions.

In the case of exchange rate changes, equation (2.1) is modified as

$$\Delta s_{t+1} = \frac{1-b}{b}[s_t - E_t(f_t)] + \varepsilon_{t+1} \quad (2.3)$$

where $\varepsilon_{t+1} = \frac{1-b}{b}\sum_{i=1}^{\infty} b^i [E_{t+1}(f_{t+1+i}) - E_t(f_{t+1+i})]$ (2.4)

The change in the exchange rate is therefore determined by a systematic and unsystematic component. The systematic component implies, according to equation (2.3), that if the current exchange rate exceeds its fundamental value, then it increases and vice versa. It is because, expected future fundamental values are incorporated in the exchange rate at a discounted rate, in the case of rational expectations. Therefore, if the current exchange rate exceeds its fundamental value, this clearly shows the expectations of market participants about the increase in the future fundamental value.

The change in the exchange rate and expectations' adjustment in the subsequent periods offset each other, thus ensuring stability. The second part is further defined by equation (2.4) representing the unsystematic component as the sum of all revisions to expectations produced by new information accessible to all market participants.

Empirical evidences showed that over the long term, the macroeconomic fundamentals which are the base of the exchange rate's fundamental value reveal weak mean reversal. Many fundamental value changes are permanent. If the systematic

component is minor and new information influences, market participants would conclude that the chance of an increase in the fundamental value is as high as a decline. Hence, the current value reflects the best predictor of all fundamental values in the future. Then the exchange rate, based on equation (2.2), corresponding to its current fundamental value, $s_t = E(f_t)$ following a random walk.

However, studies indicated that, while over time the movements in the macroeconomic fundamentals are the consequence of mainly permanent shocks, a random walk is not necessarily accompanied by the macroeconomic fundamentals. They are modelled as follows

$$\Delta f_t = \emptyset \Delta f_{t-1} + u_t \tag{2.5}$$

The present value formula (2.2) implying a systematic component in the movement of the deviation of the exchange rate from its fundamental value over time, as market participants have full information about the current state of the macroeconomic fundamentals is modified as follows:

$$s_t - f_t = \emptyset(s_{t-1} - f_{t-1}) + \frac{\emptyset b}{1-\emptyset b} u_t \tag{2.6}$$

where $\varepsilon_{t+1} = \frac{\emptyset b}{1-\emptyset b} u_{t+1}$ (2.7)

These equations potentially explain and predict the exchange rate movements.

If the market is efficient, the unexpected change in the exchange rate, $(s_{t+k} - s^e_{t+k})$, can be attributed only to news arrival, between the time of formation of expectation and the time $t+k$. Therefore, if such news effects could be measured, they would correlate significantly with the unexpected change. Its empirical implementation involves selecting

a vector of variables, f_t that are believed to affect the exchange rate, obtaining agents' expectation of f_{t+1} based on information at time t, f^e_{t+1}, and assessing news about fundamentals as $(f_{t+1} - f^e_{t+1})$. A regression of $(s_{t+k} - s^e_{t+k})$ on news should then result in a significant estimated coefficient. The researchers used the theory of exchange rates or the interest rate differential to select f_t, using either survey data (Dornbusch, 1982) or time series methods (Frenkel, 1982) to form f^e_{t+1}. Using this approach and a variety of f_t element choices, several researchers reported significant news effects, showing the significance of fundamentals in explaining changes in exchange rates (Dornbusch, 1982; Edwards, 1982; Frenkel, 1982).

The macro-information based models of exchange rates considered the role of macroeconomic news announcements in explaining exchange rate movements. They are built on the premise that only common knowledge macroeconomic information is important and there are rational and homogeneous market participants interpreting new information identically and calculate the change in exchange rate uniformly.

A strand of literature tested the significance of macroeconomic fundamentals for changes in the exchange rate by examining the effects of the news about fundamentals on unexpected changes in the exchange rate. They used "*Fama's (1970) efficient market hypothesis and the uncovered interest rate parity hypothesis*", to test the effects of the news about fundamentals on the exchange rates. Efficient markets imply that "news" should explain possible exchange rate deviations from the UIP (Dornbusch, 1982; Edwards, 1982; Frenkel, 1982).

The early studies (Hardouvelis, 1984; Ito & Roley, 1987) recognized "news" as "*information identified with residuals from regressions of fundamentals on the information*

known at time t". The changes in the exchange rate are then linked to these news based on equation (2.3) and (2.6).

The researchers (Goodhart *et al.*, 1993; Almeida, *et al.*, 1998; Andersen *et al.*, 2003) used survey data on expectations for different macroeconomic news announcements and data on the exchange rate to seek the responses to "news". They employed the basic model to examine the news effects of macroeconomic indicators on the exchange rate, which is as follows.

$$r_t = \alpha_k + \beta_k N_{kt} + u_t \qquad (2.8)$$

where r_t denotes exchange rate returns measured as the percentage change in the exchange rate from time t to time $t+1$, N_{kt} refers to the standardized macroeconomic news announcement (macroeconomic announcement surprise) k $(k = 1....n)$ at time t. The estimate of β_k gives the percentage change in the exchange rate to a surprise of one standard deviation in macroeconomic news announcement N_k.

The unexpected (surprise) portion (component) of announcements generally exerts a considerable effect on the exchange rate, while generally expected announcements do not. That is, according to rational expectations theory, only unexpected shocks to fundamentals affect the exchange rate (Andersen *et al.*, 2003). The "*efficient market hypothesis and rational expectations imply that asset prices should respond directly and immediately to the surprise component of any announcement"*. If the market immediately integrates the news into the exchange rate, then the response to news on the exchange rate should be significant even when k is just a few minutes. For market efficiency, the expected

component of an announcement should not affect the exchange rate and, further, that the constant term is zero.

Early studies focused on volatility patterns (Engle , Ito, & Lin, 1988; Harvey & Huang, 1991). They found two features in the exchange rate volatility: One is the presence of autocorrelation and the second is periodicity, display patterns. Then studies directly examined the effect of macroeconomic announcements on exchange rate volatility. They also found that several scheduled announcements influence volatility.

Ederington and Lee (1994), Payne (1996), and Andersen and Bollerslev (1998) provided an approach for detailed characterization of volatility in exchange rates. The approach captures regular periodicity, macroeconomic announcements, and volatility persistence. They employed "*Flexible Fourier Form (FFF) for the simultaneous modelling of the regular periodicity in exchange rate volatility and the effects of the calendar and scheduled macroeconomic announcement events*". The Flexible Fourier Form (FFF) specification is defined as follows.

$$2\log\left|\frac{r_t-\bar{r}}{\widehat{\sigma_t}}\right| = \hat{c} + \mu_0 + \sum_{k=1}^{K}\lambda_k . I_k(t,n) + \sum_{p=1}^{P}\left[\delta_{c,q}\, Cos\left(\frac{q2\pi t}{n}\right) + \delta_{s,q}\, Sin\left(\frac{q2\pi t}{n}\right)\right] + u_t \qquad (2.9)$$

where, r_t denotes exchange rate returns at period t, $\bar{r}$ is the sample mean of exchange rate returns, $\widehat{\sigma_t}$ is the exchange rate return standard deviation, the absolute difference between exchange rate returns and the sample mean of exchange rate returns divided by exchange rate return standard deviation gives a proxy for the exchange rate volatility, u_t is the error term, cos(q2πt/n) and sin(q2πt/n) are trigonometric functions showing periodicity c,

$I_k(t,n)$ represents calendar related characteristics and macroeconomic announcement events.

Andersen *et al.* (2003) estimated a dynamic regression of the conditional mean of exchange rates, r_t , as a linear function of I lags of all the returns, together with J lags of each of the K news announcements is as follow

$$r_t = \beta_0 + \sum_{i=1}^{I} \beta_i r_{t-i} + \sum_{k=1}^{K} \sum_{j=0}^{J} \beta_{kj} N_{k,t-j} + \varepsilon_t \quad (2.10)$$

the error term ε_t of the conditional mean model (2.10) are non-normal and heteroskedastic. It uses an iterative WLS approach. It uses two steps weighted least squares (WLS) procedure or the estimation of the model. The first step is to estimate the conditional mean model (2.10) by ordinary least squares. The second step is to estimate the time-varying volatility from the absolute value of regression residuals, which is to be used to perform a weighted least squares estimation of (2.10). The error volatility is to be estimated by using the model:

$$|\hat{\varepsilon}_t| = c + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \beta_{kj'} |N_{k,t-j'}| + \left[\sum_{q=1}^{Q} \left[\delta_q Cos\left(\frac{q2\pi t}{n}\right) + \varphi_q Sin\left(\frac{q2\pi t}{n}\right) \right] \right] + \gamma \frac{\widehat{\sigma_t}}{\sqrt{n}} + u_t \quad (2.11)$$

where $|\hat{\varepsilon}_t|$is the absolute residual value of equation (2.10), a proxy for the exchange rate volatility at time *t*. The absolute residual value from equation (2.10) is comprised of three terms: the absolute news surprise with lags in evaluating the impact of the news, the Fourier flexible form for the calendar effect with trigonometric terms and forecast of volatility to measure the level of average volatility during time *t*. The level of volatility is measured through GARCH (1,1) model for exchange rate returns. GARCH (1,1) models

are usually found "*to provide accurate approximations to asset return volatility dynamics*" (Andersen *et al.*,2003).

The empirical findings of the studies of Ederington and Lee (1994), Payne (1996) Andersen and Bollerslev (1998), and Andersen *et al.* (2003) showed that macroeconomic news accounts for exchange rate movements. Following them, many empirical studies examined the impact of macroeconomic announcements on exchange rate returns and exchange rate volatility (Ehrmann & Fratzscher, 2005; Cai *et al.,* 2009; Pearce & Solakoglu, 2007; Fatum *et al.*, 2012, among others).

2.2- Micro-Information Based Models of Exchange Rates

The theoretical micro-information based models of exchange rates are derived from the individual optimization problems of market participants, which include various micro aspects of the foreign exchange market crucial in determining the exchange rate. These micro aspects are information transmission among market participants, market agents' behaviour, heterogeneity for trading volume, order flow, and exchange rate volatility. These models determined the exchange rate in the real, complex, and dynamic settings of the foreign exchange market, where there is dispersed information, heterogeneous agents with different information sets, non- transparent trading mechanisms, and bid-ask spreads represent market-makers' cost for orders processing and inventory management.

The models assumed that the informed traders' demand for foreign currencies depends on the market maker's quoted exchange rates and informed traders' expectations about the exchange rate's fundamental value. Expectations are influenced by traders'

personal analyses, i-e private information. In turn, the market maker on the basis of available information forms his expectations of fundamental value.

In inventory models (Amihud & Mendelson, 1980; Madhavan & Smidt, 1993; O'Hara & Oldfield, 1986; Stoll, 1978) cost and inventory become part of the expected value to assess the market maker's bid and ask rate.

$$s_{it} = \mu_{it} - \alpha(I_{it} - I_{it}^{*}) + \gamma D_t \qquad (2.12)$$

where μ_{it} "*the expected value of fundamental value based on information*", I_{it} is his inventory and I_{it}^{*} is the desired inventory. Therefore, if the current inventory exceeds the desired inventory (and vice versa), the market maker reduces the bid and the ask rates temporarily. A "*transaction dummy*" D_t indicate whether the trader buys currency (ask) or sells currency (bid) allows for transaction cost identification.

The micro-information based models linked information economics, rational expectations, and imperfect competition to develop models of the effect of information on the exchange rate, including its arrival, dissemination, and processing. Such models are much more complicated when considering market makers because the market maker's actions must also be taken into account. They examined how information relevant to the foreign exchange rate is incorporated via the trading process.

These models assumed that information is dispersed across agents and traders in the foreign exchange market have differential information. They are categorized as informed and uninformed traders. Uninformed traders only have publicly available information, whereas informed traders have public and private information. The uninformed traders in the model do not affect the exchange rate. The net demand for foreign

currency from the informed trader indicates information content and is an important bid-ask spread determinant. Therefore, when the market maker receives demand inquiries from new traders, he raises the ask rate or reduces the bid rate. The decision as to which the exchange rate should carry depends on whether the trader buys or sells foreign currency. This behavior reflects the disadvantage of the market maker as opposed to that of the potentially better-informed trader with the information available to him. The price difference rises as order volume increases since to calculate the fundamental value of the trader's expected exchange rate the market maker uses the order volume. Meanwhile, the market maker also takes orders from uninformed traders, the foreign exchange transactions' fundamental value has to be perceived as noisy signals. To balance the stochastic existence of orders, the market maker uses "*the cumulative volume of foreign currency orders – known as the order flow*". The order flow provides a means of private information for the market maker on another market participants on the foreign exchange market. The classic micro-based studies such as Glosten and Milgrom (1985) and Kyle (1985) modelled the mechanism by which private information affects exchange rates via the order flow of informed traders.

The large trades are linked with exchange rate fluctuations arising from the cost of inventories and dispersed information (Keim & Madhavan, 1998; Kraus & Stoll, 1972; Loeb, 1983). The empirical evidence of how informed traders influence the exchange rate is obscured by the difficulty of detecting the effects due to dispersed information. Both information and inventory models as described above predict that order flow would influence the exchange rate. In the inventory model, order flow influences market makers' positions for adjustment of the exchange rate accordingly. In the information model, order

flow serves as a signal about future value and triggers market makers' beliefs for revision. Both factors may be significant, and a combined model may be needed. A combination of inventory and information models consists of expressions for exchange rate changes that depend on the order flow, the market maker's inventory, and the market makers' beliefs which is dependent on the direction of the trade. The change in bid and ask rate is given by

$$\Delta s_t = \beta_0 + \beta_1 \Delta x_t + \beta_2 \Delta I_t + \beta_3 D_t \quad (2.13)$$

where the coefficients β_i are structural parameters, Δx_t is the order flow, ΔI_t is the change in inventory and D_t is the trade direction dummy.

2.3- Hybrid-Information Based Models of Exchange Rates

The pattern of trading of foreign exchange exhibits two key features that provide valuable insight into the exchange rate behaviour. These are a) the equilibrium exchange rate is purely a function of the foreign currency prices quoted at a point in time by market makers and b) the information on the current and future state of the economy will only affect exchange rates if and only, it affects quotes from the market maker. In response to new public information arriving through macroeconomic announcements, market makers can revisit their quotes. Also, they can change their quotes based on orders obtained from traders. Through this order flow channel dispersed information influences quotes from market makers and thus the exchange rate (Evans, 2005).

Hybrid models incorporated these two foreign-exchange trading features into a simpler framework. Evans and Lyons (2002a) postulated a simple sequence of quoting and

trading. In order to illustrate the exchange rate's reaction to the order flow, based on the exchange rate equation (3), equations are as follows[5]:

$$\Delta s_{t+1} = \frac{1-b}{b}[s_t - E_t^m(f_t)] + \varepsilon_t^m \quad (2.14)$$

$$\text{where } \varepsilon_{t+1} = \frac{1-b}{b}\sum_{i=1}^{\infty} b^i [E_{t+1}^m(f_{t+1+i}) - E_t^m(f_{t+1+i})] \quad (2.15)$$

The hybrid models of the exchange rate focused on "*the market makers 'expectations or expectation revisions*". The order flow is the key driver that provides an early signal of the fundamental value and in equation (2.5), the process of the fundamental value must be added as follows:

$$\Delta f_t = \emptyset \Delta f_{t-1} + u_t + \delta v_t \quad (2.16)$$

and

$$\Delta x_t = \lambda \Delta x_{t-1} + v_t \quad (2.17)$$

where Δx_t indicates "*the aggregated order flow between t and t+1 for all market makers. The variable* u_t *represents observable shocks, and the variable* v_t *represents initially unidentified portion of the innovation of fundamental value which can be observed only with a time lag. The market makers, therefore, do not know the current fundamental value, thus, the expectation error*" is $f_t - E_t^m(f_t) = \delta v_t$.

The expectation error, however, is linked with the current order flow and also revealed in changes in market prices.

[5] See Evans and Lyons (2002)

$$\Delta s_{t+1} = \frac{1-b}{b}[s_t - E_t^m(f_t)] + \frac{1}{1-\emptyset b} u_{t+1} + \frac{(1+\phi(1-b))\delta}{1-\emptyset b}(x_t - \lambda x_{t-1}) \qquad (2.18)$$

The modified exchange rate equation indicates that "*the unexpected portion of the order flow* $\Delta x_t - \lambda \Delta x_{t-1}$ *also significantly affects the exchange rate whenever the discount factor is close to 1: the coefficient that measures the reaction of the exchange rate to an unexpected change in the order flow then converges to* $\frac{\delta}{1-\emptyset}$".

Therefore, the order flow correlates more strongly with the unobservable portion of the innovation of fundamental value with greater coefficient value, and thus the changes in fundamental value are more strongly autocorrelated.

The Evans-Lyons model (Evans & Lyons, 2002a) introduced the portfolio shift model which suggests that exchange rate changes are caused by both innovations in public and private information. It considered one source of exchange rate movements is the portfolio shifts that are not common knowledge providing a role for order flow. Evans and Lyons (2002a) took a simple model of determination of exchange rates which uses the information contained in order flow. They considered order flow as a proximate determinant of exchange rates that is unrelated to macroeconomic information. According to this model, exchange rate movements are determined by changes in the interest rate differential and changes in signed order flow. The model is specified as

$$\Delta s_t = \alpha + \beta \Delta x_t + \gamma f_t + \varepsilon_t \qquad (2.19)$$

where, Δs_t is "*the first difference in the log of the foreign exchange price within day t,* Δx_t *order flow, and* F_t *fundamental variables*".

Evans and Lyons (2002b) estimated the constant-coefficient model with two equations considering the likely feed-back effects of exchange rates on order flow, which is as follows

$$\Delta s_t = \beta_1 \Delta x_t + \beta_2 \Delta s_{t-1} + \varepsilon^s_t \quad (2.20)$$

$$\Delta x_t = \beta_3 \Delta x_{t-1} + \beta_4 \Delta s_t + \varepsilon^x_t \quad (2.21)$$

where Δs_t is changes in exchange rate at period t, Δx_t is the order flow. The coefficient β_1 captures the effects on exchange rate return of order flow.

Evans and Lyons (2002a, 2002b) showed that order flow is a significant determinant of exchange rates. The estimated order flow coefficient is positive and economically significant which is in line with the traders ' beliefs. Subsequent literature considers their findings to be robust (Froot & Ramadorai, 2005; Payne, 2003).

Bacchetta and Van Wincoop (2006) presented a model of exchange rate determination with heterogeneous information. In a dynamic rational expectations model, they identified that there exists a relation between order flow and exchange rates. It is assumed that the information about macroeconomic fundamentals is dispersed across market participants, and this heterogeneity produces a greater effect on the exchange rate from non-fundamental trades. Bacchetta and vanWincoop's model of exchange rate determination is as follows:

$$\Delta s_t = \beta_f f_t + \beta_v v_t + \beta_x \Delta x_t \quad (2.22)$$

where, f_t are the fundamental variables, v_t is the public signal and Δx_t is the order flow.

Love and Payne (2003) extended the analysis by examining the effects of macroeconomic news announcements on exchange rates. They studied the interplay between exchange rates, order flow, and macroeconomic news announcements. They found exchange rate responses to macroeconomic news announcements mediated by order flow. They estimate a simple bivariate model for exchange rates.

$$\Delta s_t = \alpha_s + \beta_x \Delta x_t + \sum_{i=1}^{p} \gamma_i \Delta s_{t-i} + \sum_{j=1}^{q} \theta_j N_{t-j} + \varepsilon^s{}_t \quad (2.23)$$

$$\Delta x_t = \alpha_z + \sum_{i=1}^{p} \gamma_i \Delta x_{t-i} + \sum_{j=1}^{q} \theta_j N_{t-j} + \varepsilon^x{}_t \quad (2.24)$$

where Δs_t is changes in the exchange rate at period t, Δx_t is the order flow and N_t is the standardized macroeconomic news announcement at time t.

Evans and Lyons (2005, 2008) established links between macroeconomic news announcements and order flow by extending the portfolio shift model. They adopted a simultaneous-trade approach. The model considered that macroeconomic news announcements change the information content of order flow and therefore alter the market makers ' signal processing on the order flow. It explained that information in news has two components. The first component is common knowledge whose implications for the exchange rate are agreed upon by all market participants. The second component is non-common knowledge who has different implications for the exchange rate as information is viewed by different market participants. Therefore, the information in the second component represents dispersed information which is first manifest in order flow, then these induced order flow impound information into exchange rates. The model leads to the following empirical specification:"

$$\Delta s_t = \alpha \Delta x_t + \xi_t + \nu_t \quad (2.25)$$

$$\Delta x_t = \mu_t + \kappa_t \tag{2.26}$$

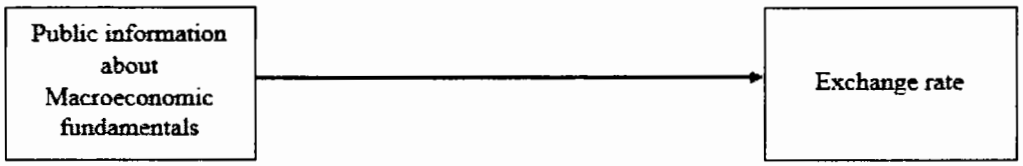
where Δs_t is *"the first difference in the log of the exchange rate within day t and* Δx_t *is order flow during the same period"*. The parameter α measures the price effect of order flow which reveals the information content of order flow. Four shocks reflect various sources of information that hit the market affecting exchange rate and order flow. *"These shocks are mean zero, mutually uncorrelated, and serially uncorrelated"*. The ξ_t *and* ν_t shocks indicate the information which is directly incorporated into exchange rates. The ξ_t indicates the common knowledge effect of announcements of macroeconomics news on the exchange rate. The ν_t indicates other information that is directly incorporated into the exchange rate but is unrelated to macroeconomics news and order flow. The μ_t *and* κ_t shocks drive order flow. The μ_t indicates the non-common-knowledge effect of the news that is order flow effects from macroeconomic news announcements. The κ_t the effects of order flow that are unrelated to macroeconomic news.

Love and Payne (2008) also estimated a similar regression model to find the indirect effect of macroeconomic announcement information on exchange rates that operates via induced order flow.

Summary

In macro models, information about macroeconomic fundamentals is publicly known and there is a direct connection between macroeconomic fundamentals and exchange rates.

Macro View



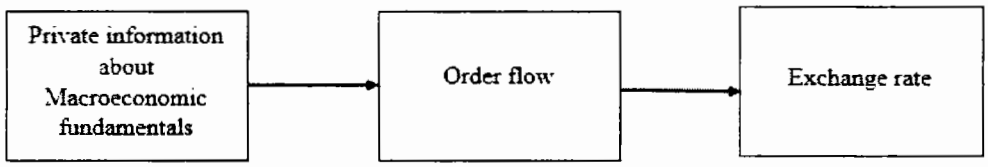
In general, they are estimated in the form:

$$\Delta s = f(\Delta i, \Delta m, ...) + \varepsilon_t \tag{2.27}$$

where Δs_t is the change in the log nominal exchange rate over the period. The independent variables in the function involve the change in nominal interest rates i, money supply m, and other macroeconomic variables.

In micro models, information about macroeconomic fundamentals is privately known and order flow is a transmission link between information about macroeconomic fundamentals and exchange rates.

Micro View

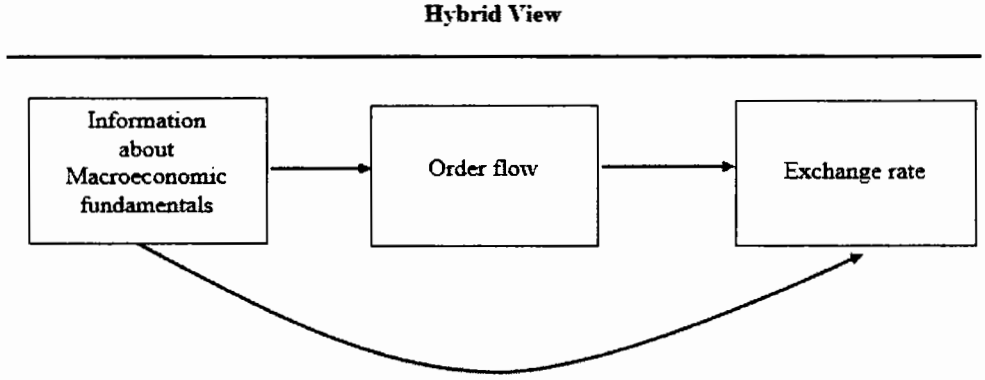


In general, they are estimated in the form:

$$\Delta s_t = f(\Delta x, \Delta I, ...) + \varepsilon_t \qquad (2.28)$$

where Δs_t is the change in the log nominal exchange rate over two transactions. The independent variables are order flow Δx, the change in net dealer positions (or inventory) ΔI, and other micro determinants.

The hybrid model combines components from both the macro and the micro models. It gives a framework where macroeconomic information not only impacts prices directly but also indirectly through order flow. In this framework, order flow reflects the heterogeneity of market participants and transmits this dispersed information to prices.



The hybrid model is estimated in the form:

$$\Delta s_t = f(\Delta i, \ldots) + g(\Delta x, \ldots) + \varepsilon_t \qquad (2.29)$$

where Δs_t is the change in the log nominal exchange rate over the period. It is the function of the change in nominal interest rates i, and other macroeconomic variable and function of order flow Δx and other micro determinants.

CHAPTER 3
REVIEW OF EMPIRICAL LITERATURE

The empirical review consists of five sub-sections which are: a) macroeconomic news announcements and foreign exchange returns, b) macroeconomic news announcements and foreign exchange volatility, c) exchange rates, order flow and fundamentals, d) exchange rates, order flow, and macroeconomic news, and e) dynamic dependencies between exchange rates and macroeconomic news.

3.1- Macroeconomic News Announcements and Foreign Exchange Returns

In the early 1980s, researchers started considering the effects of macroeconomic news announcements on foreign exchange rates. Early researchers used Fama's (1970) "*efficient market hypothesis*" and "*uncovered interest rate parity hypothesis*" for testing news effects of macroeconomic fundamentals on exchange rates (Cornell, 1982; Dornbusch, 1982; Edwards, 1982; Frenkel, 1982; Hakkio & Pearce, 1985; Hardouvelis, 1984, 1988). The efficient market hypothesis implied that any deviations of exchange rates from UIP should be explained by the "news". Dornbusch (1982), Frenkel (1982), and Edwards (1982) explored this issue and reported mixed evidence indicating deviations from UIP predicted by news differentials. Early studies on announcements focused on monetary news because of monetary models of the exchange rate in the 1970s (Hakkio & Pearce, 1985; Hardouvelis, 1984, 1988). Hardouvelis (1984, 1988) and Hakkio and Pearce (1985) examined the effects of US monetary news on US dollar exchange rates and found monetary surprises affect exchange rates. Hardouvelis (1988) also found the significant

reaction of exchange rates to macroeconomic news such as trade deficit, inflation, and business cycle news. Whereas Hakkio and Pearce (1985) also showed significant effects of news of consumer price index, producer price index, unemployment, and industrial production on exchange rates.

Several researchers studied the response of exchange rates to non-US monetary policy announcements. Doukas (1985) examined the CAD/USD exchange rate reactions to Canadian and US money supply news. He found that US money supply news influences exchange rates more than Canadian money supply news. Ito and Roley (1987) examined US dollar exchange rates response to Japanese and US money supply, consumer price index, and industrial production news announcements. He found the US money supply news has the greatest positive effect on US dollar exchange rates. MacDonald and Torrance (1988) studied reactions of exchange rates to UK inflation and money supply news announcements. They found money supply news leads to higher interest rates and appreciate exchange rates and inflation news leads to depreciate exchange rates.

Few studies examined exchange rate reactions to budget deficit news. Deravi, Gregorowicz, and Hegji (1989) found that neither anticipated nor unanticipated US treasury debt news affects foreign exchange rates. Beck (1993) considered US news of monetary supply, federal budget balance, and spending to influence exchange rates. He reported unexpected large budget deficit news boosted real US interest rates stimulating capital inflows and appreciation of the US dollar. In short, if such news is perceived as sign of persistent and unsustainable deficits, exchange rates react to news about budget deficit.

The high US unemployment rates and US trade deficits in the 1980s provoked researchers to examine the effects of news of unemployment rates and trade deficits on

foreign exchange rates. Deravi, Gregorowicz, and Hegji (1988) and Irwin (1989) found that the trade balance significantly affects exchange rates. The US dollar appreciates (depreciates) with large US trade surpluses (deficits). Hogan, Melvin, and Roberts (1991) reported that unexpected large trade deficits raise US foreign exchange intervention expectations. Klein, Mizrach, and Murphy (1991) and Aggarwal and Schirm (1992, 1998) concluded that foreign exchange rates are responsive to the news in the trade balance announcements. Karfakis and Kim (1995) discovered the significant news effects of the US trade deficit on AUD/USD exchange rates. Moorthy (1993) found that news of the US employment rate leads to exchanging rate depreciation. Ederington and Lee (1994, 1995) also found that news of employment rates influences exchange rates. Payne (1996) found news releases of US trade balance and employment rate have larger effects on exchange rates.

The efficient market hypothesis in the semi-strong form linking exchange rates to macroeconomic fundamentals indicated that exchange rate reactions to macroeconomic news have to be systematic and rapid, to prevent opportunities for excess profit. The market participants regularly gather information and develop expectations on macroeconomic fundamentals. Therefore, "*the asset prices should respond quickly react to the surprise component of an announcement at release time. Any systematic delay in the market reaction or systematic response to the expected component of the release would provide an opportunity for profit and, therefore, should not exist*" (Neely & Dey, 2010). To test this, researchers used real-time data on announcements of important macroeconomic

indicators reflecting real-time information and their market expectations based on survey data[6] (Neely & Dey, 2010).

Cornell (1982) and Engel and Frankel (1984) first used survey data to examined news announcement effects in the foreign exchange market in the literature. Ederington and Lee (1994) examined the effects of macroeconomic news releases on USD/ DEM exchange rate returns. They showed exchange rates quickly adjust to scheduled news. Using survey data Almeida *et al.* (1998) examined the US and German macroeconomic news effects on DEM/USD exchange rates and concluded that DEM/USD exchange rates reacted less strongly to German news than US news. Andersen *et al.* (2003) studied the reaction of exchange rate returns and volatility of DEM/USD, USD/GBP, JPY/USD, CHF/USD, and USD/EUR exchange rate to US and German macroeconomic news announcements. They showed average effects from macroeconomic news announcements that were incorporated in exchange rates immediately. They found that exchange rates quickly adjust to scheduled macroeconomic news whereas their volatilities adjust gradually to the news. In addition, they observed that exchange rates reacted asymmetrically to positive/negative news announcements. Pearce and Solakoglu (2007) reported symmetric, linear, and rapid effects of US macroeconomic news on JPY/USD and DEM/USD exchange rates.

To examine the effect of the news on exchange rates, Almeida *et al.* (1998) found that US news of durable goods, retail sales, trade balance, consumer price index, producer price index, and industrial production induced appreciation of DEM/USD exchange rates

[6] Survey of professional forecasters collects forecasts of all macroeconomic indicators to be released and reports the median forecasts from the survey. These includes Money Market Services, Bloomberg News Service, European Central Bank Survey of Professional Forecasters, Federal Reserve Bank of Philadelphia Survey of Professional Forecasters.

and US unemployment rate news caused the depreciation of DEM/USD exchange rates. Whereas, German news of consumer price index and wholesale price index caused appreciation of DEM/USD exchange rates and news of industrial production, retail sales, producer price index, money supply, trade balance, unemployment rate induced depreciation of DEM/USD exchange rates. They concluded that the effects of news of macroeconomic indicators depend on "*the market's belief about both the appropriate exchange rate determination model and the likely reaction of the monetary authorities*".

Similar results were found by Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Cai *et al.* (2008), Fatum *et al.* (2012), Ben Omrane, Welch, and Zhou (2018); Ben Omrane et al. (2020), and Cheung Cheung *et al.* (2019) for US news announcements on different exchange rates. Andersen *et al.* (2003) reported that German news of retail sales and unemployment rate led exchange rates appreciation and news of industrial production, producer price index, and money supply caused exchange rates depreciation against the US dollar. Whereas German news of trade balance, consumer price index, and wholesale price index had both negative and positive effects on different exchange rates. However, Ehrmann and Fratzscher (2005) concluded that German news of producer price index, industrial production, and money supply caused appreciation of USD/DM exchange rates. Fatum *et al.* (2012) and Cheung Cheung *et al.* (2019) found that Japanese news such as trade balance, money supply, industrial production, consumer price index, and machinery orders caused the depreciation of JPY/USD exchange rates. Ben Omrane *et al.* (2020) reported that Euro Area news of industrial production, retail sales, trade balance, and consumer price index led to EURO/USD appreciation.

Studies examined the effects of policy actions, policy expectations, and communications. Kearns and Manners (2006) examined the effect of monetary policy news from Australian, Canadian, New Zealand, and the United kingdom on exchange rates. They asserted that the monetary policy decision of an unanticipated monetary tightening led to a rapid appreciation of exchange rates. Faust, Rogers, Wang, and Wright (2007) found similar results that monetary tightening led to US dollar appreciation. Hayo and Neuenkirch (2012) analyzed the US and Canadian monetary policy communications and macroeconomic news announcements on Canadian exchange rate returns and volatility. They found monetary policy communications and macroeconomic news announcements from both countries had an impact on the Canadian foreign exchange market. Further, they concluded that Canadian monetary policy communication was more relevant than US monetary policy communication. The US macroeconomic news had a greater effect than Candian macroeconomic news on the Canadian exchange rate market. Hayo and Neuenkirch (2013) also analyzed the effects of US monetary policy and macroeconomic announcements on the Argentine foreign exchange market. They showed that both types of news had a significant effect on the Argentine exchange rate market. May *et al.* (2018) found the reaction of the South African rand/US dollar exchange rate to monetary policy news. Mpofu and Peters (2017) found South African rand significantly react to announcements of monetary policy and political events.

For examining Euro Area and US macroeconomic news effects on USD/EUR exchange rates, Galati and Ho (2003) and Cagliesi and Tivegna (2006) found exchange rate responses regarding the currency area of the news and concluded that scheduled US and Euro Area announcements widely affects exchange rates. Ehrmann and Fratzscher

(2005) studied the effects of the Euro Area, Germany, and US macroeconomic news. They found that US surprises are largely affected than Euro Area surprises. Ben Omrane *et al.* (2018) studied the Euro area and US macroeconomic news dynamic effects on exchange rates. The US news had a larger impact than Euro area news. Cheung Cheung *et al.* (2019) analyzed and compared the relative impact of Japanese and US macroeconomic news before, during, and after the global financial crisis. They found the importance of US macroeconomic news than Japanese macroeconomic news to influence exchange rates.

To investigate exchange rates' response to similar macroeconomic news releases of different countries, Almeida *et al.* (1998) and Kim (1998) concluded that similar macroeconomic releases produce similar or different effects on exchange rates. Several studies found asymmetrical news effects of exchange rates. Ehrmann and Fratzscher (2005) and Fatum *et al.* (2012) studied the asymmetry of the news announcements and found an asymmetry in news effects on the US dollar-euro/DEM and JPY/USD exchange rates, respectively.

The researchers continue to examine the exchange rate reactions to macroeconomic surprises. Simpson, Ramchander, and Chaudhry (2005) explored the implications of macroeconomic news for exchange rate determination theories (purchasing power parity, the international Fisher effect, covered interest parity, portfolio balance effect, and balance of payments) for "*the speed of adjustment to equilibrium foreign exchange conditions*". Ehrmann and Fratzscher (2005) examined the influence of the United States, Germany, and the Euro area news on the US dollar-euro/DEM exchange rates. They found a larger effect of US news than Euro Area news on exchange rates because the US news was released earlier. Andersen, Bollerslev, Diebold, and Vega (2007) investigated the reaction

of US, British, and German bonds, stocks, and foreign exchange rates to US macroeconomic news dependent on the state of the business cycle and co-movements among asset prices. Pearce and Solakoglu (2007) and Fatum *et al.* (2012) found that different states of the business cycle affect news announcements on exchange rates. Ben Omrane *et al.* (2020) found that the effect of most of the news varies between states of expansion and recession. Both the Euro area and US macroeconomic news had asymmetrical effects between economic states.

To examine the foreign and domestic news effects Cai *et al.* (2008) found a stronger effect of US news on exchange rates in emerging markets and also found no impact of much domestic macroeconomic news. Wong *et al.* (2014) also reported the importance of regional macroeconomic news in affecting exchange rate returns of Asia-Pacific economies. Gau and Wu (2017) examined the price discovery around macroeconomic announcements in the USD/JPY and EUR/USD markets. They found that macroeconomic announcements affect the pattern of price discovery across different markets. Caporale *et al.* (2018) showed spillovers between exchange rates macroeconomics news in emerging markets. Boudt *et al.* (2019) reported that news affects the foreign exchange exposure of multinational firms.

3.2- Macroeconomic News Announcements and Foreign Exchange Volatility

A considerable amount of research focused on understanding how foreign exchange volatility is influenced by announcements of various kinds. Early studies focused on patterns of volatility (Engle, Ito, & Lin, 1990; Harvey & Huang, 1991). Engle *et al.* (1990) presented heatwaves and meteor showers concepts in the foreign exchange market.

Heatwaves stated that volatility was determined geographically. They might increase volatility in different markets on different days. On the other hand, meteor showers stated volatility spillovers from market to market. Thus, meteor showers implied volatility clustering over time. They found that the meteor shower hypothesis better characterizes the volatility of the foreign exchange rate generated by the trade balance announcements. Baillie and Bollerslev (1991) confirmed the effect of the meteor shower and found evidence of heatwaves. Harvey and Huang (1991) discovered the pattern of volatility in foreign exchange returns and stated that macroeconomic news announcements were significant sources of volatility.

To examine the effect of the news on exchange rate volatility, Ederington and Lee (1994, 1995) investigated the short-run effects of US macroeconomic news announcements on USD/DEM and USD/JPY exchange rate volatility. They found that gross national product, producer price index, trade deficit, durable goods orders, retail sales, and employment report significantly affect USD/DEM exchange rate volatility. They emphasized the significance of announcements for volatility and that news explained volatility patterns and periodicity.

In foreign exchange volatility, Andersen and Bollerslev (1998) found two characteristics: It is autocorrelated, and periodic, exhibiting patterns. They used USD/DEM exchange rate returns to integrate persistence in daily volatility, periodicity, and effects of announcements. They affirmed the significance of macroeconomic announcements as discussed by Ederington and Lee (1993). They claimed that periodicity, persistence in volatility, and announcement effects jointly affect short-run foreign exchange rate volatility. They found US news announcements such as employment, gross

domestic product, trade balance, and durable goods orders are the most influential US news announcements in describing movements in volatility, whereas monetary policy news is most relevant amongst German news announcements.

The earlier studies on news announcement effects examined US news announcements effects. Then, the researchers began considering the effects of macroeconomic news announcements from various countries on foreign exchange rates volatility in different perspectives (Cai *et al.*, 2008; Evans & Speight, 2010; Han, 2004; Harada & Watanabe, 2009; LaakkOnen & Lanne, 2013) Several studies examined the effect of the announcements itself versus the information content (Kim, McKenzie, & Faff, 2004), conflicting information Laakkonen (2007), heterogeneous information (Hashimoto & Ito, 2010) and asymmetric information (Han, 2004). These studies concluded a) US news has influenced greatly on volatility than other foreign news and b) the effects of news announcements on volatility depends on several factors: conflicting information heterogeneous expectations, the sign of the shocks, the source of the shocks, and whether the news announcement is scheduled or unscheduled.

Han (2004) reported that the US and EMU macroeconomic announcements had a statistically significant influence on both the conditional mean and the conditional variance, but their influence seemed asymmetric depending on the region (US and EMU area) and the signs (positive and negative) of the shocks. Laakkonen (2007) examined the impact of the US and European macroeconomic news on the USD/EUR exchange rate volatility. He found the US news was the most important to influencing exchange rate volatility. He concluded that news significantly increased volatility and bad news had a greater impact on volatility.

Several researchers considered the volatility response to macroeconomic news announcements depended on the nature of the news and the nature of the economy. Pearce and Solakoglu (2007) rejected nonlinearity and asymmetry in JPY/USD and DEM/USD volatility responses, however, found some evidence of changes across the state of the business cycle. Ben Omrane *et al.* (2020) found asymmetrical effects between recession and expansion states for both US and EU macroeconomic news on EUR/USD volatility. They concluded that most US news had a larger impact than EU announcements and news raised EUR/USD volatility.

The researchers considered the monetary policy announcements' effects on foreign exchange rate volatility. They concluded firstly that surprising monetary policy actions, raised volatility, and secondly that longer-term policies reduced volatility. Sager and Taylor (2004) found that volatility generally increases following an interest rate news announcement by European Central Bank. Jansen and De Haan (2005) concluded that monetary policy stances from the European Central Bank and the national central bank raised USD/EUR volatility. Conrad and Lamla (2010) also showed that the interest rate decision by the European Central Bank significantly affects EUR/ USD volatility. Melvin, Saborowski, Sager, and Taylor (2009) found evidence of systematic patterns in USD/GBP exchange rate volatility entirely after interest rate news announcements by the Bank of England. Hayo and Neuenkirch (2012) found that the Bank of Canada's interest rate news raised CAD /EUR volatility and its communications lowered CAD/EUR volatility. May *et al.* (2018) found domestic monetary policy news effects on the volatility of the SAR/ USD exchange rates.

To investigate exchange rates' response to similar macroeconomic news releases of different countries, Neely (2011) reported that news contributed substantially to volatility but news of payrolls, trade balance, and interest rate were the most likely to affect volatility. The US news induced more volatility than the Euro area and German news. Most of the news releases increased the volatility of USD/EUR exchange rates. The news of macroeconomic indicators from the US such as balance of payments, consumer price index, gross domestic product, industrial production, personal consumption expenditures, and producer price index significantly affected USD/EUR exchange rate volatility (Neely, 2011). Omrane and Hafner (2015) decomposed announcements of macroeconomic news effects on exchange rate volatility and found news effects comprise a direct and an indirect effect caused by volatility spillover. They found similar macroeconomic news such as real activity, consumption, investment, prices, employment, monetary policy, and current account from the US, the UK, Europe, and Japan significantly affected EUR/USD, GBP/USD, and JPY/USD exchange rates.

Petralias and Dellaportas (2015) investigated the effect of macroeconomic news announcements on exchange rate volatility. They showed the degree of the volatility process affected by the news announcements. Maveé, Perrelli, and Schimmelpfennig (2016) examined potential drivers of volatility in the South African rand. They reported that SAR volatility was largely driven by global market volatility, commodity price volatility, and domestic political uncertainty. Omrane and Savaşer (2017) investigated the volatility reaction to macroeconomic news in major currency markets during the recent global financial crisis. Their results suggested that while the response of volatility to most

news was greater in expansion, the reaction of the currency market to new home sales and news of the Fed funds rate was greater during the crisis period.

Maserumule and Alagidede (2017) assessed macroeconomic news effects on exchange rate volatility. They concluded exchange rate volatility raised after the release of the news. Both US and South African macroeconomic news significantly affected exchange rate volatility. Further, negative news had a greater impact on exchange rate volatility than positive news. Caporale *et al.* (2018) analyzed mean and volatility spillovers between macroeconomics news and the exchange rates emerging countries versus USD and EURO and found the key importance of macroeconomic news as a driver of foreign exchange markets.

3.3- Exchange Rates, Order Flow, and Fundamentals

The microstructure literature provides significant evidence for understanding and explaining exchange rate movements, developed by a series of studies (Evans & Lyons, 2002a, 2002b, 2005, 2008). Evans and Lyons (2002a) proposed a microstructure model which considered the information-aggregation role of order flow linking macroeconomic fundamentals and exchange rates. They found both macroeconomic information and private information caused exchange rate movements. They showed order flow induce private portfolio shift effects on exchange rates which is unrelated to macroeconomic information. According to this model, changes in the interest rate differential and changes in order flow determined exchange rate movements. They provided empirical evidence of order flow as a significant determinant of exchange rates. They found the positive value of the order flow that caused the foreign currency to appreciate.

Evans and Lyons (2002b) reported the contemporaneous impact of order flow on exchange rate returns and found the contemporaneous impact of order flow on exchange rate returns increases when a macro announcement precedes it. Payne (2003) concluded that order flow was the fundamental determinant of exchange rate changes and had a positive impact on exchange rates.

To analyze the link between order flow, exchange rate returns and macroeconomic fundamentals Froot and Ramadorai (2005) decomposed exchange rates into permanent and transitory components. They found no significant link between permanent components of exchange rates and order flow. However, order flow has a positive impact on the transitory component of exchange rates which is unrelated to macroeconomic fundamentals Bacchetta and Van Wincoop (2006) considered an agent's heterogeneous information in the exchange rate determination model. They incorporated macroeconomic information signals that link between exchange rates, order flow, and macroeconomic fundamentals. They found that the impact of order flow is magnified with heterogeneous information about fundamentals on exchange rates. With heterogeneous information, order flow causes large variability in exchange rates over the short-run.

Following Evans and Lyons (2002a), Chinn and Moore (2011), Duffuor, Marsh, and Phylaktis (2012), Breedon and Ranaldo (2013), McIntyre and Harjes (2016), and Anifowose, Ismail, and Sukor (2018) estimated foreign exchange microstructure models and found that the order flow sufficiently explained movements in the exchange rates.

Evans and Rime (2016) reported order flow as an important proximate driver when it conveys private information about risk premiums, future interest rate differentials, and long-run exchange rates. This information cannot be derived from observed variables

publicly known. Thus, they found order flow as an empirically important driver of exchange rate dynamics. Evans and Rime (2019) discovered the link between microstructure and macro exchange-rate models. They examined how research in foreign exchange microstructure complements with research based on traditional models. They provided a microstructure perspective on returns on currency portfolios, foreign exchange trading, competition and regulation.

3.4- Exchange Rates, Order Flow, and Macroeconomic News

Several studies in the literature revealed direct and indirect channels that affect exchange rates through news releases. They explored the impact of macroeconomic news announcements through the order flow on foreign exchange rates. They argued order flow is the medium through which macroeconomic information is incorporated into exchange rates. Their main finding was the release of macroeconomic news creates trading that reveals private information which is dispersed between market agents and in turn affects exchange rates. Evans and Lyons (2005) and Love and Payne (2008) showed that if the information is revealed to all market participants publicly and simultaneously, then it is effectively incorporated directly and indirectly through order flow into exchange rates. They found the reaction of exchange rates to announcements of macroeconomic news mediated by order flow. Evans and Lyons (2005) describe the average news effect as the direct effect of announcements of macroeconomic news on exchange rates, and the total news effect as the sum of the direct effect and the indirect effect of announcements of macroeconomic news. They conclude that the total news effect on exchange rates must include the immediate reaction to new as well as reaction to trades. Evans and Lyons

(2005). Love and Payne (2008) concluded that order flow has a significant and larger effect on the exchange rates with the release of the news.

Evans and Lyons (2008) showed when a macroeconomic news release is viewed by heterogeneous agents, it has different effects on exchange rates. Although the same announcement is observed by all, different views about macroeconomic news announcements affect exchange rates via order flow and represent dispersed information. When macroeconomic news strikes the foreign exchange market, it affects the decisions of market makers, influencing order flow, and then exchange rates. This indicated the interaction between order flow and macroeconomic news. Savaser (2011) and Zhang *et al.* (2016) examined the direct effects of macroeconomic news and order flow on exchange rates and the indirect effects of macroeconomic news via order flow. Their results revealed that real-time public and private information significantly affect exchange rates. However, Zhang *et al.* (2016) found there was no interaction of order flow and macroeconomic news in the information transmission process. Savaser (2011) concluded order flow intensified macroeconomic news effects on exchange rates. Carlson and Lo (2006) and Gradojevic and Neely (2009) found a significant reaction of exchange rates to news announcements with trading.

Several studies in the literature on news announcements and order flow found the release of macroeconomic news directly and immediately affects exchange rates and their volatility but through order flow affect exchange rates and their volatility with a delay. According to Cai *et al.* (2001), the indirect effect of macroeconomic news on exchange rate volatility through order flow is more significant than the direct impact of macroeconomic news on exchange rate volatility. Evans and Lyons (2008) found similar

results. Bauwens *et al.* (2005) reported that news announcements increase foreign exchange volatility with informed trading. This is because on the basis of private information, informed traders take speculative positions. Carlson and Lo (2006) found high volatility after the release of news announcements with delayed trading flows. Frömmel *et al.* (2008) argued that informed order flow from banks and financial customers contributes to higher foreign exchange volatility. Zhang *et al.* (2016) found a significant effect of both macroeconomic news and order flow on exchange rate volatility. Their results revealed that real-time macroeconomic news and private information from market makers significantly affect exchange rate volatility.

3.5- Interdependencies between Exchange Rates

The empirical studies on exchange rates interdependencies include the contagion across currencies i-e the co-movement of currency prices during a financial crisis, the co-movements of currency volatility, and the spillovers across currencies i-e the variation in one currency caused by shocks to another currency. The early studies considered co-movements and volatility spillovers among currencies. Engle *et al.* (1990) found spillover effects in the dollar/yen exchange rate over short time periods by using impulse response functions. Bollerslev (1990) found that correlations in the volatility of exchange rates in different European currencies. Whereas, Baillie and Bollerslev (1991) concluded no systematic spillovers from one currency to another by employing Granger causality tests. Hong (2001) found spillovers from the Deutsche Mark to the Japanese yen. Farrell (2001) investigated spillovers and co-movements in volatility between exchange rates in South Africa and concluded no co-movements and spillovers in volatility between exchange rates.

By studying the persistence of volatility in exchange rates in non-synchronous markets, Melvin and Melvin (2003) concluded that the spillovers in the volatility of DM/USD and JPY/USD exchange rates are generally region-specific. Black and McMillan (2004) concluded volatility spillovers between currencies of European countries. Cai *et al.* (2008) analyzed Euro-dollar and Dollar-yen spillovers across different regions. They found significant mean and volatility spillovers across different regions. Raputsoane (2008) examined the volatility spillovers from the rand exchange rate to other exchange rates by employing an augmented Exponential GARCH model. They found a negative relationship between rand volatility and emerging and developed European countries' currencies. However, found no relationship between rand volatility and the currencies of Latin American and Asian countries. Ruiz (2009) found little evidence for co-volatility in Latin American exchange markets and concluded that the volatility of each currency exchange rate is country-specific. McMillan and Speight (2010) found a time-varying correlation across exchange rates of major currencies. They provided the evidence of bi-direction causality between GBP/EUR and USD/EUR exchange rates, causality between JPR/EUR to USD/EUR and between JPY/EUR and GBP/EUR exchange rates.

To analyze interdependence and spillovers in volatility, Kitamura (2010) showed volatility spillovers from the Euro to Swiss franc and Japanese yen by using the MGARCH model. McMillan and Speight (2010) found volatility spillovers between the exchange rates of the UK pound, Japanese yen, and the US dollar versus Euro. Bubák, Kočenda, and Žikeš (2011) identified volatility spillover between EUR/USD and Central European currencies exchange rates. They also found that during market uncertainty periods, volatility spillovers tend to increase. Antonakakis (2012) found return spillovers in GBP,

Euro, Swiss franc, and Japanese yen against the USD. Kavli and Kotzé (2014) reported exchange rate returns and volatility spillovers in emerging and developed countries' currencies. Kumar (2014) analyzed returns and volatility spillovers among exchange rates of India (in terms of US dollar, the UK pound, and Euro and Japanese yen) by employing VAR- MGARCH and DCC models. He found both unidirectional and bidirectional returns and volatility spillovers among Indian exchange rates.

Rajhans and Jain (2015) examined volatility spillovers between exchange rates of currencies by using the variance decomposition method and concluded low volatility transmission between exchange rates of currencies. Kumar, Dublish, and Haque (2016) found the volatility spillovers between Indian and Chinese foreign exchange markets by using the MGARCH model. Greenwood-Nimmo, Nguyen, and Rafferty (2016) concluded volatility spillovers and spillover intensity across G10 currencies. They found the bidirectional volatility spillovers among G10 currencies. Baruník, Kočenda, and Vácha (2017) provided evidence for asymmetric volatility spillovers in foreign exchange markets. Khan, Saeed, Ibrahim, and Rizwan (2018) explored the financial cointegration of emerging economies and found that most emerging stock markets are followers of developed markets.

Summary

In summary, on one hand, several empirical studies showed micro effects of macroeconomic news announcements on exchange rates (Almeida *et al.,* 1998; Andersen *et al.,* 2003; Ben Omrane *et al.,* 2020; Boudt *et al.,* 2019; Caporale *et al.,* 2018; Cheung *et al.,* 2019; Ehrmann & Fratzscher, 2005; Fatum *et al.,* 2012; Gau & Wu, 2017; May *et al.,*

2017; Neely, 2011; Pearce & Solakoglu, 2007). They examined how news about fundamentals is incorporated into exchange rates. They assumed that exchange rates react directly to the surprise (unexpected) component of any announcement. These studies analyzed exchange rate responses to macroeconomic announcements in many dimensions, including analysis of the speed and pattern of adjustments of exchange rates to news, asymmetry in the impact of the news announcements on exchange rates according to the sign, the effects of news announcements on exchange rates returns and volatility over time (Andersen *et al.,* 2003; Ehrmann and Fratzscher, 2005; Cai *et al.,* 2009), across countries and markets (Cai *et al.,* 2009; Wong *et al.,* 2014; Gau & Wu, 2017) and with the business cycle (Pearce and Solakoglu, 2007; Fatum *et al.,*2012; Ben Omrane *et al.,*2020).

Several studies directly examined macroeconomic news announcements effects on exchange rate volatility (Ederington and Lee, 1993; Andersen and Bollerslev, 1998; Han 2004; Laakkonen, 2007; Harada and Watanabe, 2009; Cai *et al.,* 2009; Evans and Speight, 2010; Neely, 2011; Omrane and Hafner, 2015; Omrane and Savaşer,2017). These studies dealt with periodicity, volatility persistence, and announcement effects (Ederington and Lee, 1993; Andersen and Bollerslev, 1998; Laakkonen, 2007 Evans and Speight, 2010; Neely, 2011), the effect of the announcements itself versus the information content (Kim *et al.*, 2004), conflicting information Laakkonen (2007), heterogeneous information (Hashimoto & Ito, 2010), asymmetric information (Han, 2004), during the global financial crisis (Omrane and Savaşer,2017) and with the business cycle (Ben Omrane *et al.,*2020).

On the other hand, the studies found the linkages between exchange rate movements, order flow, and macroeconomic fundamentals (Evans & Lyons, 2002a, 2002b; Payne, 2003; Chinn & Moore, 2011; Breedon & Renaldo, 2013; Evans & Rime, 2016,

2019). Several studies in the literature revealed direct and indirect channels that affect exchange rates through news releases. They explored the impact of macroeconomic news announcements through the order flow on foreign exchange rates. They argued order flow is the medium through which macroeconomic information is impounded into exchange rates (Evans & Lyons, 2008; Love & Payne, 2008; Gradojevic & Neely, 2009; Savaser, 2011; Zhang *et al.,* 2016). These studies showed that if the information is revealed to all market participants publicly and simultaneously, then it is incorporated directly and indirectly through order flow into the exchange rate. Also, several studies examined the effects of news announcements and order flow on exchange rate volatility. (Cai *et al.,* 2001; Evans & Lyons, 2008; Bauwens *et al.,* 2005; Carlson & Lo, 2006; Frömmel *et al.*, 2008; Zhang *et al.,* 2016). These studies revealed that macroeconomic news in real-time and private information significantly affect exchange rate volatility.

Most of the existing studies on information-based models of exchange rate determination considered developed economies' foreign exchange markets to investigate the link among exchange rates macroeconomic news announcements, and order flow. However, the exchange rate dynamics concerning order flow and macroeconomic news announcements for emerging economies are still unexplored in literature. Further, the effects of similar macroeconomic news releases from different economies on different exchange rates of the same currency are still unexplored. The direction and degree of impact of the similar macroeconomic news announcements on the different exchange rates of the same currency are still undiscovered. The exchange rate dynamics with respect to the news on macroeconomic fundamentals in the foreign exchange market of developing economies are also still unexplored. There is a need to investigate whether information

based models also hold for developing foreign exchange markets as they are characterized by market inefficiencies and illiquidity. There is a need to investigate whether the news on macroeconomic fundamentals interprets the process of price discovery in foreign exchange markets of developing economies as they become available to market participants. Also, there is a need to examine the direction of news effects on the exchange rate whether depends on "*the market's belief about both the exchange rate determination models and the response of the monetary authorities to new information*". Further, there is a need to explore in developing economies, the effects on exchange rates if the information is publically and simultaneously announced to all market agents and if the information is dispersed between heterogeneous market agents in an integrated framework.

In Pakistan, the empirical literature on exchange rates generally focuses on examining the role of macroeconomic fundamentals in explaining the nominal exchange rates dynamics (Abbas *et al.*, 2011; Jabeen & Khan, 2014; Kemal *et al.*, 2004; M. A. Khan & Qayyum, 2011; Zakaria *et al.*, 2007). There is no empirical study that analyzes the role of macroeconomic news announcements (both foreign and domestic) and order flow in explaining the behavior of Pak-rupee exchange rates. There is a need to examine exchange rate dynamics with respect to the news on macroeconomic fundamentals in the foreign exchange market of Pakistan. It is essential to explore which of the macroeconomic news have the most impact on Pak rupee exchange rates during and after announcements, and how much of the movements and variations in Pak rupee exchange rates do macroeconomic 'surprises' account for (or explain)? There is also a need to discover in which direction similar macroeconomic news announcements impact the different exchange rates of Pak rupee, which of mechanisms are related to the Pak rupee exchange rate determination, and

which mechanisms dominate determine the sign of the response of exchange rate to the news. Also, there is a need to investigate whether order flow drive movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. It is essential to examine whether trading signals and trading strategies of currency traders affect exchange rates and whether releases of foreign and domestic macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rates indirectly during and after announcements periods. Therefore, this study would be a considered contribution to the literature.

CHAPTER 4
EMPIRICAL MODELS AND DATA

The empirical studies focused on the relative importance of the direct and indirect information channels during and after news announcements periods. If macroeconomic news announcements contain common knowledge information, then the direct channel accounts for most of the exchange rate movements and has the same effects on exchange rates. Conversely, if macroeconomic news announcements contain dispersed information and view by different agents, then the indirect channel dominates and has different effects on exchange rates.

This study focuses on the empirical analysis of the joint dynamics of exchange rates (exchange rate returns and exchange rate volatility) with macroeconomic news announcements and order flow. It analyzes three sources of exchange rate movements: i) macroeconomic news announcements which immediately and directly affect exchange rates, ii) order flow which affect exchange rates but is unrelated to macroeconomic news announcements, iii) an indirect effect of macroeconomic news announcements that operates via order flow. For this, it examines the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of the Pak rupee. It takes into account both direct and indirect information channels during and after news announcements periods for Pak rupee exchange rate movements. It also examines the interdependencies in terms of returns and volatility spillovers between Pak rupee exchange rates.

This chapter presents the model specifications, the methodology, and data description for the joint dynamics of Pak rupee exchange rate returns, and Pak rupee exchange rate volatility with macroeconomic news announcements and order flow.

4.1- Model Specifications and Methodology

This study investigates the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of Pak rupee by following studies of Andersen et al. (2003), Evans and Lyons (2002a), and Evans and Lyons (2008).

For this, it employs Autoregressive Moving Average (ARMA) with Univariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Vector autoregressive (VAR) with Multivariate Generalized Autoregressive Conditional Heteroscedasticity (M-GARCH) models[7]. It is well-known that ARMA-GARCH models are able to capture stylized facts of the exchange rate dynamics. They are skewness, fat tails, and volatility clustering. Moreover, "*GARCH models increase estimation efficiency by modelling volatility clustering and providing explicit estimates of the parameters describing the time-varying nature of the conditional variance*" (Engle, 1982). Therefore, several studies employed GARCH models to study news effects on exchange rates (Hayo & Neuenkirch, 2012, 2013; May, Farrell, & Rossouw, 2017; Omrane & Hafner, 2015).

[7] Ehrmann and Fratzscher (2005) stated that the estimation of news models in a GARCH framework would be superior due to the direct estimation of the conditional second moments in GARCH models.

4.1.1- Macroeconomic News Announcements Effects on Exchange Rate Returns and Exchange Rate Volatility

According to Andersen *et al.* (2003) when announcements of macroeconomic news contain common knowledge information, they immediately and directly affect exchange rates. Exchange rates reflect all publically available macroeconomic information.

They employed the basic model to examine the news effects of macroeconomic indicators on the exchange rate, which is as follows.

$$r_t = \alpha_k + \beta_k N_{kt} + u_t \qquad \text{(A)}$$

where r_t denotes exchange rate returns measured as the percentage change in the exchange rate from time t to time $t+1$, N_{kt} refers to the standardized macroeconomic news announcement (macroeconomic announcement surprise) k $(k = 1....n)$ at time t. The estimate of β_k gives the percentage change in the exchange rate to a surprise of one standard deviation in macroeconomic news announcement N_k.

Therefore, in this study, the direct effects of macroeconomic news announcements on exchange rate returns and exchange rate volatility of the Pak rupee are examined by following the model developed by Andersen *et al.* (2003). Specifically, it explores contemporaneous effects, pure effects, and dynamic effects of macroeconomic news announcements on exchange rate returns and exchange rate volatility of the Pak rupee.

4.1.1.1- Contemporaneous Effects of News

To examine the contemporaneous effects of news of each of macroeconomic indicator on exchange rate returns and exchange rate volatility during announcement periods[8], ARMA (p, q) – GARCH (p, q) model is specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \theta_{i,k} N_{i,k,t} + \varepsilon_{i,t} \quad (4.1)$$

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \vartheta_{i,k} |N_{i,k,t}| \quad (4.2)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t}$ refers to the standardized macroeconomic news announcement (macroeconomic announcement surprise) k (k =1....n) at time t, $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t}$, $\varepsilon_{i,t}$ is the regression residual.

To test the asymmetric effects of news of each of macroeconomic indicator on exchange rate returns and exchange rate volatility, ARMA(p, q) – GARCH(p,q) the model is specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \theta_{i,k} N_{i,k,t} + \psi_{i,k} N_{i,k,t} I_{i,k,t-1} + \varepsilon_{i,t} \quad (4.3)$$

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \vartheta_{i,k} |N_{i,k,t}| + \gamma_{i,k} |N_{i,k,t}| I_{i,k,t-1} \quad (4.4)$$

[8] Followed from various studies (Almeida et al., 1998; Andersen et al., 2003; Cai et al., 2008; Ehrmann & Fratzscher, 2005; Pearce & Solakoglu, 2007).

where $I_{i,k,t}$ denotes a dummy variable that takes the value 1 if the news announcement is negative, and the value of 0 if positive. If $\psi_{i,k} \neq 0$ and $\gamma_{i,k} \neq 0$, the news impact is asymmetric.

To examine the pure effects of news of all macroeconomic indicators with announcement period dummies on exchange rate returns and exchange rate volatility[9], ARMA (p, q) – GARCH (p, q) and EGARCH (p, q) models are specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \theta_{i,k} N_{i,k,t} + \sum_{k=1}^{K} \lambda_{i,k} D_{i,k,t} + \varepsilon_{i,t} \quad (4.5)$$

GARCH (p, q):

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \vartheta_{i,k} |N_{i,k,t}| + \sum_{k=1}^{K} \eta_{i,k} D_{i,k,t} \quad (4.6)$$

EGARCH (p, q)

$$ln\, h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \left[\pi_{i,1,l} \frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l} \left\{ \frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}}\right) \right\} \right] + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \vartheta_{i,k} |N_{i,k,t}| + \sum_{k=1}^{K} \eta_{i,k} D_{i,k,t} \quad (4.7)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t}$ represent each of the K standardized macroeconomic news announcement (macroeconomics announcement surprise) k (k =1....n) at time t, the

[9] Followed from Andersen *et al.* (2003) and Cai et *al.* (2008).

estimate of $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t}$. The $\lambda_{i,k}$ and $\eta_{i,k}$ measure the exchange rate returns and volatility reaction to announcement period dummies of each of macroeconomic news announcement $N_{i,k,t}$, where $D_{i,k} = 1$ if there is an announcement of macroeconomic news and $D_{i,k} = 0$ otherwise.

4.1.1.2- Dynamic Effects of News

To examine the dynamic effects of news of all macroeconomic indicators on exchange rate returns and exchange rate volatility after announcements periods[10], ARMA (p, q) – GARCH (p, q) and EGARCH (p, q) models are specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \sum_{j=0}^{J} \theta_{i,k,j} N_{i,k,t-j} + \varepsilon_{i,t} \quad (4.8)$$

GARCH (p,q)

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} \left| N_{i,k,t-j'} \right| \quad (4.9)$$

EGARCH (p, q)

$$ln\, h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \left[\pi_{i,1,l} \frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l} \left\{ \frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}}\right) \right\} \right] + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} \left| N_{i,k,t-j'} \right| \quad (4.10)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro

[10] Followed from Andersen *et al.* (2003), Cai *et al.* (2009) and Ben Omrane *et al.* (2018).

and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t-j}$ represent J lags of each of the K standardized macroeconomic news announcement in exchange rate return i, $N_{i,k,t-j'}$ represent J' lags of each of the K standardized macroeconomic news announcement in exchange rate volatility i, $\theta_{i,k,j}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t-j}$ and $\vartheta_{i,k,j'}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t-j'}$.

4.1.2- Macroeconomic News Announcements and Order Flow Effects on Exchange Rate Returns and Exchange Rate Volatility

According to Evans and Lyons (2002a), order flow conveys private information which is unrelated to macroeconomic news announcement effects on exchange rates. Order flow is the proximate determinant of exchange rates. It takes the form of private portfolio shifts that induce a portfolio-balance effect on exchange rates. Exchange rates reflect all publically available macroeconomic information and private information.

Evans and Lyons (2002a) took a simple model of determination of exchange rates which uses the information contained in order flow. According to this model, exchange rate movements are determined by changes in the interest rate differential and changes in signed order flow. The model is specified as

$$\Delta s_t = \alpha + \beta \Delta x_t + \gamma f_t + \varepsilon_t \qquad \text{(B)}$$

where, Δs_t is "*the first difference in the log of the foreign exchange price within day t,* Δx_t *order flow, and* F_t *fundamental variables*".

Therefore, in this study, the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of the Pak rupee are examined by following the model developed by Evans and Lyons (2002a). Specifically, it explores contemporaneous effects, pure effects, and dynamic effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of the Pak rupee.

4.1.2.1- Contemporaneous Effects of News and Order Flow

To examine the contemporaneous effects of news of each of macroeconomic indicator and order flow on exchange rate returns and exchange rate volatility during announcement periods[11], ARMA (p, q) – GARCH (p,q) model is specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \theta_{i,k} N_{i,k,t} + \Psi_i z_{i,t} + \varepsilon_{i,t} \quad (4.11)$$

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \vartheta_{i,k} |N_{i,k,t}| + \Omega_i |z_{i,t}| \quad (4.12)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t}$ refers to the standardized macroeconomic news announcement (macroeconomics announcement surprise k (k =1....n) at time t, $z_{i,t}$ refer to order flow at time t, $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement. The Ψ_i measures the

[11] Followed from Evans and Lyons (2002).

exchange rate returns reaction to order flow $z_{i,t}$ and Ω_i captures the exchange rate volatility reaction to the absolute order flow $z_{i,t}$.

To examine the pure effects of news of all macroeconomic indicators with announcement period dummies and order flow on exchange rate returns and exchange rate volatility, ARMA (p, q) – GARCH (p, q) and EGARCH (p, q) models are specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \theta_{i,k} N_{i,k,t} + \sum_{k=1}^{K} \lambda_{i,k} D_{i,k,t} + \Psi_i z_{i,t} + \varepsilon_{i,t} \quad (4.13)$$

GARCH (p, q)

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \vartheta_{i,k} |N_{i,k,t}| + \sum_{k=1}^{K} \eta_{i,k} D_{i,k,t} + \Omega_i |z_{i,t}| \quad (4.14)$$

EGARCH (p, q)

$$\ln h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \left[\pi_{i,1,l} \frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l} \left\{ \frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}}\right) \right\} \right] + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \vartheta_{i,k} |N_{i,k,t}| + \sum_{k=1}^{K} \eta_{i,k} D_{i,k,t} + \Omega_i |z_{i,t}| \quad (4.15)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t}$ represent each of the K standardized macroeconomic news announcement (macroeconomics announcement surprise) k (k =1....n) at time t, $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute

macroeconomic news announcement $N_{i,k,t}$. The Ψ_i measures the exchange rate returns reaction to order flow $z_{i,t}$ and Ω_i captures the exchange rate volatility reaction to the absolute order flow$z_{i,t}$. The $\lambda_{i,k}$ and $\eta_{i,k}$ measure the exchange rate returns and volatility reaction to announcement period dummies of each of macroeconomic news announcement $N_{i,k,t}$, where $D_{i,k}$= 1 if there is an announcement of macroeconomic news and $D_{i,k}$= 0 otherwise.

4.1.2.2- Dynamic Effects of News and Order Flow

To examine dynamic effects of news of all macroeconomic indicators and order flow on exchange rate returns and exchange rate volatility[12], ARMA (p, q) – GARCH (p,q) and EGARCH (p, q) models model is specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \sum_{j=0}^{J} \theta_{i,k,j} N_{i,k,t-j} + \sum_{s=0}^{S} \Psi_{i,s} z_{i,t-s} + \varepsilon_{i,t} \quad (4.16)$$

GARCH (p,q)

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} \left| N_{i,k,t-j'} \right| + \sum_{s=0}^{S'} \Omega_{i,s'} \left| z_{i,t-s'} \right| \quad (4.17)$$

EGARCH (p, q)

$$ln\, h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \left[\pi_{i,1,l} \frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l} \left\{ \frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}}\right) \right\} \right] + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} \left| N_{i,k,t-j'} \right| + \sum_{s=0}^{S'} \Omega_{i,s'} \left| z_{i,t-s'} \right| \quad (4.18)$$

[12] Followed from Duffuor *et al.* (2012) and Gradojevic and Neely (2009)

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t-j}$ represent J lags of each of the K standardized macroeconomic news announcement in exchange rate return i, $N_{i,k,t-j'}$ represent J' lags of each of the K standardized macroeconomic news announcement in exchange rate volatility i, $z_{i,t-s}$ represent S lags of order flow in exchange rate return i, the estimate of $\theta_{i,k,j}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t-j}$ and $\vartheta_{i,k,j'}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t-j'}$. The $\Psi_{i,s}$ measures the exchange rate returns reaction to order flow $z_{i,t-s}$ and $\Omega_{i,s'}$ captures the exchange rate volatility reaction to the absolute order flow $z_{i,t-s'}$.

4.1.3- Macroeconomic News Announcements Indirect Effects via Order Flow on Exchange Rate Returns and Exchange Rate Volatility

According to Evans and Lyons (2008), when an announcement of macroeconomic news is viewed by heterogeneous agents, it has different effects on exchange rates. Although the same announcement is observed by everyone, different views about macroeconomic news announcements affect exchange rates via order flow and represent dispersed information. When macroeconomic news hits the foreign exchange market, it impacts decisions of market markers, affecting order flow and then exchange rates. This indicates the interaction between macroeconomic news and order flow.

The model considers that macroeconomic news announcements change the information content of order flow and therefore alter the market makers ' signal processing on the order flow. It explained that information in news has two components. The first component is common knowledge whose implications for the exchange rate are agreed upon by all market participants. The second component is non-common knowledge who has different implications for the exchange rate as information is viewed by different market participants. Therefore, the information in the second component represents dispersed information which is first manifest in order flow, then these induced order flow incorporate information into exchange rates. The model leads to the following empirical specification:"

$$\Delta s_t = \alpha \Delta x_t + \xi_t + \nu_t \qquad (C)$$

$$\Delta x_t = \mu_t + \kappa_t \qquad (D)$$

where Δs_t is *"the first difference in the log of the exchange rate within day t and* Δx_t *is order flow during the same period"*. The parameter α measures the price effect of order flow which reveals the information content of order flow. Four shocks reflect various sources of information that hit the market affecting exchange rate and order flow. "*These shocks are mean zero, mutually uncorrelated, and serially uncorrelated"*. The ξ_t *and* ν_t shocks indicate the information which is directly incorporated into exchange rates. The ξ_t indicates the common knowledge effect of announcements of macroeconomics news on the exchange rate. The ν_t indicates other information that is directly incorporated into the exchange rate but is unrelated to macroeconomics news and order flow. The

μ_t *and* κ_t shocks drive order flow. The μ_t indicates the non-common-knowledge effect of the news that is order flow effects from macroeconomic news announcements. The κ_t the effects of order flow that are unrelated to macroeconomic news.

Therefore, the effects of macroeconomic news on exchange rates can be examined by taking the direct channel and indirect channel through order flow. The indirect effects of macroeconomic news announcements via order flow on exchange rate returns and exchange rate volatility of Pak rupee are examined by following the model developed by Evans and Lyons (2008). Specifically, it explores contemporaneous effects, pure effects, and dynamic effects of macroeconomic news announcements via order flow on exchange rate returns and exchange rate volatility of Pak rupee.

4.1.3.1- Contemporaneous Effects

To examine the contemporaneous effects of news of each of macroeconomic indicator via order flow exchange rate returns and exchange rate volatility during announcement periods,[13] ARMA (p, q) – GARCH (p, q) model is specified a follows:

$$r_{i,t} = c_{1,i} + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \theta_{i,k} N_{i,k,t} + \Psi_i z_{i,t} + \Phi_{i,k} z_{i,t} N_{i,k,t} + \varepsilon_{1,i,t} \quad (4.19)$$

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \vartheta_{i,k} |N_{i,k,t}| + \Omega_i |z_{i,t}| + \psi_{i,k} |z_{i,t}| |N_{i,k,t}| \quad (4.20)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is the conditional variance that denotes

[13] Followed from Love and Payne (2006); Evans and Lyons (2008); Zhang *et al.*, (2016) and Savaser (2011)

exchange rate volatility, $N_{i,k,t}$ refers to the standardized macroeconomic news announcement (surprises of macroeconomics news) k (k =1....n) at time t in exchange rate return i, $z_{i,t}$ refer to order flow at time t, $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t}$. The Ψ_i measures the exchange rate returns reaction to order flow $z_{i,t}$ and Ω_i captures the exchange rate volatility reaction to the absolute order flow $z_{i,t}$. The $\Phi_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ via order flow and $\psi_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t}$ via order flow. The $\varepsilon_{i,t}$ is the regression residual.

To examine the pure effects of news of all macroeconomic indicators with announcement period dummies via order flow on exchange rate returns and exchange rate volatility, ARMA (p, q) – GARCH (p, q) and EGARCH (p, q) models are specified as follows:

$$r_{i,t} = c_i + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \theta_{i,k} N_{i,k,t} + \sum_{k=1}^{K} \lambda_{i,k} D_{i,k,t} + \Psi_i z_{i,t} + \sum_{k=1}^{K} \Phi_{i,k} z_{i,t} N_{i,k,t} + \varepsilon_{i,t} \quad (4.21)$$

GARCH (p, q)

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \vartheta_{i,k} |N_{i,k,t}| + \sum_{k=1}^{K} \eta_{i,k} D_{i,k,t} + \Omega_i |z_{i,t}| + \sum_{k=1}^{K} \psi_{i,k} |z_{i,t}||N_{i,k,t}| \quad (4.22)$$

EGARCH (p, q)

$$\ln h_{i,t} = \omega_i + \alpha_{i,l}\left[\pi_{i,1,l}\frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l}\left\{\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-i}|}{\sqrt{h_{i,t-l}}}\right)\right\}\right] + \beta_{i,m}\ln h_{i,t-m} + \sum_{k=1}^{K}\vartheta_{i,k}\,|N_{i,k,t}| + \sum_{k=1}^{K}\eta_{i,k}\,D_{i,k,t} + \Omega_i\,|z_{i,t}| + \sum_{k=1}^{K}\Psi_{i,k}\,|z_{i,t}||N_{i,k,t}| \quad (4.23)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is conditional variance which denotes exchange rate volatility, $N_{i,k,t}$ represent each of the K standardized macroeconomic news announcement (macroeconomics announcement surprise) k (k =1....n) at time t, $\theta_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t}$ and $\vartheta_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t}$. The Ψ_i measures the exchange rate returns reaction to order flow $z_{i,t}$ and Ω_i captures the exchange rate volatility reaction to the absolute order flow$z_{i,t}$. The $\lambda_{i,k}$ and $\eta_{i,k}$ measure the exchange rate returns and volatility reaction to announcement period dummies of each of macroeconomic news announcement $N_{i,k,t}$, where $D_{i,k}$= 1 if there is an announcement of macroeconomic news and $D_{i,k}$= 0 otherwise. The $\Phi_{i,k}$ measures the exchange rate returns reaction to the macroeconomic news announcement via order flow and $\psi_{i,k}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement via order flow.

4.1.3.2- Dynamic Effects

To examine the dynamic effects of news of all macroeconomic indicators via order flow on exchange rate returns and exchange rate volatility, ARMA (p,q)- GARCH (p, q) and EGARCH (p, q) models are specified as follow:

$$r_{i,t} = c_{1,i} + \sum_{l=1}^{p} \delta_{i,l} r_{i,t-l} + \sum_{m=1}^{q} \varphi_{i,m} \varepsilon_{i,t-m} + \sum_{k=1}^{K} \sum_{j=0}^{J} \theta_{i,k,j} N_{i,k,t-j} + \sum_{s=0}^{S} \Psi_{i,s} z_{i,t-s} + \sum_{k=1}^{K} \sum_{j=0}^{J} \sum_{s=0}^{S} \Phi_{i,k,j,s} z_{i,t-s} N_{i,k,t-j} + \varepsilon_{i,t} \quad (4.24)$$

GARCH (p, q)

$$h_{i,t} = \omega_i + \sum_{l=1}^{q} \alpha_{i,l} \varepsilon_{i,t-l}^2 + \sum_{m=1}^{p} \beta_{i,m} h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} |N_{i,k,t-j'}| + \sum_{s=0}^{S'} \Omega_{i,s'} |z_{i,t-s'}| + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \sum_{s'=0}^{S'} \Psi_{i,k,j',s'} |z_{i,t-s'}| |N_{i,k,t-j'}| \quad (4.25)$$

EGARCH(p, q)

$$\ln h_{i,t} = \omega_i + \alpha_{i,l} \left[\pi_{i,1,l} \frac{\varepsilon_{i,t-l}}{\sqrt{h_{i,t-l}}} + \pi_{i,2,l} \left\{ \frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}} - E\left(\frac{|\varepsilon_{i,t-l}|}{\sqrt{h_{i,t-l}}}\right) \right\} \right] + \beta_{i,m} \ln h_{i,t-m} + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \vartheta_{i,k,j'} |N_{i,k,t-j'}| + \sum_{s=0}^{S'} \Omega_{i,s'} |z_{i,t-s'}| + \sum_{k=1}^{K} \sum_{j'=0}^{J'} \sum_{s'=0}^{S'} \Psi_{i,k,j',s'} |z_{i,t-s'}| |N_{i,k,t-j'}| \quad (4.26)$$

where $r_{i,t}$ is each exchange rate return i at time t (Pak rupee to US dollar, UK pound, Euro and Japanese yen exchange rate returns), $h_{i,t}$ is the conditional variance that denotes exchange rate volatility, $N_{i,k,t-j}$ represent J lags of each of the K macroeconomic news announcement in exchange rate return $i, N_{i,k,t-j'}$ represent J' lags of each of the K macroeconomic news announcement in exchange rate volatility i, $z_{i,t-s}$ represent S lags of order flow in exchange rate return i, $\theta_{i,k,j}$ measures the exchange rate returns reaction to the macroeconomic news announcement $N_{i,k,t-j}$ and $\vartheta_{i,k,j'}$ captures the exchange rate

volatility reaction to the absolute macroeconomic news announcement $N_{i,k,t-j'}$. The $\Psi_{i,s}$ measures the exchange rate returns sensitivity to order flow $z_{i,t-s}$ and $\Omega_{i,s'}$ captures the exchange rate volatility reaction to the absolute order flow $z_{i,t-s'}$. The $\Phi_{i,k,j,s}$ measures the exchange rate returns reaction to the macroeconomic news announcement via order flow and $\psi_{i,k,j',s'}$ captures the exchange rate volatility reaction to the absolute macroeconomic news announcement via order flow.

For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns based on the Schwarz Information Criteria (SIC) and Akaike Information Criteria (AIC). For Pak rupee exchange rate volatility, the univariate GARCH (p, q) and EGARCH (p, q) and multivariate GARCH (1,1) models are used for capturing volatility dynamics in Pak rupee exchange rates. The GARCH (p,q) and EGARCH (p,q) models are selected because these models adequately capture the volatility dynamics in Pak rupee exchange rates and perform better when evaluated through diagnostic testing. While estimating GARCH and EGARCH models with news variables, the general-to-specific approach is adopted (Hendry & Doornik, 1994).

For the estimation of GARCH models, this study uses the maximum-likelihood (MLE) method. Using an iterative computer algorithm, a set of parameters is selected under the maximum likelihood method that has most likely generated observed data. Since the residual term follows Gaussian conditional distribution, the conditional likelihood function is

$$L = \prod_{t=1}^{T}\left(\sqrt{\frac{1}{\sqrt{2\pi h_t}}}\right)\exp\left(\frac{-\varepsilon_t^2}{2h_t}\right)$$

The log-likelihood function is

$$lnL = -\frac{T}{2}\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T} lnh_t - \frac{1}{2}\sum_{t=1}^{T}\left(\frac{\varepsilon_t^2}{h_t}\right)$$

The maximum likelihood (ML) estimates maximize the conditional log-likelihood and are "*consistent and asymptotically normally distributed*".

For the numerical accuracy of GARCH estimates, "*Broyden–Fletcher–Goldfarb-Shanno (Fletcher, 1987) numerical optimization algorithm*" with a maximum number of iteration =1000 and strong convergence tolerance = 0.0001 are used. Further, the Gaussian conditional distribution and the Generalized error distribution are followed by residual term. The covariance matrix of the estimates (outer-product of gradients) is computed with the maximum likelihood estimation (MLE) method.

To check the adequacy of the estimated univariate GARCH models, for the high-order serial correlation detection and the volatility clustering or ARCH effect testing, the Ljung-Box-Pierce Q statistic and Q^2 statistic are employed. The Q^2 statistic states the null hypothesis as there is no serial correlation in the residuals up to the specified order. The Q^2 statistic states the null hypothesis as there is no serial correlation in the squared residuals up to the specified order. For the existence of the ARCH effect, the LM ARCH test is employed. The F statistic states the null hypothesis as there are no ARCH effects in square residuals.

4.2- Interdependencies between Exchange Rates and Macroeconomic News Announcements

To examine the interdependencies among exchange rates and macroeconomic news announcements effects on exchange rate returns and exchange rate volatility, VAR(p)- M-GARCH (1,1) is used which is as follow:

The conditional mean is specified as VAR (p) model:

$$r_t = c + \sum_{l=1}^{P} \delta_l r_{t-l} + \sum_{k=1}^{K} \sum_{j=0}^{J} \theta_{k,j} N_{k,t-j} + \varepsilon_t \tag{4.27}$$

$$c = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{bmatrix}, \quad \delta_l = \begin{bmatrix} \delta_{11,l} & \delta_{12,l} & \delta_{13,l} & \delta_{14,l} \\ \delta_{21,l} & \delta_{22,l} & \delta_{23,l} & \delta_{24,l} \\ \delta_{31,l} & \delta_{32,l} & \delta_{33,l} & \delta_{34,l} \\ \delta_{41,l} & \delta_{42,l} & \delta_{43,l} & \delta_{44,l} \end{bmatrix}, \quad \theta_k = \begin{bmatrix} \theta_{1,k} \\ \theta_{2,k} \\ \theta_{3,k} \\ \theta_{4,k} \end{bmatrix}, \quad \varepsilon_t = \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \end{bmatrix}$$

where r_t is a 4x1 column vector, in which $[r_{1,t}, r_{2,t}, r_{3,t}\, r_{4,t}]'$ indicate each Pak rupee exchange rate returns, $N_{k,t-j}$ represent each of the K standardized macroeconomic news announcement (macroeconomics announcement surprise) and c is the 4 × 1 column vector of constants and δ_l is the 4 × 4 matrix of parameters which measure the response of each exchange rate returns to its own past returns and cross past returns of other exchange rates which indicates return spillovers, The 4 × 1 column vector θ_k represents the response of each exchange rate returns to macroeconomic news announcements and ε_t is the vector of residuals. The residual vector ε_t normally distributed. The corresponding variance-covariance matrix is given by $|H_t|$ that is $(\varepsilon_t|\Psi_{t-1}) \sim N(0, h_t)$ where Ψ_{t-1} is the information set up to time t-1.

The MARCH with BEKK (1, 1) representation is used for modelling the variance-covariance matrix $|H_t|$. The conditional variances are given by the diagonal of the variance-covariance matrix $|H_t|$. The MARCH (1, 1) model with BEKK is specified as

$$H_t = C'C + A'\varepsilon_{t-1}\dot{\varepsilon_{t-1}}A + B'H_{t-1}B + D'\left|N_{k,t-j}\right| D \tag{4.28}$$

$$C = \begin{bmatrix} c_{11} & 0 & 0 & 0 \\ c_{21} & c_{22} & 0 & 0 \\ c_{31} & c_{32} & c_{33} & 0 \\ c_{41} & c_{42} & c_{43} & c_{44} \end{bmatrix} \quad A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

$$B = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \\ b_{31} & b_{32} & b_{33} & b_{34} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix} \quad D = \sum_{k=1}^{K} \begin{bmatrix} d_{11,k} & 0 & 0 & 0 \\ d_{21,k} & d_{22,k} & 0 & 0 \\ d_{31,k} & d_{32,k} & d_{33,k} & 0 \\ d_{41,k} & d_{42,k} & d_{43,k} & d_{44,k} \end{bmatrix}$$

where C is the lower triangular matrix for constants, A and B are ARCH and GARCH coefficient matrices. The diagonal coefficients in A matrix indicate past own shocks effect while the off-diagonal coefficients in A matrix measure past cross shock effect. The diagonal coefficients in B matrix indicate past conditional variances effects while the off-diagonal coefficients in B matrix measure the volatility spillover effects. The coefficients D matrix indicate the response of each exchange rate volatility to macroeconomic news surprise.

For Pak rupee exchange rate returns, VAR (p) model is employed to incorporate serial correlation in exchange rate returns. For Pak rupee exchange rate volatility, the M-GARCH (1,1) model with full BEKK specification is used for capturing volatility dynamics in Pak rupee exchange rates.

For adequacy checking of the estimated M- GARCH model, the LM ARCH test, Ljung-Box Q test, and McLeod-Li test are employed for the detection of serial correlation in standardized residuals and squared standardized residuals.

4.3- Data

The data overview with descriptions, variables definitions, and constructions, and sources of data are presented here:

4.3.1- Variables Definitions, Construction, and Sources

4.3.1.1- Exchange Rates

This study uses daily Pak rupee exchange rates data to investigate the effects of macroeconomic news announcements on exchange rates. The key reason behind daily data use is to investigate the full reaction of exchange rates to news announcements that adjust gradually over time period. This implies analyzing "*the permanent effect of macroeconomic news announcements on exchange rates which may be different from initial immediate reaction*" (Ehrmann & Fratzscher, 2005). Further, it uses the daily Pak rupee exchange rate data from January 2008 to December 2018 for a total of 11,456 observations. The daily exchange rate data was obtained from the State Bank of Pakistan. Moreover, it takes the Pak rupee nominal exchange rates relative to the US dollar, UK pound, Euro, and Japanese yen quoted as the domestic currency per unit of foreign currency. The exchange rate returns are the first logarithmic difference of exchange rates of successive time periods as the continuously compounded returns.

They express as

$$r_t = \ln (E_t/E_{t-1}) = \ln (E_t) - \ln (E_{t-1})$$

where, r_t is the nominal exchange rate returns, and E_t and E_{t-1} are the nominal exchange rates at *t* and *t-1* period of time.

4.3.1.2- Scheduled Macroeconomic News Announcements

According to Fama (1970), the asset prices should reflect relevant available information and react significantly to unexpected component (surprise) or news of an announcement. An announcement is "news or surprise", defines as the difference between a released value of an indicator and its market expectation (Andersen *et al.*, 2003; Ehrmann & Fratzscher, 2005). In foreign exchange markets, exchange rates react to news or surprise of macroeconomic announcements. Macroeconomic news announcements are defined as scheduled announcements of macroeconomic indicators. Macroeconomic news announcement or macroeconomic announcement surprise is the difference between a released scheduled macroeconomic indicator and its market expectation.

This study uses real-time data on announcements of important macroeconomic indicators reflecting real-time information for the United States (US), the United Kingdom (UK), Eurozone (EZ), Japan (JP), and Pakistan (PAK), and their market expectations based on survey data[14]. It uses the monthly data on real-time reporting of released macroeconomic indicators and their forecasts from January 2008 to December 2018. The

[14] Survey of professional forecasters collects forecasts of all macroeconomic indicators to be released and reports the median forecasts from the survey. These includes Money Market Services, Bloomberg News Service, European Central Bank Survey of Professional Forecasters, Federal Reserve Bank of Philadelphia Survey of Professional Forecasters.

monthly data of released macroeconomic indicators and their forecasts obtain from the investing.com database. Further, this study selects those macroeconomic indicators that are available with their actual release as well as forecast and widely use in literature. It selects time period base on the availability of market expectation data (forecasts).

For the comparison of coefficients of macroeconomic news announcement series with different units of measurement, researchers (Andersen *et al.*, 2003; Ehrmann & Fratzscher, 2005; Faust *et al.*, 2007) follow Balduzzi, Elton, and Green (2001) in standardizing macroeconomic news announcement by taking the difference of the market expectation (forecasts) from the release (actual) and dividing them by the sample standard deviation of the difference. The standardized macroeconomic news for announcement k is as follows:

$$N_{k,t} = \frac{A_{k,t} - E_{k,t}}{\hat{\sigma}_k}$$

where $A_{k,t}$ is the actual announcement k of macroeconomic indicators on time t, $E_{k,t}$ is the market expectation, and $\hat{\sigma}_k$ is the sample standard deviation of the difference (difference of its actual and market expected values). Thus, standardized macroeconomic news announcements are "close to zero mean and have a unit standard deviation"(Andersen *et al.*, 2003).

For empirical analysis, the announcement of each news is added at every point of each exchange rate series. Therefore, for estimation, those observations $(r_t, N_{k,t})$ are considered where an announcement was made at time t (Almeida *et al.*, 1998; Andersen *et al.*, 2003).

4.3.1.3- Order Flow

"Order flow is a measure of buying/selling pressure. It is the net of buyer-initiated orders and seller-initiated orders" Evans and Lyons (2002a, 2002b, 2005, 2008). The order flow is signed trades between dealers of foreign exchange cumulated over time. Trades are signed depending on whether the initiator sells or buys. A purchase (sale) of 1 unit of a currency initiated by a trader on a dealer's quote, order flow is 1(–1). Evans and Lyons (2002a, 2002b) measure order flow as *"the difference between the number of buyer-initiated and seller-initiated trades"*. They take a number of transactions/trades (buying and selling) for measuring order flow. They point out a drawback that the size of individual transactions/trades can not be identified. They further point out this drawback may not be acute. The size of trades does not contain any information content beyond the number of transactions[15] .

Payne (2003) defines order flow as trade size. He measures order flow as the traded volume of currency. However, Bjønnes and Rime (2005) and Killeen, Lyons, and Moore (2006) show that *"analysis based on trade size and the number of trades is not qualitatively different"*. Following them, researchers use these measures for order flow in the literature (Bacchetta & Van Wincoop, 2006; Breedon & Ranaldo, 2013; Evans & Rime, 2016; Froot & Ramadorai, 2005; Gradojevic & Neely, 2009; Love & Payne, 2008; McIntyre & Harjes, 2016; Rime, Sarno, & Sojli, 2010; Savaser, 2011; Zhang *et al.*, 2016).

This study uses the daily data of foreign exchange transactions of Pak rupee between dealers in terms of traded contracts from January 2008 to December 2018. The

[15] For more detail, see, Evans and Lyons (2002a, 2008).

data was obtained from the barchart.com database. This study follows the convention of signing a trade using the direction of the market order. For every trade executed, "*the data set contains a time-stamped record of the transaction price and a bought/sold indicator. The bought/sold indicator allows signing trades for measuring order flow*" Evans and Lyons (2002a, 2002b).

4.4- Data Description

4.4.1- Exchange Rates

This study takes Pak rupee nominal exchange rates relative to the US dollar, UK pound, Euro, and Japanese yen. Table 4.1 shows that for the last decade, depreciation in the Pak rupee against major currencies is observed. The Pak rupee depreciates from 61.84 against USD (in Jan 2008) to 138.86 against USD (in December 2018). Similarly, the Pak rupee also significantly falls against other major currencies. During the period 2018, large changes in Pak rupee exchange rates and high volatility of Pak rupee exchange rates are observed. In October 2018, there is a sharp nominal depreciation of 7 percent in the Pak rupee against major currencies.

Table 4.1: Pak Rupee Exchange Rates

Exchange rates	January 2008	December 2018
PKR/USD	61.8485	138.8619
PKR /GBP	122.8157	176.8962
PKR /JPY	0.5542	1.2606
PKR /EURO	90.6483	158.8372

Source: State Bank of Pakistan.

4.4.2- Macroeconomic News Announcements

This study takes macroeconomic news announcements from the US, the UK, Japan, the Euro Zone, and Pakistan. Table 4.2 presents salient features of foreign and domestic macroeconomic news announcements (which include their frequency, unit, source, announcement release date, and time. This study considers forty-six different types of announcements of macroeconomic news for the US, the UK, Japan, the Euro Zone, and Pakistan are considered. The US accounts for 10, the UK for 10, Japan for 10, Euro Zone for 8, and Pakistan for 8 macroeconomic news announcements. There are 6072 total announcements during the sample period. There is 1320 news from the US, the UK, and Japan, and 1056 news from the Euro Zone and Pakistan.

Table 4.2: Macroeconomic News Announcements

Macroeconomic News Announcements					
Announcement	**Frequency**	**Unit**	**Source**	**Dates**	**Announcement Time**
US Macroeconomic News Announcements					
Business Inventories	Monthly	% m-m	Census Bureau	15/1/2008 - 14/12/2018	10:00 a.m.
Consumer Price Index	Monthly	% m-m	Bureau of Labor Statistics	14/1/2008 - 12/12/2018	8:30 a.m.
Durable Goods Orders	Monthly	% m-m	Census Bureau	22/1/2008 - 21/12/2018	10:00 a.m.
Federal Budget Balance	Monthly	$ Billion	Department of Treasury	13/1/2008 - 14/12/2018	2:00 p.m.
Industrial Production	Monthly	% m-m	Federal Reserve Board	18/1/2008- 14/12/2018	9:15 a.m.
Producer Price Index	Monthly	% m-m	Bureau of Labor Statistics	9/1/2008 - 11/12/2018	8:30 a.m.
Repo Rate	Monthly	%	Federal Reserve Board	21/1/2008 - 19/12/2018	9:15 a.m.
Retail Sales	Monthly	% m-m	Census Bureau	13/1/2008 - 14/12/2018	10:00 a.m.
Trade Balance	Monthly	$ Billion	Bureau of Economic Analysis	2/1/2008 - 6/12/2018	8:30 a.m.
Unemployment Rate	Monthly	%	Bureau of Labor Statistics	4/1/2008 - 7/12/2018	8:30 a.m.
UK Macroeconomic News Announcements					
Average Earnings Index	Monthly	%m-m	Office of National Statistics	13/1/2008- 11/12/2018	10:30 a.m.

Consumer Price Index	Monthly	%m-m	Office of National Statistics	16/1/2008-19/12/2018	10:30 a.m.
Housing Price Index	Monthly	%m-m	Office of National Statistics	7/1/2008-8/12/2018	10:30 a.m.
Industrial Production	Monthly	% m-m	Office of National Statistics	10/1/2008-11/12/2018	10:30 a.m.
Money Supply	Monthly	% m-m	Bank of England	29/1/2008-30/12/2018	9:30 a.m.
Producer Price Index	Monthly	% m-m	Office of National Statistics	16/1/2008-19/12/2018	10:30 a.m.
Repo Rate	Monthly	%	Bank of England	20/1/2008 - 21/12/2018	9:30 a.m.
Retail Sales	Monthly	%	Office of National Statistics	18/1/2008-20/12/2018	10:30 a.m.
Trade Balance	Monthly	£ Billion	Office of National Statistics	10/1/2008-11/12/2018	10:30 a.m.
Unemployment Rate	Monthly	%	Office of National Statistics	16/1/2008-11/12/2018	10:30 a.m.
Japan Macroeconomic News Announcements					
All Industries Activity Index	Monthly	%m-m	Ministry of Economy, Trade and Industry	20/1/2008-23/12/2018	9:30 a.m.
Consumer Price Index	Monthly	%m-m	Japan Statistics Bureau	17/1/2008-20/12/2018	8:30 a.m.
Industrial Production	Monthly	% m-m	Ministry of Economy, Trade, and Industry	15/1/2008-17/12/2018	9:30 a.m.
Machinery Orders	Monthly	% m-m	Economic and Social Research Institute	12/1/2008-16/12/2018	9:30 a.m.
Money Supply	Monthly	% m-m	Bank of Japan	7/1/2008-4/12/2018	10:30 a.m.
Producer Price Index	Monthly	% m-m	Japan Statistics Bureau	16/1/2008-12/12/2018	8:30 a.m.
Repo Rate	Monthly	%	Bank of Japan	19/1/2008 - 22/12/2018	10:30 a.m.
Retail Sales	Monthly	% m-m	Ministry of Economy, Trade and Industry	29/1/2008-27/12/201	9:30 a.m.
Trade Balance	Monthly	¥ Trillion	Ministry of Finance	23/1/2008-19/12/2018	9:30 a.m.
Unemployment Rate	Monthly	%	Japan Statistics Bureau	28/1/2008-26/12/2018	8:30 a.m.
Euro Zone Macroeconomics News Announcements					
Consumer Price Index	Monthly	% m-m	Eurostat	15/1/2008-17/12/2018	10:00 a.m.
Industrial Production	Monthly	% m-m	Eurostat	14/1/2008-12/12/2018	10:00 a.m.
Money Supply	Monthly	% m-m	European Central Bank	28/1/2008-27/12/2018	9:30 a.m.
Producer Price Index	Monthly	% m-m	Eurostat	4/1/2008-4/12/2018	10:00 a.m.
Repo Rate	Monthly	%	European Central Bank	13/1/2008 - 15/12/2018	9:30 a.m.

Retail Sales	Monthly	% m-m	Eurostat	7/1/2008-5/12/2018	10:00 a.m.
Trade Balance	Monthly	€ Billion	Eurostat	15/1/2008-27/12/2018	10:00 a.m.
Unemployment Rate	Monthly	%	Eurostat	9/1/2008-1/12/2018	10:00 a.m.
Pakistan Macroeconomics News Announcements					
Consumer Price Index	Monthly	% m-m	Pakistan Economic Survey	1/2008-12/2018	9.00 a. m.
Foreign Exchange Reserve	Monthly	% m-m	State Bank of Pakistan	1/2008-12/2018	10.00 a. m.
Manufacturing Production Index	Monthly	% m-m	Pakistan Economic Survey	1/2008-12/2018	9.00 a. m.
Money Supply	Monthly	% m-m	State Bank of Pakistan	1/2008-12/2018	10.00 a. m.
Net Financial Assets	Monthly	% m-m	State Bank of Pakistan	1/2008-12/2018	10.00 a. m.
Repo Rate	Monthly	%	State Bank of Pakistan	1/2008-12/2018	10.00 a. m.
Trade Balance	Monthly	% m-m	Pakistan Economic Survey	1/2008-12/2018	9.00 a. m.
Wholesale Price Index	Monthly	% m-m	Pakistan Economic Survey	1/2008-12/2018	9.00 a. m.

4.4.3- Order flow

This study takes foreign exchange transactions of Pak rupee between dealers in terms of traded contracts. These transactions are cumulated over each 24 hour trading day. The sign of transactions is used for the direction of the market orders. The buying signal indicates when the closing price of Pak rupee against the foreign currency at time *t* is greater than the closing price of Pak rupee against the foreign currency at time *t-1*. It gives a purchase order of foreign currency. The selling signal indicates when the closing price of Pak rupee against the foreign currency at time *t* is lower than the closing price of Pak rupee against the foreign currency at time *t-1*. It gives a sale order of foreign currency. "*A market order indicates the intention to buy (sell) immediately a given quantity of the foreign currency at the existing best price*". Table 4.3 shows the details of the number of market orders of each foreign currency against Pak rupee and buying and selling signals (in

percentage) at each Pak rupee exchange rate. The percentage of buying signals is greater than selling signals which indicate the net purchase of foreign currencies which in turn causes an appreciation of Pak rupee exchange rates.

Over the sample period, the EURO has a greater number of market orders against the Pak rupee with 52% buying transactions and 48% selling transactions. The JPY has a lower number of market orders against the Pak rupee with 51% buying transactions and 49% selling transactions. The USD has a greater percentage of buying transactions that are 57% against Pak rupee and GBP has a lower percentage of buying transactions that are 50% against Pak rupee. The GBP has a greater percentage of selling transactions that are 50% against Pak rupee and USD has a lower percentage of selling transactions that are 43% against Pak rupee.

Table 4.3: Order Flow

Exchange rates	No. of orders	Buy (%)	Sell (%)
PKR/USD	9931	57%	43%
PKR /GBP	9276	50%	50%
PKR /JPY	8883	51%	49%
PKR /EURO	10444	52%	48%

Note: Computed by Researcher

CHAPTER 5
EMPIRICAL ANALYSIS

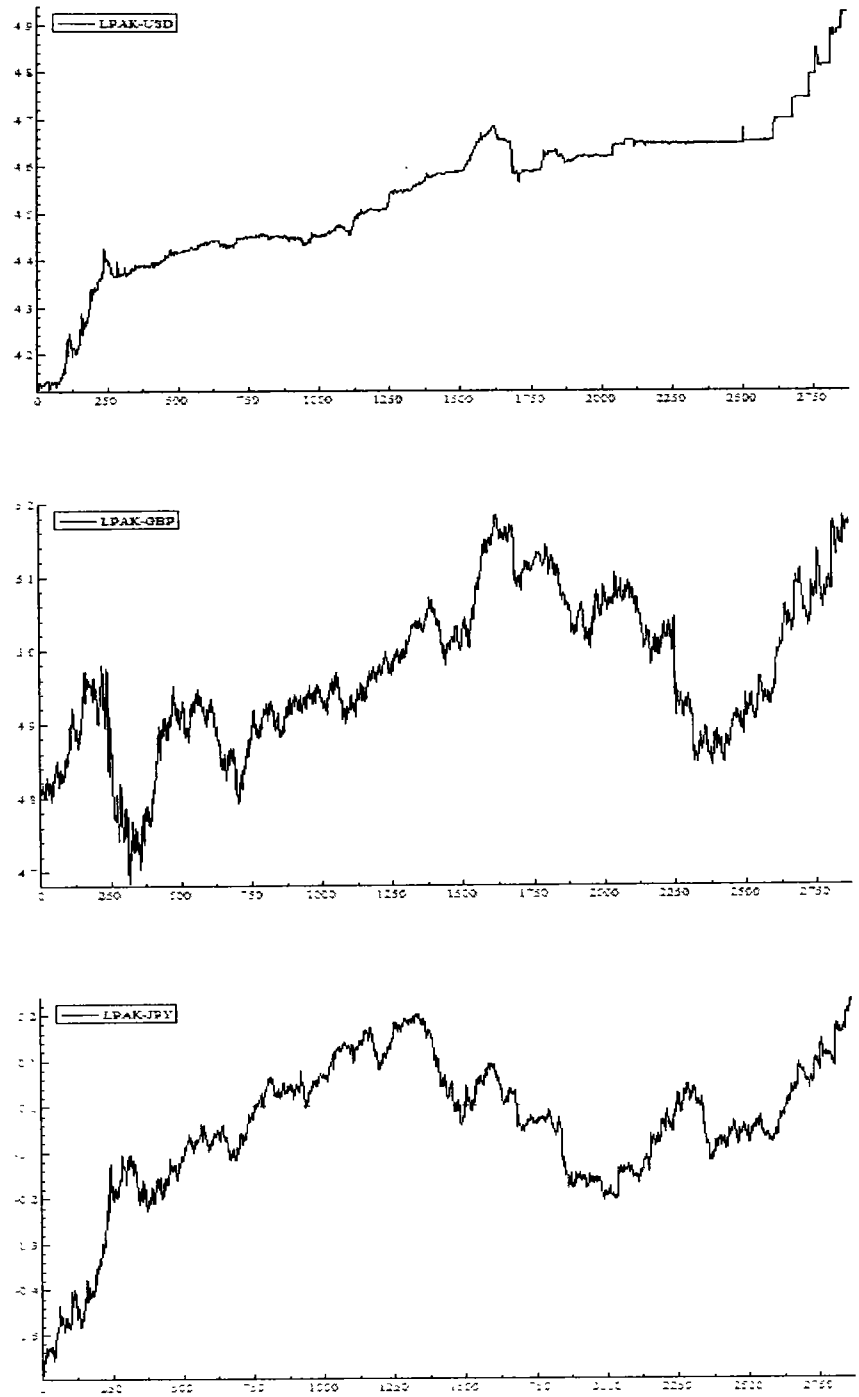
The primary objective of the study is to examine the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of the Pak rupee. For this, it is reasonable to investigate the nature and characteristics of the data set and descriptive for empirical analysis. Further, it is essential to have a technical analysis of Pak rupee exchange rates for trading analysis. This study uses the daily exchange rate data, monthly macroeconomic news announcements, and daily cumulated order flow data from January 2008 to December 2018. The data was obtained from the State Bank of Pakistan's economic data, investing.com database, and barchart.com database. It uses univariate and multivariate GARCH models for empirical analysis.

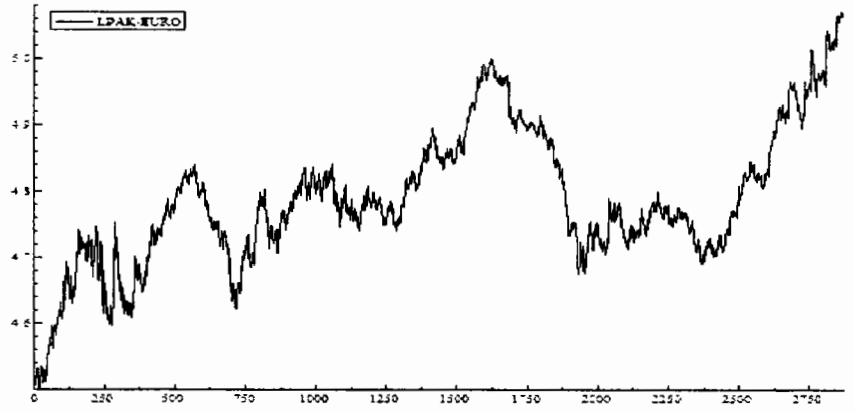
This chapter presents descriptive analysis and technical analysis of Pak rupee exchange rates, foreign and domestic macroeconomic news announcements and order flow, and estimated empirical results from models stated in chapter 4.

5.1- Graphical Analysis

The plots of daily exchange rates in the logarithmic level given in Figure 5.1 reveal an increasing trend over the time period. They show the depreciation of the Pak rupee against foreign currencies.

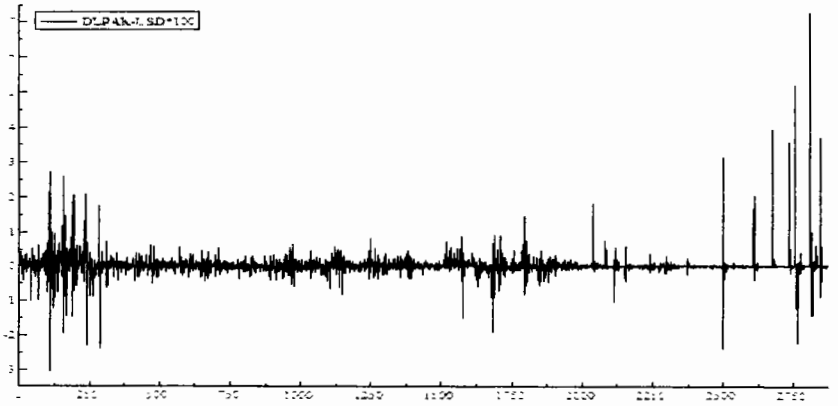
Figure 5.1: Daily Pak Rupee Exchange Rates

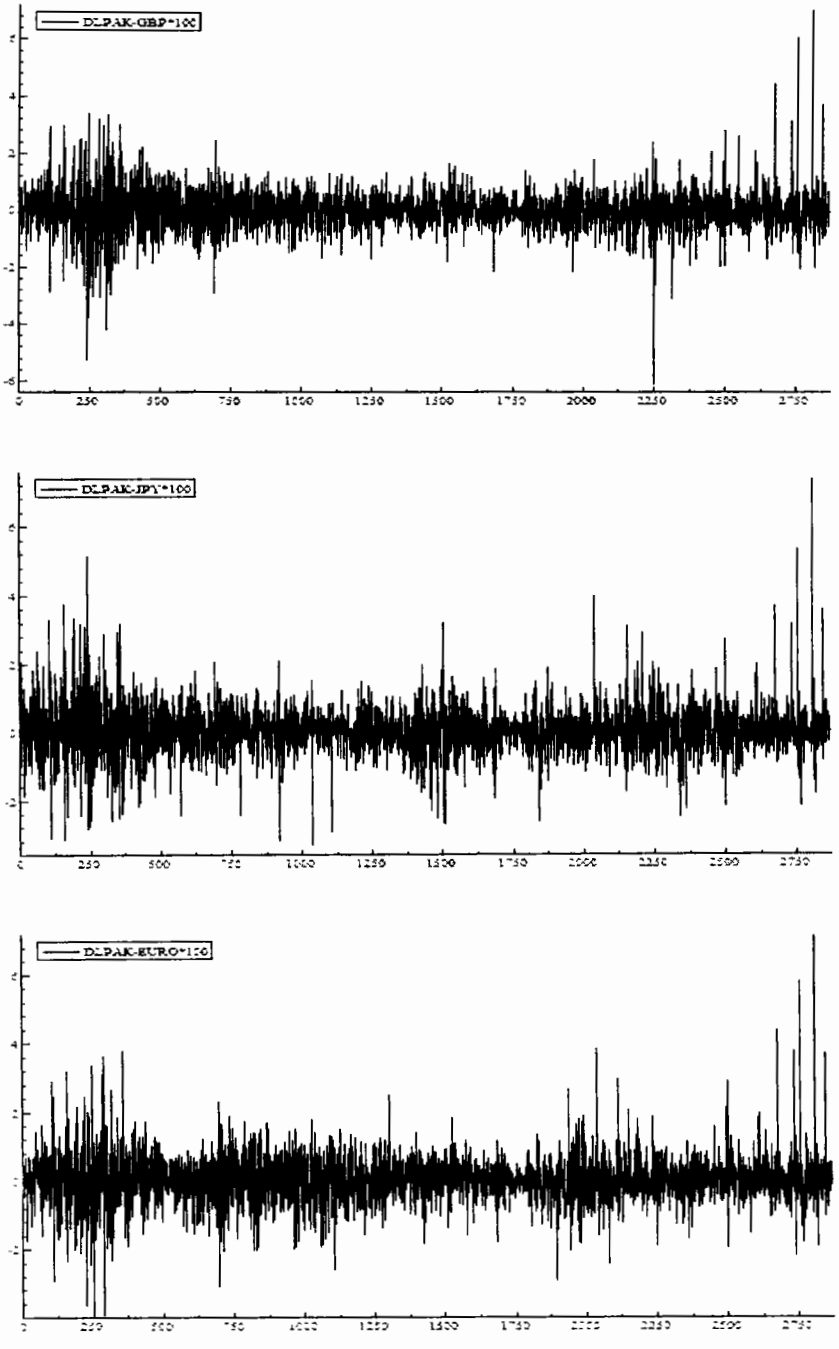




The plots of daily exchange rate returns as logarithmic changes (in percentage) in exchange rates given in Figure 5.2 show frequent and rapid fluctuations in exchange rates from 2008 to 2018. They indicate no definite pattern in the exchange rate returns. They also reflect huge changes in exchange rates and high exchange rate volatility are observed during the period 2018. They show clearly increasing volatility over time. High periods of volatility can be distinguished from periods of low volatility. Thus, the Pak rupee exchange rate returns are conforming with stylized facts such as the mean-reverting and volatility clustering.

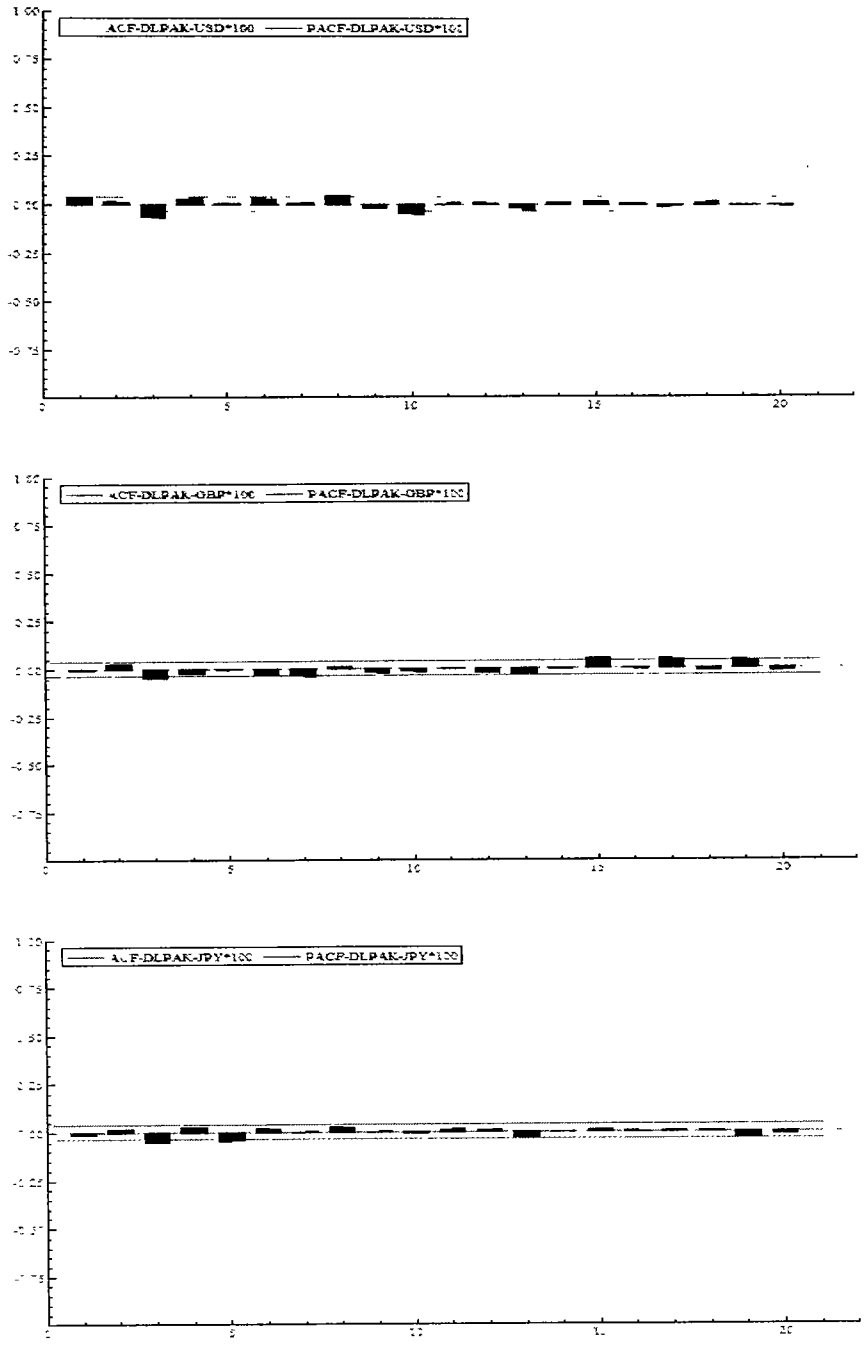
Figure 5.2: Daily Pak Rupee Exchange Returns

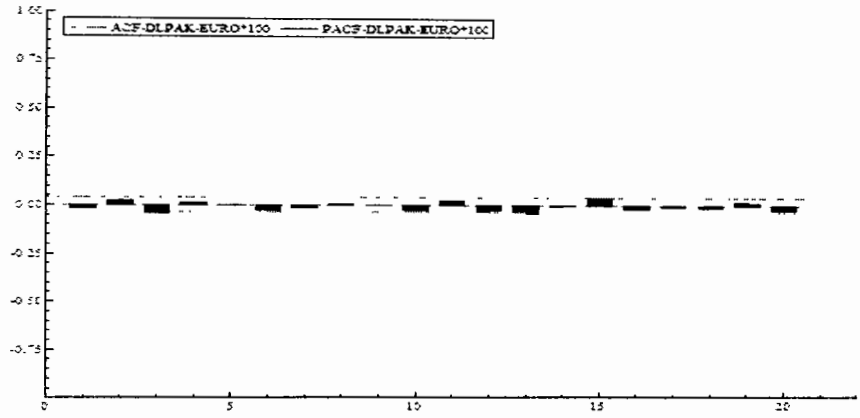




The plots of autocorrelations and partial autocorrelations of daily exchange rate returns given in Figure 5.3 show that autocorrelations are not persistent and die out very fast. They exhibit a short memory process.

Figure 5.3: The Autocorrelations and Partial Autocorrelations of Daily Pak Rupee Exchange Rate Returns

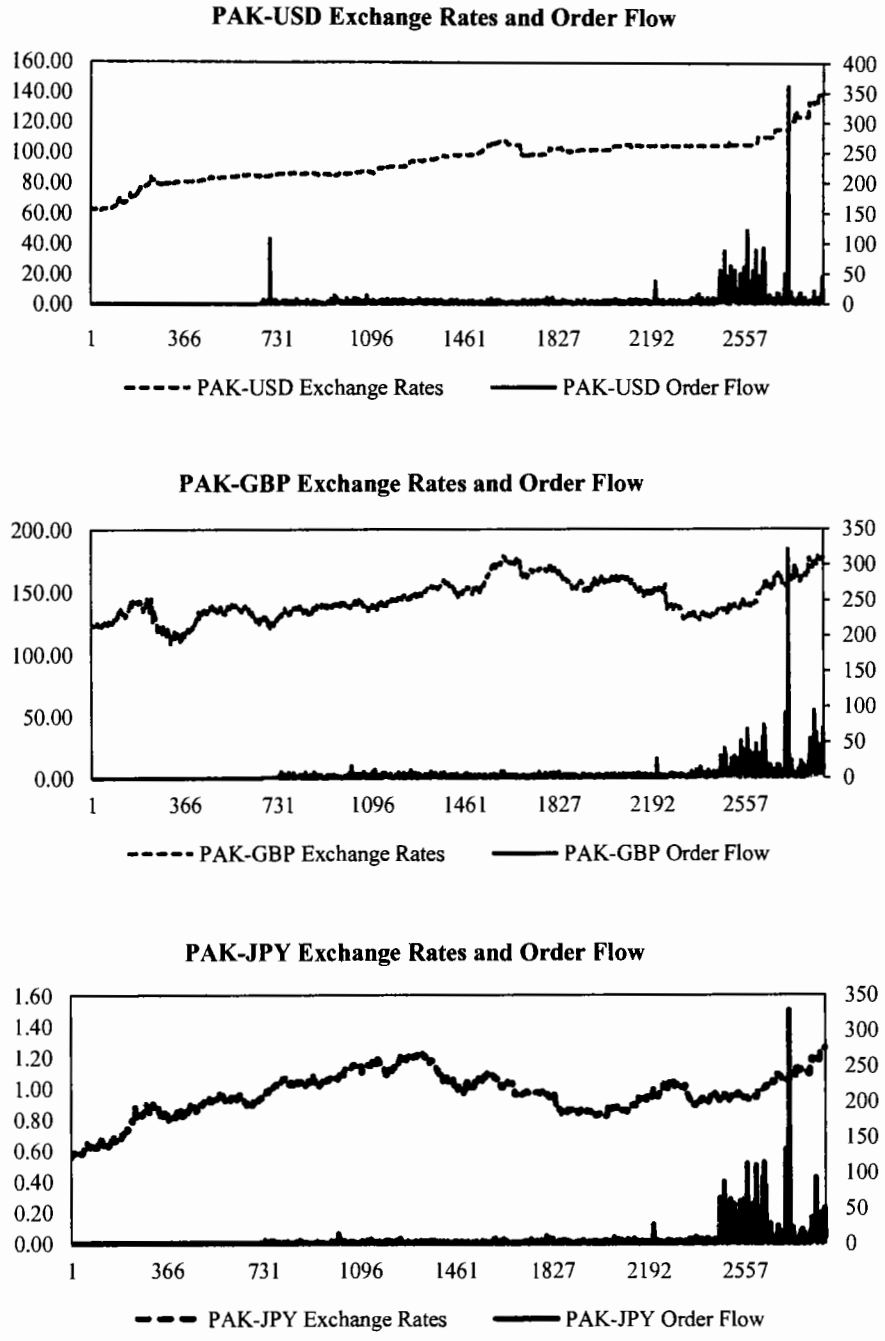


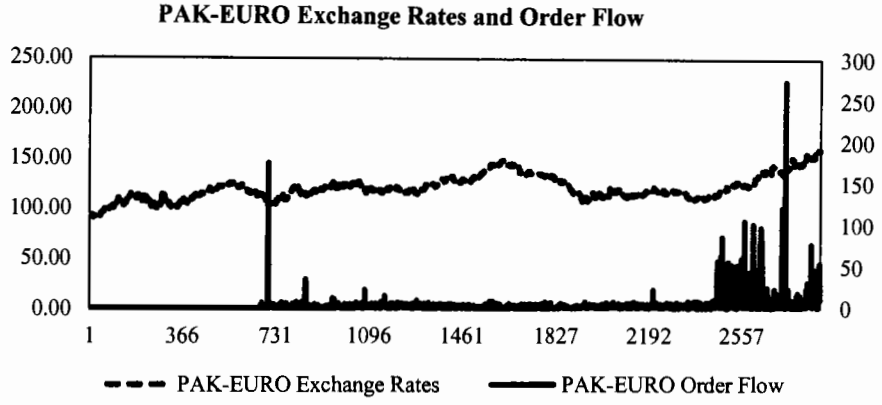


The plots of daily Pak rupee exchange rates and order flow given in figure 5.4 exhibit co-movements and a positive correlation between Pak rupee nominal exchange rates and Order flow. They indicate increases in buying pressure drives foreign exchange rates of the Pak rupee to appreciate. They show foreign currency buy orders exceed sell orders leads to the appreciation of foreign currencies. This is consistent with the microfinance theory and the studies on the microstructure of financial markets. The market microstructure theory studies behaviour of traders in financial markets. It explains that trading in financial markets has significant implications for the price formation process in these markets.

From the plots, it is observed that during the period 2018, large changes in Pak rupee exchange rates and high volatility of Pak rupee exchange rates are taken place. In October 2018, there is a sharp nominal depreciation of 7 percent in the Pak rupee against major currencies. Consequently, large foreign exchange transactions and the greater number of market orders of foreign currencies against the Pak rupee are taking place.

Figure 5.4: Daily Pak Rupee Exchange Rate and Order Flow





5.2- Descriptive Summary and Preliminary Analysis

Table 5.1 presents summary statistics of daily Pak rupee exchange rate returns. The daily exchange returns means are positive, indicating exchange rates increase over time. This implies Pak rupee depreciates against foreign currencies over time. The PKR/JPY has the highest means returns and PKR/GBP has the lowest mean returns. The standard deviation of daily exchange returns exhibits a similar degree of volatility. The PKR/USD is the least volatile. The Pak rupee exchange rate returns have positive skewness. The Pak rupee exchange rate returns show excess kurtosis indicating heavy-tailed and leptokurtic distribution. The PKR/USD has high values of skewness and kurtosis indicating Cauchy distribution. The significant Jarque-Bera test statistic shows non-normality in Pak rupee exchange rates returns.

Table 5.1 presents the means and standard deviations of the macroeconomic news announcements for the sample period. The standardized macroeconomic news announcements are close to zero mean and have a unit standard deviation.

Table 5.1: Descriptive Summary of Pak Rupee Exchange Rate Returns and Standardized Macroeconomic News Announcements

Variables	Obs	Min	Max	Mean	Standard Deviation	Skewness	Excess Kurtosis	Jarque-Bera
Exchange Rate Returns								
PKR/USD	2863	-3.0459	7.2717	0.0282	0.3475	5.6941	109.15	143660 ***
PKR /GBP	2863	-6.1198	7.1875	0.0127	0.7482	0.1805	10.29	12656 ***
PKR /JPY	2863	-3.3058	7.3893	0.0287	0.7483	0.7539	7.54	7054.1 ***
PKR /EURO	2863	-3.9128	7.1322	0.0195	0.7261	0.6289	7.89	7624.9 ***
US Macroeconomic News Announcements								
Business Inventories	132	-0.6	0.60	-0.0022	0.2137	0.0388	1.0195	5.7499*
Consumer Price Index	132	-0.5	0.4	-0.0234	0.1331	0.0880	1.9803	21.739***
Durable Goods Orders	132	-8.2	15.1	0.0333	2.4057	1.3553	10.992	704.96***
Federal Budget Balance	132	-138.2	77	0.5606	24.1690	-1.2478	8.0055	386.74***
Industrial Production	132	-2.1	1.2	-0.0681	0.4419	-0.7917	3.0056	63.475***
Producer Price Index	132	-1.1	1	0.0053	0.3541	0.1109	0.7741	3.566
Repo Rate	132	-0.75	0.5	-0.0284	0.1618	-1.3958	8.1376	407.08***
Retail Sales	132	-1.5	0.9	-0.0734	0.4219	-0.8625	1.5813	30.119***
Trade Balance	132	-10.17	13.1	0.1701	3.5652	0.3073	1.4433	13.534***
Unemployment Rate	132	-0.6	0.4	-0.025	0.1563	-0.2712	0.9543	6.6277**
UK Macroeconomic News Announcements								
Average Earnings Index	132	-1.4	1.8	-0.0166	0.3435	0.4620	7.4743	311.95***
Consumer Price Index	132	-0.7	0.8	-0.0015	0.2631	0.6476	1.6324	23.883***
Housing Price Index	132	-4.2	3.6	0.0196	1.1525	0.1211	1.6861	15.959***
Industrial Production	132	-2.5	2	-0.1598	0.6646	-0.1772	1.6667	15.97***
Money Supply	132	-3.2	2.4	-0.2795	0.8124	-0.4698	1.788	22.441***
Producer Price Index	132	-0.7	1	0.0280	0.2855	0.5615	1.452	18.535***
Repo Rate	132	-1.5	0.25	-0.0189	0.1495	-7.8268	71.719	29637***
Retail Sales	132	-1.3	0.9	-0.0295	0.3644	-0.1341	1.1657	7.8699***
Trade Balance	132	-3.04	2.09	-0.1971	1.0145	-0.0040	-0.0807	0.0362
Unemployment Rate	132	-0.2	0.2	-0.0189	0.0930	0.2146	-0.0527	1.0289
Japan Macroeconomic News Announcements								
All Industries Activity Index	132	-1.0	2.3	-0.0530	0.3695	2.0736	12.479	951.03***
Consumer Price Index	132	-0.2	0.2	0.0061	0.0832	0.0437	-0.0814	0.0785
Industrial Production	132	-4	2	-0.1439	0.8701	-0.9555	2.858	65.027***
Money Supply	132	-12.8	11.1	-0.4462	3.1162	-0.1153	3.339	61.617***
Machinery Orders	132	-20.2	13.8	0.3568	6.1358	-0.1867	0.0912	0.8132

Producer Price Index	132	-1.3	1.4	0.0061	0.3795	-0.2222	2.0451	24.09***
Repo Rate	132	-0.2	0.05	-0.0037	0.0305	-5.9433	35.875	7855.8***
Retail Sales	132	-2.7	2.7	0.0507	0.9973	-0.2463	0.4843	2.6248
Trade Balance	132	-0.93	0.57	-0.0330	0.2028	-0.6363	2.3424	39.086***
Unemployment Rate	132	-0.5	0.3	-0.0311	0.1543	-0.4994	0.6232	7.6254***
Euro Zone Macroeconomics News Announcements								
Consumer Price Index	132	-1.4	2	-0.1439	0.4965	0.5028	1.6423	20.395***
Industrial Production	132	-2	2	-0.0893	0.5755	-0.2662	1.6787	17.058***
Money Supply	132	-1	1.1	-0.0462	0.3968	0.0140	-0.2671	0.3966
Producer Price Index	132	-0.8	0.6	-0.0181	0.2145	-0.5091	1.8852	25.25***
Repo Rate	132	-0.25	0.5	0.0106	0.0814	2.2242	13.263	1076.3***
Retail Sales	132	-1.3	1.2	-0.0939	0.4853	-0.0151	0.4171	0.9620
Trade Balance	132	-9.3	8	-0.0841	3.3635	-0.2313	0.1638	1.325
Unemployment Rate	132	-0.3	0.3	-0.0075	0.0989	-0.0357	0.6364	2.2557
Pakistan Macroeconomics New Announcements								
Consumer Price Index	132	-1.32	3.3391	0.7057	0.9016	0.4569	-0.08381	4.6332
Foreign Exchange Reserve	132	-28.52	72.504	0.12818	11.464	2.3126	12.145	928.95***
Manufacturing Production Index	132	-5.49	5.061	1.0101	1.5409	-0.3408	1.6104	16.819***
Money Supply	132	-17.68	21.711	0.4065	6.9764	0.3937	0.4360	4.4562
Net Financial Assets	132	-41.41	52.059	-0.6970	11.009	0.3904	5.484	168.76***
Repo Rate	132	-12.5	16.724	0.0959	4.0738	0.7698	5.5216	180.72***
Trade Balance	132	-65.1	233.65	5.0512	34.318	2.5695	14.059	1232.4***
Wholesale Price Index	132	-5.11	4.9721	0.7244	1.4161	0.19433	2.2634	29.008***

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.2 presents a descriptive summary of daily order flow dominated in foreign currencies. The negative order flow indicates sales of foreign currencies while the positive order flow indicates the purchase of foreign currencies. In other words, a buying trade generates positive order flow and a selling trade generates negative order flow. The mean of order flow of all currencies is positive indicating net buying of foreign currencies over the sample period. The standard deviation shows variability in the order flow. Order flow are positively skewed and display a high degree of kurtosis.

Table 5.2: Order Flow Descriptive Summary

Exchange Rates	No. of orders	Mean	Standard Deviation	Skewness	Excess Kurtosis	Jarque-Bera
PKR/USD	9931	3.4675	10.146	18.229	557.65	37268***
PKR /GBP	9276	3.2388	8.9873	18.011	560.56	37653***
PKR /JPY	8883	3.1016	10.745	13.487	319.23	12248***
PKR /EURO	10444	3.6466	10.218	11.411	217.62	57137***

Note: *** showing 1%, significance.

This study employs the Augmented Dickey-Fuller (ADF) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test in order to test the stationarity of exchange rate returns and macroeconomic news announcements. Both tests are used with intercept terms and with intercept and trend terms. ADF statistic tests the null hypothesis that the series is non-stationary. While the KPSS statistic tests the null hypothesis that the series is stationary. The length of lag is selected on the base of the Schwarz Information Criteria (SIC) and Akaike Information Criteria (AIC). The results in Tables 5.3 and 5.4 show the stationarity of Pak rupee exchange rate returns and macroeconomic news announcements. They provide strong evidence that Pak rupee exchange rate returns and macroeconomic news announcements are integrated of order zero, I(0).

Table 5.3: Augmented Dickey-Fuller (ADF) Unit Root Tests

Variables	ADF Test			
	Level			
	Intercept and no time trend	Lags	Intercept and time trend	Lags
Exchange Rate Returns				
PKR/USD	-32.24***	2	-32.23***	2
PKR /GBP	-31.66***	2	-31.65***	2

PKR /JPY	-32.39***	2	-32.41***	2
PKR /EURO	-31.84***	2	-31.83***	2
US Macroeconomic News Announcements				
Business Inventories	-7.44***	2	-7.63***	2
Consumer Price Index	-7.463***	2	-7.55***	2
Durable Goods Orders	-6.99***	2	-7.06***	2
Federal Budget Balance	-5.30***	2	-5.35***	2
Industrial Production	-6.87***	2	-7.04***	2
Producer Price Index	-7.59***	2	-7.60***	2
Repo Rate	-4.16***	2	-4.17***	2
Retail Sales	-6.42***	2	-6.39***	2
Trade Balance	-6.26***	2	-6.31***	2
Unemployment Rate	-7.03***	2	-6.99***	2
UK Macroeconomic News Announcements				
Average Earnings Index	-8.66***	2	-8.91***	2
Consumer Price Index	-6.26***	2	-6.26***	2
Housing Price Index	-7.70***	2	-7.68***	2
Industrial Production	-6.45***	2	-6.56***	2
Money Supply	-6.34***	2	-6.47***	2
Producer Price Index	-9.15***	2	-9.16***	2
Repo Rate	-5.41***	2	-5.17***	2
Retail Sales	-8.10***	2	-8.07***	2
Trade Balance	-8.46***	2	-8.55***	2
Unemployment Rate	-6.11***	2	-6.27***	2
Japan Macroeconomic News Announcements				
All Industries Activity Index	-7.01***	2	-6.99***	2
Consumer Price Index	-6.45***	2	-6.46***	2
Industrial Production	-6.65***	2	-6.67***	2
Machinery Orders	-7.86***	2	-7.84***	2

Money Supply	-6.29***	2	-6.40***	2
Producer Price Index	-7.71***	2	-7.68***	2
Repo Rate	-5.71***	2	-5.58***	2
Retail Sales	-6.79***	2	-6.80***	2
Trade Balance	-5.39***	2	-5.35***	2
Unemployment Rate	-6.11***	2	-6.17***	2
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	-8.91***	2	-8.90***	2
Industrial Production	-6.21***	2	-6.20***	2
Money Supply	-7.23***	2	-7.66***	2
Producer Price Index	-4.98***	2	-5.29***	2
Repo Rate	-5.67***	2	-6.48***	2
Retail Sales	-5.76***	2	-5.88***	2
Trade Balance	-6.72***	2	-6.69***	2
Unemployment Rate	-5.19***	2	-5.62***	2
Pakistan Macroeconomic News Announcements				
Consumer Price Index	-4.30***	2	-5.08***	2
Foreign Exchange Reserve	-5.32***	2	-5.33***	2
Manufacturing Production Index	-6.38***	2	-6.37***	2
Money Supply	-7.97***	2	-7.94***	2
Net Financial Assets	-5.58***	2	-5.58***	2
Repo Rate	-3.82***	2	-3.78***	2
Trade Balance	-7.22***	2	-7.32***	2
Wholesale Price Index	-4.55***	2	-4.75***	2

Critical values	**With Intercept**	**With Intercept and Trend**
	1% -3.4323	1% -3.9610
	5% -2.8622	5% -3.4112
	10% - 2.5672	10% -3.1274

Note: *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.4: Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Unit Root Test

Variables	KPSS Test			
	Level			
	Intercept and no time trend	Band-width	Intercept and time trend	Band-width
Exchange Rate Returns				
PKR/USD	0.3030**	2	0.1867**	2
PKR /GBP	0.0586***	2	0.0602***	2
PKR /JPY	0.4071**	2	0.1402**	2
PKR /EURO	0.1171***	2	0.1171***	2
US Macroeconomic News Announcements				
Business Inventories	0.2786***	2	0.0909***	2
Consumer Price Index	0.1127***	2	0.0236***	2
Durable Goods Orders	0.1397***	2	0.0374***	2
Federal Budget Balance	0.2915***	6	0.1957***	10
Industrial Production	0.1714***	2	0.0317***	2
Producer Price Index	0.1089***	2	0.0378***	2
Repo Rate	0.3682**	4	0.1687***	2
Retail Sales	0.0903***	2	0.0896***	2
Trade Balance	0.1205***	2	0.0692***	2
Unemployment Rate	0.3189***	2	0.1745***	10
UK Macroeconomic News Announcements				
Average Earnings Index	0.1502***	2	0.0146***	2
Consumer Price Index	0.1990***	2	0.0567***	2
Housing Price Index	0.1799***	2	0.1245**	2
Industrial Production	0.1668***	2	0.0525***	2
Money Supply	0.2636***	2	0.1754*	4
Producer Price Index	0.2738***	2	0.0735***	2
Repo Rate	0.3360***	4	0.0680***	2
Retail Sales	0.0170***	2	0.0165***	2

Trade Balance	0.1314***	2	0.0258***	2
Unemployment Rate	0.2968***	2	0.0520***	2
Japan Macroeconomic News Announcements				
All Industries Activity Index	0.1120***	2	0.0850***	2
Consumer Price Index	0.1796***	2	0.1014***	2
Industrial Production	0.1137***	2	0.0886***	2
Machinery Orders	0.0282***	2	0.0230***	2
Money Supply	0.1952***	2	0.0464***	2
Producer Price Index	0.0336***	2	0.0318***	2
Repo Rate	0.3151***	2	0.1299**	6
Retail Sales	0.0742***	2	0.0284***	2
Trade Balance	0.14365***	2	0.0898***	2
Unemployment Rate	0.1027***	2	0.0353***	2
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	0.0779***	2	0.0361***	2
Industrial Production	0.0398***	2	0.0399***	2
Money Supply	0.3896**	2	0.0776***	2
Producer Price Index	0.3250***	2	0.0700***	2
Repo Rate	0.6077*	10	0.2102*	12
Retail Sales	0.4262**	4	0.1426**	8
Trade Balance	0.0375***	2	0.0351***	2
Unemployment Rate	0.6125*	4	0.1250**	6
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.6217*	4	0.1250**	4
Foreign Exchange Reserve	0.1138***	2	0.1042***	2
Manufacturing Production Index	0.0131***	2	0.0131***	2
Money Supply	0.0931***	2	0.0793***	2
Net Financial Assets	0.2906***	4	0.1404*	4

Repo Rate	0.2678***	4	0.1838*	4
Trade Balance	0.1512***	2	0.0316***	2
Wholesale Price Index	0.5581*	4	0.10297***	4
Critical values	**With Intercept**		**With Intercept and Trend**	
	1% 0.739 5% 0.463 10% 0.347		1% 0.216 5% 0.146 10% 0.119	

Note: *** showing 1%, ** showing 5%, and * showing 10% significance.

This study employs the Lagrange Multiplier test and the Ljung-Box test in order to test conditional heteroscedasticity on the Pak rupee exchange rate return series (PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO). For the high-order serial correlation detection and the volatility clustering or ARCH effect testing, the Ljung-Box-Pierce Q statistic and Q^2 statistic are employed. The Q^2 statistic states the null hypothesis as there is no serial correlation in the residuals up to the specified order. The Q^2 statistic states the null hypothesis as there is no serial correlation in the squared residuals up to the specified order. For the existence of the ARCH effect, the LM ARCH test is employed. The F statistic states the null hypothesis as there are no ARCH effects in square residuals.

Table 5.5 represents the Ljung-Box–Pierce Q statistic and Q^2 statistic and ARCH LM test of the Pak rupee exchange rate return series. The Ljung-Box–Pierce Q statistic is highly significant at lags 10 and 20, indicating serial correlation in residuals. Q^2 statistic is highly significant at lags 10 and 20, indicating serial correlation in squared residuals and showing volatility clustering. The LM test shows strong evidence that the square residuals exhibit an ARCH effect. These results support the estimation of conditional heteroscedasticity models for Pak rupee exchange rate returns.

Table 5.5: ARCH Test of Daily Pak Rupee Exchange Rate Returns

	Lags	PKR/USD	PKR/GBP	PKR/EURO	PKR/JPY
Q-Statistics for Raw data	5	88.7477*** (0.0000)	11.2257** (0.0470)	13.3953** (0.0199)	24.6255*** (0.0001)
	10	135.379*** (0.0000)	18.6670** (0.0447)	18.5477** (0.0463)	37.8104*** (0.0000)
	20	156.839*** (0.0000)	43.6621*** (0.0016)	32.4551** (0.0386)	47.5150*** (0.0004)
	50	317.590*** (0.0000)	95.8422*** (0.0001)	70.5792** (0.0291)	105.124*** (0.0000)
Q-Statistics for Squared data	5	829.896*** (0.0000)	1045.98*** (0.0000)	871.424*** (0.0000)	509.403*** (0.0000)
	10	894.923*** (0.0000)	1420.50*** (0.0000)	890.648*** (0.0000)	671.662*** (0.0000)
	20	954.912*** (0.0000)	1753.14*** (0.0000)	919.291*** (0.0000)	844.281*** (0.0000)
	50	1595.34 *** (0.0000)	2455.01*** (0.0000)	991.279*** (0.0000)	1238.71*** (0.0000)
ARCH LM test (F-Statistics)	ARCH 1-2	323.84*** (0.0000)	284.28*** (0.0000)	606.01*** (0.0000)	156.20*** (0.0000)
	ARCH 1-5	134.16*** (0.0000)	140.21*** (0.0000)	265.24*** (0.0000)	75.482*** (0.0000)
	ARCH 1-10	68.352*** (0.0000)	77.254*** (0.0000)	132.93*** (0.0000)	41.711*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.6 presents a technical analysis of Pak rupee exchange rates. The "(M)Buy" refers to the number of the daily Pak rupee exchange rate returns generated by the buy signals, while "(M)Sell" refers to numbers of the daily Pak rupee exchange rate returns generated by the sell signals. They show the PKR/USD exchange rate has large numbers of buying returns generated by buying signals and has the lowest number of selling returns generated by selling signals as compared to other exchange rates. The "(μ)Buy" and "(μ)Sell" are the means of the daily Pak- rupee exchange rate returns generated by buy signals and sell signals respectively. A buy signal on average generates positive daily returns, whereas, a sell signal generates negative daily returns of all Pak rupee exchange

rates. Further, both buy returns and sell returns of all Pak rupee exchange rates are statistically significant.

Since the buy returns are positive and the sell returns are negative, their mean difference (Buy-Sell) will be positive. Moreover, the mean difference of buy returns and sell returns is statistically significant showing buy returns are significantly different from sell returns in all Pak rupee exchange rates.

Table 5.6: Technical Analysis of Pak Rupee Exchange Rates

Exchange Rate Returns	Observations		Mean		Mean Difference
	(M)Buy	(M)Sell	(μ)Buy	(μ)Sell	Buy- Sell
PKR/USD	1630	1233	0.1428*** (0.0000)	-0.1232*** (0.0000)	0.2661*** (0.0000)
PKR/GBP	1436	1427	0.5228*** (0.0000)	-0.5006*** (0.0000)	1.0234*** (0.0000)
PKR/JPY	1452	1411	0.5429*** (0.0000)	-0.5005*** (0.0000)	1.0433*** (0.0000)
PKR/EURO	1484	1379	0.5108*** (0.0000)	-0.5091*** (0.0000)	1.0199*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

5.3- Empirical Results

5.3.1- Macroeconomic News Announcements Effects on Exchange Rate Returns and Exchange Rate Volatility

5.3.1.1- Contemporaneous Effects of News

To examine the contemporaneous effects of news of each of the macroeconomic indicators on exchange rate returns and exchange rate volatility during announcement periods, equations (4.1) and (4.2) are estimated. The estimated coefficients show effects for each of the foreign and domestic macroeconomic news announcements on exchange rate returns and their volatilities during announcement periods.

In the return equation, the positive coefficient of macroeconomic news announcement indicates positive effects on Pak rupee exchange rate returns implying good news (positive surprise) leads to an appreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). The negative coefficient of macroeconomic news announcement indicates negative effects on Pak rupee exchange rate returns implying good news (positive surprise) leads to a depreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). Further, for foreign macroeconomic news announcements, the positive coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to an appreciation of foreign currencies and vice versa for bad news (negative surprise). The negative coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to a depreciation of foreign currencies and vice versa for bad news (negative surprise). For domestic macroeconomic news announcements, the positive

coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to a depreciation of the Pak rupee and vice versa for bad news (negative surprise). While the negative coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to an appreciation of the Pak rupee and vice versa for bad news (negative surprise).

In the variance equation, the positive coefficient indicates that good news (positive surprise) representing higher/stronger than expected announcement leads to raise Pak rupee exchange rate volatility while the negative coefficient indicates that good news (positive surprise) representing higher/stronger than expected announcement leads to reduce Pak rupee exchange rate volatility.

Tables (5.7) to (5.10) present the estimated contemporaneous effects of news for each of the macroeconomic indicators on Pak rupee exchange rate returns and their volatilities during announcement periods. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns. For Pak rupee exchange rate volatility, GARCH (1,1) model is used. The significant ARMA (p, q) specifications indicate that the Pak rupee exchange rate returns series shows prediction of exchange rate movements based on past information. These findings imply market inefficiency. The significant coefficients of ARCH and GARCH terms imply that the volatility of each exchange rate reacts significantly to its own past squared shocks and to its own past volatility. These estimates exhibit volatility persistence.

The magnitudes of estimated coefficients of foreign macroeconomic news announcements suggest a surprise of one standard deviation in foreign macroeconomic indicators leads to appreciation/depreciation of the foreign currency against PKR.

Similarly, the magnitudes of estimated coefficients of domestic macroeconomic news announcements suggest a surprise of one standard deviation in domestic macroeconomic indicators leads to appreciation/depreciation of PKR against foreign currency.

The results show that only few foreign and domestic news of macroeconomic indicators have significant contemporaneous effects on Pak rupee exchange rate returns during announcements periods. The contemporaneous news effects of US macroeconomic indicators on PKR/USD are significantly positive for US federal budget balance and US industrial production and significantly negative for US producer price index. A surprise of one standard deviation improvement in US federal budget balance and rise in US industrial production leads to 0.29% and 0.04% appreciation of USD against PKR respectively. A surprise of one standard deviation rise in the US producer price index causes a 0.017% depreciation of USD against PKR.

The contemporaneous news effects of UK macroeconomic indicators on PKR/GBP are significantly positive for the UK consumer price index. A surprise of one standard deviation rise in the UK consumer price index induces a 0.12% appreciation of GBP against PKR. The contemporaneous news effects of JP macroeconomic indicators on PKR/JPY are significantly positive for JP retail sales and significantly negative for the JP consumer price index. A surprise of one standard deviation rise in JP retail sales tends to 0.084% appreciation of JPY against PKR. A surprise of one standard deviation rise in the JP consumer price index causes 0.074% depreciation of JPY against PKR. The contemporaneous news effects of EZ macroeconomic indicators on PKR/EURO are significantly negative for EZ industrial production. A surprise of one standard deviation rise in EZ industrial production induces a 0.18% depreciation of EURO against PKR.

The contemporaneous news effects of PAK macroeconomic indicators on PKR/USD are significantly negative for PAK foreign exchange reserves and PAK net financial assets and significantly positive for PAK consumer price index and PAK wholesale price index. A surprise of one standard deviation increase in PAK foreign exchange reserves and an increase in PAK net financial assets induces 0.11 % and 0.32% appreciation of PKR against USD respectively. A surprise of one standard deviation rise in PAK consumer price index and rise in PAK wholesale price index leads to 0.15% and 0.035% depreciation of PKR against USD respectively.

The contemporaneous news effects of PAK macroeconomic indicators on PKR/GBP are significantly positive for the PAK money supply. A surprise of one standard deviation increase in PAK money supply causes a 0.14 % depreciation of PKR against GBP. The contemporaneous news effects of PAK macroeconomic indicators on PKR/JPY are significantly positive for the PAK repo rate. A surprise of one standard deviation rise in the PAK repo rate tends to 0.20 % depreciation of PKR against JPY. The contemporaneous news effects of PAK macroeconomic indicators on PKR/EURO are significantly positive for PAK money supply and significantly negative for PAK net financial assets. A surprise of one standard deviation increase in PAK net financial assets induces a 0.12 % appreciation of PKR against the EURO. A surprise of one standard deviation increase in PAK money supply causes a 0.17 % depreciation of PKR against the EURO.

Most of the estimated coefficients of news of macroeconomic indicators are correctly signed as anticipated by the response of the reaction function to news and exchange rate determination models. The direction of contemporaneous effects of news of

macroeconomic indicators depends on *"the market's belief about both the appropriate exchange rate determination model and the likely reaction of the monetary authorities"*(Almeida *et al.*, 1998). The news of improvement in US federal budget balance and higher US industrial production leads to an appreciation of USD against PKR. The rise in JP retail sales news causes an appreciation of JPY against PKR. These are coherent with monetary models of Frenkel (1976) and Mussa (1977) and also consistent with a market belief about the reaction function of monetary authority for an unanticipated monetary tightening which leads to an appreciation of the foreign currency against PKR. This is because the higher than expected real activity will increase inflation and to curb these inflationary pressures, the monetary authority is likely to raise interest rates causing an appreciation of the foreign currency against PKR. These results are in line with the findings of Almeida *et al.* (1998), Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), and Pearce and Solakoglu (2007), Cai *et al.* (2008), Fatum *et al.* (2012), Cheung et al. (2019), and Ben Omrane *et al.* (2020).

The depreciation of USD against PKR occurs with the rise in US producer price index news. The EURO depreciates against PKR with the higher EZ industrial production news. These are coherent with the Mundell-Fleming model. The rise in the UK consumer price index news leads to an appreciation of GBP against PKR. This is consistent with the market belief about the reaction function of monetary authority that the higher than expected inflation will raise expectations of monetary policy tightening by the monetary authority for price stability which leads to an appreciation of foreign currency against PKR. These results are aligned with the findings of Almeida *et al.* (1998), Andersen *et al.* (2003) Cai *et al.* (2008), Fatum *et al.* (2012), and Cheung *et al.* (2019). However, the depreciation

of JPY against PKR occurs with the news of the rise in the JP consumer price index which is consistent with the monetary models. Also conforms with the findings of Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), and Ben Omrane *et al.* (2020).

The PKR appreciates against the USD with an increase in PAK foreign exchange reserves news and the rise in PAK net financial assets news. The news of the increase in PAK wholesale price index and PAK consumer price index causes depreciation of PKR against USD. The rise in PAK net financial assets news and increase in PAK money supply news leads to an appreciation of PKR against the EURO. The depreciation of PKR against GBP occurs with news of an increase in the PAK money supply. The rise in PAK repo rate news leads to the depreciation of PKR against JPY. These are consistent with monetary models and also consistent with the market belief about the reaction function of monetary authority for an unanticipated monetary tightening which leads to a depreciation of the PKR against foreign currency. This is because the higher than expected monetary growth will increase inflation and reduce these inflationary pressures and monetary growth, the monetary authority is likely to raise interest rates causing a depreciation of the PKR against foreign currency. These findings are in line with the results of Cai *et al.* (2008), Hayo and Neuenkirch (2012), May *et al.* (2018), and Mpofu and Peters (2017).

The PKR exchange rate volatility reacts significantly to most of the foreign macroeconomic news as well as domestic macroeconomic news during announcement periods. The news of the US federal budget balance raises PKR/USD exchange rate volatility by 0.092%. As large foreign budget deficit surprises raise real foreign interest rates, which cause capital outflow and thus increases Pak rupee exchange rate volatility. The US trade balance and UK trade balance news increase volatilities of PKR/USD and

PKR/GBP exchange rate by 0.26% and 0.035% respectively. The large foreign trade deficit surprises tend to increase Pak rupee exchange rate volatility via the current account. The news of the US unemployment rate raises PKR/USD exchange rate volatility by 0.20%. As higher foreign unemployment surprises decrease foreign consumer spending and decrease foreign price level and thus increase Pak rupee exchange rate volatility. These results are conforming with the findings of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Andersen *et al.* (2003), Evans and Speight (2010), Neely (2011), and Ben Omrane *et al.* (2020).

The volatilities of PKR/GBP and PKR/EURO exchange rates are reduced with the UK unemployment rate and EZ unemployment rate news by 0.051% and 0.052%, respectively. The PKR/GBP and PKR/EURO exchange rate volatilities are raised with the news of the UK consumer price index and EZ consumer price index by 0.052% and 0.020%, respectively. The higher foreign consumer price index surprises lead to an increase in Pak rupee exchange rate volatility via capital account. These confirm the findings of Neely (2011), and Omrane and Hafner (2015). The news of the US consumer price index and JP consumer price index reduce PKR/USD and PKR/JPY exchange rate volatilities by 0.023% and 0.086%, respectively. As higher foreign consumer price index surprises decrease foreign demand for money and thus decreases Pak rupee exchange rate volatility. Ben Omrane *et al.* (2020) find the same results.

The PKR/USD, PKR/GBP, and PKR/EURO exchange rate volatilities are raised by news of US retail sales, UK retail sales, and EZ retail sales by 0.17%, 0.027%, and 0.017%, respectively. The UK housing price index news increases the PKR/GBP exchange rate volatility by 0.024%. The UK producer price index and EZ producer price index news raise

volatilities of PKR/GBP and PKR/EURO exchange rate by 0.022% and 0.051%, respectively. The higher foreign real activity surprises lead to an increase in Pak rupee exchange rate volatility via an increase in foreign demand for money. These findings support the results of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Evans and Speight (2010), Neely (2011), and Ben Omrane *et al.* (2020).

The volatilities of PKR/USD, PKR/GBP, and PKR/EURO exchange rate are reduced by US industrial production, UK industrial production, and EZ industrial production news by 0.029%, 0.026%, and 0.029%, respectively. The UK average earnings index news decreases PKR/GBP exchange rate volatility by 0.017%. The news of US business inventories, US durable goods orders, and the US producer price index decreases the volatility of the PKR/USD exchange rate by 0.027%, 0.013%, and 0.027%, respectively. The JP all industries activity index and JP retail sales news decrease PKR/JPY exchange rate volatility 0.074% and 0.10%, respectively. The higher foreign real activity surprises lead to a decrease in Pak rupee exchange rate volatility via improvement in the current account. These confirm the findings of Neely (2011), and Ben Omrane *et al.* (2020).

The news of the EZ repo rate increases PKR/EURO exchange rate volatility by 0.070%. A high foreign interest rate leads to capital outflow and thus increases Pak rupee exchange rate volatility. Hayo and Neuenkirch (2012), May *et al.* (2018), and Mpofu and Peters (2017) find similar results. However, the volatilities of PKR/GBP and PKR/JPY exchange rates are reduced by UK money supply and JP money supply news by 0.018% and 0.091%, respectively.

The PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO exchange rates volatilities are increased by PAK consumer price index news by 0.072%, 0.040%, 0.10%, and 0.057%,

respectively. As higher domestic consumer price index surprises cause an increase in domestic demand for money and thus increases Pak rupee exchange rate volatility. These findings support the results of Omrane & Savaşer (2017), and Maserumule and Alagidede (2017).

The PAK money supply news raises PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO exchange rates volatilities by 0.21%, 0.069%, 0.32%, and 0.033%, respectively. The higher domestic money supply surprises lead to an increase in Pak rupee exchange rate volatility via a rise in the domestic price level. This is consistent with Cai *et al.* (2008). The PAK net financial asset news increases PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO exchange rates volatilities by 0.24%, 0.24% 0.47%, and 0.38%, respectively. As higher net financial assets surprises increase risk premium or expected rate of return and thus increase Pak rupee exchange rate volatility.

The PAK foreign exchange reserves news raises volatilities of PKR/USD, PKR/GBP, and PKR/JPY exchange rates by 0.035%, 0.025%, and 0.40%, respectively. As higher foreign exchange reserves surprises cause an increase in the monetary base which leads to a rise in domestic price level and thus increases Pak rupee exchange rate volatility. The PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO exchange rates volatilities are increased by news of PAK manufacturing production index by 0.016%, 0.053%, 0.40%, and 0.053%, respectively. As higher domestic real output/income surprises cause increase imports which worsen trade balance and thus increases Pak rupee exchange rate volatility. These results are in line with the findings of Omrane and Hafner (2015), Omrane & Savaşer (2017), and Cheung *et al.* (2019).

The volatilities of PKR/USD, PKR/GBP, PKR/JPY, and PKR/EURO exchange rates are increased by the PAK repo rate news by 0.26%, 0.20%, 0.14%, and 0.084%, respectively. The higher domestic interest rate surprises lead to an increase in Pak rupee exchange rate volatility via the reduction in domestic demand for money. Hayo and Neuenkirch (2012), and May *et al.* (2018) find the same results. The news of the PAK wholesale price index raises PKR/GBP and PKR/EURO by 0.043% and 0.082% and reduces PKR/USD and PKR/JPY exchange rate volatilities by 0.033% and 0.095%, respectively. The increase is associated with an increase in domestic demand for money and decrease is associated with improvement in the capital account.

The news of the PAK trade balance reduces PKR/USD and raises the PKR/EURO exchange rate volatilities by 0.016% and 0.030% respectively. The decrease is associated with improvement in trade balance surprises which increase net foreign demand for domestic goods and thus reduce Pak rupee exchange rate volatility. The increase is associated with improvement in trade balance surprises which increase domestic income and domestic prices level and thus raise Pak rupee exchange rate volatility. The increase in volatility is found by Evans and Speight (2010), Omrane and Hafner (2015), and Maserumule and Alagidede (2017), and a decrease in volatility is found by Neely (2011), and Ben Omrane *et al.* (2020).

The above analysis shows that only a few foreign and domestic macroeconomic news affect Pak rupee exchange rate returns during announcements periods. It indicates that only seven out of thirty-eight foreign news and six out of eight domestic news significantly affect Pak rupee exchange rate returns respectively. It means many macroeconomic news announcements are redundant during announcements periods and

Pak rupee exchange rate returns react to only a few macroeconomic news announcements. However, most foreign and domestic macroeconomic news affects Pak rupee exchange rate volatility during announcements periods. The Pak rupee exchange rates react to both real activity and monetary news. The Pak rupee exchange rate returns and their volatilities are responsive to foreign and domestic macroeconomic news announcements with different magnitudes for all the currency pairs.

The magnitudes of estimated coefficients of macroeconomic news announcements suggest that news regarding PAK foreign exchange reserves, PAK money supply, PAK repo rate, and PAK net financial assets have a greater impact among domestic news. The US federal budget balance, UK average earnings index, UK consumer price index, JP retail sales, EZ repo rate, JP industrial production, JP consumer price index, and EZ trade balance have a greater impact among foreign news.

Table 5.7: Contemporaneous Effects of News for PKR/USD Exchange Rates

News Announcements	PKR/USD			
	Returns	Volatility	ARCH Coefficient	GARCH Coefficient
	$\theta_{1,k}$	$\vartheta_{1,k}$	α	β
US Macroeconomic News Announcements				
Business Inventories	0.0098 (0.4082)	-0.0274 *** (0.0000)	0.0891*** (0.0000)	0.8166*** (0.0000)
Consumer Price Index	0.0181 (0.4993)	-0.0226*** (0.0000)	0.0706*** (0.0000)	0.8578*** (0.0000)
Durable Goods Orders	-0.0205 (0.6540)	-0.0125*** (0.0000)	0.0818*** (0.0000)	0.7728*** (0.0000)
Federal Budget Balance	0.2898*** (0.0000)	0.0920*** (0.0000)	0.3239*** (0.0000)	0.3414*** (0.0000)
Industrial Production	0.0399* (0.0864)	-0.0285*** (0.0000)	0.0986*** (0.0000)	0.7831*** (0.0000)
Producer Price Index	-0.0166** (0.0161)	-0.0271*** (0.0000)	0.0967*** (0.0000)	0.7743*** (0.0000)
Repo Rate	-0.0502 (0.3284)	0.0087 (0.6489)	0.1881*** (0.0000)	0.3462*** (0.0000)
Retail Sales	-0.0401 (0.6731)	0.1669*** (0.0000)	0.1199*** (0.0000)	0.4009*** (0.0000)
Trade Balance	0.0345 (0.8064)	0.2684*** (0.0000)	0.1587*** (0.0000)	0.5893*** (0.0000)
Unemployment Rate	0.0464 (0.6415)	0.2038*** (0.0000)	0.0593*** (0.0000)	0.8917*** (0.0000)
Pakistan Macroeconomic New Announcements				
Consumer Price Index	0.1470*** (0.0020)	0.0718*** (0.0000)	0.0385*** (0.0000)	0.9406*** (0.0000)
Foreign Exchange Reserves	-0.1142*** (0.0084)	0.0358*** (0.0000)	0.0265*** (0.0000)	0.9663*** (0.0000)
Manufacturing Production Index	0.0100 (0.6149)	0.0155*** (0.0000)	0.0193 *** (0.0000)	0.9753*** (0.0000)
Money Supply	-0.0127 (0.9068)	0.2132*** (0.0000)	0.0617*** (0.0000)	0.8922*** (0.0000)
Net Financial Assets	-0.3191*** (0.0000)	0.2401*** (0.0000)	0.0957*** (0.0000)	0.7962*** (0.0000)
Repo Rate	0.0511 (0.7234)	0.2633*** (0.0000)	0.0741*** (0.0000)	0.8768*** (0.0000)
Trade Balance	0.0155 (0.7723)	-0.0166*** (0.0000)	0.0801*** (0.0000)	0.8170*** (0.0000)
Wholesale Price Index	0.0353*** (0.0001)	-0.0329*** (0.0000)	0.0377*** (0.0000)	0.8689*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.8: Contemporaneous Effects of News for PKR/GBP Exchange Rates

News Announcements	PKR/GBP			
	Returns	Volatility	ARCH Coefficient	GARCH Coefficient
	$\theta_{2,k}$	$\vartheta_{2,k}$	α	β
UK Macroeconomic News Announcements				
Average Earnings Index	-0.0894 (0.1706)	-0.0165*** (0.0029)	0.0261*** (0.0000)	0.9718*** (0.0000)
Consumer Price Index	0.1203** (0.0148)	0.0520*** (0.0000)	0.0268*** (0.0000)	0.9710*** (0.0000)
Housing Price Index	-0.0169 (0.7937)	0.0241*** (0.0082)	0.0281*** (0.0000)	0.9687*** (0.0000)
Industrial Production	-0.0190 (0.7149)	-0.0263*** (0.0063)	0.0264*** (0.0000)	0.9712*** (0.0000)
Money Supply	-0.0153 (0.7777)	-0.0187* (0.0641)	0.0261*** (0.0000)	0.9717*** (0.0000)
Producer Price Index	-0.0062 (0.9060)	0.0218** (0.0363)	0.0264*** (0.0000)	0.9716*** (0.0000)
Repo Rate	0.0517 (0.6037)	0.0109 (0.5195)	0.0262*** (0.0000)	0.9718*** (0.0000)
Retail Sales	0.0265 (0.5611)	0.0270** (0.0441)	0.0255*** (0.0000)	0.9720*** (0.0000)
Trade Balance	0.0104 (0.8234)	0.0351*** (0.0000)	0.0275*** (0.0000)	0.9694*** (0.0000)
Unemployment Rate	-0.0168 (0.7082)	-0.0508*** (0.0000)	0.0225*** (0.0000)	0.9741*** (0.0000)
Pakistan Macroeconomic New Announcements				
Consumer Price Index	0.0377 (0.4977)	0.0402*** (0.0003)	0.0261*** (0.0000)	0.9710*** (0.0000)
Foreign Exchange Reserves	-0.0082 (0.9186)	0.0254*** (0.0031)	0.0277*** (0.0000)	0.9695*** (0.0000)
Manufacturing Production Index	-0.0798 (0.1368)	0.0531*** (0.0247)	0.0247*** (0.0000)	0.9725*** (0.0000)
Money Supply	0.1401* (0.0550)	0.0648*** (0.0000)	0.0253*** (0.0000)	0.9708*** (0.0000)
Net Financial Assets	-0.0621 (0.3200)	0.2427*** (0.0000)	0.0632*** (0.0000)	0.9021*** (0.0000)
Repo Rate	0.1599 (0.1487)	0.1993*** (0.0000)	0.0967*** (0.0000)	0.8240*** (0.0000)
Trade Balance	-0.0047 (0.9544)	-0.0105 (0.3069)	0.0261*** (0.0000)	0.9716*** (0.0000)
Wholesale Price Index	0.0510 (0.4553)	0.0432*** (0.0000)	0.0251*** (0.0000)	0.9714*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.9: Contemporaneous Effects of News for PKR/JPY Exchange Rates

News Announcements	PKR/JPY			
	Returns	Volatility	ARCH Coefficient	GARCH Coefficient
	$\theta_{3,k}$	$\vartheta_{3,k}$	α	β
Japanese Macroeconomic News Announcements				
All Industries Activity Index	-0.0285 (0.5458)	-0.0747*** (0.0000)	0.1414*** (0.0000)	0.6961*** (0.0000)
Consumer Price Index	-0.0739* (0.0895)	-0.0855*** (0.0018)	0.1305*** (0.0000)	0.7225*** (0.0000)
Industrial Production	-0.0268 (0.7477)	0.0324 (0.2605)	0.1308*** (0.0000)	0.7163*** (0.0000)
Machinery Orders	-0.0109 (0.8763)	0.0349 (0.1326)	0.1307*** (0.0000)	0.7175*** (0.0000)
Money Supply	-0.0072 (0.8706)	-0.0906*** (0.0000)	0.1184*** (0.0000)	0.7288*** (0.0000)
Producer Price Index	-0.0301 (0.5950)	0.0331 (0.4597)	0.1296*** (0.0000)	0.7158*** (0.0000)
Repo Rate	0.0428 (0.6866)	-0.0190 (0.8563)	0.1315*** (0.0000)	0.7153*** (0.0000)
Retail Sales	0.0841** (0.0259)	-0.1030*** (0.0000)	0.1289*** (0.0000)	0.7093*** (0.0000)
Trade Balance	-0.0062 (0.9386)	-0.0190 (0.1253)	0.1298*** (0.0000)	0.7174*** (0.0000)
Unemployment Rate	-0.0346 (0.6291)	0.0038 (0.9066)	0.1319*** (0.0000)	0.7152*** (0.0000)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0443 (0.5713)	0.1026*** (0.0000)	0.0217*** (0.0000)	0.9631*** (0.0000)
Foreign Exchange Reserves	-0.1176 (0.4035)	0.4010*** (0.0000)	0.0671*** (0.0000)	0.8437*** (0.0000)
Manufacturing Production Index	-0.0906 (0.4248)	0.4040** (0.0000)	0.1171*** (0.0000)	0.7606*** (0.0000)
Money Supply	0.1039 (0.3082)	0.3189*** (0.0000)	0.0998*** (0.0000)	0.7735*** (0.0000)
Net Financial Assets	-0.1377 (0.1188)	0.4653*** (0.0000)	0.1414*** (0.0000)	0.7188*** (0.0000)
Repo Rate	0.1957*** (0.0758)	0.1353*** (0.0005)	0.1354*** (0.0000)	0.7087*** (0.0000)
Trade Balance	-0.0504 (0.4361)	-0.0105 (0.7349)	0.1308*** (0.0000)	0.7165*** (0.0000)
Wholesale Price Index	0.0081 (0.8976)	-0.0953*** (0.0000)	0.1352*** (0.0000)	0.7183*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.10: Contemporaneous Effects of News for PKR/EURO Exchange Rates

News Announcements	PKR/EURO			
	Returns	Volatility	ARCH Coefficient	GARCH Coefficient
	$\theta_{4,k}$	$\vartheta_{4,k}$	α	β
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	0.0524 (0.3875)	0.0201** (0.0181)	0.0226*** (0.0000)	0.9735*** (0.0000)
Industrial Production	-0.1847*** (0.0002)	-0.0285*** (0.0006)	0.0215*** (0.0000)	0.9746*** (0.0000)
Money Supply	-0.0492 (0.3927)	-0.0184 (0.1206)	0.0223*** (0.0000)	0.9741*** (0.0000)
Producer Price Index	0.0539 (0.5503)	0.0506*** (0.0000)	0.0237*** (0.0000)	0.9717*** (0.0000)
Repo Rate	0.1072 (0.2487)	0.0703*** (0.0000)	0.0201*** (0.0000)	0.9741*** (0.0000)
Retail Sales	0.0267 (0.6468)	0.0172* (0.0563)	0.0226*** (0.0000)	0.9734*** (0.0000)
Trade Balance	0.0782 (0.1334)	-0.0065 (0.3867)	0.0225*** (0.0000)	0.9736*** (0.0000)
Unemployment Rate	-0.0258 (0.7503)	-0.0515*** (0.0000)	0.0206*** (0.0000)	0.9756*** (0.0000)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0122 (0.8659)	0.0568*** (0.0000)	0.0207*** (0.0000)	0.9743*** (0.0000)
Foreign Exchange Reserves	0.0068 (0.9257)	0.0138 (0.1232)	0.0228*** (0.0000)	0.9729*** (0.0000)
Manufacturing Production Index	-0.0465 (0.4368)	0.0525*** (0.0001)	0.0215*** (0.0000)	0.9750*** (0.0000)
Money Supply	0.1772*** (0.0005)	0.0330** (0.0150)	0.0229*** (0.0000)	0.9724*** (0.0000)
Net Financial Assets	-0.1291* (0.0650)	0.3843*** (0.0000)	0.0984*** (0.0000)	0.7863*** (0.0000)
Repo Rate	0.0922 (0.1681)	0.0836*** (0.0000)	0.0211*** (0.0000)	0.9724*** (0.0000)
Trade Balance	0.0298 (0.7795)	0.0303** (0.0238)	0.0227*** (0.0000)	0.9721*** (0.0000)
Wholesale Price Index	0.0688 (0.2877)	0.0821*** (0.0000)	0.0192*** (0.0000)	0.9750*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

5.3.1.2- Asymmetric Effects of News

To examine the response of exchange rates asymmetric to good (positive) news and bad (negative) news equations (4.3) and (4.4) are estimated. The estimated coefficients show contemporaneous and asymmetric effects for each of the macroeconomic news announcements on exchange rate returns and their volatilities. The good (positive) news and bad (negative) news have a different effects on exchange rates. The negative news is captured by $(\psi_k + \gamma_k)$ and positive news is captured by ψ_k. The exchange rates react more strongly to bad (negative) news than to good (positive) news. This asymmetry is called the leverage effect. Therefore, the values of ψ_k and γ_k greater than zero reflects the leverage effect.

The results in tables (5.11) to (5.14) show that few macroeconomic news asymmetrically and significantly influence Pak rupee exchange rate returns. However, most of the macroeconomic news asymmetrically and significantly influence Pak rupee exchange rate volatilities. This implies that good (positive) news and bad (negative) news have a different effects on exchange rates. These results are aligned with the findings of Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Laakkonen (2009), and Fatum *et al.* (2012).

The PKR/USD exchange rate returns react asymmetrically and significantly to macroeconomic news such as US federal budget balance, US trade balance, PAK consumer price index, and PAK net financial assets. Whereas, the PKR/USD exchange rate volatility reacts asymmetrically and significantly to US macroeconomic news announcements such as US consumer price index, US durable goods orders, US federal budget balance, US

industrial production, US retail sales, US trade balance, US unemployment rate. The PKR/USD exchange rate volatility reacts asymmetrically and significantly to PAK macroeconomic news announcements such as PAK foreign exchange reserve, PAK manufacturing production index, PAK money supply, PAK net financial asset, PAK repo rate, PAK trade balance, and PAK wholesale price index. These asymmetry effects of US news are consistent with studies of Andersen *et al.* (2003) and Laakkonen (2009). The macroeconomic news announcements such as UK trade balance, PAK consumer price index, PAK manufacturing production index, and PAK repo rate asymmetrically and significantly affect the PKR/GBP exchange rate returns. Whereas UK macroeconomic news announcements such as UK average earnings index, UK housing price index, UK repo rate, UK retail sales, UK trade balance, and UK unemployment rate asymmetrically and significantly affect the PKR/GBP exchange rate volatility. The PAK macroeconomic news announcements such as PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK repo rate, PAK trade balance, and PAK wholesale price index also asymmetrically and significantly affect the PKR/GBP exchange rate volatility. These asymmetry effects of UK news are conformed with studies of Ehrmann and Fratzscher (2005) and Laakkonen (2009).

The PKR/JPY exchange rate returns do not react asymmetrically to any macroeconomic news announcements which are consistent with the study of Pearce and Solakoglu (2007) who do not find any asymmetric effects of news on exchange rate returns. Whereas, JP macroeconomic news announcements such as JP consumer price index, JP industrial production, JP machinery orders, JP trade balance, and JP unemployment rate have an asymmetric and significant effect on PKR/JPY exchange rate volatility. The PAK

macroeconomic news announcements such as PAK consumer price index PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK repo rate, PAK trade balance, and PAK wholesale price index have an asymmetric and significant effect on PKR/JPY exchange rate volatility. These asymmetry effects of JP news are consistent with studies of Fatum *et al.* (2012) and Laakkonen (2009).

The PKR/EURO exchange rate returns react does not asymmetrically to any macroeconomic news announcements. which are consistent with the study of Pearce and Solakoglu (2007) who do not find any asymmetric effects of news on exchange rate returns. However, PKR/USD exchange rate volatility reacts asymmetrically and significantly to EZ macroeconomic news announcements such as EZ trade balance and PAK macroeconomic news announcements such as PAK foreign exchange reserves, PAK manufacturing production index, PAK net financial assets, PAK repo rate, PAK trade balance, and PAK wholesale price index. These asymmetry effects of EZ news are consistent with the study of Laakkonen (2009).

The above results show only few foreign and domestic macroeconomic news asymmetrically and significantly influence Pak rupee exchange rate returns. However, most of the foreign and domestic macroeconomic news asymmetrically and significantly influence Pak rupee exchange rate volatilities. These infer that good (positive) news and bad (negative) news have a different effects on exchange rates.

Table 5.11: Asymmetric Contemporaneous Effects of News for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{1,k}$	$\Psi_{1,k}$	$\vartheta_{1,k}$	$\gamma_{1,k}$	α	β
US Macroeconomic News Announcements						
Business Inventories	0.0025 (0.8881)	0.0101 (0.6534)	-0.0276*** (0.0000)	-0.0006 (0.7921)	0.0899*** (0.0000)	0.7941*** (0.0000)
Consumer Price Index	0.0484*** (0.0043)	-0.0389 (0.1511)	-0.0189*** (0.0000)	0.0054*** (0.0003)	0.0445*** (0.0000)	0.9540*** (0.0000)
Durable Goods Orders	-0.0211 (0.7475)	0.0021 (0.9970)	-0.0104*** (0.0003)	-0.0124*** (0.0010)	0.0969*** (0.0000)	0.7971*** (0.0000)
Federal Budget Balance	0.5627*** (0.0000)	-0.5830*** (0.0000)	0.1793** (0.0140)	-0.1939** (0.0078)	0.2857*** (0.0000)	0.3748*** (0.0000)
Industrial Production	0.0179 (0.5695)	0.0364 (0.4875)	-0.0435*** (0.0000)	0.0628*** (0.0000)	0.0791*** (0.0000)	0.7351*** (0.0000)
Producer Price Index	-0.0270 (0.1367)	0.0122 (0.5288)	-0.0277*** (0.0000)	0.0001 (0.9815)	0.0904*** (0.0000)	0.7554*** (0.0000)
Repo Rate	-0.0117 (0.8880)	-0.0809 (0.4380)	0.0240* (0.0618)	0.0385 (0.3611)	0.1974*** (0.0000)	0.3408*** (0.0000)
Retail Sales	-0.0491 (0.1106)	0.0133 (0.9295)	0.0288*** (0.0000)	0.3066*** (0.0000)	0.1335 (0.0000)	0.3929 (0.0000)
Trade Balance	0.6007*** (0.0000)	-0.6008*** (0.0000)	0.2407*** (0.0000)	-0.2677*** (0.0000)	0.2990 (0.0000)	0.4822 (0.0000)
Unemployment Rate	0.0307 (0.9255)	0.0543 (0.8687)	0.2144*** (0.0000)	-0.2302*** (0.0000)	0.1700 (0.0000)	0.5928 (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.4021*** (0.0000)	-0.3967*** (0.0000)	0.0612*** (0.0000)	-0.0957*** (0.0000)	0.1152*** (0.0000)	0.8025*** (0.0000)
Foreign Exchange Reserves	-0.0654 (0.1872)	-0.0958 (0.3518)	0.0165*** (0.0000)	0.0323*** (0.0000)	0.0481*** (0.0000)	0.9243*** (0.0000)
Manufacturing Production Index	0.0217 (0.9739)	-0.0079 (0.9905)	0.1125*** (0.0000)	-0.0461*** (0.0000)	0.1500*** (0.0000)	0.6895*** (0.0000)
Money Supply	-0.0150 (0.9556)	0.0012 (0.9789)	0.2990*** (0.0000)	-0.0178*** (0.0000)	0.0923*** (0.0000)	0.6945*** (0.0000)
Net Financial Assets	-0.6744*** (0.0000)	0.5430*** (0.0000)	0.3532*** (0.0000)	-0.0935*** (0.1975)	0.1402*** (0.0000)	0.8125*** (0.0000)
Repo Rate	0.0676 (0.8053)	-0.0624 (0.8207)	0.5612 *** (0.0000)	-0.5794 *** (0.0000)	0.0526*** (0.0000)	0.8922*** (0.0000)
Trade Balance	0.0126 (0.8478)	-0.0188 (0.7759)	-0.0163*** (0.0000)	-0.0317*** (0.0000)	0.1118*** (0.0000)	0.6005*** (0.0000)
Wholesale Price Index	0.0396 (0.1915)	-0.0500 (0.6650)	-0.0437*** (0.0000)	0.0326*** (0.0000)	0.0349*** (0.0000)	0.9685*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.12: Asymmetric Contemporaneous Effects of News for PKR/GBP Exchange Rates

News Announcements	PKR/GBP					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{2,k}$	$\Psi_{2,k}$	$\vartheta_{2,k}$	$\gamma_{2,k}$	α	β
UK Macroeconomic News Announcements						
Average Earnings Index	-0.0391 (0.6586)	-0.1010 (0.4453)	-0.0372*** (0.0001)	0.0918*** (0.0000)	0.0231*** (0.0000)	0.9756*** (0.0000)
Consumer Price Index	0.1447** (0.0302)	-0.0667 (0.5381)	0.0587 (0.4730)	-0.0654*** (0.0014)	0.0281*** (0.0000)	0.9697*** (0.0000)
Housing Price Index	-0.1078 (0.1147)	0.2070 (0.1230)	0.0417*** (0.0135)	0.1152*** (0.0000)	0.0297*** (0.0000)	0.9658*** (0.0000)
Industrial Production	-0.0885 (0.3130)	0.1054 (0.3509)	-0.0176 (0.3158)	-0.0122 (0.4424)	0.0263*** (0.0000)	0.9713*** (0.0000)
Money Supply	-0.0678 (0.6608)	0.0502 (0.7594)	0.0278 (0.1554)	-0.0627*** (0.0026)	0.0255*** (0.0000)	0.9724*** (0.0000)
Producer Price Index	-0.0332 (0.6607)	0.0866 (0.4199)	-0.0070 (0.6061)	-0.0536** (0.0151)	0.0274*** (0.0000)	0.9704*** (0.0000)
Repo Rate	0.1019 (0.5378)	0.1645 (0.4411)	-0.1261*** (0.0007)	0.1235*** (0.0037)	0.0262*** (0.0000)	0.9718*** (0.0000)
Retail Sales	0.0218 (0.7340)	0.0394 (0.7018)	0.0682*** (0.0000)	-0.0998*** (0.0000)	0.0232 (0.0000)	0.9737 (0.0000)
Trade Balance	-0.1237* (0.0517)	0.2139** (0.0430)	0.0765*** (0.0000)	-0.0594*** (0.0006)	0.0277*** (0.0000)	0.9691*** (0.0000)
Unemployment Rate	-0.0983 (0.2166)	0.1764* (0.0785)	-0.0428*** (0.0082)	-0.0113 (0.4764)	0.0224*** (0.0000)	0.9741*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.2117** (0.0170)	-0.3373** (0.0063)	0.0384*** (0.0013)	-0.0076 (0.6353)	0.0267*** (0.0000)	0.9703*** (0.0000)
Foreign Exchange Reserves	-0.0072 (0.2984)	0.1236 (0.5395)	0.0505 (0.7550)	0.1272*** (0.0000)	0.0289*** (0.0000)	0.9656*** (0.0000)
Manufacturing Production Index	-0.3227** (0.0041)	0.3614** (0.0168)	0.4053** ((0.0000))	-0.3403*** ((0.0000))	0.0813*** (0.0000)	0.8805*** (0.0000)
Money Supply	0.2110 (0.1290)	-0.0460 0.5263	0.0561*** (0.0000)	0.0247* (0.0344)	0.0240*** (0.0000)	0.9719*** (0.0000)
Net Financial Assets	-0.0837 (0.3915)	0.2397* (0.0857)	0.0716* (0.0000)	0.1727*** (0.0000)	0.0530*** (0.0000)	0.9262*** (0.0000)
Repo Rate	0.2437*** (0.0064)	-0.2564* (0.0934)	0.1065*** (0.0000)	-0.1064*** (0.0000)	0.0254*** (0.0000)	0.9695*** (0.0000)
Trade Balance	-0.0013 (0.9991)	-0.0195 (0.9076)	-0.0081 (0.5158)	-0.0145 (0.5251)	0.0257*** (0.0000)	0.9719*** (0.0000)
Wholesale Price Index	0.0317 (0.7209)	0.1819 (0.1997)	0.0482*** (0.0069)	-0.0135*** (0.4459)	0.0251*** (0.0000)	0.9713*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.13: Asymmetric Contemporaneous Effects of News for PKR/JPY Exchange Rates

News Announcements	PKR/JPY					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{3,k}$	$\Psi_{3,k}$	$\vartheta_{3,k}$	$\gamma_{3,k}$	α	β
Japanese Macroeconomic News Announcements						
All Industries Activity Index	-0.0242 (0.9750)	-0.0193 (0.8390)	-0.0546* (0.0958)	-0.0363 (0.4029)	0.1333*** (0.0000)	0.7193*** (0.0000)
Consumer Price Index	-0.0826* (0.0725)	0.0725 (0.4923)	-0.1187*** (0.0000)	0.1397** (0.0111)	0.1256*** (0.0000)	0.7301*** (0.0000)
Industrial Production	-0.0434 (0.8265)	-0.0883 (0.6827)	0.1795*** (0.0001)	-0.2084*** (0.0000)	0.1251*** (0.0000)	0.7254*** (0.0000)
Machinery Orders	-0.0170 (0.8921)	0.0243 (0.8665)	0.2114*** (0.0000)	-0.2885*** (0.0000)	0.1216*** (0.0000)	0.7382*** (0.0000)
Money Supply	-0.0011 (0.9357)	-0.0020 (0.9009)	-0.0816*** 0.0000)	-0.0187*** (0.0059)	0.1003*** (0.0000)	0.7956*** (0.0000)
Producer Price Index	-0.0885 (0.3437)	0.1048 (0.3891)	0.0705 (0.2862)	-0.0654 (0.4234)	0.1298*** (0.0000)	0.7154*** (0.0000)
Repo Rate	0.1039 (0.5219)	-0.1306 (0.9827)	-0.0847 (0.1725)	0.3516 (0.3220)	0.1255*** (0.0000)	0.7255*** (0.0000)
Retail Sales	0.0948* (0.0670)	-0.0232 (0.7703)	-0.1155*** (0.0000)	0.0243 (0.5343)	0.1286*** (0.0000)	0.7108*** (0.0000)
Trade Balance	-0.0037 (0.9803)	-0.0120 (0.9443)	-0.0236* 0.0854)	-0.0722*** (0.0000)	0.1000*** (0.0000)	0.7993*** (0.0000)
Unemployment Rate	-0.1334 (0.5760)	0.1342 (0.5906)	0.2156*** (0.0011)	-0.2322*** (0.0009)	0.1229*** (0.0000)	0.7425*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0559 (0.7692)	0.1708 (0.4163)	0.3897*** (0.0000)	-0.3795*** (0.0000)	0.0480*** (0.0000)	0.9008*** (0.0000)
Foreign Exchange Reserves	-0.1345* (0.0979)	0.3475 (0.0048)	0.0553*** (0.0000)	0.2219*** (0.0000)	0.0112*** (0.0000)	0.9805*** (0.0000)
Manufacturing Production Index	-0.2024 (0.3837)	0.2147 (0.3930)	0.7701*** (0.0000)	-0.6378*** (0.0000)	0.0975*** (0.0000)	0.8169*** (0.0000)
Money Supply	0.1736 (0.4284)	-0.0306 (0.7981)	0.1354*** (0.0003)	0.4975*** (0.0000)	0.0900*** (0.0000)	0.7931*** (0.0000)
Net Financial Assets	0.0567 (0.6920)	-0.3545* (0.0605)	0.3444*** (0.0000)	0.1584* (0.0557)	0.1383*** (0.0000)	0.7282*** (0.0000)
Repo Rate	0.2167 (0.2737)	-0.0581 (0.7832)	0.2935*** (0.0026)	-0.3663** (0.0006)	0.1392*** (0.0000)	0.6960*** (0.0000)
Trade Balance	-0.0141 (0.9146)	-0.1196 (0.4835)	-0.0125 (0.7984)	-0.1535*** (0.0231)	0.1332*** (0.0000)	0.7075*** (0.0000)
Wholesale Price Index	-0.0138 0.8365)	0.0494 (0.7185)	-0.0455 (0.3812)	-0.0622 (0.2918)	0.1341*** (0.0000)	0.7171*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.14: Asymmetric Contemporaneous Effects of News for PKR/EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{4,k}$	$\Psi_{4,k}$	$\vartheta_{4,k}$	$\gamma_{4,k}$	α	β
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.1845 (0.1939)	-0.1967 (0.2134)	0.0263** (0.0406)	-0.0140 (0.3687)	0.0231*** (0.0000)	0.9730*** (0.0000)
Industrial Production	-0.2184* (0.0593)	0.0494 (0.7007)	-0.0222* (0.0682)	-0.0087 (0.5157)	0.0214*** (0.0000)	0.9746*** (0.0000)
Money Supply	-0.0340 (0.6256)	-0.0292 (0.8090)	-0.0229* (0.0899)	0.0133 (0.4898)	0.0224*** (0.0000)	0.9738*** (0.0000)
Producer Price Index	0.0193 (0.9011)	0.0631 (0.7416)	0.0403*** (0.0082)	0.0146 (0.3190)	0.0238*** (0.0000)	0.9715*** (0.0000)
Repo Rate	0.1186 (0.3093)	-0.0436 (0.8190)	0.0658*** (0.0001)	0.0115 (0.6464)	0.0201*** (0.0000)	0.9742*** (0.0000)
Retail Sales	0.0165 (0.8494)	0.0169 (0.8892)	0.0156 (0.1445)	0.0039 (0.7561)	0.0226*** (0.0000)	0.9734*** (0.0000)
Trade Balance	0.1344** (0.0343)	-0.1085 (0.3443)	-0.0284** (0.0163)	0.0615*** (0.0002)	0.0213*** (0.0000)	0.9748*** (0.0000)
Unemployment Rate	-0.0778 (0.6686)	0.0851 (0.6886)	-0.0665*** (0.0001)	0.0216 (0.2563)	0.0208*** (0.0000)	0.9759*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0283 (0.7713)	-0.0316 (0.8295)	0.0561*** (0.0000)	0.0017 (0.9105)	0.0207*** (0.0000)	0.9743*** (0.0000)
Foreign Exchange Reserves	0.0098 (0.9356)	0.0351 (0.8357)	0.0050 (0.5070)	0.1218*** (0.0000)	0.0223*** (0.0000)	0.9720*** (0.0000)
Manufacturing Production Index	-0.1523* (0.0579)	0.1917 (0.1179)	0.0720*** (0.0000)	-0.0382*** (0.0054)	0.0234*** (0.0000)	0.9724*** (0.0000)
Money Supply	0.1819* (0.0798)	-0.0043 (0.9250)	0.0385*** (0.0086)	-0.0171 (0.3335)	0.0232*** (0.0000)	0.9724*** (0.0000)
Net Financial Assets	0.0531 (0.7291)	-0.3316* (0.0625)	0.3233*** (0.0000)	0.0416*** (0.4477)	0.0928*** (0.0000)	0.8030*** (0.0000)
Repo Rate	0.1848** (0.0359)	-0.1641 (0.2950)	0.1355*** (0.0000)	-0.0748*** (0.0003)	0.0193*** (0.0000)	0.9734*** (0.0000)
Trade Balance	0.0282 (0.8723)	0.0101 (0.9634)	0.0516** (0.0119)	-0.0623** (0.0362)	0.0229*** (0.0000)	0.9714*** (0.0000)
Wholesale Price Index	0.0261 (0.7902)	0.2088 (0.1379)	0.0801*** (0.0000)	-0.0004** (0.9814)	0.0194*** (0.0000)	0.9748*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

5.3.1.3- Pure Effects of News

To examine the pure effects of news of all macroeconomic indicators with announcement period dummies on exchange rate returns and Pak rupee exchange rate volatility equations (4.5) to (4.7) are estimated. The estimated coefficients show contemporaneous and pure effects of all macroeconomic news announcements and their announcement period dummies on exchange rate returns and their volatilities during announcement periods. The results in tables (5.15) to (5.18) present the estimated contemporaneous and pure effects of all macroeconomic news announcements and their announcements period dummies on Pak rupee exchange rate returns and their volatilities.

The results show that the PKR/USD exchange rate returns react significantly to all of the US and PAK macroeconomic news announcement period dummies. However, the PKR/USD exchange rate volatility reacts significantly to few US macroeconomic news announcement period dummies such as US business inventories, US durable goods orders, US federal budget balance, US industrial production, and US unemployment rate. Andersen *et al.* (2003), Cai *et al.* (2009), Laakkonen (2008, 2009), and Neely (2011) find similar findings for US news period dummies. The PKR/USD exchange rate volatility reacts significantly to most of PAK macroeconomic news announcements period dummies such as PAK consumer price index, PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK repo rate, PAK trade balance, and PAK wholesale price index.

Table 5.15: Pure Effects of News for PKR/USD Exchange Rates

News Announcements	PKR/USD			
	Returns		Volatility	
	$\theta_{1,k}$	$\lambda_{1,k}$	$\vartheta_{1,k}$	$\eta_{1,k}$
US Macroeconomic News Announcements				
Business Inventories	-0.0052** (0.0026)	0.1257*** (0.0000)	-1.9437*** (0.0000)	1.1409* (0.0672)
Consumer Price Index	0.0411*** (0.0000)	-0.0043** (0.0237)	0.6896 (0.1882)	0.0617 (0.9004)
Durable Goods Orders	-0.0126*** (0.0000)	-0.0102*** (0.0000)	-0.2515 (0.6745)	-1.7276*** (0.0002)
Federal Budget Balance	0.0191*** (0.0000)	-0.0134*** (0.0000)	-1.8070*** (0.0000)	0.8519* (0.0676)
Industrial Production	0.0424*** (0.0000)	-0.0161*** (0.0000)	-0.4505 (0.3556)	-2.2093*** (0.0000)
Producer Price Index	-0.0151*** (0.0000)	0.0295*** (0.0000)	0.4462 (0.3392)	-0.7041 (0.1537)
Repo Rate	-0.0270*** (0.0000)	0.0351*** (0.0000)	0.2333 (0.1702)	-0.5553 (0.2307)
Retail Sales	-0.1153*** (0.0000)	-0.0852*** (0.0000)	0.1312 (0.5652)	-0.1398 (0.6457)
Trade Balance	0.0071*** (0.0000)	-0.0129*** (0.0000)	0.1179 (0.7930)	-0.3494 (0.5231)
Unemployment Rate	0.0214*** (0.0000)	-0.0090*** (0.0000)	-0.7591* (0.0863)	1.3934** (0.0137)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	-0.0091 (0.7371)	0.0861*** (0.0000)	1.3941* (0.0767)	-2.1497*** (0.0002)
Foreign Exchange Reserves	-0.0130*** (0.0000)	0.0105*** (0.0000)	1.4363*** (0.0004)	-2.7538*** (0.0000)
Manufacturing Production Index	0.0063*** (0.0000)	0.0066*** (0.0000)	2.3711*** (0.0000)	-3.8549*** (0.0000)
Money Supply	-0.0108*** (0.0000)	0.0408*** (0.0000)	0.1643 (0.5615)	-2.2720*** (0.0000)
Net Financial Assets	-0.0719*** (0.0000)	0.0206*** (0.0000)	0.4056* (0.0718)	0.7927 (0.1359)
Repo Rate	0.0112 (0.6525)	0.0219*** (0.0000)	-0.5328** (0.0173)	0.6655* (0.0564)
Trade Balance	0.0129*** (0.0000)	0.0221*** (0.0000)	-0.5631 (0.4482)	0.9885* (0.0975)
Wholesale Price Index	-0.0171*** (0.0000)	-0.0015*** (0.0010)	0.1871 (0.7672)	-1.7791*** (0.0022)
α_1 ARCH-Co			0.4090* (0.0668)	
β_1 GARCH-Co			0.8868*** (0.0000)	
π_1 EGARCH-Co			-0.3937*** (0.0000)	
π_2 EGARCH-Co			0.6515*** (0.0000)	

G.E.D.(DF)	0.3473*** (0.0000)
Log-likelihood	1260.659
LM-ARCH 1-2	0.0211 (0.9791)
LM-ARCH 1-5	0.0289 (0.9996)
LM-ARCH 1-10	0.0282 (1.0000)
LB- Q(10)	0.2822 (0.9999)
LB- Q(20)	2.4203 (0.9999)
LB- $Q(10)^2$	0.2774 (0.9999)
LB- $Q(20)^2$	0.4937 (1.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Few UK macroeconomic news announcement period dummies such as UK average earnings index, UK consumer price, UK trade balance, and UK unemployment rate significantly affect PKR/GBP exchange rate returns. Laakkonen (2008, 2009) find similar results for UK news period dummies. Also, few PAK macroeconomic news announcement period dummies such as PAK foreign exchange reserve, PAK repo rate, and PAK wholesale price index significantly affect PKR/GBP exchange rate returns.

However, the PKR/GBP exchange rate volatility reacts significantly to most of the UK macroeconomic news announcement period dummies such as UK average earnings index, UK housing price index, UK industrial production, UK money supply, UK producer price index, UK trade balance, UK unemployment rate. Laakkonen (2008, 2009) find similar results for UK news period dummies. The PKR/GBP exchange rate volatility reacts significantly to most of PAK macroeconomic news announcement period dummies such as PAK foreign exchange reserve, PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK trade balance, and PAK wholesale price index.

Table 5.16: Pure Effects of News for PKR/GBP Exchange Rates

News Announcements	PKR/GBP			
	Returns		Volatility	
	$\theta_{2,k}$	$\lambda_{2,k}$	$\vartheta_{2,k}$	$\eta_{2,k}$
UK Macroeconomic News Announcements				
Average Earnings Index	-0.1263** (0.0450)	-0.5298** (0.0225)	0.0211 (0.6157)	1.7438*** (0.0035)
Consumer Price Index	0.1148** (0.0390)	0.0842 (0.3684)	0.1245** (0.0500)	-0.0336 (0.5467)
Housing Price Index	-0.0615 (0.3365)	-0.1516** (0.0412)	-0.0239 (0.6130)	0.0990* (0.0909)
Industrial Production	-0.0192 (0.5674)	0.0462 (0.4034)	-0.0344 (0.2702)	-0.1019** (0.0464)
Money Supply	-0.1122* (0.0582)	-0.1192 (0.1914)	-0.2050*** (0.0000)	0.3321*** (0.0000)
Producer Price Index	0.0196 (0.8947)	-0.0550 (0.5110)	-0.0326 (0.5746)	0.1161* (0.0635)
Repo Rate	0.0630 (0.6066)	0.0111 (0.8799)	0.2218 (0.2148)	0.0507 (0.1880)
Retail Sales	0.0610 (0.2511)	0.0251 (0.6889)	0.0255 (0.5861)	-0.0076 (0.8796)
Trade Balance	0.0187 (0.7773)	-0.1452* (0.0532)	-0.0906 (0.1174)	0.2948*** (0.0000)
Unemployment Rate	-0.0208 (0.6998)	0.5754** (0.0129)	0.0164 (0.3713)	-1.8412*** (0.0021)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0482 (0.5018)	-0.0067 (0.9312)	-0.0207 (0.9889)	0.1103 (0.1208)
Foreign Exchange Reserves	-0.0014 (0.9864)	-0.1522** (0.0120)	0.0434 (0.3713)	-0.1115* (0.0494)
Manufacturing Production Index	-0.0499 (0.4144)	-0.1019 (0.1594)	0.0454 (0.2699)	0.1282** (0.0510)
Money Supply	0.1685*** (0.0008)	0.0405 (0.5027)	0.0859** (0.0218)	-0.1205** (0.0124)
Net Financial Assets	-0.0520 (0.5747)	-0.0837 (0.1284)	0.3789*** (0.0000)	-0.2290*** (0.0000)
Repo Rate	0.0885 (0.3717)	0.0927* (0.0935)	0.1875*** (0.0002)	-0.0615 (0.1285)
Trade Balance	-0.0095 (0.9262)	-0.0586 (0.4099)	0.0094 (0.8750)	0.1711*** (0.0008)
Wholesale Price Index	0.0358 (0.5906)	-0.1601*** (0.0043)	0.0975* (0.0887)	-0.1368*** (0.0022)
α_1 ARCH-Co			0.1173*** (0.0000)	
β_1 GARCH-Co			0.7466*** (0.0000)	
Log-likelihood			-2856.37	
LM-ARCH 1-2			0.37691 (0.6860)	

LM-ARCH 1-5	0.25525 (0.9373)
LM-ARCH 1-10	0.44292 (0.9258)
LB- Q(10)	10.1799 (0.3361)
LB- Q(20)	21.5915 (0.3051)
LB- $Q(10)^2$	4.5271 (0.8067)
LB- $Q(20)^2$	7.1621 (0.9886)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

The PKR/JPY exchange rate returns react significantly to only one JP macroeconomic news announcement period dummies such as JP retail sales. However, most of JP news macroeconomic announcement period dummies such as JP all industries activity index, JP consumer price index, JP machinery orders, JP repo rate, JP retail sales, JP trade balance, JP unemployment rate have a significant effect on PKR/JPY exchange rate volatility. Laakkonen (2008, 2009) find similar results for JP news period dummies. Few PAK macroeconomic news announcement period dummies such as PAK manufacturing production index, PAK net financial assets, and PAK wholesale price index have a significant effect on PKR/JPY exchange rate volatility.

Table 5.17: Pure Effects of News for PKR/JPY Exchange Rates

News Announcements	PKR/JPY			
	Returns		Volatility	
	$\theta_{3,k}$	$\lambda_{3,k}$	$\vartheta_{3,k}$	$\eta_{3,k}$
Japanese Macroeconomic News Announcements				
All Industries Activity Index	0.0174 (0.7193)	0.0043 (0.9380)	-0.0029 (0.9352)	-0.1568*** (0.0001)
Consumer Price Index	-0.0645 (0.1555)	-0.0603 (0.3397)	-0.0194 (0.7881)	-0.1529*** (0.0000)
Industrial Production	-0.0298 (0.7081)	0.0405 (0.5745)	0.0418 (0.4211)	-0.0143 (0.6984)
Machinery Orders	0.0062 (0.9249)	0.0051 (0.9273)	0.0855 (0.2111)	-0.1463** (0.0229)
Money Supply	-0.0303 (0.7002)	-0.0552 (0.4875)	-0.0532*** (0.0099)	0.0870 (0.2862)
Producer Price Index	-0.0354 (0.4849)	0.0371 (0.6013)	0.0458 (0.4447)	0.0058 (0.9198)
Repo Rate	0.0085 (0.9994)	-0.0474 (0.4942)	-0.0197 (0.8976)	0.0866*** (0.0047)
Retail Sales	0.0507 (0.1553)	0.1163** (0.0258)	-0.0471 (0.1664)	-0.1168** (0.0133)
Trade Balance	-0.0081 (0.9252)	0.0167 (0.8204)	-0.1044*** (0.0000)	0.2472*** (0.0000)
Unemployment Rate	-0.0514 (0.3954)	-0.0596 (0.4783)	0.0675 (0.1166)	0.2666*** (0.0000)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0205 (0.7236)	-0.1061 (0.1251)	0.0251 (0.7054)	-0.0153 (0.8110)
Foreign Exchange Reserves	-0.0901 (0.1847)	-0.0048 (0.9504)	0.0413 (0.4845)	-0.1201 (0.1451)
Manufacturing Production Index	-0.1076* (0.0560)	-0.0610 (0.3446)	-0.0654* (0.0614)	0.1977*** (0.0004)
Money Supply	0.1680*** (0.0000)	-0.0141 (0.7867)	0.0061 (0.8700)	-0.0422 (0.3402)
Net Financial Assets	-0.1140 (0.1570)	-0.0615 (0.2623)	0.4666*** (0.0000)	-0.2635*** (0.0000)
Repo Rate	0.1513* (0.0628)	-0.0364 (0.5863)	0.0249 (0.5894)	0.0191 (0.8397)
Trade Balance	-0.0623 (0.5075)	-0.0443 (0.5180)	0.0747 (0.2828)	-0.0261 (0.6339)
Wholesale Price Index	0.0517 (0.3891)	0.0305 (0.5612)	-0.0127 (0.7531)	-0.0978** (0.0136)
α_1 ARCH-Co	0.1122*** (0.0000)			
β_1 GARCH-Co	0.7064*** (0.0000)			
Log-likelihood	-2962.76			
LM-ARCH 1-2	0.1079 (0.8977)			

LM-ARCH 1-5	0.3401 (0.88880
LM-ARCH 1-10	0.4972 (0.8928)
LB- Q(10)	7.9644 (0.5377)
LB- Q(20)	14.2672 (0.7678)
LB- $Q(10)^2$	5.0296 (0.7544)
LB- $Q(20)^2$	10.0090 (0.9316)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Few EZ macroeconomic news announcement period dummies such as EZ producer price index, EZ repo rate, EZ trade balance, and EZ unemployment rate have a significant effect on the PKR/EURO exchange rate returns. Also, few PAK macroeconomic news announcements period dummies such as PAK manufacturing production index, PAK money supply, and PAK wholesale price index have a significant effect on the PKR/EURO exchange rate returns. However, the PKR/EURO exchange rate volatility reacts significantly to most of EZ macroeconomic news announcement period dummies such as EZ producer price index, EZ retail sales, EZ repo rate, EZ trade balance, and EZ unemployment rate. Few PAK macroeconomic news announcement period dummies such as PAK consumer price index, PAK money supply, PAK net financial assets, and PAK wholesale price index significantly affect the PKR/EURO exchange rate volatility. These results are similar to the findings of Laakkonen (2008, 2009) and Neely (2011) for EZ news period dummies.

Table 5.18: Pure Effects of News for PKR/EURO Exchange Rates

News Announcements	PKR/EURO			
	Returns		Volatility	
	$\theta_{4,k}$	$\lambda_{4,k}$	$\vartheta_{4,k}$	$\eta_{4,k}$
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	0.0904 (0.1832)	0.0508 (0.5109)	0.0584 (0.1917)	0.0254 (0.5608)
Industrial Production	-0.2220*** (0.0000)	-0.0697 (0.1616)	-0.0151 (0.5976)	0.0281 (0.4655)
Money Supply	-0.0223 (0.7290)	0.0065 (0.9120)	0.0690 (0.1762)	0.0053 (0.9124)
Producer Price Index	0.0895** (0.0226)	-0.1210** (0.0351)	0.0041 (0.8858)	-0.1263*** (0.0033)
Repo Rate	0.4523*** (0.0000)	-0.1494* (0.0499)	0.1034** (0.0168)	0.1651*** (0.0000)
Retail Sales	0.0626 (0.2425)	-0.0092 (0.8734)	-0.0054 (0.8936)	0.1453*** (0.0023)
Trade Balance	0.1196** (0.0211)	0.1328** (0.0248)	-0.0195 (0.5905)	0.0801* (0.0618)
Unemployment Rate	-0.0675 (0.4237)	-0.1523** (0.0413)	-0.0629 (0.1486)	0.0878* (0.0606)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0229 (0.9601)	-0.0500 (0.4302)	0.0659* (0.0851)	-0.1357*** (0.0033)
Foreign Exchange Reserves	-0.0088 (0.8116)	-0.0169 (0.7868)	-0.0587*** (0.0000)	0.0214 (0.6115)
Manufacturing Production Index	0.0054 (0.8624)	-0.1387*** (0.0033)	-0.0608* (0.0439)	0.0063 (0.9141)
Money Supply	0.1664*** (0.0037)	0.0980* (0.0685)	0.0765* (0.0896)	-0.1009* (0.0536)
Net Financial Assets	-0.1623*** (0.0029)	-0.0509 (0.2787)	0.1575*** (0.0000)	-0.1521*** (0.0002)
Repo Rate	0.0657 (0.3666)	-0.0154 (0.7498)	0.1210*** (0.0000)	-0.1331*** (0.0000)
Trade Balance	-0.1110 (0.2631)	-0.0347 (0.5868)	0.2121*** (0.0000)	-0.0049 (0.9070)
Wholesale Price Index	0.0092 (0.8643)	-0.1450*** (0.0029)	0.0230 (0.5115)	-0.1388*** (0.0000)
α_1 ARCH-Co			0.0947*** (0.0000)	
β_1 GARCH-Co			0.7592*** (0.0000)	
Log-likelihood			-2914.41	
LM-ARCH 1-2			0.2949 (0.7446)	
LM-ARCH 1-5			0.4177 (0.8367)	
LM-ARCH 1-10			0.6457 (0.7754)	

LB- Q(10)	6.0723 (0.5313)
LB- Q(20)	16.8859 (0.4621)
LB- $Q(10)^2$	6.2348 (0.6209)
LB- $Q(20)^2$	10.2057 (0.9249)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

These results indicate that the existence or happening of news of macroeconomic indicators affects Pak rupee exchange rates. It implies that macroeconomic indicators also have an announcement period effect on Pak rupee exchange rates even after taking into account the news impact. Furthermore, the announcement period effects exist not only for Pak rupee exchange rate returns but also for Pak rupee exchange rate volatility. Moreover, news events do affect Pak rupee exchange rates during announcements.

5.3.1.4- Dynamic Effects of News

To examine the dynamic effects of news of all macroeconomic indicators on exchange rate returns and exchange rate volatility, news equations (4.8) to (4.10) are estimated. The estimated coefficients show dynamic effects for all of the foreign and domestic macroeconomic news announcements on Pak rupee exchange rate returns and their volatilities after announcement periods.

Tables (5.19) to (5.22) present the estimated dynamic effects for all macroeconomic news announcements on Pak rupee exchange rate returns and their volatilities after announcements periods. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns with $J = 2$ lags of each of the K standardized macroeconomic news announcements. For

exchange rate volatility, EGARCH (1, 1) and GARCH (1, 1) models with $J' = 2$ lags of each of the K standardized macroeconomic news announcements are used.

The results show that the Pak rupee exchange rate returns and volatility react significantly to macroeconomic announcements after announcement periods. The PKR/USD exchange rate returns and volatility react significantly to most of US macroeconomic news announcements and PAK macroeconomic news announcements. They immediately adjust to news i.e. full response to news occurs in one day. However, they adjust to news like US consumer price, US retail sales, and PAK repo rate gradually i.e. full response to news occurs after one and two days. The PKR/GBP exchange rate returns and volatility react significantly to UK macroeconomic announcements and PAK macroeconomic news announcements. They immediately adjust to news i.e. full response to news occurs in one day. However, they adjust to news like UK industrial production and UK unemployment rate, PAK foreign exchange reserve, and PAK manufacturing production index gradually i.e. full response to news occurs after one and two days. The PKR/JPY exchange rate returns and volatility react significantly to JP macroeconomic announcements and PAK macroeconomic news announcements. They gradually adjust to news i.e full response to news occurs after one day. The PKR/EURO exchange rate returns and volatility react significantly to EZ macroeconomic announcements and PAK macroeconomic news announcements. They adjust to most of the news immediately i.e. full response to news occurs in one day. However, they adjust to news like EZ retail sales, EZ repo rate, PAK manufacturing production index, and PAK net financial assets gradually i.e. full response to news occurs after one and two days.

The direction of the effects of macroeconomic news announcements is almost the same as the contemporaneous effects of news. Most of the estimated coefficients of news of macroeconomic indicators are correctly signed as anticipated by the response of the reaction function to news and exchange rate determination models. These results are consistent with the findings of Almeida *et al.* (1998), Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Cai et *al.* (2008), Fatum *et al.* (2012), Caporale *et al.* (2018), Cheung *et al.* (2019) and Ben Omrane *et al.* (2020).

The pattern of significance is strong for PKR/USD exchange rate returns corresponding to US macroeconomic news announcements such as US business inventories, US durable goods orders, US federal budget balance, US industrial production, US producer price index, US repo rate, US trade balance, and US unemployment rate over time period. Similarly, the pattern of significance is strong for PKR/USD exchange rate returns corresponding to PAK macroeconomic news announcements such as PAK consumer price index, PAK foreign exchange reserve, PAK manufacturing production index, PAK money supply, PAK net financial asset, PAK trade balance, and PAK wholesale price index over the period of time.

Also, the pattern of significance is strong for PKR/USD exchange rate volatility corresponding to US macroeconomic news announcements such as US trade balance and US unemployment rate over time period. Likewise, the pattern of significance is strong for PKR/USD exchange rate volatility corresponding to PAK macroeconomic news announcements such as PAK consumer price index, PAK foreign exchange reserves, PAK money supply, PAK trade balance, and PAK wholesale price index over the period of time.

Further, there are persistence patterns associated with announcements such as US durable goods orders, US repo rate, US unemployment rate, PAK consumer price index, PAK foreign exchange reserves, and PAK wholesale price index on PKR/USD exchange rate returns. Also, there are persistence patterns associated with announcements such as US trade balance, PAK consumer price index, PAK foreign exchange reserves, PAK money supply, PAK trade balance, and PAK wholesale price index on PKR/USD exchange rate volatility.

The PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns, and their volatilities show no strong significance pattern corresponding to foreign and domestic macroeconomic news announcements. Also, PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns, and their volatilities show no persistence patterns associated with announcements. It implies that "*the effect of unanticipated macroeconomic information is drowned in the subsequent random fluctuations of the exchange rates*".

The above estimation results imply that many macroeconomic news announcements affect Pak rupee exchange rate returns and Pak exchange rate volatility after announcement periods. Most of Pak rupee exchange rate returns and Pak rupee exchange rate volatility adjust to most of the foreign and domestic macroeconomic news announcements immediately i.e. full response to news occurs in a day. Further, they suggest the pattern of the significance of news is strong only in PKR/USD exchange rates. There are persistence patterns associated with announcements of few news on PAK/USD exchange rate returns and volatility only. They also indicate that the very short-term reaction to the news is drowned very rapidly in subsequent random fluctuations of the exchange rates. The Pak rupee exchange rates react to both real activity and monetary news.

The Pak rupee exchange rate returns and Pak rupee exchange rate volatility are "*sensitive with different degrees to the various foreign or domestic macroeconomic news announcements with respect to the currency area*". These results are consistent with the findings of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Andersen *et al.* (2003), Pearce and Solakoglu (2007), Laakkonen (2008, 2009), Cai *et al.* (2008), Evans and Speight (2010), Neely (2011), Omrane and Hafner (2015), Omrane & Savaşer (2017), Maserumule and Alagidede (2017), Caporale *et al.* (2018), Cheung *et al.* (2019) and Ben Omrane *et al.* (2020). These results suggest that macroeconomic news announcements play an important role in predicting Pak rupee exchange rates. Investors can formulate expectations by observing these news in order to take advantage of changes in exchange rates that will affect their portfolio returns.

Table 5.19: Dynamic Effects of News for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns			Volatility		
	$\theta_{1,k,0}$	$\theta_{1,k,1}$	$\theta_{1,k,2}$	$\vartheta_{1,k,0}$	$\vartheta_{1,k,1}$	$\vartheta_{1,k,2}$
US Macroeconomic News Announcements						
Business Inventories	-0.0126*** (0.0000)	0.0181*** (0.0000)	-0.0172*** (0.0000)	-0.4781 (0.1712)	-0.4984 (0.2696)	0.2283 (0.6641)
Consumer Price Index	0.0282 (0.0000)	0.0034 (0.1059)	0.0060*** (0.0000)	-0.7100** (0.0459)	-0.9440*** (0.0002)	-0.2695 (0.5284)
Durable Goods Orders	-0.0333*** (0.0000)	-0.0040* (0.0727)	-0.0056*** (0.0000)	-0.9213*** (0.0000)	-0.4630 (0.4870)	-0.7552* (0.0916)
Federal Budget Balance	0.0365*** (0.0000)	-0.0064*** (0.0000)	0.0199*** (0.0000)	0.6851 (0.2496)	-1.3184*** (0.0000)	0.7911* (0.0939)
Industrial Production	0.0098*** (0.0000)	0.0151*** (0.0000)	-0.0056** (0.0131)	-0.2174 (0.4840)	1.7749*** (0.0000)	2.5914*** (0.0000)
Producer Price Index	-0.0129*** (0.0000)	-0.0263*** (0.0000)	0.0066*** (0.0052)	-0.7668** (0.0181)	0.4035 (0.4181)	0.3421 (0.4980)
Repo Rate	-0.0491** (0.0304)	-0.0096*** (0.0005)	-0.0202*** (0.0000)	1.3276* (0.0959)	0.0420 (0.8455)	0.1666 (0.6778)
Retail Sales	-0.0027 (0.3261)	0.0592*** (0.0000)	0.0029* (0.0619)	1.5622*** (0.0004)	0.6497 (0.1573)	-0.5255 (0.3144)
Trade Balance	-0.0078*** (0.0000)	0.0149*** (0.0000)	0.0908*** (0.0000)	-1.1986*** (0.0003)	-1.5201*** (0.0000)	-2.2198*** (0.0000)
Unemployment Rate	-0.0425*** (0.0000)	-0.0474*** (0.0000)	-0.0225*** (0.0000)	-0.9105*** (0.0000)	3.6576*** (0.0000)	-0.6269* (0.0890)

Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0048* (0.0000)	0.0568*** (0.0000)	0.0014** (0.0304)	-0.8817*** (0.0000)	-3.2384*** (0.0000)	-2.2541*** (0.0000)
Foreign Exchange Reserves	-0.0582*** (0.0000)	-0.0337*** (0.0000)	-0.0237*** (0.0000)	2.7490*** (0.0000)	1.5625*** (0.0012)	1.1982*** (0.0031)
Manufacturing Production Index	0.0235*** (0.0000)	-0.0067*** (0.0000)	-0.0765*** (0.0000)	-0.0752 (0.8642)	0.1731 (0.7613)	1.2154* (0.0712)
Money Supply	-0.0066*** (0.0000)	0.0198*** (0.0000)	0.0018** (0.0117)	-2.8736*** (0.0000)	-0.8013** (0.0346)	-1.6275*** (0.0026)
Net Financial Assets	-0.0116** (0.0139)	-0.0197*** (0.0000)	0.0224*** (0.0000)	0.6808** (0.0369)	1.2031 (0.0019)	0.0529 (0.8356)
Repo Rate	0.0016 (0.5226)	0.0354*** (0.0000)	-0.0004 (0.8224)	-0.8770*** (0.0024)	0.6020 (0.2250)	-1.7023*** (0.0000)
Trade Balance	0.0088*** (0.0000)	-0.0289* (0.0000)	0.0062*** (0.0000)	-1.8659*** (0.0000)	-0.9805** (0.0453)	-1.8850*** (0.0000)
Wholesale Price Index	0.0037*** (0.0000)	0.0084*** (0.0000)	0.0052*** (0.0017)	-2.0212*** (0.0000)	-1.1814*** (0.0099)	-0.7628** (0.0235)
α_1 ARCH-Co	0.1748*** (0.0000)					
β_1 GARCH-Co	0.8133*** (0.0000)					
π_1 EGARCH-Co	-0.3574*** (0.0003)					
π_2 EGARCH-Co	0.9259 *** (0.0000)					
G.E.D.(DF)	0.284526 (0.0000)					
Log-likelihood	1098.954					
LM-ARCH 1-2	3.4222 (0.1328)					
LM-ARCH 1-5	2.0448 (0.1695)					
LM-ARCH 1-10	1.0844 (0.3703)					
LB- Q(10)	10.9843 (0.1393)					
LB- Q(20)	13.7829 (0.6824)					
LB- $Q(10)^2$	23.3931 (0.1368)					
LB- $Q(20)^2$	53.6584 (0.2342)					

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.20: Dynamic Effects of News for PKR/GBP Exchange Rates

News Announcements	PKR/GBP					
	Returns			Volatility		
	$\theta_{2,k,0}$	$\theta_{2,k,1}$	$\theta_{2,k,2}$	$\vartheta_{2,k,0}$	$\vartheta_{2,k,1}$	$\vartheta_{2,k,2}$
UK Macroeconomic News Announcements						
Average Earnings Index	-0.1177* (0.0856)	-0.0162 (0.7567)	-0.0714 (0.1847)	-0.0132 (0.7445)	0.0116 (0.8429)	-0.0097 (0.8445)
Consumer Price Index	0.1402** (0.0239)	-0.0870 (0.1814)	0.0317 (0.5616)	0.0346 (0.6024)	0.0652 (0.3409)	-0.0659 (0.1461)
Housing Price Index	-0.0385 (0.3338)	-0.0148 (0.6807)	0.0201 (0.6705)	-0.0716*** (0.0088)	-0.0439** (0.0498)	0.06281* (0.0703)
Industrial Production	-0.0317 (0.6075)	-0.0266 (0.5849)	-0.0861* (0.0825)	0.0896*** (0.0079)	-0.0754 (0.1714)	0.0230 (0.6287)
Money Supply	-0.0655 (0.3548)	-0.0030 (0.9595)	-0.0040 (0.9437)	0.0285 (0.6056)	-0.0323 (0.6453)	-0.0350 (0.4816)
Producer Price Index	-0.0138 (0.8423)	-0.0424 (0.4360)	0.0246 (0.6673)	0.0218 (0.5912)	0.0027 (0.9644)	-0.0635 (0.1972)
Repo Rate	0.0265 (0.8152)	0.0884 (0.5056)	-0.0242 (0.8659)	0.0661 (0.6729)	0.0566 (0.7529)	-0.0202 (0.8684)
Retail Sales	0.1170** (0.0411)	0.0255 (0.5810)	-0.1044** (0.0025)	0.1277* (0.0820)	-0.1291* (0.0562)	-0.0329 (0.4200)
Trade Balance	0.0272 (0.5850)	0.0769 (0.1082)	0.0219 (0.6334)	-0.0283 (0.4581)	-0.0012 (0.9790)	-0.0263 (0.4542)
Unemployment Rate	-0.0757 (0.1434)	-0.2056*** (0.0008)	0.0505 (0.3819)	0.0335 (0.4421)	-0.0261 (0.6779)	0.0023 (0.9604)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0402 (0.4852)	0.0417 (0.3262)	0.0794* (0.0877)	0.0414 (0.5081)	-0.0372 (0.4914)	0.0498 (0.2076)
Foreign Exchange Reserves	-0.0177 (0.7112)	-0.0709** (0.0335)	-0.0180 (0.7895)	-0.0518** (0.0162)	-0.0220 (0.5965)	0.0996** (0.0192)
Manufacturing Production Index	-0.0728 (0.2201)	-0.0664* (0.0665)	0.0632 (0.2258)	0.0597* (0.0656)	-0.1011*** (0.0048)	-0.0058 (0.8772)
Money Supply	0.1898*** (0.0000)	0.0775 (0.1577)	-0.0529 (0.1981)	-0.0467* (0.0986)	0.0655 (0.2155)	-0.0338 (0.4426)
Net Financial Assets	-0.1109 (0.1872)	-0.0546 (0.2838)	-0.0902 (0.2008)	0.1998*** (0.0000)	-0.1535*** (0.0012)	0.0344 (0.5005)
Repo Rate	0.1562* (0.0896)	-0.0534 (0.4853)	0.0628 (0.5135)	0.1885*** (0.0000)	-0.1062 (0.2079)	0.0389 (0.5586)
Trade Balance	-0.0160 (0.7977)	0.0489 (0.5220)	-0.0846 (0.2124)	-0.0375 (0.3513)	0.1242* (0.0949)	-0.0117 (0.8380)
Wholesale Price Index	0.0751 (0.2175)	0.0178 (0.7617)	0.0529 (0.2704)	-0.0151 (0.7478)	-0.0062 (0.9207)	0.0199 (0.6947)
α_1 ARCH-Co				0.1316*** (0.0000)		
β_1 GARCH-Co				0.7191*** (0.0000)		
Log-likelihood				-2886.73		
LM-ARCH 1-2				0.7183 (0.4876)		

LM-ARCH 1-5	0.5555 (0.7342)
LM-ARCH 1-10	0.4447 (0.9248)
LB- Q(10)	8.3087 (0.2163)
LB- Q(20)	21.5767 (0.1573)
LB- $Q(10)^2$	4.4623 (0.8131)
LB- $Q(20)^2$	6.0859 (0.9958)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.21: Dynamic Effects of News for PKR/JPY Exchange Rates

News Announcements	PKR/JPY					
	Returns			Volatility		
	$\theta_{3,k,0}$	$\theta_{3,k,1}$	$\theta_{3,k,2}$	$\vartheta_{3,k,0}$	$\vartheta_{3,k,1}$	$\vartheta_{3,k,2}$
Japanese Macroeconomic News Announcements						
All Industries Activity Index	0.0181 (0.7265)	-0.0982*** (0.0004)	-0.0925 (0.1151)	-0.0240 (0.5244)	-0.0694* (0.0583)	0.0670 (0.1216)
Consumer Price Index	-0.0990* (0.0576)	-0.0251 (0.6310)	-0.0181 (0.6583)	0.0239 (0.6522)	-0.0471 (0.3772)	-0.0854** (0.0100)
Industrial Production	-0.0801 (0.1860)	0.0092 (0.9021)	-0.0348 (0.5449)	-0.0071 (0.9021)	0.1032 (0.2376)	-0.0361 (0.5637)
Machinery Orders	-0.0155 (0.7981)	-0.0372 (0.5605)	0.0780 (0.2564)	-0.0402 (0.4187)	0.0413 (0.4286)	-0.0216 (0.6860)
Money Supply	0.0671 (0.1121)	-0.0097 (0.8345)	0.0451 (0.1239)	-0.0387 (0.2972)	-0.0304 (0.4919)	-0.0457 (0.1737)
Producer Price Index	-0.0239 (0.6309)	-0.0107 (0.8430)	-0.0873 (0.3025)	0.0146 (0.8265)	-0.0447 (0.4425)	0.0595 (0.2414)
Repo Rate	0.0075 (0.9112)	0.1402 (0.3093)	0.0577 (0.8617)	-0.0556 (0.5174)	0.1373 (0.5970)	-0.0662 (0.7579)
Retail Sales	0.0505 (0.3053)	-0.0748** (0.0418)	-0.1172** (0.0412)	0.0034 (0.9247)	-0.0766*** (0.0053)	0.0649* (0.0727)
Trade Balance	-0.0281 (0.6769)	0.0472 (0.5690)	-0.0392 (0.4790)	0.0044 (0.9153)	0.2065*** (0.0005)	-0.1174** (0.0191)
Unemployment Rate	-0.0157 (0.7738)	0.0042 (0.9643)	0.1015* (0.0618)	-0.0144 (0.7460)	0.2223** (0.0004)	-0.0318 (0.5594)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0207 (0.6955)	0.0158 (0.7933)	-0.0657 (0.3647)	0.0215 (0.7080)	0.0026 (0.9696)	0.0458 (0.4975)
Foreign Exchange Reserves	-0.1286* (0.0804)	-0.0998 (0.2968)	-0.0702 (0.4462)	0.0438 (0.5790)	-0.0211 (0.7831)	0.1663** (0.0476)
Manufacturing Production Index	-0.0359 (0.6088)	0.0434 (0.4272)	-0.0052 (0.9224)	0.0473 (0.5349)	-0.0142 (0.8278)	-0.0971*** (0.0051)
Money Supply	0.2066*** (0.0009)	-0.0228 (0.7786)	-0.1523** (0.0110)	0.0447 (0.5092)	0.1171* (0.0982)	-0.0646 (0.2898)
Net Financial Assets	-0.0881 (0.3502)	0.0386 (0.7121)	-0.0523 (0.5356)	0.4589*** (0.0000)	-0.1086 (0.2957)	-0.0598 (0.4334)

Repo Rate	0.1546 (0.1059)	0.0429 (0.4279)	0.1371*** (0.0006)	0.1147* (0.0664)	-0.1366*** (0.0014)	-0.0171 (0.6127)
Trade Balance	-0.0241 (0.7650)	0.0143 (0.8213)	0.0349 (0.6185)	0.0043 (0.9483)	0.0871 (0.3560)	0.0479 (0.5102)
Wholesale Price Index	-0.0067 (0.8902)	-0.0397 (0.4308)	0.0625 (0.2584)	-0.1118*** (0.0016)	0.0232 (0.5925)	-0.0166 (0.6663)
α_1 ARCH-Co	0.1367*** (0.0000)					
β_1 GARCH-Co	0.6447*** (0.0000)					
Log-likelihood	-2935.54					
LM-ARCH 1-2	0.6464 (0.5241)					
LM-ARCH 1-5	0.8124 (0.5406)					
LM-ARCH 1-10	0.6322 (0.7873)					
LB- Q(10)	5.1357 (0.5265)					
LB- Q(20)	11.7269 (0.7625)					
LB- $Q(10)^2$	6.4230 (0.4913)					
LB- $Q(20)^2$	11.1369 (0.8493)					

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.22: Dynamic Effects of News for PKR/EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns			Volatility		
	$\theta_{4,k,0}$	$\theta_{4,k,1}$	$\theta_{4,k,2}$	$\vartheta_{4,k,0}$	$\vartheta_{4,k,1}$	$\vartheta_{4,k,2}$
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.0763 (0.2008)	0.0194 (0.7382)	0.0956 (0.1492)	0.0329 (0.4627)	0.0013 (0.9797)	0.0855* (0.0978)
Industrial Production	-0.1569*** (0.0065)	-0.0750 (0.1454)	-0.0465 (0.3238)	0.0272 (0.4821)	0.0388 (0.5204)	-0.0923** (0.0403)
Money Supply	-0.0246 (0.6687)	-0.0241 (0.6654)	0.0308 (0.6574)	0.0500 (0.1338)	0.01917 (0.7081)	0.0326 (0.5707)
Producer Price Index	0.0684 (0.2541)	-0.0841 (0.1233)	0.0421 (0.5249)	0.0299 (0.5160)	0.0231 (0.7170)	0.0552 (0.3512)
Repo Rate	0.1118 (0.2333)	0.0867* (0.0656)	-0.0840 (0.1928)	0.0422 (0.6074)	0.0589 (0.3892)	-0.0700 (0.1027)
Retail Sales	0.0281 (0.6103)	-0.0337 (0.5594)	0.1130** (0.0250)	-0.0164 (0.7584)	0.0834 (0.2295)	-0.0511 (0.2663)
Trade Balance	0.0946** (0.0396)	-0.0553 (0.2474)	-0.0028 (0.9581)	0.0448 (0.1483)	-0.0862** (0.0283)	0.0326 (0.3588)
Unemployment Rate	-0.0647 (0.5792)	0.0369 (0.7127)	0.0361 (0.7285)	0.1107** (0.0200)	0.0835 (0.3953)	-0.1255 (0.1196)

Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0241 (0.6770)	-0.0077 (0.8842)	0.0679 (0.1755)	-0.0031 (0.9586)	-0.0474 (0.4379)	-0.0022 (0.9962)
Foreign Exchange Reserve	0.0221 (0.8144)	-0.0465 (0.4890)	0.0018 (0.9985)	-0.0091 (0.9056)	-0.0342 (0.6533)	0.0521 (0.3310)
Manufacturing Production Index	-0.0110 (0.7659)	0.0787** (0.0254)	-0.0326 (0.4721)	-0.0371 (0.1772)	-0.0457** (0.0495)	-0.0087 (0.6136)
Money Supply	0.1932** (0.0063)	0.0334 (0.5627)	-0.0721 (0.1105)	0.0848 (0.2380)	-0.0646 (0.3791)	-0.0176 (0.7197)
Net Financial Asset	-0.1339** (0.0239)	-0.0363 (0.4270)	-0.0765* (0.0729)	0.1646*** (0.0000)	-0.1458** (0.0023)	-0.0066 (0.8694)
Repo Rate	0.0779 (0.4115)	-0.0071 (0.9363)	0.0834 (0.3496)	0.1822*** (0.0000)	-0.0530 (0.6421)	0.0596 (0.4844)
Trade Balance	-0.0127 (0.8372)	0.0383 (0.6161)	0.0258 (0.6678)	0.0441 (0.4325)	0.0656 (0.2352)	0.0570 (0.1856)
Wholesale Price Index	0.0118 (0.8444)	0.0453 (0.4428)	0.0567 (0.2598)	-0.0087 (0.7440)	0.0013 (0.9964)	-0.0334 (0.2776)
α_1 ARCH-Co				0.1085*** (0.0000)		
β_1 GARCH-Co				0.7325*** (0.0000)		
Log-likelihood				-2900.48		
LM-ARCH 1-2				0.82961 (0.4363)		
LM-ARCH 1-5				0.51834 (0.7626)		
LM-ARCH 1-10				0.5882 (0.8249)		
LB- Q(10)				7.8101 (0.5533)		
LB- Q(20)				19.1546 (0.4469)		
LB- $Q(10)^2$				5.7256 (0.5721)		
LB- $Q(20)^2$				11.0944 (0.8516)		

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

5.3.2- Macroeconomic News Announcements and Order Flow Effect on Exchange Rate Returns and Exchange Rate Volatility

5.3.2.1- Contemporaneous Effects of News and Order Flow

To examine the contemporaneous effects of each of macroeconomic news and order flow for each foreign currency on exchange rate returns and exchange rate volatility during announcement periods, equations (4.11) and (4.12) are estimated.

In the return equation, the positive coefficient of order flow dominated in foreign currencies indicates positive effects on Pak rupee exchange rate returns implying net purchase of foreign currency which in turn causes an appreciation of Pak rupee exchange rates. The negative coefficient of order flow indicates negative effects on Pak rupee exchange rate returns implying net sale of foreign currency which in turn causes depreciation of PKR exchange rates. Further, the positive coefficient of order flow indicates foreign currency buy orders exceed sell orders leads to an appreciation of foreign currencies. The negative coefficient of order flow indicates foreign currency sell orders exceed buy orders leads to the depreciation of foreign currencies. The estimated coefficients of order flow indicate the impact of a hundred more buy (sell) order than sell (buy) order on Pak rupee exchange rates. In the variance equation, the positive coefficient indicates that order flow i-e net purchase of foreign currency leads to raise Pak rupee exchange rate volatility while the negative coefficient indicates that order flow i-e net sale of foreign currency leads to reduce Pak rupee exchange rate volatility.

Tables (5.23) to (5.26) present the estimated contemporaneous effects of each of macroeconomic news and order flow for each foreign currency on Pak rupee exchange rate returns and their volatilities during announcement periods. For Pak rupee exchange rate returns, different ARMA (p,q) specifications are selected for incorporating serial correlation in exchange rate returns. For Pak rupee exchange rate volatility, GARCH (1,1) model is used. The significant ARMA (p, q) specifications indicate that the Pak rupee exchange rate returns series shows prediction of exchange rate movements based on past information. These findings imply market inefficiency. The significant coefficients of ARCH and GARCH terms imply that the volatility of each exchange rate reacts

significantly to its own past squared shocks and to its own past volatility. These estimates exhibit volatility persistence.

The results show that order flow significantly affect Pak rupee exchange rate returns and their volatilities during announcement periods. The significant effect of order flow implies that order flow are able to explain contemporaneous movements in the Pak rupee exchange rates. Further, the role of order flow to convey private/ incremental information unrelated to macroeconomic information is identified in the determination of Pak rupee exchange rates.

The effect of order flow on PKR/USD exchange rate returns is positive and significant corresponding to each US macroeconomic news such as US business inventories, US consumer price index, US durable goods orders, US industrial production index, US producer price index, US repo rate, and US retail sales. The positive effect implies the net purchase of USD which in turn causes an appreciation of USD against PKR.

The effect of order flow on PKR/USD exchange rate returns is negative and significant corresponding to each US macroeconomic news such as US federal budget balance, US trade balance, and the US unemployment rate. The negative effect implies the net sale of USD which in turn causes depreciation of USD against PKR.

The magnitudes of estimated coefficients of order flow vary considerably with macroeconomic news flow for PKR/USD exchange rates. The magnitudes of positive coefficients of order flow for PKR/USD exchange rate returns corresponding to each US macroeconomic news such as US business inventories, US consumer price index, US durable goods orders, US industrial production index, US producer price index, US repo rate, and US retail sales are 0.30%, 0.12%, 0.31%, 0.47%, 0.44%, 0.50%, and 0.65%

respectively. These suggest a hundred more US dollar purchases than sales induce an increase in the Pak rupee price of a US dollar.

However, the magnitudes of negative coefficients of order flow for PKR/USD exchange rate returns corresponding to each US macroeconomic news such as US federal budget balance, US trade balance, and US unemployment rate are 0.38%, 1.69%, and 0.18%. These suggest a hundred more US dollar sales than purchases induce a decrease in the Pak rupee price of a US dollar.

The effect of order flow on PKR/USD exchange rate volatility is positive and significant corresponding to each of US macroeconomic news. The positive effect implies the order flow raise the PKR/USD exchange rate volatility corresponding to each US and macroeconomic news such as US business inventories, US consumer price index, US durable goods orders, US federal budget balance, US industrial production index, US producer price index, US repo rate, and US retail sales, US trade balance, US unemployment rate by 0.105%, 0.077%, 0.051% 0.044%, 0.230%, 0.057%, 1.594%, 1.329%, 0.123%, and 0.017%, respectively.

The effect of order flow on PKR/USD exchange rate returns is positive and significant corresponding to each PAK macroeconomic news such as PAK consumer price index, PAK foreign exchange reserves, PAK trade balance, and PAK wholesale price index. The positive effect implies the net purchase of USD which in turn causes depreciation of PKR against USD. The effect of order flow on PKR/USD exchange rate returns is negative corresponding to each PAK macroeconomic news such as PAK money supply and PAK repo rate. The negative effect implies the net sale of USD which in turn causes an appreciation of PKR against USD.

The magnitudes of positive coefficients of order flow for PKR/USD exchange rate returns corresponding to each PAK macroeconomic news such as PAK consumer price index, PAK foreign exchange reserves, PAK trade balance, and PAK wholesale price index are 0.086%, 0.027%, 0.29%, and 0.33% respectively. These suggest a hundred more US dollar purchases than sales induce an increase in the Pak rupee price of a US dollar.

However, the magnitudes of negative coefficients of order flow for PKR/USD exchange rate returns corresponding to each PAK macroeconomic news such as PAK money supply and PAK repo rate are 0.056% and 0.651%, respectively. These suggest a hundred more US dollar sales than purchases induce a decrease in the Pak rupee price of a US dollar.

The effect of order flow on PKR/USD exchange rate volatility is negative and significant corresponding to PAK macroeconomic news such as PAK consumer price index, PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, and PAK net financial assets. The negative effect implies the order flow reduce PKR/USD exchange rate volatility. The effect of order flow on PKR/USD exchange rate volatility is positive and significant corresponding to PAK macroeconomic news such as PAK repo rate, PAK trade balance, and PAK wholesale price index.

The positive effect implies the order flow raise PKR/USD exchange rate volatility corresponding to each PAK macroeconomic news such as PAK repo rate, PAK trade balance, and PAK wholesale price index by 0.062%, 0.090%, and 0.076%, respectively. The order flow reduce PKR/USD exchange rate volatility corresponding to each the PAK macroeconomic news such as PAK consumer price index, PAK foreign exchange reserves,

PAK manufacturing production index, PAK money supply, and PAK net financial assets by 0.005%, 0.004%, 0.012%, 0.019%, and 0.011%, respectively.

The order flow insignificantly affect PKR/GBP exchange rate returns corresponding to each UK and PAK macroeconomic news. However, the order flow positively and significantly affect PKR/GBP exchange rate volatility corresponding to each UK and PAK macroeconomic news. The positive effect implies the order flow raises the PKR/GBP exchange rate volatility. The order flow insignificantly affect PKR/JPY exchange rate returns corresponding to each UK and PAK macroeconomic news. Similarly, the order flow insignificantly affect PKR/JPY exchange rate volatility except corresponding to the news of PAK consumer price index, PAK manufacturing production index, and PAK net financial assets. The order flow insignificantly affect PKR/EURO exchange rate returns for each EZ and PAK macroeconomic news. However, the order flow positively and significantly affect PKR/EURO exchange rate volatility corresponding to each EZ and PAK macroeconomic news released. The positive effect implies the order flow raises the PKR/EURO exchange rate volatility. However, the magnitude of estimated coefficients of order flow are more or less the same with macroeconomic news flow for PKR/GBP, PKR/JPY, and PKR/EURO exchange rates.

These results reflect order flow drive Pak rupee exchange rates and are the cause of private portfolio shifts that are unrelated to macroeconomic information causing portfolio-balance effects on exchange rates. The reasons for these shifts may be changing hedging demand, changing risk tolerance, changing liquidity demand, etc. The positive effects of order flow are associated with demanding liquidity due to portfolio rebalancing by market agents involves in foreign exchange trading. The negative effect of order flow are

associated with supplying liquidity when market agents respond to exchange rates changes by buying (selling) more foreign currencies when foreign currencies are less (more) expensive (Gradojevic & Neely, 2009). These findings are in line with the results of Evans and Lyons (2002a, 2002b), Evans and Lyons (2005), Love and Payne (2008), Gradojevic and Neely (2009), Chinn and Moore (2011), Savaser (2011), McIntyre and Harjes (2016), Zhang *et al.* (2016) and Anifowose et al. (2018).

The Pak rupee exchange rate returns react significantly to few of foreign and domestic macroeconomic news announcements. However, the Pak rupee exchange rate volatility reacts significantly to most of the foreign and domestic macroeconomic news announcements. The direction of the contemporaneous effects of news of macroeconomic indicators depends on exchange rate determination models and news reactions by the monetary authorities.

The PKR/USD exchange rate returns react positively and significantly to macroeconomic news such as US consumer price index, US federal budget balance, US trade balance, and US unemployment rate, PAK consumer price index, and PAK wholesale price index and negatively and significantly to PAK foreign exchange reserves, and PAK net financial assets. That is, PKR/USD exchange rate appreciates with news of improvement in US federal budget balance and US trade balance, rise in the US consumer price index, US unemployment rate, PAK consumer price index, and PAK wholesale price index and depreciates with news of increase in PAK foreign exchange reserves, and PAK net financial assets.

The PKR/GBP exchange rate returns react positively and significantly to macroeconomic news such as the UK consumer price index and PAK money supply. That

is, the PKR/GBP exchange rate appreciates with news of a rise in the UK consumer price index and an increase in PAK money supply. The PKR/JPY exchange rate returns react positively and significantly to macroeconomic news such as JP retail sales, PAK repo rate, and negatively to JP consumer price index and PAK net financial assets. That is, PKR/JPY exchange rate appreciates with news of an increase in JP retail sales and a rise in PAK repo rate and depreciates in with news of a rise in JP consumer price index and increase in PAK net financial assets. The PKR/EURO exchange rate returns react positively and significantly to macroeconomic news announcements such as PAK money supply and negatively to EZ industrial production and PAK net financial assets. That is, PKR/EURO exchange rate appreciates with news of an increase in PAK money supply and depreciates with news of a rise in EZ industrial production and an increase in PAK net financial assets.

The PKR/USD exchange rate volatility react significantly to US macroeconomic news announcements such as US business inventories, US consumer price index, US durable goods orders, US federal budget balance, US industrial production, US producer price index, US repo rate, and US retail sales, and PAK macroeconomic new announcements such as PAK consumer price index, PAK foreign exchange reserves and PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK repo rate, PAK trade balance, and PAK wholesale price index.

The PKR/GBP exchange rate volatility reacts significantly to UK macroeconomic news announcements such as UK average earnings index, UK consumer price index, UK housing price index, UK money supply, UK retail sales, UK unemployment rate, and PAK macroeconomic new announcements such as PAK consumer price index, PAK foreign

exchange reserves, PAK money supply, PAK net financial assets, PAK repo rate, and PAK wholesale price index.

The PKR/JPY exchange rate volatility reacts significantly to JP macroeconomic news announcements such as JP all industries activity index, JP consumer price index, JP money supply, JP machinery orders, JP retail sales, JP trade balance, and PAK macroeconomic new announcements such as PAK consumer price index, PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK net financial asset, PAK repo rate, and PAK wholesale price index.

The PKR/EURO exchange rate volatility reacts significantly to EZ macroeconomic news announcements such as EZ consumer price index, EZ industrial production, EZ producer price index, EZ repo rate, EZ retail sales, and EZ unemployment rate and PAK macroeconomic new announcements such as PAK consumer price index, PAK foreign exchange reserves, PAK manufacturing production index PAK money supply, PAK net financial asset, PAK repo rate, PAK trade balance, and PAK wholesale price index.

These results are coherent with the flexible-price monetary model (FPMM), Keynesian model, and monetary approach to the balance of payments and also consistent with the market belief about the reaction function of the monetary authority. These results are consistent with the findings of Almeida *et al.* (1998), Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Cai et *al.* (2008), Fatum *et al.* (2012), Caporale *et al.* (2018), Cheung *et al.* (2019) and Ben Omrane *et al.* (2020).

Table 5.23: Contemporaneous Effects of News and Order Flow for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{1,k}$	Ψ_1	$\vartheta_{1,k}$	Ω_1	α	β
US Macroeconomic News Announcements						
Business Inventories	0.0061 (0.6558)	0.2983*** (0.0000)	-0.0212*** (0.0000)	0.1051*** (0.0000)	0.0829*** (0.0000)	0.8078*** (0.0000)
Consumer Price Index	0.0189** (0.0258)	0.1232*** (0.0000)	-0.0244*** (0.0000)	0.0776*** (0.0000)	0.0773*** (0.0000)	0.8684*** (0.0000)
Durable Goods Orders	-0.0216 (0.6160)	0.3130*** (0.0000)	-0.0127*** (0.0000)	0.0511*** (0.0002)	0.0992*** (0.0000)	0.7968*** (0.0000)
Federal Budget Balance	0.2072*** (0.0000)	-0.3784*** (0.0000)	0.0963*** (0.0000)	0.0445*** (0.0000)	0.0553*** (0.0000)	0.9170*** (0.0000)
Industrial Production	0.0349 (0.1860)	0.4651*** (0.0000)	-0.0213*** (0.0000)	0.2295*** (0.0000)	0.0986*** (0.0000)	0.7899**** (0.0000)
Producer Price Index	-0.0179 (0.4661)	0.4422*** (0.0000)	-0.0216*** (0.0000)	0.0573*** (0.0000)	0.1119*** (0.0000)	0.7155*** (0.0000)
Repo Rate	-0.0363 (0.2727)	0.5019*** (0.0000)	0.0230* (0.0883)	1.5943*** (0.0000)	0.2362*** (0.0000)	0.5943*** (0.0000)
Retail Sales	-0.0629 (0.2047)	0.6453*** (0.0000)	0.1696*** (0.0000)	1.3288*** (0.0000)	0.1912*** (0.0000)	0.6101*** (0.0000)
Trade Balance	0.0346*** (0.0000)	-1.6910*** (0.0000)	0.0012 (0.9967)	0.1233*** (0.0000)	0.1363*** (0.0000)	0.6586*** (0.0000)
Unemployment Rate	0.0287* (0.0531)	-0.1834*** (0.0003)	0.0036 (0.3478)	0.0173*** (0.0000)	0.0277*** (0.0000)	0.9696*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0690*** (0.0089)	0.0855*** (0.0002)	0.0173*** (0.0000)	-0.0052*** (0.0000)	0.0277*** (0.0000)	0.9697*** (0.0000)
Foreign Exchange Reserves	-0.1244** (0.0332)	0.0246*** (0.0000)	0.1567*** (0.0000)	-0.0039*** (0.0000)	0.0260*** (0.0000)	0.9683*** (0.0000)
Manufacturing Production Index	0.0150 (0.7715)	-0.0247 (0.6527)	0.1070*** (0.0000)	-0.0121*** (0.0000)	0.0903*** (0.0000)	0.7083*** (0.0000)
Money Supply	-0.0163 (0.9152)	-0.0556* (0.0603)	0.3098*** (0.0000)	-0.0185*** (0.0000)	0.0417*** (0.0000)	0.8522*** (0.0000)
Net Financial Assets	-0.1918*** (0.0000)	-0.0175 (0.8414)	0.1387*** (0.0000)	-0.0111*** (0.0000)	0.0743*** (0.0000)	0.7106*** (0.0000)
Repo Rate	0.0505 (0.6846)	-0.6507*** (0.0000)	0.3175*** (0.0000)	0.0616*** (0.0000)	0.0665*** (0.0000)	0.8027*** (0.0000)
Trade Balance	0.0142 (0.4569)	0.2879*** (0.0000)	-0.0161*** (0.0000)	0.0899*** (0.0000)	0.0821*** (0.0000)	0.8644*** (0.0000)
Wholesale Price Index	0.0224*** (0.0096)	0.3259*** (0.0000)	-0.0334*** (0.0000)	0.0763*** (0.0001)	0.0366*** (0.0000)	0.8675*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.24: Contemporaneous Effects of News and Order Flow for PKR/GBP Exchange Rates

News Announcements	PKR/GBP					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{2,k}$	Ψ_2	$\vartheta_{2,k}$	Ω_2	α	β
UK Macroeconomic News Announcements						
Average Earnings Index	-0.0840 (0.1712)	0.3554 (0.1572)	-0.0182** (0.0390)	0.0709*** (0.0000)	0.0308*** (0.0000)	0.9645*** (0.0000)
Consumer Price Index	0.1163** (0.0273)	0.3554 (0.1448)	0.0228* (0.0589)	0.0728*** (0.0000)	0.0309*** (0.0000)	0.9637*** (0.0000)
Housing Price Index	-0.0198 (0.7478)	0.3624 (0.1205)	0.0182* (0.0986)	0.0671*** (0.0000)	0.0330*** (0.0000)	0.9623*** (0.0000)
Industrial Production	-0.0192 (0.7068)	0.3592 (0.1289)	-0.0155 (0.1375)	0.0624*** (0.0000)	0.0311*** (0.0000)	0.9651*** (0.0000)
Money Supply	-0.0228 (0.6452)	0.3547 (0.1393)	-0.0322*** (0.0016)	0.0657*** (0.0000)	0.0302*** (0.0000)	0.9661*** (0.0000)
Producer Price Index	-0.0055 (0.9205)	0.3634 (0.1208)	0.0417* (0.0568)	0.0650*** (0.0000)	0.0312*** (0.0000)	0.9645*** (0.0000)
Repo Rate	0.0461 (0.6680)	0.3592 (0.1305)	0.0155 (0.5101)	0.0680*** (0.0000)	0.0315*** (0.0000)	0.9635*** (0.0000)
Retail Sales	0.0277 (0.5312)	0.3590 (0.1287)	0.0357** (0.0205)	0.0656*** (0.0000)	0.0301*** (0.0000)	0.9649*** (0.0000)
Trade Balance	0.0105 (0.8393)	0.3665 (0.1375)	-0.0172 (0.1227)	0.0702*** (0.0000)	0.0306*** (0.0000)	0.9653*** (0.0000)
Unemployment Rate	-0.0179 (0.6892)	0.3560 (0.1254)	-0.0350*** (0.0037)	0.0551*** (0.0000)	0.0283*** (0.0000)	0.9671*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0440 (0.4230)	0.3762* (0.0923)	0.0469*** (0.0004)	0.0657*** (0.0000)	0.0305*** (0.0000)	0.9634*** (0.0000)
Foreign Exchange Reserves	-0.0031 (0.9690)	0.3492 (0.1535)	0.0313*** (0.0006)	0.0717*** (0.0000)	0.0330*** (0.0000)	0.9623*** (0.0000)
Manufacturing Production Index	-0.0766 (0.1248)	0.3666 (0.1150)	0.0047 (0.7629)	0.0664*** (0.0000)	0.0313*** (0.0000)	0.9645*** (0.0000)
Money Supply	0.1423** (0.0309)	0.3492 (0.1091)	0.0496*** (0.0004)	0.0583*** (0.0000)	0.0293*** (0.0000)	0.9647*** (0.0000)
Net Financial Assets	-0.0605 (0.3622)	0.2343 (0.4022)	0.2331*** (0.0000)	0.0670*** (0.0022)	0.0703*** (0.0000)	0.8939*** (0.0000)
Repo Rate	0.0738 (0.2655)	0.3551 (0.1315)	0.0115*** (0.3699)	0.0621*** (0.0000)	0.0314*** (0.0000)	0.9642*** (0.0000)
Trade Balance	-0.0105 (0.9009)	0.3646 (0.1191)	0.0231 (0.2097)	0.0714*** (0.0000)	0.0323*** (0.0000)	0.9630*** (0.0000)
Wholesale Price Index	0.0441 (0.5113)	0.3551 (0.1371)	0.0641*** (0.0007)	0.0677*** (0.0000)	0.0284*** (0.0000)	0.9644*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.25: Contemporaneous Effects of News and Order Flow for PKR/ JPY Exchange Rates

News Announcements	PKR/ JPY					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{3,k}$	Ψ_3	$\vartheta_{3,k}$	Ω_3	α	β
Japanese Macroeconomic News Announcements						
All Industries Activity Index	-0.0256 (0.5831)	0.1232 (0.1070)	-0.0763*** (0.0000)	-0.0393 (0.1070)	0.1414*** (0.0000)	0.7088*** (0.0000)
Consumer Price Index	-0.0731* (0.0930)	0.0966 (0.3075)	-0.0835*** (0.0028)	-0.0140 (0.6018)	0.1307*** (0.0000)	0.7212*** (0.0000)
Industrial Production	-0.0255 (0.7625)	0.1347 (0.1304)	0.0382 (0.1984)	-0.0159 (0.5859)	0.1317*** (0.0000)	0.7149*** (0.0000)
Machinery Orders	-0.0166 (0.9308)	0.0851 (0.3644)	0.0494* (0.0591)	-0.0401 (0.1835)	0.1313*** (0.0000)	0.7112*** (0.0000)
Money Supply	-0.0094 (0.8235)	0.1153 (0.2231)	-0.0883 *** (0.0000)	-0.0219 (0.4074)	0.1318 *** (0.0000)	0.7203 *** (0.0000)
Producer Price Index	-0.0293 (0.6019)	0.1256 (0.1785)	0.0312 (0.4909)	-0.0132 (0.6529)	0.1306*** (0.0000)	0.7148*** (0.0000)
Repo Rate	0.0426 (0.6868)	0.1252 (0.1685)	-0.0149 (0.8569)	-0.0167 (0.5628)	0.1323*** (0.0000)	0.7138*** (0.0000)
Retail Sales	0.0893** (0.0184)	0.0961 (0.3093)	-0.1037*** (0.0000)	-0.0352 (0.1979)	0.1278*** (0.0000)	0.7073*** (0.0000)
Trade Balance	-0.0067 (0.9331)	0.1236 (0.1756)	-0.0209* (0.0977)	-0.0195 (0.5006)	0.1305*** (0.0000)	0.7155*** (0.0000)
Unemployment Rate	-0.0346 (0.6311)	0.1274 (0.1616)	0.0032 (0.9209)	-0.0155 (0.5947)	0.1325*** (0.0000)	0.7145*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0475 (0.5238)	0.1192 (0.3882)	0.0877*** (0.0000)	0.0231*** (0.0000)	0.0199*** (0.0000)	0.9684*** (0.0000)
Foreign Exchange Reserves	-0.1310 (0.3610)	0.0782 (0.5473)	0.4173*** (0.0000)	-0.0169 (0.2516)	0.0675*** (0.0000)	0.8394*** (0.0000)
Manufacturing Production Index	-0.1020 (0.3859)	-0.0747 (0.5089)	0.4281* (0.0000)	-0.0878*** (0.0000)	0.1141*** (0.0000)	0.7547*** (0.0000)
Money Supply	0.1055 (0.3060)	0.1248 (0.2267)	0.3246*** (0.0000)	-0.0260 (0.2705)	0.1010*** (0.0000)	0.7688*** (0.0000)
Net Financial Assets	-0.1641*** (0.0010)	-0.0759 (0.5232)	0.1037*** (0.0000)	-0.0914*** (0.0000)	0.1022*** (0.0000)	0.7842*** (0.0000)
Repo Rate	0.1941* (0.0785)	0.1290 (0.1526)	0.1369*** (0.0005)	-0.0132 (0.6590)	0.1362*** (0.0000)	0.7080*** (0.0000)
Trade Balance	-0.0506 (0.4297)	0.1255 (0.1662)	-0.0111 (0.7246)	-0.0112 (0.5412)	0.1317*** (0.0000)	0.7149*** (0.0000)
Wholesale Price Index	0.0077 (0.9022)	0.1280 (0.1439)	-0.0964*** (0.0000)	-0.0205 (0.4720)	0.1359*** (0.0000)	0.7169*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.26: Contemporaneous Effects of News and Order Flow for PKR/EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns		Volatility		ARCH Coefficient	GARCH Coefficient
	$\theta_{4,k}$	Ψ_4	$\vartheta_{4,k}$	Ω_4	α	β
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.0505 (0.4014)	0.1807 (0.3014)	0.0254*** (0.0031)	0.0249*** (0.0000)	0.0226*** (0.0000)	0.9742*** (0.0000)
Industrial Production	-0.1871*** (0.0002)	0.1998 (0.2462)	-0.0175** (0.0363)	0.0214*** (0.0000)	0.0217*** (0.0000)	0.9748*** (0.0000)
Money Supply	-0.0436 (0.4655)	0.1851 (0.2962)	-0.0138 (0.3365)	0.0235*** (0.0000)	0.0224*** (0.0000)	0.9744*** (0.0000)
Producer Price Index	0.0533 (0.5346)	0.1792 (0.2972)	0.0372*** (0.0003)	0.0219*** (0.0000)	0.0236*** (0.0000)	0.9724*** (0.0000)
Repo Rate	0.1058 (0.2869)	0.1756 (0.3357)	0.0923*** (0.0000)	0.0369*** (0.0000)	0.0169*** (0.0000)	0.9775*** (0.0000)
Retail Sales	0.0206 (0.7295)	0.1786 (0.3111)	0.0295*** (0.0013)	0.0276*** (0.0000)	0.0224*** (0.0000)	0.9742*** (0.0000)
Trade Balance	0.0744 (0.1337)	0.1872 (0.2775)	-0.0072 (0.2829)	0.0244*** (0.0000)	0.0222*** (0.0000)	0.9742*** (0.0000)
Unemployment Rate	-0.0248 (0.7672)	0.1849 (0.2911)	-0.0381*** (0.0018)	0.0207*** (0.0000)	0.0212*** (0.0000)	0.9755*** (0.0000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0145 (0.8359)	0.1758 (0.3015)	0.0555*** (0.0000)	0.0248*** (0.0000)	0.0199*** (0.0000)	0.9745*** (0.0000)
Foreign Exchange Reserves	0.0111 (0.8832)	0.1773 (0.3057)	0.0249* (0.0000)	0.0154* (0.0701)	0.0228*** (0.0000)	0.9737*** (0.0000)
Manufacturing Production Index	-0.0415 (0.4597)	0.1768 (0.3127)	0.0237* (0.0950)	0.0175*** (0.0006)	0.0223*** (0.0000)	0.9743*** (0.0000)
Money Supply	0.1753*** (0.0004)	0.1697 (0.3129)	0.0281* (0.0472)	0.0240*** (0.0000)	0.0223*** (0.0000)	0.9737*** (0.0000)
Net Financial Assets	-0.1296* (0.0811)	0.1365 (0.1712)	0.4320*** (0.0000)	-0.0961*** (0.0000)	0.1067*** (0.0000)	0.7487*** (0.0000)
Repo Rate	0.0837 (0.2199)	0.1805 (0.2738)	0.0764*** (0.0000)	0.0186*** (0.0000)	0.0214*** (0.0000)	0.9729*** (0.0000)
Trade Balance	0.0321 (0.7678)	0.1832 (0.2936)	0.0620*** (0.0008)	0.0323*** (0.0000)	0.0226*** (0.0000)	0.9719*** (0.0000)
Wholesale Price Index	0.0674 (0.2757)	0.1683 (0.3055)	0.0825*** (0.0000)	0.0260*** (0.0000)	0.0171*** (0.0000)	0.9758*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

The above analysis shows that order flow explains movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. The order flow significantly affects only PKR/USD exchange rate returns and affects PKR/USD, PKR/GBP, and PKR/EURO exchange rate

volatilities corresponding to each news. The coefficients of order flow are positive and significant for most of the news implying that the purchase of foreign currencies causes an appreciation in foreign currencies relative to domestic currency. The positive results are in line with Evans and Lyons (2002a). However, coefficients of order flow are negative and significant for few of news implying that the sale of foreign currencies causes depreciation in foreign currencies relative to domestic currency. These negative results are because of negative feedback trading which is similar to findings by Marsh and O'Rourke (2005). The magnitudes of coefficients of order flow are larger implying market illiquidity. This is consistent with the findings by Marsh and O'Rourke (2005). These imply that the magnitudes of the impact of order flow on exchange rates depend on the level of liquidity in the foreign exchange market in Pakistan.

5.3.2.2- Pure Effects of News and Order Flow

To examine the pure effects of news of all macroeconomic indicators with announcement period dummies and order flow on exchange rate returns and exchange rate volatility news equations (4.13) to (4.15) are estimated. The estimated coefficients show contemporaneous and pure effects of all macroeconomic news announcements and their announcement period dummies on Pak rupee exchange rates during announcement periods. The estimated coefficients of order flow indicate the impact of a hundred more buy (sell) order than sell (buy) order on Pak rupee exchange rates.

Tables (5.27) to (5.30) present the estimated contemporaneous and pure effects of all macroeconomic news announcements and their announcements period dummies and order flow on Pak rupee exchange rate returns and their volatilities. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial

correlation in exchange rate returns. For Pak rupee exchange rate volatility, GARCH (1,1) and EGARCH (1,1) models are used.

The results show that order flow significantly affect Pak rupee exchange rate returns and their volatilities around news announcements release. The order flow positively and significantly affects PKR/GBP and PKR/JPY exchange rate returns and negatively and significantly affects PKR/USD exchange rate returns. The positive effect implies the net purchase of foreign currencies which in turn causes an appreciation of foreign currencies against PKR. The negative effect implies the net sale of foreign currencies which in turn causes depreciation of foreign currencies against PKR. The order flow negatively and significantly affects PKR/USD, PKR/GBP, and PKR/JPY exchange rate volatility.

These results reflect order flow drive Pak rupee exchange rates and are the cause of private portfolio shifts that are unrelated to macroeconomic information causing portfolio-balance effects on exchange rates. The reasons of these shifts may be changing hedging demand, changing risk tolerance, changing liquidity demand, etc. The positive effects of order flow are associated with demanding liquidity due to portfolio rebalancing by market agents involves in foreign exchange trading. The negative effect of order flow are associated with supplying liquidity when market agents respond to exchange rates changes by buying (selling) more foreign currencies when foreign currencies are less (more) expensive (Gradojevic & Neely, 2009). These findings are in line with the results of Evans and Lyons (2002a, 2002b), Evans and Lyons (2005), Love and Payne (2008), Gradojevic and Neely (2009), Chinn and Moore (2011), Savaser (2011), McIntyre and Harjes (2016), Zhang et al. (2016) and Anifowose et al. (2018).

The PKR/USD exchange rate returns react significantly to all of US and PAK macroeconomic news announcement period dummies. However, the PKR/USD exchange rate volatility reacts significantly to few US macroeconomic news announcement period dummies such as US producer price index and US trade balance and to most of PAK macroeconomic news announcement period dummies such as PAK consumer price index. PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, and PAK wholesale price index. Andersen *et al.* (2003), Cai *et al.* (2009), Laakkonen (2008, 2009), and Neely (2011) find similar findings for US news period dummies.

Table 5.27: Order Flow and Pure Effects of News for PKR/USD Exchange Rates

News Announcements	PKR/USD			
	Returns		Volatility	
	$\theta_{1,k}$	$\lambda_{1,k}$	$\vartheta_{1,k}$	$\eta_{1,k}$
US Macroeconomic News Announcements				
Business Inventories	0.0030 (0.1871)	-0.0085*** (0.0000)	-0.3635 (0.3195)	1.2962 (0.6170)
Consumer Price Index	0.0129*** (0.0000)	-0.0168*** (0.0000)	0.3750 (0.5722)	0.0255 (0.9671)
Durable Goods Orders	-0.0121*** (0.0000)	-0.0423*** (0.0000)	-0.8517 (0.2571)	-0.8536 (0.2275)
Federal Budget Balance	0.0155*** (0.0008)	-0.0090*** (0.0000)	-0.6444 (0.1832)	0.3941 (0.4292)
Industrial Production	0.0131*** (0.0000)	-0.0080*** (0.0000)	-0.4079 (0.1886)	0.0186 (0.9710)
Producer Price Index	-0.0234*** (0.0000)	0.0062*** (0.0013)	1.9688*** (0.0007)	-2.1957*** (0.0000)
Repo Rate	-0.0240 *** (0.0000)	0.0160*** (0.0000)	0.6724 (0.2749)	-0.7840 (0.1565)
Retail Sales	-0.0277*** (0.0000)	-0.0025*** (0.0000)	0.0765 (0.8884)	-0.5335 (0.8397)
Trade Balance	0.0042*** (0.0000)	-0.0162*** (0.0001)	1.2306*** (0.0005)	-1.5574** (0.0237)
Unemployment Rate	0.0393*** (0.0000)	-0.0021 (0.2587)	-0.2781 (0.5748)	-0.1888 (0.7446)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0164*** (0.0000)	0.0118*** (0.0000)	1.1101 (0.1538)	-1.4854** (0.0424)

Foreign Exchange Reserves	-0.0366*** (0.0000)	0.0127*** (0.0000)	0.6567*** (0.0010)	-0.6908* (0.0510)
Manufacturing Production Index	0.0150*** (0.0000)	0.0065*** (0.0001)	1.9157*** (0.0001)	-2.3265*** (0.0000)
Money Supply	-0.0049*** (0.0002)	0.0031*** (0.0000)	0.7253 (0.2555)	-1.1506* (0.0508)
Net Financial Assets	0.0059 (0.8262)	0.0092*** (0.0000)	0.3780* (0.0877)	0.6704 (0.1513)
Repo Rate	0.0142*** (0.0000)	0.0292*** (0.0000)	-0.4607* (0.0974)	-0.6681 (0.1174)
Trade Balance	0.0170*** (0.0000)	0.0049*** (0.0002)	-0.9326 (0.1153)	-0.0781 (0.8904)
Wholesale Price Index	-0.0074*** (0.0005)	-0.0079*** (0.0000)	0.1371 (0.8317)	-1.4691** (0.0220)
Order Flow	-0.0730*** (0.0000)		-1.751*** (0.0000)	
α_1 ARCH-Co			0.8192** (0.0102)	
β_1 GARCH-Co			0.8234*** (0.0000)	
π_1 EGARCH-Co			-0.3984*** (0.0001)	
π_2 EGARCH-Co			0.6786*** (0.0000)	
G.E.D.(DF)			0.3617*** (0.0000)	
Log-likelihood			1549.884	
LM-ARCH 1-2			0.0090 (0.9910)	
LM-ARCH 1-5			0.0108 (1.0000)	
LM-ARCH 1-10			0.0107 (1.0000)	
LB- Q(10)			2.1566 (0.9887)	
LB- Q(20)			3.7351 (0.9999)	
LB- $Q(10)^2$			0.1065 (0.9999)	
LB- $Q(20)^2$			0.2029 (1.0000)	

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Few UK macroeconomic news announcement period dummies such as UK trade balance and UK unemployment rate significantly affect PKR/GBP exchange rate returns. Laakkonen (2008, 2009) find similar results for UK news period dummies. Most of PAK macroeconomic news announcement period dummies such as PAK foreign exchange reserves, PAK manufacturing production index, PAK net financial assets, PAK repo rate, and PAK wholesale price index significantly affect PKR/GBP exchange rate returns.

The PKR/GBP exchange rate volatility reacts significantly to most of UK macroeconomic news announcement period dummies such as UK housing price index, UK industrial production, UK money supply, UK retail sales, UK trade balance, and to most of PAK macroeconomic news announcement period dummies such as PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK repo rate, and PAK wholesale price index. Laakkonen (2008, 2009) find similar results for UK news period dummies.

Table 5.28: Order Flow and Pure Effects of News for PKR/GBP Exchange Rates

News Announcements	PKR/GBP			
	Returns		Volatility	
	$\theta_{2,k}$	$\lambda_{2,k}$	$\vartheta_{2,k}$	$\eta_{2,k}$
UK Macroeconomic News Announcements				
Average Earnings Index	-0.1509** (0.0174)	0.0189 (0.9603)	0.0488 (0.2003)	-0.0123 (0.9857)
Consumer Price Index	0.1363*** (0.0082)	0.0753 (0.3044)	0.0112 (0.7484)	-0.0094 (0.8096)
Housing Price Index	-0.0491 (0.3479)	-0.1741*** (0.0054)	-0.0255 (0.4159)	0.0766* (0.0870)
Industrial Production	-0.0628 (0.1960)	0.0701 (0.1831)	-0.0222 (0.3267)	-0.0721* (0.0605)
Money Supply	-0.1213* (0.0737)	-0.0894 (0.1924)	-0.0865** (0.0197)	0.0873** (0.0139)
Producer Price Index	0.0221 (0.6840)	-0.0777 (0.2383)	-0.0341 (0.2338)	0.0661* (0.0845)
Repo Rate	0.0521 (0.4101)	0.0231 (0.9643)	0.0495 (0.3911)	0.0272 (0.3667)

Retail Sales	0.0885** (0.0385)	0.0165 (0.7372)	0.0552* (0.0861)	-0.0744** (0.0306)
Trade Balance	0.0191 (0.8728)	-0.1592*** (0.0094)	-0.0166 (0.6458)	0.1500*** (0.0006)
Unemployment Rate	-0.0133 (0.9431)	0.0272 (0.9431)	-0.0149 (0.6311)	-0.0254 (0.9706)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0462 (0.3763)	-0.0083 (0.8908)	-0.0284 (0.4254)	-0.0142 (0.7836)
Foreign Exchange Reserves	-0.0032 (0.9637)	-0.1295** (0.0103)	0.0407 (0.2043)	-0.1248*** (0.0017)
Manufacturing Production Index	-0.0565 (0.2709)	-0.1138** (0.0428)	0.0278 (0.3302)	-0.0256 (0.5818)
Money Supply	0.1458*** (0.0005)	0.0086 (0.8732)	0.0389 (0.1097)	-0.1369*** (0.0003)
Net Financial Assets	-0.0988 (0.1303)	-0.0853* (0.0729)	0.1760*** (0.0000)	-0.2146*** (0.0000)
Repo Rate	0.1235*** (0.0082)	0.1054* (0.0270)	0.0331* (0.0993)	-0.1245*** (0.0005)
Trade Balance	0.0133 (0.8575)	-0.0225 (0.6696)	0.0019 (0.9552)	-0.0247 (0.4394)
Wholesale Price Index	0.0523 (0.3025)	-0.1391*** (0.0015)	0.0507 (0.1512)	-0.1871*** (0.0000)
Order Flow	0.1934*** (0.0015)		-0.0569** (0.0287)	
α_1 ARCH-Co	0.1006*** (0.0000)			
β_1 GARCH-Co	0.7481*** (0.0000)			
Log-likelihood	-2954.034			
LM-ARCH 1-2	0.322 (0.7246)			
LM-ARCH 1-5	0.1981 (0.9633)			
LM-ARCH 1-10	0.2628 (0.9888)			
LB- Q(10)	10.1806 (0.3361)			
LB- Q(20)	22.6807 (0.2516)			
LB- $Q(10)^2$	2.6006 (0.9568)			
LB- $Q(20)^2$	3.6149 (0.9998)			

Note: In parentheses p – values are given. *** showing 1%, ** showing 5%, and * showing 10% significance.

The PKR/JPY exchange rate returns react significantly to only one JP macroeconomic news announcement period dummies such as JP retail sales. However, the PKR/JPY exchange rate volatility reacts significantly to most of JP news macroeconomic announcement period dummies such as JP all industries activity index, JP consumer price index, JP industrial production, JP trade balance, JP unemployment rate, and PAK macroeconomic announcements period dummies such as PAK manufacturing production index, PAK net financial assets, PAK trade balance, and PAK wholesale price index. Laakkonen (2008, 2009) find similar results for JP news period dummies.

Table 5.29: Order Flow and Pure Effects of News for PKR/JPY Exchange Rates

News Announcements	PKR/JPY			
	Return		Volatility	
	$\theta_{3,k}$	$\lambda_{3,k}$	$\vartheta_{3,k}$	$\eta_{3,k}$
Japanese Macroeconomic News Announcements				
All Industries Activity Index	0.0300 (0.5876)	0.0197 (0.7373)	-0.0247 (0.5792)	-0.0946** (0.0249)
Consumer Price Index	-0.0507 (0.2953)	-0.0486 (0.3997)	-0.0220 (0.4557)	-0.1560*** (0.0000)
Industrial Production	-0.0145 (0.9556)	0.0386 (0.6147)	0.0260 (0.6866)	0.1160* (0.0707)
Machinery Orders	0.0178 (0.7962)	0.019 (0.8256)	0.0819 (0.2025)	-0.0802 (0.1508)
Money Supply	-0.0110 (0.9919)	-0.0447 (0.5620)	-0.0386 (0.2515)	0.0377 (0.6216)
Producer Price Index	-0.0211 (0.6209)	0.0141 (0.8280)	0.0032 (0.9440)	-0.0538 (0.2399)
Repo Rate	0.0020 (0.9871)	-0.0336 (0.6047)	-0.0165 (0.8892)	0.0159 (0.5843)
Retail Sales	0.0659* (0.0931)	0.0953* (0.0949)	-0.0811*** (0.0064)	-0.0529 (0.3407)
Trade Balance	-0.0394 (0.5997)	0.0353 (0.6551)	-0.1068*** (0.0000)	0.3039*** (0.0000)
Unemployment Rate	-0.0423 (0.5534)	-0.0624 (0.4428)	0.0010 (0.9894)	0.2451*** (0.0000)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0160 (0.9188)	-0.0744 (0.2601)	0.0397 (0.5461)	-0.0158 (0.7927)
Foreign Exchange Reserves	-0.0859 (0.1838)	0.0025 (0.9734)	0.0149 (0.7729)	-0.0659 (0.3799)
Manufacturing Production Index	-0.0729 (0.3331)	-0.0469 (0.4929)	0.0423 (0.5036)	0.1121* (0.0781)

Money Supply	0.1108** (0.0236)	-0.0456 (0.4461)	0.0100 (0.8375)	-0.0433 (0.3611)
Net Financial Assets	-0.0625 (0.4510)	-0.0372 (0.4846)	0.5389*** (0.0000)	-0.2800*** (0.0000)
Repo Rate	0.1148* (0.0882)	-0.0144 (0.8262)	0.0196 (0.5621)	0.0158 (0.7569)
Trade Balance	-0.0450 (0.5686)	-0.0703 (0.2519)	0.0504 (0.3943)	-0.1002* (0.0912)
Wholesale Price Index	0.0443 (0.4967)	0.0517 (0.3254)	-0.0222 (0.6526)	-0.0783* (0.0833)
Order Flow	-0.0292 (0.5291)		-0.0941*** (0.0000)	
α_1 ARCH-Co			0.1284*** (0.0000)	
β_1 GARCH-Co			0.7006*** (0.0000)	
Log-likelihood			-2960.954	
LM-ARCH 1-2			0.2514 (0.7777)	
LM-ARCH 1-5			0.5397 (0.7463)	
LM-ARCH 1-10			0.4472 (0.9234)	
LB- Q(10)			7.8103 (0.4522)	
LB- Q(20)			14.053 (0.7255)	
LB- $Q(10)^2$			4.4985 (0.8095)	
LB- $Q(20)^2$			9.3909 (0.9499)	

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Few EZ macroeconomic news announcement period dummies such as EZ producer price index and EZ trade balance have a significant effect on the PKR/EURO exchange rate returns. Also, few PAK macroeconomic news announcements period dummies such as PAK manufacturing production index, PAK trade balance, and PAK wholesale price index have a significant effect on the PKR/EURO exchange rate returns. However, the PKR/EURO exchange rate volatility reacts significantly to most of EZ macroeconomic news announcement period dummies such as EZ producer price index, EZ retail sales, EZ repo rate, EZ trade balance, EZ unemployment rate, and to most of PAK macroeconomic

news announcement period dummies such as PAK consumer price index, PAK money supply, PAK net financial assets, PAK repo rate, and PAK wholesale price index. These results are similar to the findings of Laakkonen (2008, 2009) and Neely (2011) for EZ news period dummies.

Table 5.30: Order Flow and Pure Effects of News for PKR/EURO Exchange Rates

News Announcements	PKR/EURO			
	Return		Volatility	
	$\theta_{4,k}$	$\lambda_{4,k}$	$\vartheta_{4,k}$	$\eta_{4,k}$
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	0.0568 (0.3321)	0.0058 (0.9318)	0.0105 (0.7325)	0.0432 (0.1981)
Industrial Production	-0.1763*** (0.0004)	-0.0219 (0.6636)	-0.0113 (0.7140)	0.0028 (0.9448)
Money Supply	-0.0296 (0.6874)	0.0249 (0.6771)	0.1516*** (0.0041)	0.0112 (0.7837)
Producer Price Index	0.0706* (0.0600)	-0.0882* (0.0679)	0.0172 (0.5002)	-0.1405*** (0.0000)
Repo Rate	0.2679*** (0.0050)	0.0065 (0.9320)	0.1526*** (0.0066)	0.1163*** (0.0003)
Retail Sales	0.0411 (0.4863)	-0.0546 (0.3702)	-0.0174 (0.7499)	0.1715*** (0.0037)
Trade Balance	0.0633 (0.1246)	0.1479*** (0.0054)	-0.0607** (0.0354)	0.1002*** (0.0093)
Unemployment Rate	-0.0826 (0.4328)	-0.0943 (0.2498)	-0.0225 (0.6454)	0.1389*** (0.0020)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0302 (0.5881)	-0.0427 (0.4095)	0.1039*** (0.0004)	-0.1968*** (0.0000)
Foreign Exchange Reserve	-0.0041 (0.9984)	-0.0356 (0.5416)	-0.0274 (0.2398)	-0.0013 (0.9586)
Manufacturing Production Index	0.0087 (0.8642)	-0.1579*** (0.0045)	0.0107 (0.8288)	-0.0281 (0.6712)
Money Supply	0.2275*** (0.0001)	0.0674 (0.2388)	0.0999* (0.0824)	-0.0654 (0.2654)
Net Financial Assets	-0.1988** (0.0009)	-0.0836 (0.1209)	0.1493*** (0.0000)	-0.1193** (0.0108)
Repo Rate	0.0093 (0.9198)	-0.0062 (0.8873)	0.1787*** (0.0000)	-0.1449*** (0.0000)
Trade Balance	-0.0086 (0.9251)	-0.0596 (0.3127)	0.1646*** (0.0001)	0.0227 (0.5611)
Wholesale Price Index	0.0419 (0.3874)	-0.0915* (0.0586)	0.0170 (0.4865)	-0.0962*** (0.0020)
Order Flow	0.4111*** (0.0000)		0.0054 (0.8198)	

α_1 ARCH-Co	0.1214*** (0.0000)
β_1 GARCH-Co	0.7355*** (0.0000)
Log-likelihood	-2907.756
LM-ARCH 1-2	1.2502 (0.2866)
LM-ARCH 1-5	0.8344 (0.5250)
LM-ARCH 1-10	0.8943 (0.5377)
LB- Q(10)	7.0721 (0.6296)
LB- Q(20)	17.2656 (0.5718)
LB- $Q(10)^2$	8.584 (0.3785)
LB- $Q(20)^2$	14.3331 (0.7071)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

These results indicate that the existence or happening of news of macroeconomic indicators affects Pak rupee exchange rates. It implies that macroeconomic indicators also have an announcement period effect on Pak rupee exchange rates even after taking into account the news impact. Furthermore, the announcement period effects exist not only for Pak rupee exchange rate returns but also for Pak rupee exchange rate volatility. Moreover, news events do affect Pak rupee exchange rates during announcements.

5.3.2.3- Dynamic Effects of News and Order Flow

To examine the dynamic effects of news of all macroeconomic indicators and order flow on exchange rate returns and exchange rate volatility, news equations (4.16) to (4.18) are estimated. The estimated coefficients show dynamic effects for all of the foreign and domestic macroeconomic news announcements and order flow on Pak rupee exchange rate returns and their volatilities after announcement periods.

Tables (5.31) to (5.34) present the estimated dynamic effects for all macroeconomic news announcements and order flow on Pak rupee exchange rate returns and their volatilities after announcements periods. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns with $J = 2$ lags of each of the K standardized macroeconomic news announcements. For exchange rate volatility, EGARCH (1, 1) and GARCH (1, 1) models with $J' = 2$ lags of each of the K standardized macroeconomic news announcements are used.

The results show that order flow significantly affect Pak rupee exchange rate returns and their volatilities corresponding to after news announcements. They indicate that there is positive momentum in order flows of PKR/USD and PKR/JPY exchange rate returns i.e positive flows follow positive flows. Whereas a negative momentum in order flows of PKR/USD exchange rate volatility i.e negative flows follow negative flows. The order flow has instantaneous and significant effects on PKR/USD exchange rate returns as well as on PKR/USD exchange rate volatility corresponding to after news announcements. There are positive lagged effects of order flow on PKR/USD exchange rate returns corresponding to after the release of the news. This positive effect implies two days ago trading causes an appreciation of today's PKR/USD exchange rate. This finding is in line with Evans and Lyons (2005) that the news effect of an announcement on exchange rates includes the quick reaction as well as the response to trades. The momentum effect is in line with Duffuor et al. (2012), and Breedon and Ranaldo (2013).

The order flow has no instantaneous and significant effects on PKR/GBP exchange rate returns but has positive lagged effects on PKR/JPY exchange rate volatility

corresponding to after the release of the news. The order flow has no instantaneous and significant effects on PKR/JPY and PKR/EURO exchange rate returns and their volatilities.

The Pak rupee exchange rate returns and volatility react significantly to macroeconomic announcements after announcement periods. The PKR/USD exchange rate returns and volatility react significantly to most of US macroeconomic news announcements and PAK macroeconomic news announcements. They immediately adjust to news i-e full response to news occurs in one day. The PKR/GBP exchange rate returns and volatility react significantly to UK macroeconomic announcements and PAK macroeconomic news announcements. They immediately adjust to news i.e full response to news occurs in one day. However, they adjust to news like UK industrial production, PAK consumer price, PAK foreign exchange reserve and PAK manufacturing production index, and PAK trade balance gradually i.e full response to news occurs after one and two days.

The PKR/JPY exchange rate returns and volatility react significantly to JP macroeconomic announcements and PAK macroeconomic news announcements. They gradually adjust to news i.e full response to news occurs after one day. The PKR/EURO exchange rate returns and volatility react significantly to EZ macroeconomic announcements and PAK macroeconomic news announcements. They adjust to most of the news immediately i.e full response to news occurs in one day. However, they adjust to news like EZ retail sales, EZ repo rate, PAK manufacturing production index, and PAK net financial assets gradually i.e full response to news occurs after one and two days.

The direction of the effects of macroeconomic news announcements is almost the same as the contemporaneous effects of news. Most of the estimated coefficients of news of macroeconomic indicators are correctly signed as anticipated by the response of the reaction function to news and exchange rate determination models. These results are consistent with the findings of Almeida *et al.* (1998), Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Cai et *al.* (2008), Fatum *et al.* (2012), Caporale *et al.* (2018), Cheung *et al.* (2019) and Ben Omrane *et al.* (2020).

The pattern of significance is strong for PKR/USD exchange rate returns corresponding to most of US macroeconomic news announcements such as US business inventories, US federal budget balance, US industrial production, US producer price index, US repo rate, US retail sales, US trade balance and to all PAK macroeconomic news announcements such as PAK consumer price index, PAK foreign exchange reserves, PAK manufacturing production index, PAK money supply, PAK net financial assets, PAK repo rate, PAK trade balance, and PAK wholesale price index over the period of time.

The pattern of significance is not strong for PKR/USD exchange rate volatility corresponding to US and PAK macroeconomic news announcements over the period of time. Further, there are persistence patterns associated with announcements such as US business inventories, US industrial production, US producer price index, US repo rate, US trade balance, PAK manufacturing production index, PAK net financial assets, PAK repo rate, on PKR/USD exchange rate returns. These findings are consistent with Almeida *et al.* (1998), Andersen *et al.* (2003), Pearce and Solakoglu (2007), Cai *et al.* (2009), and Omrane and Savaşer (2017).

The pattern of significance is not strong for PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns and their volatilities corresponding to foreign and domestic macroeconomic news announcements. There are no persistence patterns associated with announcements on PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns, and their volatilities from any of the individual announcements. It implies that "*the effect of unanticipated macroeconomic information is drowned in the subsequent random fluctuations of the exchange rates*".

Table 5.31: Dynamic Effects of News and Order Flow for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns			Volatility		
	$\theta_{1,k,0}$	$\theta_{1,k,1}$	$\theta_{1,k,2}$	$\vartheta_{1,k,0}$	$\vartheta_{1,k,1}$	$\vartheta_{1,k,2}$
US Macroeconomic News Announcements						
Business Inventories	-0.0771*** (0.0000)	-0.0848*** (0.0000)	-0.0082*** (0.0027)	-0.9385*** (0.0000)	-0.3099 (0.5333)	-0.4723 (0.3185)
Consumer Price Index	-0.0043 (0.2198)	0.0348*** (0.0000)	-0.0137*** (0.0000)	-0.4646 (0.1636)	-0.9961*** (0.0010)	-0.9516*** (0.0005)
Durable Goods Orders	-0.0132*** (0.0000)	-0.0199*** (0.0000)	0.0004 (0.5538)	-0.3409 (0.4880)	-1.5578*** (0.0000)	-1.8887*** (0.0000)
Federal Budget Balance	0.0765*** (0.0000)	-0.1123*** (0.0000)	-0.0336*** (0.0000)	0.0027 (0.9910)	-0.4477* (0.0610)	0.1224 (0.7934)
Industrial Production	0.0042** (0.0318)	0.0072*** (0.0000)	0.0165*** (0.0000)	0.1580 (0.6791)	0.0863 (0.7341)	1.3444*** (0.0003)
Producer Price Index	-0.0300*** (0.0000)	-0.0368*** (0.0000)	-0.0447*** (0.0000)	-1.1547*** (0.0000)	-0.0998 (0.7975)	-0.9345*** (0.0010)
Repo Rate	-0.0199*** (0.0003)	-0.1310*** (0.0000)	-0.1016*** (0.0000)	0.6794 (0.1461)	0.0911 (0.7110)	0.1977 (0.5531)
Retail Sales	-0.0528*** (0.0000)	-0.0106*** (0.0001)	0.0084*** (0.0000)	0.4235 (0.1622)	0.0386 (0.9474)	-0.8137* (0.0606)
Trade Balance	-0.0381*** (0.0000)	-0.0196*** (0.0000)	-0.0176*** (0.0000)	-1.9444*** (0.0000)	0.5459 (0.1838)	-0.5168 (0.1030)
Unemployment Rate	-0.0025 (0.2241)	0.0793*** (0.0000)	-0.0549*** (0.0000)	0.1409 (0.6905)	-0.9592*** (0.0004)	-0.3107 (0.3000)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0406** (0.0000)	-0.0383*** (0.0000)	0.0054*** (0.0090)	-1.0012*** (0.0000)	0.3229 (0.6091)	-1.2898*** (0.0000)
Foreign Exchange Reserves	-0.0335*** (0.0000)	-0.0271*** (0.0000)	0.0158*** (0.0000)	0.5816 (0.1895)	-0.8841*** (0.0000)	-0.4256 (0.2150)
Manufacturing Production Index	0.0050** (0.0216)	0.1364*** (0.0000)	0.2924*** (0.0000)	-0.4024 (0.2689)	0.9538 (0.2057)	1.0280** (0.0272)
Money Supply	-0.0034** (0.0303)	0.0580*** (0.0000)	0.0473*** (0.0000)	-1.5746*** (0.0000)	-0.5669 (0.2576)	0.1909 (0.7831)

Net Financial Assets	-0.2980*** (0.0000)	-0.1417*** (0.0000)	-0.2469*** (0.0000)	0.3063*** (0.2081)	2.0376*** (0.0000)	0.0758 (0.7855)
Repo Rate	0.4506*** (0.0000)	0.1017*** (0.0000)	0.0652*** (0.0000)	0.9363*** (0.0014)	0.2507 (0.5296)	-1.1522*** (0.0000)
Trade Balance	0.0235*** (0.0000)	-0.0071*** (0.0000)	-0.0350*** (0.0000)	-2.0208*** (0.0000)	-1.3770*** (0.0000)	0.0038 (0.9942)
Wholesale Price Index	0.0193*** (0.0000)	0.0042*** (0.0053)	-0.0190*** (0.0000)	-1.4479*** (0.0000)	-1.2565*** (0.0003)	0.0268 (0.9370)
	$\Psi_{1,o}$	$\Psi_{1,1}$	$\Psi_{1,2}$	$\Omega_{1,0}$	$\Omega_{1,1}$	$\Omega_{1,2}$
Order Flow	0.0172*** (0.0000)	0.0023*** (0.1899)	0.0254*** (0.0000)	-1.6805*** (0.0000)	-1.1498 (0.3476)	-0.7930 (0.4107)
α_1 ARCH-Co				0.7490*** (0.0003)		
β_1 GARCH-Co				0.7622*** (0.0000)		
π_1 EGARCH-Co				-0.4717*** (0.0000)		
π_2 EGARCH-Co				0.9289*** (0.0000)		
G.E.D.(DF)				0.3450 (0.0000)		
Log-likelihood				683.116		
LM-ARCH 1-2				0.6898 (0.5017)		
LM-ARCH 1-5				0.4967 (0.7789)		
LM-ARCH 1-10				0.7867 (0.6417)		
LB- Q(10)				41.9534 (0.1393)		
LB- Q(20)				48.5669 (0.6824)		
LB- $Q(10)^2$				7.8294 (0.4503)		
LB- $Q(20)^2$				10.2381 (0.9238)		

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.32: Dynamic Effects of News and Order Flow for PKR/GBP Exchange Rates

News Announcements	PKR/GBP					
	Returns			Volatility		
	$\theta_{2,k,0}$	$\theta_{2,k,1}$	$\theta_{2,k,2}$	$\vartheta_{2,k,0}$	$\vartheta_{2,k,1}$	$\vartheta_{2,k,2}$
UK Macroeconomic News Announcements						
Average Earnings Index	-0.1287* (0.0581)	-0.0445 (0.2882)	-0.0546 (0.2741)	0.0095 (0.8156)	-0.0157 (0.7705)	0.0069 (0.8716)
Consumer Price Index	0.1418*** (0.0052)	-0.0829 (0.1937)	0.0318 (0.5234)	0.0225 (0.6614)	0.1314** (0.0298)	-0.0920** (0.0352)
Housing Price Index	-0.0835** (0.0338)	0.0028 (0.9468)	0.0340 (0.4592)	-0.0654*** (0.0089)	-0.0339* (0.0918)	0.0787** (0.0142)
Industrial Production	-0.0345 (0.5548)	-0.0206 (0.6402)	-0.0960** (0.0211)	0.0986*** (0.0010)	-0.0759* (0.0895)	0.0010 (0.9812)
Money Supply	-0.1000 (0.1564)	0.0017 (0.9723)	-0.0226 (0.6678)	0.0459 (0.3232)	-0.0812** (0.0488)	0.0133 (0.6364)
Producer Price Index	-0.0198 (0.7584)	-0.0551 (0.2585)	0.0196 (0.6788)	0.0422 (0.2770)	-0.0335 (0.4915)	-0.0441 (0.2175)
Repo Rate	0.0399 (0.7224)	0.1268 (0.4126)	-0.0441 (0.7125)	0.0794 (0.7376)	0.0993 (0.7102)	-0.0341 (0.8311)
Retail Sales	0.1330** (0.0172)	0.0302 (0.4781)	-0.0899** (0.0263)	0.1099* (0.0518)	-0.1245** (0.0183)	0.0017 (0.9560)
Trade Balance	0.0101 (0.8136)	0.0650 (0.1291)	0.0218 (0.6090)	-0.0322 (0.3394)	0.0077 (0.8601)	-0.0169 (0.6412)
Unemployment Rate	-0.0891* (0.0691)	-0.1899*** (0.0001)	0.0472 (0.3566)	0.0615 (0.1684)	-0.0611 (0.1895)	0.0021 (0.9410)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0421 (0.4449)	0.0571 (0.1755)	0.0783* (0.0918)	0.0678 (0.2320)	-0.0573 (0.1996)	0.0620** (0.0443)
Foreign Exchange Reserves	-0.0620** (0.0171)	-0.1312*** (0.0097)	-0.0115 (0.8392)	-0.0545*** (0.0000)	-0.0186*** (0.0043)	0.0924*** (0.0007)
Manufacturing Production Index	-0.0751 (0.1564)	-0.0455 (0.1386)	0.0560 (0.2264)	0.0517 (0.1728)	-0.0953*** (0.0047)	0.0022 (0.9283)
Money Supply	0.2068*** (0.0000)	0.0583 (0.2606)	-0.0845** (0.0123)	-0.0439* (0.0642)	0.0822* (0.0808)	-0.0517 (0.1387)
Net Financial Assets	-0.1365* (0.0569)	-0.0209 (0.5755)	-0.1337** (0.0451)	0.1634 (0.0000)	-0.1503 (0.0000)	0.0503 (0.1484)
Repo Rate	0.2768*** (0.0003)	-0.0561 (0.3233)	0.09591 (0.2533)	0.2228*** (0.0000)	-0.1819** (0.0001)	0.0727** (0.0954)
Trade Balance	- 0.0053 (0.9177)	0.0651 (0.4051)	-0.1037* (0.0995)	-0.0546*** (0.0000)	0.2137 (0.0028)	-0.0500 (0.4272)
Wholesale Price Index	0.0620 (0.2835)	0.0216 (0.6775)	0.0511 (0.3178)	-0.0203* (0.5895)	0.0015 (0.9750)	0.0281 (0.4799)
	$\Psi_{2,o}$	$\Psi_{2,1}$	$\Psi_{2,2}$	$\Omega_{2,0}$	$\Omega_{2,1}$	$\Omega_{2,2}$
Order Flow	0.1350 (0.3492)	0.0644 (0.6128)	-0.0497 (0.7891)	-0.0836 (0.2886)	-0.0280 (0.6925)	0.1798*** (0.0005)
α_1 ARCH-Co				0.1220*** (0.0000)		
β_1 GARCH-Co				0.7457*** (0.0000)		
Log likelihood				-2884.240		

LM-ARCH 1-2	1.511 (0.2210)
LM-ARCH 1-5	0.9862 (0.4246)
LM-ARCH 1-10	0.7170 (0.7092)
LB- Q(10)	7.4426 (0.4897)
LB- Q(20)	19.3771 (0.3689)
LB- $Q(10)^2$	7.2772 (0.5070)
LB- $Q(20)^2$	9.2644 (0.9532)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.33: Dynamic Effects of News and Order Flow for PKR/ JPY Exchange Rates

News Announcements	PKR/JPY					
	Returns			Volatility		
	$\theta_{3,k,0}$	$\theta_{3,k,1}$	$\theta_{3,k,2}$	$\vartheta_{3,k,0}$	$\vartheta_{3,k,1}$	$\vartheta_{3,k,2}$
Japanese Macroeconomic News Announcements						
All Industries Activity Index	0.0081 (0.8911)	-0.0633 (0.2322)	-0.0813 (0.1745)	-0.0383 (0.4287)	-0.0378 (0.6288)	0.0157 (0.7943)
Consumer Price Index	-0.0482 (0.4420)	-0.0207 (0.7580)	-0.0182 (0.7219)	0.0250 (0.7429)	-0.0012 (0.9880)	0.9880* (0.0735)
Industrial Production	-0.0213 (0.7461)	0.0169 (0.8195)	-0.0283 (0.6365)	-0.0320 (0.6346)	0.0565 (0.4371)	-0.0197 (0.6882)
Machinery Orders	-0.0046 (0.9585)	0.0020 (0.9784)	0.0590 (0.4374)	-0.1003 (0.3057)	-0.0642 (0.4088)	-0.0565 (0.2216)
Money Supply	0.0121 (0.8336)	-0.0250 (0.6410)	0.0252 (0.4449)	-0.0738* (0.0570)	-0.0245 (0.7040)	-0.0626 (0.2019)
Producer Price Index	0.0031 (0.9521)	0.0147 (0.8151)	-0.0543 (0.6050)	-0.0079 (0.9168)	-0.0386 (0.5895)	0.0362 (0.5505)
Repo Rate	0.0101 (0.9476)	0.0129 (0.8900)	0.0095 (0.9771)	-0.0139 (0.9563)	-0.0013 (0.9963)	-0.0086 (0.9628)
Retail Sales	0.0546 (0.2856)	-0.0695 (0.2580)	-0.0989* (0.0941)	-0.0506* (0.0570)	-0.0388 (0.4846)	0.0384 (0.5065)
Trade Balance	-0.0141 (0.8650)	0.0459 (0.6037)	-0.0426** (0.0340)	0.0266 (0.6447)	0.1335** (0.0274)	-0.0532 (0.2811)
Unemployment Rate	-0.0114 (0.8717)	0.0154 (0.8696)	-0.0124 (0.8538)	0.0399 (0.5700)	0.0950 (0.3151)	0.0141 (0.8346)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0242 (0.6791)	0.0212 (0.7608)	-0.0407 (0.6769)	0.0193 (0.8064)	0.0341 (0.7151)	0.1095 (0.2895)
Foreign Exchange Reserve	-0.0667 (0.4415)	-0.0367 (0.7396)	-0.0250 (0.8273)	0.0536 (0.5716)	0.0621 (0.7293)	0.1477 (0.3338)
Manufacturing Production Index	-0.0500 (0.5590)	-0.0012 (0.9989)	0.0073* (0.0916)	0.0694 (0.5346)	0.0875 (0.5571)	0.1081 (0.4328)
Money Supply		0.0311 (0.7439)	-0.0704* (0.0916)	0.0732 (0.4419)	0.1105 (0.2984)	0.0619 (0.6108)

Net Financial Asset	-0.1119* (0.0517)	0.0365 (0.8364)	-0.0352 (0.7906)	0.5634**** (0.0000)	-0.0542 (0.7996)	-0.0170 (0.9211)
Repo Rate	0.0989 (0.4166)	0.0299 (0.7333)	0.0703** (0.0554)	0.1128*** (0.2301)	-0.0898 (0.3826)	-0.0204 (0.7556)
Trade Balance	-0.0243 (0.7392)	-0.0012 (0.9817)	0.0331 (0.6077)	-0.0304 (0.2029)	0.0715 (0.3040)	0.0214 (0.7577)
Wholesale Price Index	-0.0028 (0.9677)	-0.0342 (0.5995)	0.0310 (0.6599)	-0.0433 (0.4723)	0.0531 (0.4830)	-0.0127 (0.8433)
	$\Psi_{3,o}$	$\Psi_{3,1}$	$\Psi_{3,2}$	$\Omega_{3,0}$	$\Omega_{3,1}$	$\Omega_{3,2}$
Order Flow	0.0174 (0.9024)	0.0249 (0.8802)	0.0259 (0.8654)	-0.0680 (0.6933)	-0.0299 (0.8909)	0.0117 (0.9354)

α_1 ARCH-Co	0.0974*** (0.0000)
β_1 GARCH-Co	0.7585*** (0.0000)
Log likelihood	-2981.546
LM-ARCH 1-2	0.1714 (0.8425)
LM-ARCH 1-5	0.5403 (0.7458)
LM-ARCH 1-10	0.5616 (0.8462)
LB- Q(10)	4.4147 (0.7309)
LB- Q(20)	11.1640 (0.8479)
LB- $Q(10)^2$	5.6383 (0.6876)
LB- $Q(20)^2$	8.01140 (0.9784)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.34: Dynamic Effects of News and Order Flow for PKR/ EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns			Volatility		
	$\theta_{4,k,0}$	$\theta_{4,k,1}$	$\theta_{4,,k,2}$	$\vartheta_{4,k,0}$	$\vartheta_{4,k,1}$	$\vartheta_{4,,k,2}$
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.1124* (0.0788)	-0.0102 (0.8421)	0.0744 (0.2550)	0.0536 (0.3143)	-0.0360 (0.4595)	0.0687 (0.1683)
Industrial Production	-0.1589*** (0.0096)	-0.0861 (0.1320)	-0.0583 (0.3095)	0.0250 (0.6118)	0.0421 (0.5889)	-0.0706 (0.2377)
Money Supply	-0.0285 (0.6855)	-0.0265 (0.7029)	0.0368 (0.6084)	0.0912* (0.0972)	0.0408 (0.5925)	-0.0185 (0.7869)
Producer Price Index	0.0648 (0.2200)	-0.0851 (0.1689)	0.0776 (0.2872)	0.0335 (0.4736)	0.0405 (0.5939)	0.0056 (0.9398)
Repo Rate	0.1596 (0.1486)	0.1153* (0.0824)	-0.1263 (0.1767)	0.0617 (0.6795)	0.1381 (0.3371)	-0.1012 (0.2559)
Retail Sales	0.0103 (0.8724)	-0.0125 (0.8544)	0.0686 (0.2856)	0.0206 (0.7652)	0.0794 (0.3527)	-0.0395 (0.5304)

Trade Balance	0.1010** (0.0451)	-0.0253 (0.5542)	-0.0062 (0.9163)	0.1308* (0.0633)	-0.1727*** (0.0034)	0.0725* (0.0547)
Unemployment Rate	-0.0910 (0.4591)	0.0219 (0.7907)	0.0248 (0.6884)	0.1224* (0.0510)	-0.0079 (0.9251)	-0.1721*** (0.0045)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0019 (0.9756)	-0.0039 (0.9440)	0.0932* (0.0989)	0.0091 (0.8882)	-0.0130 (0.8539)	0.0506 (0.3956)
Foreign Exchange Reserve	0.0543 (0.3835)	-0.1004 (0.1471)	-0.0182 (0.8681)	-0.0581 (0.3386)	-0.0344 (0.4780)	0.1002* (0.0921)
Manufacturing Production Index	-0.0236 (0.6857)	0.0486 (0.2739)	-0.0254 (0.7164)	0.0277 (0.6933)	-0.0652 (0.2786)	-0.0082 (0.8308)
Money Supply	0.2140*** (0.0062)	0.0231 (0.7362)	-0.0645 (0.2483)	0.0661 (0.4190)	-0.0657 (0.4735)	0.0183 (0.7755)
Net Financial Asset	-0.1751** (0.0439)	-0.0455 (0.3617)	-0.0835 (0.1524)	0.3555*** (0.0000)	-0.3078*** (0.0000)	0.0035 (0.3810)
Repo Rate	0.0959 (0.4657)	-0.0146 (0.9034)	0.0964 (0.4505)	0.3189*** (0.0000)	-0.1004 (0.5373)	0.1147 (0.3664)
Trade Balance	-0.0349 (0.5665)	0.0478 (0.6021)	0.0464 (0.5318)	0.0509 (0.2885)	0.1590** (0.0329)	0.0683 (0.2860)
Wholesale Price Index	0.0105 (0.8802)	0.0421 (0.5669)	0.0541 (0.4356)	-0.0037 (0.9279)	0.0486 (0.3842)	-0.0283 (0.5882)
	$\Psi_{4,o}$	$\Psi_{4,1}$	$\Psi_{4,2}$	$\Omega_{4,0}$	$\Omega_{4,1}$	$\Omega_{4,2}$
Order Flow	-0.0117 (0.9143)	0.0119 (0.9368)	0.0662 (0.5975)	-0.0559 (0.5113)	-0.0095 (0.9574)	0.0597 (0.6868)

α_1 ARCH-Co	0.1013*** (0.0000)
β_1 GARCH-Co	0.7734*** (0.0000)
Log likelihood	-2836.79
LM-ARCH 1-2	0.5454 (0.5796)
LM-ARCH 1-5	0.5020 (0.7749)
LM-ARCH 1-10	0.6864 (0.7381)
LB- Q(10)	6.9715 (0.5397)
LB- Q(20)	18.2728 (0.4378)
LB- $Q(10)^2$	6.7819 (0.5603)
LB- $Q(20)^2$	14.3430 (0.7064)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

The above estimation results imply that many macroeconomic news announcements affect Pak rupee exchange rate returns and Pak rupee exchange rate volatility after announcement periods. Most of Pak rupee exchange rate returns and Pak rupee exchange rate volatility adjust to most of the foreign and domestic macroeconomic news announcements immediately i.e full response to news occurs in a day. Further, they suggest the pattern of the significance of news is strong only in PKR/USD exchange rates. There are persistence patterns associated with announcements of few of news on PAK/USD exchange rate returns and volatility only. They also indicate that the very short-term reaction to the news is drowned very rapidly in subsequent random fluctuations of the exchange rates. The Pak rupee exchange rates react to both real activity and monetary news. The Pak rupee exchange rate returns and Pak rupee exchange rate volatility are "*sensitive with different degrees to the various foreign or domestic macroeconomic news announcements with respect to the currency area*". These results are consistent with the findings of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Andersen *et al.* (2003), Pearce and Solakoglu (2007), Laakkonen (2008, 2009), Cai *et al.* (2008), Evans and Speight (2010), Neely (2011), Omrane and Hafner (2015), Omrane & Savaşer (2017), Maserumule and Alagidede (2017), Caporale *et al.* (2018), Cheung *et al.* (2019) and Ben Omrane *et al.* (2020). These results suggest that macroeconomic news announcements play an important role in predicting Pak rupee exchange rates. Investors can formulate expectations by observing these news in order to take advantage of changes in exchange rates that will affect their portfolio returns.

The results also indicate that there is positive momentum in order flows of PKR/USD and PKR/JPY exchange rate returns i.e positive flows follow positive flows.

Whereas a negative momentum in order flows of PKR/USD exchange rate volatility i.e negative flows follow negative flows. The order flow has instantaneous and significant effects on PKR/USD exchange rate returns as well as on PKR/USD exchange rate volatility corresponding to after news announcements. These results are consistent with the studies of Love and Payne (2008), Gradojevic and Neely (2009), Chinn and Moore (2011), Duffuor *et al.* (2012), and Anifowose *et al.* (2018). Whereas the order flow has no instantaneous and significant effects on PKR/GBP, PKR/JPY, and PKR/EURO exchange rate returns and their volatilities.

5.3.3- Macroeconomic News Announcement Indirect Effects via Order Flow on Exchange Rate Returns and Exchange Rate Volatility

5.3.3.1- Contemporaneous Effects of News via Order Flow

To examine the contemporaneous effects of each of macroeconomic news via order flow on exchange rate returns and exchange rate volatility during announcement periods, equations (4.19) and (4.20) are estimated.

In the return equation, the positive coefficient of interaction between macroeconomic news and order flow indicates positive effects on Pak rupee exchange rate returns implying good news (positive surprise) representing higher/stronger than expected announcement causes net purchase of foreign currencies which leads to an appreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). The negative coefficient of interaction between macroeconomic news and order flow indicates negative effects on Pak rupee exchange rate returns implying good news (positive surprise) representing higher/stronger than expected announcement causes net sale of foreign

currencies which leads to depreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). The estimated interaction coefficients indicate the impact of dispersed information on Pak rupee exchange rates. In the variance equation, the positive coefficient indicates that dispersed information leads to a raise in Pak rupee exchange rate volatility while the negative coefficient indicates that dispersed information leads to reduce Pak rupee exchange rate volatility.

Tables (5.35) to (5.38) present the estimated contemporaneous effects of each of macroeconomic news via order flow for each foreign currency on Pak rupee exchange rate returns and their volatilities during announcement periods. For Pak rupee exchange rate returns, different ARMA (p,q) specifications are selected for incorporating serial correlation in exchange rate returns. For Pak rupee exchange rate volatility, GARCH (1,1) model is used. The significant ARMA (p,q) specifications indicate that the Pak rupee exchange rate returns series shows prediction of exchange rate movements based on past information. These findings imply market inefficiency. The significant coefficients of ARCH and GARCH terms imply that the volatility of each exchange rate reacts significantly to its own past squared shocks and to its own past volatility. These estimates exhibit volatility persistence.

The results show that few of macroeconomic news via order flow significantly affect Pak rupee exchange rate returns and their volatilities during announcement periods. However, most of the macroeconomic news via order flow significantly affect Pak rupee exchange rate volatilities during announcement periods. They also show a significant impact of order flow following the announcement of macroeconomic news on Pak rupee exchange rates. Further, the role of order flow to convey private/ incremental information

with the release of public news which increases information asymmetry among market agents is identified in the determination of Pak rupee exchange rates.

The PKR/USD exchange rates appreciate with the announcements of US federal budget balance news due to the net purchase of US dollars and depreciate with the announcements of US consumer price index news, PAK consumer price index news, and PAK foreign exchange reserves news due to net sale of US dollars. The appreciation occurs because large foreign budget deficit surprises raise real foreign interest rates which raise the demand for foreign currencies. The depreciation occurs because higher foreign consumer price index surprises decrease foreign demand for money which reduces the demand for foreign currencies and higher domestic consumer price index surprises increase demand for domestic currencies via capital account. The depreciation also occurs because PAK foreign exchange reserves surprises reduce the demand for foreign currencies.

The PKR/USD and PKR/JPY exchange rates appreciate with the announcements of PAK net financial assets news due to the net purchase of US dollars and Japanese yens. However, the PKR/GBP and PKR/EURO exchange rates depreciate with the announcements of PAK net financial assets news due to the net sale of British pounds and Euros. The appreciation occurs because an increase in net financial assets surprises leads to an increase in risk premium or expected rate on returns and hence increases the demand for foreign currencies. The depreciation occurs because an increase in net financial assets surprises lead to an improvement in the export competitiveness and hence decreases the demand for foreign currencies. The PKR/JPY exchange rates appreciate with the announcements of JP all industries activity index news and JP unemployment rate news due to the net purchase of Japanese yens. The appreciation occurs because higher foreign

real activity surprises increase foreign demand for money which raises the demand for foreign currencies and higher foreign unemployment surprise decreases foreign price level which raises the demand for foreign currencies.

The magnitudes of the interaction coefficients suggest order flow intensifies the impact of macroeconomics news considerably. The estimates of the interaction of macroeconomic news with order flow are larger as compared to estimates of macroeconomic news. There is a slight decline in most of the individual estimates of macroeconomic news. A surprise of one standard deviation in an increase in US federal budget balance leads to 9.592% appreciation of USD against PKR due to the net purchase of US dollars. A surprise of one standard deviation rise in the US consumer price index leads to 0.722% depreciation of USD against PKR due to the net sale of US dollars. A surprise of one standard deviation rise in JP all industries activity and rise in JP unemployment rate leads to 3.412% and 1.891% appreciation of JPY against PKR respectively due to the net purchase of Japanese yens. A surprise of one standard deviation in a rise in PAK consumer price index news and increase in PAK foreign exchange reserves leads to 2.81% and 4.043% appreciation of PKR against USD respectively due to net sale of US dollars. A surprise of one standard deviation increase in PAK net financial assets leads to 3.675% and 2.621% depreciation of PKR against USD and JPY respectively due to net purchase of US dollars and Japanese yens. A surprise of one standard deviation increase in PAK net financial assets leads to 2.948% and 4.177% appreciation of PKR against GBP and EURO respectively due to net sale of British pounds and Euros.

The PKR/USD exchange rate volatility raises with the announcements of foreign macroeconomic news such as US federal budget balance, and US Trade Balance due to net

purchase of US dollars by 8.42% and 1.38% respectively. However, the PKR/USD exchange rate volatility reduces with the announcements of foreign macroeconomic news such as US business inventories, US consumer price index, US durable goods orders, US industrial production, US producer price index, US retail sales, and US unemployment rate due to the net sale of US dollars by 0.147%, 0.162%, 0.227%, 0.283%, 0.234%, 0.477%, and 0.179% respectively.

The PKR/GBP exchange rate volatility raises with the announcements of foreign macroeconomic news such as the UK average earnings index and the UK housing price index due to net purchase of British pounds by 0.315% and 0.372% respectively. However, The PKR/GBP exchange rate volatility reduces with the announcements of foreign macroeconomic news such as UK consumer price index, UK industrial production, UK producer price index, UK retail sales, and UK unemployment rate due to net sale of British pounds by 3.057%, 0.997%, 3.313%, 2.411%, and 0.651% respectively.

The PKR/JPY exchange rate volatility raises with the announcements of foreign macroeconomic news such as JP retail sales due to the net purchase of Japanese yens by 1.276%. However, the PKR/JPY exchange rate volatility reduces with the announcements of foreign macroeconomic news such as JP all industries activity index, JP consumer price index, JP industrial production, JP machinery orders, JP producer price index, and JP trade balance due to the net sale of Japanese yens by 2.208%, 0.165%, 0.418%, 0.247%, 1.488%, and 1.276% respectively.

The PKR/EURO exchange rate volatility raises with the announcements of foreign macroeconomic news such as the EZ money supply due to the net purchase of Euros by 1.158%. However, the PKR/EURO exchange rate volatility reduces with the

announcements of foreign macroeconomic news such as EZ consumer price index, EZ industrial production, EZ repo rate, and EZ trade balance due to net sale of Euros by 0.629%, 1.036%, 5.536%, and 0.393% respectively.

The PKR/USD and PKR/GBP exchange rate volatilities raise with the announcements of domestic macroeconomic news such as PAK consumer price index, PAK money supply, and PAK repo rate due to net purchase of US dollars and British pounds by 0.289%, 0.397%, 5.313%, 0.703%, 1.217%, and 2.341% respectively. The announcement of PAK foreign exchange reserves news and PAK trade balance news raises the PKR/USD exchange rate volatility due to net purchase of US dollars by 5.431% and 0.289% respectively and reduce PKR/GBP and PKR/JPY exchange rate volatilities due to net sale of British pounds and Japanese yens by 1.193%, 1.400%, 2.791%, and 1.061% respectively. The announcement of PAK net financial assets news reduces the PKR/USD and PKR/JPY exchange rate volatilities due to net sales of US dollars and Japanese yens by 1.619% and 1.483% respectively and raises PKR/GBP and PKR/EURO exchange rate volatility due to net purchase of British pounds and Euros by 2.347% and 3.002 % respectively. The announcement of PAK manufacturing production index news reduces the PKR/USD and PKR/JPY exchange rate volatilities due to net sales of US dollars and Japanese yens by 0.247% and 0.729% respectively and raises PKR/EURO exchange rate volatility due to net purchase of Euro by 0.588%. The announcement of PAK wholesale price index news reduces the PKR/USD exchange rate volatility due to net sales of US dollars by 0.275% and raises PKR/EURO exchange rate volatility due to the net purchase of Euros by 0.805%. The announcement of PAK money supply news raises PKR/JPY exchange rate volatility due to the net purchase of Japanese yens by 0.923%.

The PKR/JPY and PKR/EURO exchange rate volatilities reduce with the announcements of PAK consumer price index news due to the net sale of Japanese yens and Euros by 0.635% and 1.012% respectively. The announcement of PAK trade balance news raises PKR/EURO exchange rate volatility due to the net purchase of Euros by 1.364% and PKR/EURO exchange rate volatility reduces with the announcement of PAK repo rate news due to net sale of Euros by 0.495%.

The above findings show that releases of foreign and domestic macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rate returns and their volatilities indirectly during announcements periods. They also show that the order flow effect varies to the macroeconomic news announcements. Further, the finding also reveals that order flow intensifies the effects of macroeconomics news substantially which is in line with Evans and Lyons (2008) and Savaser (2011). Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes the foreign exchange market, it affects the decisions of market makers, influencing order flow and then exchange rates.

Table 5.35: Contemporaneous Effects of News via Order Flow for PKR/ USD Exchange Rates

News Announcements	PKR/USD							
	Returns			Volatility			ARCH Coefficient	GARCH Coefficient
	$\theta_{1,k}$	Ψ_1	$\Phi_{1,k}$	$\vartheta_{1,k}$	Ω_1	$\psi_{1,k}$	α	β
US Macroeconomic News Announcements								
Business Inventories	0.0097 (0.4712)	0.1634*** (0.0000)	-0.0968 (0.9477)	-0.0239*** (0.0000)	0.0226*** (0.0000)	-0.1473** (0.0266)	0.0906*** (0.0000)	0.8025 *** (0.0000)
Consumer Price Index	0.0210*** (0.0098)	0.2468*** (0.0000)	-0.7215*** (0.0001)	-0.0210*** (0.0000)	0.0579*** (0.0000)	-0.1627*** (0.0000)	0.0722*** (0.0000)	0.8858*** (0.0000)
Durable Goods Orders	-0.0180 (0.6793)	0.3227*** (0.0000)	-0.1720 (0.8034)	-0.0100*** (0.0000)	0.0681*** (0.0000)	-0.2276*** (0.0070)	0.0977*** (0.0000)	0.7241*** (0.0000)
Federal Budget Balance	0.2012*** (0.0000)	-0.3641*** (0.0000)	9.5923*** (0.0000)	0.0939*** (0.0000)	0.0381*** (0.0000)	8.4196*** (0.0000)	0.1753*** (0.0000)	0.6320*** (0.0000)
Industrial Production	0.0396** (0.0500)	0.3408*** (0.0000)	0.4661 (0.5651)	-0.0243*** (0.0000)	0.0546*** (0.0010)	-0.2826*** (0.0015)	0.0841*** (0.0000)	0.7927*** * (0.0000)
Producer Price Index	-0.0230 (0.3534)	0.1463*** (0.0026)	0.1436 (0.8117)	-0.0230*** (0.0000)	0.0348*** (0.0000)	-0.2341*** (0.0000)	0.0951*** (0.0000)	0.7576*** (0.0000)
Repo Rate	-0.0584 (0.1758)	0.4137*** (0.0000)	1.8702 (0.9683)	0.0064 (0.6706)	0.1010*** (0.0000)	-1.1581 (0.1312)	0.3011*** (0.0000)	0.3560*** (0.0000)
Retail Sales	-0.0283 (0.7666)	0.4415*** (0.0000)	-0.3182 (0.3685)	0.1489*** (0.0000)	0.0816*** (0.0000)	-0.4772*** (0.0000)	0.1424*** (0.0000)	0.5990*** (0.0000)
Trade Balance	0.0541*** (0.0000)	-1.6253*** (0.0000)	0.6119 (0.1655)	0.0014 (0.7132)	0.0762*** (0.0000)	1.3835*** (0.0000)	0.0972*** (0.0000)	0.6908*** (0.0000)
Unemployment Rate	0.0207 (0.3653)	-0.1905*** (0.0001)	0.7906 (0.3193)	0.0022** (0.0159)	0.0196*** (0.0000)	-0.1786*** (0.0000)	0.0274*** (0.0000)	0.9687*** (0.0000)
Pakistan Macroeconomic News Announcements								
Consumer Price Index	0.0799*** (0.0004)	0.0796*** (0.0075)	-2.8061*** (0.0000)	0.0260*** (0.0000)	-0.0035*** (0.0000)	0.2899*** (0.0000)	0.0238*** (0.0000)	0.9761*** (0.0000)
Foreign Exchange Reserves	-0.1170*** (0.0222)	0.0648*** (0.0000)	-4.0435* (0.0503)	0.0195*** (0.0000)	-0.0076*** (0.0000)	5.4308*** (0.0000)	0.0797*** (0.0000)	0.9061*** (0.0000)
Manufacturing Production Index	0.0163 (0.8259)	-0.0223 (0.8151)	-0.0156 (0.9398)	0.0956*** (0.0000)	-0.0123*** (0.0000)	-0.2470*** (0.0000)	0.0950*** (0.0000)	0.7216*** (0.0000)
Money Supply	-0.0232 (0.8408)	-0.0325 (0.1315)	0.3561 (0.3573)	0.2128*** (0.0000)	-0.0214*** (0.0000)	0.3971*** (0.0000)	0.0653*** (0.0000)	0.8308*** (0.0000)
Net Financial Assets	-0.4568*** (0.0000)	-0.0255 (0.8106)	3.6755** (0.0300)	0.2839*** (0.0000)	-0.0205*** (0.0000)	-1.6194*** (0.0000)	0.0994*** (0.0000)	0.7971*** (0.0000)
Repo Rate	0.0457*** (0.0241)	-0.3768*** (0.0000)	1.0714 (0.8351)	0.2238*** (0.0000)	0.0210*** (0.0000)	5.3130*** (0.0000)	0.0561*** (0.0000)	0.8072*** (0.0000)
Trade Balance	0.0182 (0.4486)	0.2001*** (0.0000)	-0.0915 (0.9168)	-0.0248*** (0.0000)	0.0586** (0.0151)	0.2891*** (0.0000)	0.0764*** (0.0000)	0.8036*** (0.0000)
Wholesale Price Index	0.0374*** (0.0039)	0.2748*** (0.0000)	-0.4145 (0.6762)	-0.0288*** (0.0000)	0.0680*** (0.0000)	-0.2758*** (0.0074)	0.0361*** (0.0000)	0.8765*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.36: Contemporaneous Effects of News via Order Flow for PKR/ GBP Exchange Rates

News Announcements	PKR/GBP							
	Returns			Volatility			ARCH Coefficient	GARCH Coefficient
	$\theta_{2,k}$	Ψ_2	$\Phi_{2,k}$	$\vartheta_{2,k}$	Ω_2	$\psi_{2,k}$	α	β
UK Macroeconomic News Announcements								
Average Earnings Index	-0.0957 (0.2399)	0.3658 (0.1288)	0.2897 (0.8203)	-0.0321 ** (0.0148)	0.0555*** (0.0000)	0.3154*** (0.0013)	0.0303*** (0.0000)	0.9647*** (0.0000)
Consumer Price Index	0.1488** (0.0303)	0.3445 (0.2038)	-1.3411 (0.5717)	0.0696 *** (0.0001)	0.1392*** (0.0000)	-3.0573*** (0.0000)	0.0318*** (0.0000)	0.9603 *** (0.0000)
Housing Price Index	-0.0209 (0.7984)	0.3691 (0.1112)	0.0433 (0.9869)	0.0198 ** (0.0109)	0.0615*** (0.0000)	0.3723* (0.0947)	0.0343*** (0.0000)	0.9606 *** (0.0000)
Industrial Production	-0.0220 (0.6687)	0.3501 (0.1598)	-0.5304 (0.8429)	-0.0147 (0.3401)	0.0723*** (0.0000)	-0.9972** (0.0111)	0.0304*** (0.0000)	0.9643*** (0.0000)
Money Supply	-0.0202 (0.7644)	0.3442 (0.1680)	-1.2761 (0.4124)	-0.0275* (0.0984)	0.0702*** (0.0000)	-0.1546 (0.6708)	0.0304*** (0.0000)	0.9657 *** (0.0000)
Producer Price Index	-0.0080 (0.9113)	0.2707 (0.3534)	0.9424 (0.6613)	0.0514* (0.0769)	0.0633*** (0.0000)	-3.3138*** (0.0000)	0.0322*** (0.0000)	0.9635*** (0.0000)
Repo Rate	0.0292 (0.7683)	0.3539 (0.1434)	7.9767 (0.9024)	0.0191 (0.4575)	0.0676*** (0.0000)	-2.4844 (0.1278)	0.0309*** (0.0000)	0.9645*** (0.0000)
Retail Sales	0.0254 (0.5663)	0.2561 (0.3751)	1.5994 (0.5566)	0.0543*** (0.0013)	0.1126 *** (0.0000)	-2.4111*** (0.0000)	0.0382*** (0.0000)	0.9666*** (0.0000)
Trade Balance	0.0240 (0.7202)	0.3794 (0.1253)	-0.4791 (0.6917)	-0.0141 (0.2185)	0.0752*** (0.0000)	-0.1982 (0.2770)	0.0311*** (0.0000)	0.9649*** (0.0000)
Unemployment Rate	-0.0571 (0.3907)	0.3537 (0.1401)	1.3426 (0.4148)	-0.0173 (0.2256)	0.0732*** (0.0000)	-0.6512** (0.0300)	0.0295*** (0.0000)	0.9651*** (0.0000)
Pakistan Macroeconomic News Announcements								
Consumer Price Index	0.0443 (0.4897)	0.3894** (0.0614)	0.0308 (0.9832)	0.0400*** (0.0037)	0.0448*** (0.0000)	0.7033*** (0.0009)	0.0308*** (0.0000)	0.9634*** (0.0000)
Foreign Exchange Reserve	-0.0024 (0.9806)	0.3443 (0.1796)	-0.2547 (0.9452)	0.0501*** (0.0000)	0.0872*** (0.0000)	-1.1927*** (0.0003)	0.0310*** (0.0000)	0.9640*** (0.0000)
Manufacturing Production Index	-0.0764 (0.3108)	0.3643 (0.1478)	0.0188 (0.9897)	0.0019 (0.9102)	0.0757*** (0.0000)	-0.2136 (0.3289)	0.0312*** (0.0000)	0.9645*** (0.0000)
Money Supply	0.1472** (0.0304)	0.3004 (0.2801)	-0.2464 (0.9139)	0.0260** (0.0433)	-0.0268*** (0.0001)	1.2175*** (0.0000)	0.0247*** (0.0000)	0.9688*** (0.0000)
Net Financial Assets	-0.0532 (0.5752)	0.2337 (0.4118)	-2.9482*** (0.0091)	0.0694*** (0.0071)	0.0489*** (0.0211)	2.3479*** (0.0000)	0.0642*** (0.0000)	0.9096*** (0.0000)
Repo Rate	0.0415 (0.5912)	0.3520 (0.1104)	1.5050 (0.6071)	0.0295* (0.0846)	0.0347*** (0.0002)	2.3405*** (0.0001)	0.0295*** (0.0000)	0.9660*** (0.0000)
Trade Balance	-0.0023 (0.9842)	0.3581 (0.1616)	-0.5018 (0.8628)	0.0476** (0.0288)	0.1013*** (0.0000)	-1.4000*** (0.0000)	0.0303*** (0.0000)	0.9645*** (0.0000)
Wholesale Price Index	0.0386 (0.5928)	0.3522 (0.1546)	0.2191 (0.9639)	0.0633*** (0.0012)	0.0648*** (0.0000)	0.1340 (0.5432)	0.0287*** (0.0000)	0.9642*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.37: Contemporaneous Effects of News via Order Flow for PKR/ JPY Exchange Rates

News Announcements	PKR/JPY							
	Returns			Volatility			ARCH Coefficient	GARCH Coefficient
	$\theta_{3,k}$	Ψ_3	$\Phi_{3,k}$	$\vartheta_{3,k}$	Ω_3	$\psi_{3,k}$	α	β
Japanese Macroeconomic News Announcements								
All Industries Activity Index	-0.0254 (0.5870)	0.1219 (0.2786)	3.4124** (0.0338)	-0.0757*** (0.0000)	-0.0216 (0.9623)	-2.2080*** (0.0000)	0.1345*** (0.0000)	0.6921*** (0.0000)
Consumer Price Index	-0.1047** (0.0348)	0.1539* (0.0752)	0.6430 (0.3894)	-0.0723*** (0.0192)	-0.0118 (0.6927)	-0.1653*** (0.0000)	0.1393*** (0.0000)	0.7069*** (0.0000)
Industrial Production	-0.0458 (0.6245)	0.0645 (0.6257)	0.5466 (0.6822)	0.0573* (0.0677)	- 0.0189 (0.2979)	-0.4181*** (0.0000)	0.1316*** (0.0000)	0.7137*** (0.0000)
Machinery Orders	-0.0197 (0.8145)	0.0431 (0.7567)	0.4658 (0.7037)	0.0590** (0.0179)	-0.0120 (0.6938)	-0.2477*** (0.0000)	0.1331*** (0.0000)	0.7155*** (0.0000)
Money Supply	-0.0129 (0.8548)	0.1292 (0.1159)	0.1531 (0.9201)	-0.0720*** (0.0094)	-0.0279 (0.2556)	-0.4156 (0.5430)	0.1208*** (0.0000)	0.7322*** (0.0000)
Producer Price Index	-0.0185 (0.7536)	0.1141 (0.2793)	0.7956 (0.4436)	0.0417 (0.3772)	-0.0139 (0.8980)	-1.4887*** (0.0000)	0.1321*** (0.0000)	0.7158*** (0.0000)
Repo Rate	0.0671 (0.5368)	0.1242 (0.1735)	3.5636 (0.2822)	-0.0147 (0.8750)	-0.0166 (0.5667)	-2.4824 (0.8560)	0.1327*** (0.0000)	0.7137*** (0.0000)
Retail Sales	0.0831** (0.0173)	0.0977 (0.2608)	0.1219 (0.9950)	-0.1139*** (0.0000)	-0.0427 (0.1085)	1.2765*** (0.0007)	0.1304*** (0.0000)	0.7117*** (0.0000)
Trade Balance	-0.0046 (0.6292)	0.1620 (0.1235)	0.3497 (0.3445)	-0.0164* (0.0985)	-0.0213 (0.4945)	-1.2760*** (0.0000)	0.1215*** (0.0000)	0.7408*** (0.0000)
Unemployment Rate	-0.0693 (0.3743)	0.1241 (0.2146)	1.8912** (0.0224)	0.0062 (0.8865)	-0.0159 (0.8630)	-0.6245 (0.4537)	0.1350*** (0.0000)	0.7099*** (0.0000)
Pakistan Macroeconomic New Announcements								
Consumer Price Index	0.0433 (0.6554)	0.1917** (0.0356)	0.5839 (0.2993)	0.2362*** (0.0000)	0.0219 (0.2899)	-0.6353*** (0.0001)	0.0953*** (0.0000)	0.8016*** (0.0000)
Foreign Exchange Reserves	-0.1195 (0.4319)	0.1047 (0.3851)	0.8503 (0.8689)	0.4096*** (0.0000)	-0.0150 (0.4615)	-2.7908*** (0.0000)	0.0897*** (0.0000)	0.8004*** (0.0000)
Manufacturing Production Index	-0.0473 (0.6915)	-0.0846 (0.4092)	-0.1883 (0.7391)	0.4225*** (0.0000)	-0.0936*** (0.0000)	-0.7296*** (0.0000)	0.1215*** (0.0000)	0.7328*** (0.0000)
Money Supply	0.1061 (0.2906)	0.0672 (0.5478)	-0.1959 (0.9156)	0.2598*** (0.0000)	-0.1013*** (0.0002)	0.9236*** (0.0071)	0.1054*** (0.0000)	0.7552*** (0.0000)
Net Financial Assets	-0.2347*** (0.0142)	-0.0751 (0.5285)	2.6217*** (0.0000)	0.3675*** (0.0000)	-0.0860*** (0.0000)	-1.4837*** (0.0000)	0.1517*** (0.0000)	0.7174*** (0.0000)
Repo Rate	0.1909* (0.0870)	0.1201 (0.2099)	-0.0512 (0.9710)	0.1849*** (0.0038)	-0.0078 (0.7937)	-1.1767 (0.3285)	0.1340*** (0.0000)	0.7128*** (0.0000)
Trade Balance	-0.0280 (0.7439)	0.1427 (0.1269)	-1.7615 (0.4805)	-0.0100 (0.7511)	-0.0084 (0.7862)	-1.0607*** (0.0000)	0.1303*** (0.0000)	0.7182*** (0.0000)
Wholesale Price Index	0.0144 (0.8328)	0.1498* (0.0907)	-0.2606 (0.9375)	-0.0939*** (0.0000)	-0.0080 (0.7935)	-0.2580 (0.2703)	0.1353*** (0.0000)	0.7199*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.38: Contemporaneous Effects of News via Order Flow for PKR/ EURO Exchange Rates

News Announcements	PKR/ EURO							
	Returns			Volatility			ARCH Coefficient	GARCH Coefficient
	$\theta_{4,k}$	Ψ_4	$\Phi_{4,k}$	$\vartheta_{4,k}$	Ω_4	$\psi_{4,k}$	α	β
Euro Zone Macroeconomic News Announcements								
Consumer Price Index	0.0410 (0.5171)	0.1418 (0.3839)	0.1883 (0.7982)	0.0315*** (0.0003)	0.0528*** (0.0000)	-0.6294*** (0.0000)	0.0223*** (0.0000)	0.9740*** (0.0000)
Industrial Production	-0.1742** (0.0165)	0.1903 (0.2818)	0.6744 (0.7916)	-0.0156** (0.0459)	0.0750*** (0.0000)	-1.0362*** (0.0000)	0.0829*** (0.0000)	0.8255*** (0.0000)
Money Supply	-0.0232 (0.7345)	0.1918 (0.2409)	-1.2702 (0.6204)	-0.0176 (0.2251)	0.0228*** (0.0000)	1.1588*** (0.0006)	0.0221*** (0.0000)	0.9741*** (0.0000)
Producer Price Index	0.0480 (0.6440)	0.1827 (0.2855)	0.1630 (0.9752)	0.0334*** (0.0059)	0.0187*** (0.0001)	0.0854 (0.3507)	0.0235*** (0.0000)	0.9725*** (0.0000)
Repo Rate	0.1065 (0.3154)	0.1681 (0.3653)	4.6183 (0.8336)	0.0972*** (0.0000)	0.0379*** (0.0000)	-5.5360** (0.0379)	0.0171*** (0.0000)	0.9774*** (0.0000)
Retail Sales	0.0301 (0.6942)	0.1839 (0.3076)	0.5466 (0.8334)	0.0380*** (0.0004)	0.0365*** (0.0000)	-0.3852 (0.1268)	0.0226*** (0.0000)	0.9736*** (0.0000)
Trade Balance	0.0877 (0.1052)	0.2110 (0.1858)	-0.4148 (0.3144)	-0.0059 (0.3312)	0.0449*** (0.0000)	-0.3926*** (0.0002)	0.0224*** (0.0000)	0.9736*** (0.0000)
Unemployment Rate	-0.0293 (0.6728)	0.1842 (0.3033)	-3.8823 (0.3437)	-0.0244*** (0.0039)	0.0230*** (0.0000)	-0.6338 (0.1073)	0.0209*** (0.0000)	0.9756*** (0.0000)
Pakistan Macroeconomic News Announcements								
Consumer Price Index	0.0687 (0.4416)	0.1582 (0.3588)	-2.5650 (0.2550)	0.0670*** (0.0000)	0.0389*** (0.0000)	-1.0115*** (0.0000)	0.0183*** (0.0000)	0.9760*** (0.0000)
Foreign Exchange Reserves	0.0559 (0.6015)	0.1921 (0.2711)	-2.0985 (0.4089)	0.0213** (0.0362)	0.0289*** (0.0000)	-0.3447 (0.2504)	0.0225*** (0.0000)	0.9737*** (0.0000)
Manufacturing Production Index	-0.0316 (0.5656)	0.1799 (0.2374)	0.0645 (0.9510)	0.0221* (0.0773)	-0.0272*** (0.0000)	0.5881*** (0.0000)	0.0197*** (0.0000)	0.9753*** (0.0000)
Money Supply	0.2007*** (0.0007)	0.1994 (0.2482)	-0.4570 (0.7496)	0.0242* (0.0972)	0.0213*** (0.0000)	0.0523 (0.1812)	0.0228*** (0.0000)	0.9733*** (0.0000)
Net Financial Assets	-0.1218* (0.0681)	0.1291 (0.2690)	-4.1779** (0.0187)	0.2751*** (0.0000)	-0.0855*** (0.0001)	3.0018** (0.0157)	0.0998*** (0.0000)	0.7759*** (0.0000)
Repo Rate	0.0474 (0.5252)	0.1849 (0.2547)	0.8589 (0.2262)	0.1017*** (0.0000)	0.0272*** (0.0000)	-0.4957*** (0.0001)	0.0221*** (0.0000)	0.9718*** (0.0000)
Trade Balance	0.0161 (0.8588)	0.1882 (0.3013)	-0.2534 (0.9374)	0.0204*** (0.2499)	0.0166*** (0.0000)	1.3640*** (0.0018)	0.0217*** (0.0000)	0.9745*** (0.0000)
Wholesale Price Index	0.0645 (0.3165)	0.1703 (0.2689)	-0.2439 (0.9514)	0.0749*** (0.0000)	0.0168*** (0.0000)	0.8050*** (0.0000)	0.0176*** (0.0000)	0.9757*** (0.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

5.3.3.2- Pure Effects and Contemporaneous Effects of News via Order Flow

To examine the pure effects and contemporaneous effects of all of the macroeconomic news via order flow on exchange rate returns and exchange rate volatility during announcement periods, equations (4.21) and (4.23) are estimated.

The results in tables (5.39) to (5.42) present the estimated contemporaneous and pure effects of all macroeconomic news announcements via order flow and their announcements period dummies on Pak rupee exchange rate returns and their volatilities. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns. For Pak rupee exchange rate volatility, GARCH (1,1) and EGARCH (1,1) models are used.

The order flow negatively and significantly affect PKR/USD exchange rate returns and volatility. The negative effect implies the net sale of USD which in turn causes depreciation of USD against PKR and raises the PKR/USD exchange rate volatility. The order flow positively and significantly affects PKR/GBP exchange rate returns and negatively and significantly affects PKR/GBP exchange rate volatility. The positive effect implies the net purchase of GBP which in turn causes an appreciation of GBP against PKR and the negative effect implies order flow reduces PKR/USD exchange rate volatility. The positive effects of order flow are associated with demanding liquidity due to portfolio rebalancing by market agents that involves in foreign exchange trading. The negative effect of order flow are associated with supplying liquidity when market agents respond to exchange rates changes by buying (selling) more foreign currencies when foreign currencies are less (more) expensive (Gradojevic & Neely, 2009). The coefficients of order flow are positive and significant for most of the news implying that the purchase of foreign

currencies causes an appreciation in foreign currencies relative to domestic currency. The positive results are in line with Evans and Lyons (2002a). However, coefficients of order flow are negative and significant for few of news implying that the sale of foreign currencies causes depreciation in foreign currencies relative to domestic currency. These negative results are because of negative feedback trading which is similar to findings by Marsh and O'Rourke (2005).

Most of the macroeconomic news announcements via order flow significantly affect PKR/USD exchange rate returns only. However, macroeconomic news announcements via order flow do not significantly affect PKR/GBP, PKR/JPY, and PKR/EURO exchange rate returns and their volatilities. Further, the finding also reveals that order flow intensifies the effects of macroeconomics news substantially which is in line with Evans and Lyons (2008) and Savaser (2011). Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes the foreign exchange market, it affects the decisions of market makers, influencing order flow, and then exchange rates.

The results show PKR/USD exchange rate returns and volatility react significantly to most of US and PAK macroeconomic news announcement period dummies. However, the PKR/GBP, PKR/JPY, and PKR/EURO exchange rate returns and their volatilities react significantly to few foreign and domestic macroeconomic news announcement period dummies.

Table 5.39: Pure Effects and Contemporaneous Effects of News via Order Flow for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns			Volatility		
	$\theta_{1,k}$	$\lambda_{1,k}$	$\Phi_{1,k}$	$\vartheta_{1,k}$	$\eta_{1,k}$	$\psi_{1,k}$
US Macroeconomic News Announcements						
Business Inventories	-0.0066 (0.1647)	1.0588*** (0.0000)	0.0725 (0.7506)	-1.5695*** (0.0000)	1.4838** (0.0147)	-0.0597 (0.9969)
Consumer Price Index	0.0043 (0.4117)	0.0018 (0.2218)	0.0737 (0.4126)	0.9845 (0.0267)	-1.2526*** (0.0056)	0.5456 (0.9036)
Durable Goods Orders	-0.0075 (0.8073)	-0.0016 (0.4246)	0.0521 (0.3657)	-0.4574 (0.2200)	0.1215 (0.7966)	-0.1055 (0.9929)
Federal Budget Balance	0.1386*** (0.0000)	-0.0187*** (0.0000)	-2.3138*** (0.0000)	-2.0866*** (0.0000)	2.0321*** (0.0000)	0.1749 (0.9935)
Industrial Production	0.0603*** (0.0000)	-0.0687*** (0.0000)	1.1327*** (0.0000)	0.9653* (0.0732)	-1.7270*** (0.0007)	0.1136 (0.9720)
Producer Price Index	0.0020 (0.6018)	0.0353*** (0.0000)	-0.5229*** (0.0001)	2.3662*** (0.0000)	-1.8516*** (0.0001)	-0.1662 (0.9676)
Repo Rate	-0.4735*** (0.0000)	0.0100*** (0.0096)	0.7128 (0.8663)	1.9660*** (0.0000)	0.9831** (0.0415)	0.0196 (0.9999)
Retail Sales	-0.0467*** (0.0000)	-1.0072*** (0.0000)	0.7149*** (0.0001)	0.5142 (0.2103)	0.5187*** (0.0051)	0.1939 (0.9663)
Trade Balance	0.0144*** (0.0000)	-0.0429*** (0.0000)	0.8854*** (0.0000)	-2.4407*** (0.0000)	2.0760*** (0.0000)	0.8437 (0.9051)
Unemployment Rate	0.0244*** (0.0000)	-0.0011 (0.3022)	0.4756*** (0.0000)	-2.7941*** (0.0000)	2.6175*** (0.0000)	0.1114 (0.9927)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0132*** (0.0000)	0.0133*** (0.0000)	-0.0097 (0.4069)	2.2808*** (0.0000)	-3.2080*** (0.0000)	-0.3722 (0.9460)
Foreign Exchange Reserves	-0.0672*** (0.0000)	0.0027** (0.0161)	-1.5174*** (0.0000)	-0.0414 (0.8768)	-1.7745*** (0.0000)	0.7385 (0.8897)
Manufacturing Production Index	0.0469*** (0.0000)	0.0251*** (0.0000)	-0.9378*** (0.0000)	1.9744*** (0.0000)	-3.465*** (0.0000)	0.0888 (0.9513)
Money Supply	-0.0141*** (0.0000)	0.0111*** (0.0000)	0.0875*** (0.0000)	-0.7219*** (0.0007)	-2.3442*** (0.0000)	5.5865** (0.0161)
Net Financial Assets	-0.0252*** (0.0021)	0.0113*** (0.0000)	1.1898*** (0.0000)	1.8614*** (0.0000)	-3.5348*** (0.0000)	0.7475 (0.7443)
Repo Rate	0.0527*** (0.0000)	0.0160*** (0.0000)	-0.5832*** (0.0003)	-0.2968 (0.3630)	-0.5827 (0.1156)	-0.4753 (0.9539)
Trade Balance	0.0051*** (0.0000)	0.0119*** (0.0000)	0.3407*** (0.0000)	-1.2904** (0.0134)	-0.8101 (0.1250)	-0.08230 (0.9878)
Wholesale Price Index	-0.0151*** (0.0000)	-0.0159*** (0.0000)	0.0317 (0.5180)	0.9606 (0.1426)	-1.9451*** (0.0019)	0.7822 (0.9564)
	Ψ_1			Ω_1		
Order Flow	-0.0305*** (0.0000)			-4.5400*** (0.0006)		
α_1 ARCH-Co				0.5336** (0.0122)		
β_1 GARCH-Co				0.8175*** (0.0000)		

π_1 EGARCH-Co	-0.4088*** (0.0000)
π_2 EGARCH-Co	0.8064*** (0.0000)
G.E.D.(DF)	0.3858*** (0.0000)
Log likelihood	1237.420
LM-ARCH 1-2	0.0223 (0.9779)
LM-ARCH 1-5	0.0215 (0.9998)
LM-ARCH 1-10	0.0256 (1.0000)
LB- Q(10)	5.2820 (0.8091)
LB- Q(20)	8.9086 (0.9749)
LB- $Q(10)^2$	0.2548 (0.9999)
LB- $Q(20)^2$	0.4419 (1.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.40: Pure Effects and Contemporaneous Effects of News via Order Flow for PKR/GBP Exchange Rates

News Announcements	PKR/GBP					
	Returns			Volatility		
	$\theta_{2,k}$	$\lambda_{2,k}$	$\Phi_{2,k}$	$\vartheta_{2,k}$	$\eta_{2,k}$	$\psi_{2,k}$
UK Macroeconomic News Announcements						
Average Earnings Index	-0.1578*** (0.0459)	0.0166 (0.9663)	0.1317 (0.8948)	0.0362 (0.5888)	0.1014 (0.9208)	0.2331 (0.7375)
Consumer Price Index	0.0624 (0.3769)	0.1263 (0.1354)	-0.0689 (0.9827)	0.0787 (0.1568)	-0.0084 (0.8781)	-0.4660 (0.8110)
Housing Price Index	-0.0335 (0.5803)	-0.1606 (0.0139)	0.1900 (0.9132)	-0.0613* (0.0559)	0.0533 (0.3513)	0.2867 (0.6613)
Industrial Production	-0.0404 (0.5648)	0.0643 (0.2569)	-0.0784 (0.9775)	-0.0084 (0.8618)	-0.0519 (0.2104)	0.1361 (0.9098)
Money Supply	-0.1842** (0.0497)	-0.1994 (0.0097)	-0.0751 (0.9464)	-0.1598*** (0.0010)	0.3050*** (0.0000)	-0.4674 (0.4843)
Producer Price Index	0.0175 (0.7889)	-0.1648 (0.0323)	0.1284 (0.9597)	-0.0580 (0.2286)	0.1407** (0.0191)	-0.3446 (0.8319)
Repo Rate	0.0215 (0.8315)	0.0226 (0.7589)	0.0139 (0.9986)	0.1096 (0.4282)	0.1008*** (0.0112)	0.0337 (0.9958)
Retail Sales	0.1036** (0.0443)	0.0121 (0.8018)	0.1028 (0.9527)	0.0345 (0.2942)	-0.0530 (0.1316)	-0.6761 (0.5015)
Trade Balance	0.0187 (0.7722)	-0.1700 (0.0083)	0.0086 (0.9940)	-0.0784* (0.0867)	0.1305** (0.0406)	0.1649 (0.8181)
Unemployment Rate	-0.0123 (0.8482)	0.0223 (0.9547)	0.2291 (0.8757)	0.0315 (0.4601)	-0.1785 (0.8612)	-0.1588 (0.8924)

Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0463 (0.5475)	-0.0364 (0.6073)	-0.1218 (0.9198)	-0.0720 (0.1754)	0.0301 (0.5890)	0.3978 (0.5019)
Foreign Exchange Reserves	-0.0631 (0.4082)	-0.1856*** (0.0008)	-0.0277 (0.9927)	-0.0561*** (0.0000)	-0.0407 (0.3820)	0.1147 (0.8921)
Manufacturing Production Index	-0.0484 (0.5256)	-0.0731 (0.2772)	-0.1512 (0.9241)	0.0427 (0.3798)	0.1423*** (0.0065)	0.3283 (0.6302)
Money Supply	0.1157** (0.0146)	0.0166 (0.9905)	-0.2084 (0.8345)	0.0393 (0.2577)	-0.0757* (0.0937)	0.1298 (0.2773)
Net Financial Assets	-0.0512 (0.6247)	-0.0866 (0.1181)	-0.2236 (0.8727)	0.2411*** (0.0033)	-0.1576*** (0.0000)	0.1861 0.8171
Repo Rate	0.1855** (0.0181)	0.1091** (0.0342)	-0.0198 (0.9900)	0.1240*** (0.0022)	-0.0345 (0.3005)	0.0070 (0.9955)
Trade Balance	-0.0042 (0.9611)	-0.0302 (0.5826)	-0.0429 (0.9845)	0.0269 (0.5289)	0.0914*** (0.0093)	-0.1603 (0.8229)
Wholesale Price Index	0.0199 (0.7647)	-0.1827*** (0.0001)	0.1934 (0.9016)	0.1184** (0.0327)	-0.0953*** (0.0032)	0.0593 (0.8849)
	Ψ_2			Ω_2		
Order Flow	0.2934* (0.0850)			-0.1270*** (0.0040)		
α_1 ARCH-Co	0.1371*** (0.0000)					
β_1 GARCH-Co	0.6892*** (0.0000)					
Log likelihood	-2889.61					
LM-ARCH 1-2	1.3486 (0.2598)					
LM-ARCH 1-5	0.59945 (0.7004)					
LM-ARCH 1-10	0.5356 (0.8660)					
LB- Q(10)	10.8017 (0.1475)					
LB- Q(20)	21.8330 (0.1912)					
LB- $Q(10)^2$	5.3921 (0.7149)					
LB- $Q(20)^2$	7.9534 (0.9793)					

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.41: Pure Effects and Contemporaneous Effects of News via Order Flow for PKR/JPY Exchange Rates

News Announcements	PKR/JPY					
	Returns			Volatility		
	$\theta_{3,k}$	$\lambda_{3,k}$	$\Phi_{3,k}$	$\vartheta_{3,k}$	$\eta_{3,k}$	$\psi_{3,k}$
Japanese Macroeconomic News Announcements						
All Industries Activity Index	0.0163 (0.7567)	0.0091 (0.8668)	0.0146 (0.9930)	-0.0306 (0.4243)	-0.1321*** (0.0025)	0.0118 (0.9921)
Consumer Price Index	-0.0660 (0.2456)	-0.0263 (0.6879)	0.0613 (0.9694)	-0.0144 (0.7115)	-0.0795 (0.1105)	-0.0322 (0.9258)
Industrial Production	-0.0277 (0.7330)	0.0264 (0.7234)	0.0488 (0.9557)	0.0238 (0.9474)	-0.0833 (0.1866)	0.0937 (0.8920)
Machinery Orders	0.0292 (0.6935)	-0.0045 (0.9445)	0.0835 (0.9568)	0.0192 (0.7756)	-0.0424 (0.5319)	-0.0514 (0.8630)
Money Supply	-0.0201 (0.9892)	-0.0517 (0.4920)	0.0050 (0.9980)	-0.0423 (0.2312)	0.0645 (0.3394)	-0.0143 (0.9883)
Producer Price Index	-0.0159 (0.7209)	0.0292 (0.6646)	0.0137 (0.9949)	0.0061 (0.8936)	0.0191 (0.7222)	-0.0624 (0.9571)
Repo Rate	0.0047 (0.9699)	-0.0408 (0.5208)	-0.0019 (0.9999)	-0.0012 (0.9874)	0.0194 (0.4856)	0.0090 (0.9999)
Retail Sales	0.0611 (0.2102)	0.0983* (0.0844)	0.0269 (0.9790)	-0.0346 (0.4556)	-0.0748 (0.1288)	0.0512 (0.9182)
Trade Balance	-0.0157 (0.8469)	0.0237 (0.7011)	-0.0121 (0.9931)	-0.0467 (0.1990)	0.1371*** (0.0091)	-0.0170 (0.9779)
Unemployment Rate	-0.0623 (0.4509)	-0.0883 (0.3213)	0.0430 (0.9773)	0.0233 (0.6909)	0.2298*** (0.0002)	-0.0479 (0.9677)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0123 (0.8409)	-0.0943 (0.1467)	0.0249 (0.9845)	0.0296 (0.6337)	-0.0412 (0.4470)	-0.0162 (0.9655)
Foreign Exchange Reserves	-0.0731 (0.2827)	-0.0165 (0.8174)	0.0044 (0.9985)	0.0187 (0.7048)	-0.1053 (0.1265)	-0.0496 (0.9741)
Manufacturing Production Index	-0.0750 (0.2432)	-0.0412 (0.5074)	-0.0043 (0.9957)	-0.0375 (0.4184)	0.1637*** (0.0046)	-0.0394 (0.8867)
Money Supply	0.1465*** (0.0011)	-0.0076 (0.8881)	-0.1292 (0.8588)	0.0142 (0.7078)	-0.0052 (0.8968)	0.0015 (0.9994)
Net Financial Assets	-0.1492 (0.1639)	-0.0339 (0.5613)	0.0320 (0.9725)	0.4765*** (0.0000)	-0.2232*** (0.0000)	0.0217 (0.9848)
Repo Rate	0.1349* (0.0959)	-0.0030 (0.9641)	-0.0112 (0.9931)	0.0262 (0.5732)	0.0262 (0.6163)	0.0137 (0.9889)
Trade Balance	-0.0577 (0.4282)	-0.0353 (0.5731)	-0.0236 (0.9911)	0.0182 (0.7083)	-0.0233 (0.6994)	0.0530 (0.9679)
Wholesale Price Index	0.0208 (0.7450)	0.0291 (0.5334)	-0.0793 (0.9706)	-0.0071 (0.8579)	-0.1079*** (0.0044)	0.0267 (0.9450)
	Ψ_3			Ω_3		
Order Flow	-0.0169 (0.9165)			-0.0784 (0.4638)		
α_1 ARCH-Co				0.1196*** (0.0000)		
β_1 GARCH-Co				0.7354*** (0.0000)		

Log likelihood	-2954.35
LM-ARCH 1-2	0.2810 (0.7550)
LM-ARCH 1-5	0.6536 (0.6587)
LM-ARCH 1-10	0.5178 (0.8787)
LB- Q(10)	5.4541 (0.6047)
LB- Q(20)	12.9981 (0.7363)
LB- $Q(10)^2$	5.1828 (0.7378)
LB- $Q(20)^2$	9.0236 (0.9591)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.42: Pure Effects and Contemporaneous Effects of News via Order Flow for PKR/EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns			Volatility		
	$\theta_{4,k}$	$\lambda_{4,k}$	$\Phi_{4,k}$	$\vartheta_{4,k}$	$\eta_{4,k}$	$\psi_{4,k}$
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.0976** (0.0362)	0.0283 (0.6114)	0.0035 (0.9959)	-0.0291* (0.0813)	-0.0079 (0.7566)	-0.0125 (0.9782)
Industrial Production	-0.2342*** (0.0000)	-0.0526 (0.2142)	0.0021 (0.9981)	-0.01939 (0.4128)	0.0177 (0.6339)	-0.0049 (0.9999)
Money Supply	-0.0447 (0.4253)	0.0115 (0.8077)	-0.0068 (0.9956)	0.0140 (0.7099)	-0.0309 (0.3636)	0.0138 (0.9738)
Producer Price Index	0.0656* (0.0861)	-0.0882* (0.0763)	0.0034 (0.9986)	0.0221 (0.2957)	-0.0339* (0.0837)	-0.0602 (0.8203)
Repo Rate	0.1844* (0.0572)	-0.0239 (0.6616)	0.0062 (1.0000)	0.1513*** (0.0003)	0.0315 (0.3228)	0.0065 (0.9999)
Retail Sales	0.0244 (0.6447)	-0.0815* (0.0625)	-0.0036 (0.9985)	-0.0257 (0.4070)	0.0278 (0.3143)	-0.0034 (0.9958)
Trade Balance	0.1139*** (0.0089)	0.1578*** (0.0006)	0.0116 (0.9837)	-0.0112 (0.5514)	0.0048 (0.9869)	-0.0079 (0.9823)
Unemployment Rate	-0.1231 (0.1776)	-0.0915* (0.0808)	-0.0065 (0.9989)	-0.0205 (0.5698)	0.0686** (0.0204)	0.0181 (0.9882)
Pakistan Macroeconomic New Announcements						
Consumer Price Index	0.0191 (0.7074)	-0.0463 (0.3712)	-0.0123 (0.9914)	0.0615** (0.0395)	-0.1383*** (0.0000)	0.0107 (0.9849)
Foreign Exchange Reserves	-0.0041 (0.9381)	-0.0563 (0.2372)	-0.0064 (0.9947)	-0.0359 (0.2534)	0.0028 (0.9305	0.0197 (0.9472)
Manufacturing Production Index	-0.0180 (0.6722)	-0.1430 (0.0014)	-0.0248 (0.9522)	-0.0596 (0.1373)	0.0087 (0.9981)	0.0788 (0.4644)

Money Supply	0.2580*** (0.0000)	0.0992** (0.0362)	-0.0215 (0.9453)	0.0099 (0.7650)	0.0371 (0.3351)	-0.0421 (0.8294)
Net Financial Assets	-0.2392*** (0.0028)	-0.0743 (0.1238)	-0.0195 (0.9876)	0.1497*** (0.0020)	-0.1122*** (0.0025)	0.0631 (0.8973)
Repo Rate	0.1151 (0.1117)	-0.0366 (0.3990)	0.0139 (0.9866)	0.1424*** (0.0000)	-0.0974*** (0.0004)	-0.0163 (0.9838)
Trade Balance	-0.0162 (0.8301)	-0.0458 (0.3307)	-0.0013 (0.9995)	0.0922*** (0.0012)	-0.0467 (0.1290)	-0.0215 (0.9869)
Wholesale Price Index	0.0393 (0.4352)	-0.1382*** (0.0011)	0.0067 (0.9997)	0.0122 (0.5763)	-0.1292*** (0.0000)	0.0025 (0.9955)
	Ψ_4			Ω_4		
Order Flow	0.0642 (0.6420)			-0.0068 (0.9034)		
α_1 ARCH-Co	0.0993*** (0.0000)					
β_1 GARCH-Co	0.7709*** (0.0000)					
Log likelihood	-2967.092					
LM-ARCH 1-2	1.3503 (0.2593)					
LM-ARCH 1-5	1.1193 (0.3477)					
LM-ARCH 1-10	1.2568 (0.2495)					
LB- Q(10)	5.1349 (0.6434)					
LB- Q(20)	15.9989 (0.5239)					
LB- $Q(10)^2$	11.7474 (0.1628)					
LB- $Q(20)^2$	17.3038 (0.5023)					

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

These results imply that macroeconomic indicators have an announcement effect on Pak rupee exchange rates even after taking into account the news impact. Furthermore, the announcement effects exist not only for Pak rupee exchange rate returns but also for Pak rupee exchange rate volatility.

5.3.3.3- Dynamic Effects of News via Order Flow

To examine the dynamic effects of news of all macroeconomic indicators via order flow on exchange rate returns and exchange rate volatility, news equations (4.24) to (4.26)

are estimated. The estimated coefficients show dynamic effects for all of the foreign and domestic macroeconomic news announcements via order flow on Pak rupee exchange rate returns and their volatilities after announcement periods.

Tables (5.43) to (5.46) present the estimated dynamic effects for all macroeconomic news announcements via order flow on Pak rupee exchange rate returns and their volatilities after announcements periods. For Pak rupee exchange rate returns, different ARMA (p, q) specifications are selected for incorporating serial correlation in exchange rate returns with $J = 2$ lags of each of the K standardized macroeconomic news announcements. For exchange rate volatility, EGARCH (1, 1) and GARCH (1, 1) models with $J' = 2$ lags of each of the K standardized macroeconomic news announcements are used.

The results show that few of macroeconomic news via order flow significantly affect PKR/USD exchange rate returns only after announcement periods. This may be attributed to information asymmetry in the foreign exchange market among the market agents affecting the speed of order flow to incorporate the news. However, none of the macroeconomic news via order flow significantly affect PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns, and volatilities after announcement periods. They also show a significant impact of order flow following the announcement of macroeconomic news on PKR/USD exchange rate returns only. The order flow has instantaneous and significant effects on PKR/USD exchange rate returns only corresponding to after news announcements. There are lagged effects of order flow on PKR/USD exchange rate returns corresponding to after the release of the news. Further, the role of order flow to convey private/ incremental information with the release of public news which increases

information asymmetry among market agents is identified in PKR/USD exchange rate returns only.

The Pak rupee exchange rate returns and volatility react significantly to macroeconomic announcements after announcement periods. The PKR/USD exchange rate returns and volatility react significantly to most of US macroeconomic news announcements and PAK macroeconomic news announcements. They immediately adjust to news i-e full response to news occurs in one day. However, the PKR/GBP, PKR/JPY, PKR/EURO exchange rate returns and their volatilities react significantly to few foreign and domestic macroeconomic announcements. The direction of the effects of macroeconomic news announcements is almost the same as the contemporaneous effects of news. Most of the estimated coefficients of news of macroeconomic indicators are correctly signed as anticipated by the response of the reaction function to news and exchange rate determination models.

The above analysis shows few of macroeconomic news directly and indirectly via order flow affect Pak rupee exchange rate returns after announcement periods. This implies that information asymmetry in the foreign exchange market among the market agents affects the speed of order flow to incorporate the news. Further, the role of order flow to convey private/ incremental information with the release of public news which increases information asymmetry among market agents is identified in Pak rupee exchange rate returns only. Moreover, the finding also reveals that order flow intensifies the effects of macroeconomic news substantially. Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes

the foreign exchange market, it affects the decisions of market makers, influencing order flow, and then exchange rates.

Table 5.43: Dynamic Effects of News via Order Flow for PKR/USD Exchange Rates

News Announcements	PKR/USD					
	Returns			Volatility		
	$\theta_{1,k,0}$	$\theta_{1,k,1}$	$\theta_{1,k,2}$	$\vartheta_{1,k,0}$	$\vartheta_{1,k,1}$	$\vartheta_{1,k,2}$
US Macroeconomic News Announcements						
Business Inventories	-0.0054 (0.2580)	0.0013 (0.8223)	0.0283*** (0.0000)	-0.7247*** (0.0031)	-0.1957 (0.7846)	-0.2356 (0.7024)
Consumer Price Index	0.0092** (0.0115)	-0.0031 (0.2957)	0.0188*** (0.0000)	-0.5006 (0.1291)	-0.6709** (0.0104)	-0.8948*** (0.0037)
Durable Goods Orders	-0.0056*** (0.0011)	-0.0223*** (0.0000)	0.0077*** (0.0000)	-0.2674 (0.3974)	-1.4492*** (0.0000)	-1.7209*** (0.0000)
Federal Budget Balance	0.0164** (0.0112)	-0.0237*** (0.0000)	-0.0272*** (0.0000)	0.6470 (0.3590)	-0.0714 (0.8467)	0.9597 (0.1386)
Industrial Production	0.0356*** (0.0000)	-0.0264*** (0.0000)	-0.0011 (0.6911)	0.2242 (0.5502)	-0.1113 (0.5864)	1.4092*** (0.0023)
Producer Price Index	-0.0408*** (0.0000)	-0.0188*** (0.0000)	0.0137*** (0.0006)	-0.2681 (0.3346)	0.6328 (0.2916)	-0.7915*** (0.0028)
Repo Rate	-0.2861*** (0.0000)	-0.7131*** (0.0000)	-0.0008 (0.8968)	0.6649** (0.0135)	1.9984*** (0.0007)	-0.5703** (0.0196)
Retail Sales	-0.0568*** (0.0000)	-0.0132*** (0.0002)	-0.0257*** (0.0000)	0.4199 (0.2219)	0.0297 (0.9656)	0.0383 (0.9495)
Trade Balance	-0.0283*** (0.0000)	-0.0448*** (0.0000)	0.0340*** (0.0000)	-1.8000*** (0.0000)	0.6740 (0.1634)	-0.4844 (0.3197)
Unemployment Rate	-0.0383*** (0.0000)	0.0210*** (0.0001)	-0.0203*** (0.0000)	0.3418 (0.3297)	0.8601 (0.1314)	-0.7147** (0.0801)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0100*** (0.0000)	-0.0801*** (0.0000)	0.0107*** (0.0000)	-1.6447*** (0.0000)	0.9611* (0.0972)	-0.7044* (0.0736)
Foreign Exchange Reserves	-0.1819*** (0.0000)	-0.0232*** (0.0000)	-0.0612*** (0.0000)	1.4532** (0.0001)	-0.7280* (0.0456)	0.4204** (0.2682)
Manufacturing Production Index	0.0011 (0.4664)	0.0408*** (0.0000)	0.0121*** (0.0011)	-0.5484 (0.1179)	1.0854 (0.1660)	-0.9856*** (0.0058)
Money Supply	-0.0290*** (0.0000)	-0.0383*** (0.0000)	0.0442*** (0.0000)	-0.8360 (0.1651)	-0.9069*** (0.0280)	0.5287 (0.4279)
Net Financial Assets	-0.0258*** (0.0000)	-0.1041*** (0.0000)	0.0192*** (0.0008)	1.8287*** (0.0001)	2.6202*** (0.0000)	0.4518*** (0.2586)
Repo Rate	0.2524*** (0.0000)	-0.0058 (0.1275)	0.0193*** (0.0000)	0.7386* (0.0951)	0.0934 (0.8768)	-1.2118*** (0.0000)
Trade Balance	0.0069** (0.0142)	-0.0376*** (0.0000)	-0.1138*** (0.0000)	-1.4043*** (0.0000)	-1.1891*** (0.0020)	-0.4461 (0.2749)
Wholesale Price Index	0.0061*** (0.0000)	-0.0012 (0.4476)	-0.0279*** (0.0000)	-1.2523*** (0.0000)	-0.7024* (0.0903)	0.4203 (0.3629)
	$\Psi_{1,o}$	$\Psi_{1,1}$	$\Psi_{1,2}$	$\Omega_{1,0}$	$\Omega_{1,1}$	$\Omega_{1,2}$
Order Flow	0.0592*** (0.0000)	-0.0436*** (0.0000)	0.1247*** (0.0000)	-1.4406 (0.5083)	-1.2367 (0.5958)	-0.5236 (0.8069)

	$\Phi_{1,k,0}$	$\Phi_{1,k,1}$	$\Phi_{1,k,2}$	$\psi_{1,k,0}$	$\psi_{1,k,1}$	$\psi_{1,k,2}$
US Macroeconomic News Announcements						
Business Inventories	0.1744 (.2391)	0.3562* (0.0614)	-0.2528 (0.2151)	-0.0574 (0.9979)	0.0144 (0.9995)	-0.0029 (0.9999)
Consumer Price Index	0.0622 (0.3250)	0.0085 (0.8539)	0.3729*** (0.0000)	-0.1580 (0.9837)	-0.0428 (0.9957)	0.0762 (0.9891)
Durable Goods Orders	-0.0661 (0.2504)	0.6545*** (0.0000)	-0.2574*** (0.0000)	-0.0282 (0.9984)	-0.0596 (0.9840)	-0.0960 (0.9888)
Federal Budget Balance	-0.1151 (0.5649)	0.3123*** (0.0000)	0.6981*** (0.0000)	-0.0159 (0.9994)	-0.0561 (0.9980)	0.0181 (0.9994)
Industrial Production	-0.2591 (0.1727)	-0.0493 (0.6906)	0.0102 (0.9094)	-0.0191 (0.9987)	0.0016 (0.9999)	-0.0334 (0.9974)
Producer Price Index	-0.0620 (0.2347)	0.2845*** (0.0064)	-0.2238** (0.0357)	-0.0178 (0.9991)	-0.0450 (0.9988)	-0.0354 (0.9976)
Repo Rate	0.0662 (0.9997)	0.0933 (0.9998)	0.0062 (0.9996)	-0.0004 (1.0000)	0.0042 (1.0000)	-0.0032 (1.0000)
Retail Sales	0.2601*** (0.0023)	0.0047 (0.9361)	0.5813*** (0.0000)	-0.0552 (0.9974)	-0.0505 (0.9971)	0.0144 (0.9984)
Trade Balance	-0.0693** (0.0342)	0.3832*** (0.0000)	-0.1737*** (0.0000)	0.0486 (0.9959)	0.0223 (0.9990)	0.0141 (0.9995)
Unemployment Rate	0.0607 (0.5272)	-0.1138 (0.4853)	-0.1248*** (0.0000)	-0.0071 (0.9997)	0.0381 (0.9985)	0.0030 (0.9999)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.1840*** (0.0000)	0.2460*** (0.0005)	-0.0334 (0.6499)	-0.0278 (0.9930)	0.0358 (0.9944)	-0.0308 (0.9956)
Foreign Exchange Reserves	0.1529 (0.6218)	-0.0304 (0.6010)	0.0343 (0.8520)	0.1642 (0.9909)	0.0209 (0.9982)	-0.0102 (0.9996)
Manufacturing Production Index	-0.0325 (0.1725)	0.0879*** (0.0069)	-0.2039*** (0.0052)	-0.0154 (0.9977)	0.0476 (0.9970)	0.0066 (0.9992)
Money Supply	-0.0100 (0.7915)	-0.1855*** (0.0059)	0.2936*** (0.0000)	0.2363 (0.9401)	0.3623 (0.9383)	0.4399 (0.9035)
Net Financial Assets	0.4150 (0.0013)	-0.1831 (0.6748)	-0.6924*** (0.0000)	0.2200 (0.9808)	0.1444 (0.9791)	0.1316 (0.9949)
Repo Rate	0.6166 (0.1320)	-0.1678** (0.0476)	-1.1911*** (0.0000)	-0.0534 (0.9959)	0.0249 (0.9984)	0.0154 (0.9985)
Trade Balance	0.1934** (0.0204)	-0.0329 (0.5977)	0.5084*** (0.0000)	-0.0852 (0.9928)	-0.0650 (0.9951)	0.0012 (0.9999)
Wholesale Price Index	0.1626*** (0.0003)	-0.0653 (0.3014)	0.1853** (0.0611)	-0.0616 (0.9931)	-0.0766 (0.9952)	0.0073 (0.9996)

α_1 ARCH-Co	0.2354*** (0.0000)
β_1 GARCH-Co	0.6757*** (0.0000)
π_1 EGARCH-Co	-0.4736*** (0.0000)
π_2 EGARCH-Co	0.8865*** (0.0000)
G.E.D.(DF)	0.3174*** (0.0000)
Log likelihood	792.952
LM-ARCH 1-2	0.0201 (0.9801)

LM-ARCH 1-5	0.0246 (0.9997
LM-ARCH 1-10	0.0248 (1.0000)
LB- Q(10)	1.4844 (0.9972)
LB- Q(20)	3.1068 (0.9999)
LB- $Q(10)^2$	0.2441 (0.9999)
LB- $Q(20)^2$	0.4609 (1.0000)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.44: Dynamic Effects of News via Order Flow for PKR/GBP Exchange Rates

	PKR/GBP					
	Returns			Volatility		
	$\theta_{2,k,0}$	$\theta_{2,k,1}$	$\theta_{2,k,2}$	$\vartheta_{2,k,0}$	$\vartheta_{2,k,1}$	$\vartheta_{2,k,2}$
UK Macroeconomic News Announcements						
Average Earnings Index	-0.1185 (0.1927)	-0.0269 (0.6802)	-0.0588 (0.4041)	-0.0211 (0.8023)	0.0048 (0.9594)	-0.0165 (0.8186)
Consumer Price Index	0.1372** (0.0393)	-0.0839, (0.2619)	0.0341 (0.5509)	0.0320 (0.6686)	0.0733 (0.3420)	-0.0651 (0.2214)
Housing Price Index	-0.0632 (0.2033)	-0.0019 (0.9743)	0.0275 (0.6670)	-0.0667 (0.1304)	-0.0352 (0.4041)	0.0480 (0.2690)
Industrial Production	-0.0248 (0.8001)	-0.0364 (0.5372)	-0.0933 (0.2473)	0.0822 (0.3986)	-0.0815 (0.3403)	0.0171 (0.7673)
Money Supply	-0.0699 (0.4480)	-0.0107 (0.8665)	-0.0034 (0.9649)	0.0212 (0.7184)	-0.0582 (0.3623)	-0.0055 (0.9139)
Producer Price Index	-0.0153 (0.8445)	-0.0506 (0.4259)	0.0337 (0.6481)	0.0382 (0.5765)	0.0111 (0.9009)	-0.0480 (0.4770)
Repo Rate	0.0287 (0.7913)	0.0831 (0.3845)	-0.0228 (0.8558)	0.0637 (0.7667)	0.0646 (0.8675)	-0.0226 (0.9337)
Retail Sales	0.1440** (0.0267)	0.0244 (0.6838)	-0.1288** (0.0321)	0.0910 (0.1283)	-0.0985 (0.1737)	-0.0023 (0.9675)
Trade Balance	0.0272 (0.6313)	0.0740 (0.1880)	0.0388 (0.5633)	-0.0306 (0.5597)	0.0156 (0.8183)	-0.0188 (0.7338)
Unemployment Rate	-0.0809 (0.3047)	-0.1943** (0.0138)	0.0485 (0.5051)	0.0424 (0.5672)	-0.0321 (0.7782)	0.0098 (0.9056)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0423 (0.4803)	0.0451 (0.4004)	0.0947 (0.1185)	0.0357 (0.6146)	-0.0556 (0.3618)	0.0506 (0.2359)
Foreign Exchange Reserve	-0.0269 (0.6607)	-0.1106 (0.1796)	-0.0139 (0.8619)	-0.0414 (0.3337)	-0.0164 (0.7304)	0.1010** (0.0276)
Manufacturing Production Index	-0.0841 (0.2496)	-0.0706 (0.1486)	0.0630 (0.3819)	0.0629 (0.5293)	-0.1033 (0.1922)	0.01640 (0.7250)
Money Supply	0.2053*** (0.0000)	0.0955 (0.1787)	-0.0505 (0.1827)	-0.0673*** (0.0020)	0.0509 (0.4426)	-0.0262 (0.6462)
Net Financial Asset	-0.1117 (0.3232)	-0.0556 (0.3899)	-0.1101 (0.2778)	0.1691 (0.1868)	-0.1485 (0.1597)	0.0557 (0.4291)

	0.1725	-0.0633	0.0700	0.1810**	-0.1306	0.0288
Repo Rate	(0.1277)	(0.4143)	(0.4537)	(0.0363)	(0.1964)	(0.7336)
	-0.0185	0.0589	-0.0862	-0.0460	0.1263	-0.0154
Trade Balance	(0.7927)	0.4708)	(0.2089)	(0.1827)	(0.1416)	(0.8322)
Wholesale Price	0.0738	0.0438	0.0518	-0.0109	-0.0185	0.0075
Index	(0.2492)	(0.4506)	(0.3891)	(0.8305)	(0.7697)	(0.8784)
	$\Psi_{2,o}$	$\Psi_{2,1}$	$\Psi_{2,2}$	$\Omega_{2,0}$	$\Omega_{2,1}$	$\Omega_{2,2}$
	0.1082	0.0252	-0.0041	-0.0823	-0.0206	0.1144
Order Flow	(0.7255)	(0.9168)	(0.9881)	(0.6677)	(0.9373)	(0.5527)
	$\Phi_{2,k,0}$	$\Phi_{2,k,1}$	$\Phi_{2,k,2}$	$\psi_{2,k,0}$	$\psi_{2,k,1}$	$\psi_{2,k,2}$
UK Macroeconomic News Announcements						
Average	0.0014	-0.0093	0.0091	0.0142	0.0054	0.0082
Earnings Index	(0.9992)	(0.9912)	(0.9930)	(0.9923)	(0.9979)	(0.9954)
Consumer Price	0.0027	0.0038	-0.0053	-0.0128	-0.0116	-0.0085
Index	(0.9999)	(0.9993)	(0.9986)	(0.9974)	(0.9980)	(0.9980)
Housing	0.0089	-0.0036	-0.0046	-0.0141	-0.0065	0.0258
Price Index	(0.9926)	(0.9974)	(0.9977)	(0.9929)	(0.9957)	(0.9747)
Industrial	-0.0037	-0.0030	-0.0046	0.0025	-0.0081	-0.0062
Production	(0.9991)	(0.9999)	(0.9984)	(0.9992)	(0.9973)	(0.9973)
	-0.0048	0.0015	-0.0023	-0.0022	0.0067	-0.0063
Money Supply	(0.9977)	(0.9988)	(0.9989)	(0.9992)	(0.9972)	(0.9948)
Producer Price	0.0038	-0.0022	0.0066	-0.0092	-0.0151	-0.0098
Index	(0.9987)	(0.9994)	(0.9979)	(0.9976)	(0.9965)	(0.9969)
	0.0093	-0.0026	-0.0015	0.0029	0.0032	0.0002
Repo Rate	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
	-0.0027	-0.0132	-0.0050	-0.0324	-0.0273	-0.0351
Retail Sales	(0.9980)	(0.9937)	(0.9981)	(0.9909)	(0.9918)	(0.9835)
	-0.0027	0.0093	-0.0046	0.0163	0.0108	0.0310
Trade Balance	(0.9975)	(0.9946)	(0.9968)	(0.9754)	(0.9944)	(0.9797)
	0.0069	-0.0049	0.0100	-0.0010	-0.0065	-0.0050
Unemployment Rate	(0.9978)	(0.9998)	(0.9952)	(0.9997)	(0.9983)	(0.9982)
Pakistan Macroeconomic New Announcements						
Consumer Price	-0.0099	-0.0042	0.0096	0.0128	-0.0006	0.0202
Index	(0.9910)	(0.9978)	(0.9955)	(0.9902)	(0.9995)	(0.9801)
Foreign Exchange	-0.0035	0.0065	-0.0046	0.0005	0.0093	0.0079
Reserve	(1.0000)	(0.9984)	(1.0000)	(0.9997)	(0.9958)	(0.9967)
Manufacturing	-0.0100	0.0053	0.0171	0.0015	-0.0066	0.0289
Production Index	(0.9943)	(0.9954)	(0.9914)	(0.9993)	(0.9961)	(0.9742)
	0.0376	0.0167	-0.0070	-0.0067	0.0150	0.0572
Money Supply	(0.9710)	(0.9906)	(0.9909)	(0.9798)	(0.9726)	(0.8795)
	-0.0152	-0.0020	-0.0074	0.0235	-0.0244	-0.0160
Net Financial Asset	(0.9914)	(0.9991)	(0.9998)	(0.9851)	(0.9912)	(0.9938)
	0.0039	-0.0010	0.0035	-0.0018	-0.0154	-0.0101
Repo Rate	(0.9989)	(0.9998)	(0.9993)	(0.9996)	(0.9971)	(0.9974)
	-0.0046	0.0017	-0.0028	-0.0120	-0.0050	-0.0151
Trade Balance	(0.9979)	(0.9992)	(0.9985)	(0.9908)	(0.9978)	(0.9930)
Wholesale Price	0.0045	0.0041	-0.0153	-0.0119	0.0184	0.0455
Index	(0.9987)	(0.9963)	(0.9838)	(0.9895)	(0.9904)	(0.9685)
α_1 ARCH-Co				0.1170*** (0.0000)		
β_1 GARCH-Co				0.7463*** (0.0000)		

Log likelihood	-2888.332
LM-ARCH 1-2	0.9069 (0.4039)
LM-ARCH 1-5	0.5927 (0.7055)
LM-ARCH 1-10	0.4412 (0.9267)
LB- Q(10)	9.5849 (0.1432)
LB- Q(20)	22.5517 (0.1262)
LB- $Q(10)^2$	4.4551 (0.7261)
LB- $Q(20)^2$	6.3464 (0.9905)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.45: Dynamic Effects of News via Order Flow for PKR/JPY Exchange Rates

News Announcements	PKR/JPY					
	Returns			Volatility		
	$\theta_{3,k,0}$	$\theta_{3,k,1}$	$\theta_{3,k,2}$	$\vartheta_{3,k,0}$	$\vartheta_{3,k,1}$	$\vartheta_{3,k,2}$
Japanese Macroeconomic News Announcements						
All Industries Activity Index	0.0107 (0.8671)	-0.0853** (0.0343)	-0.1083 (0.1137)	-0.0460 (0.3712)	-0.0509 (0.4867)	0.0531 (0.4093)
Consumer Price Index	-0.0723 (0.3475)	-0.0224 (0.7947)	-0.0248 (0.6704)	0.0547 (0.5711)	0.0352 (0.7379)	-0.1305 (0.0667)
Industrial Production	-0.0269 0.7112	0.0192 0.8292	-0.0356 0.6023	-0.0328 (0.6553)	0.0888 (0.4510)	-0.0101 (0.9067)
Machinery Orders	-0.0060 (0.9501)	-0.0081 (0.9207)	0.0744 (0.3997)	-0.1218 (0.1931)	-0.0487 (0.5108)	-0.0535 (0.3723)
Money Supply	0.0055 (0.9396)	-0.0366 (0.6394)	0.0282 (0.7279)	-0.0466 (0.2955)	-0.0139 (0.9019)	-0.0526 (0.5737)
Producer Price Index	0.0041 (0.9375)	0.0136 (0.8107)	-0.0793 (0.5105)	-0.0123 (0.8765)	-0.0674 (0.3692)	0.1035 (0.1579)
Repo Rate	0.0134 (0.9327)	0.0187 (0.9468)	0.0132 (0.9665)	-0.0204 (0.9373)	-0.0031 (0.9966)	-0.0123 (0.9824)
Retail Sales	0.0702 (0.2496)	-0.0858 * (0.0549)	-0.1351* (0.0675)	-0.0425 (0.3490)	-0.0553 (0.1906)	0.0697 (0.2662)
Trade Balance	-0.0216 (0.8146)	0.0578 (0.5724)	-0.0535 (0.4714)	0.0138 (0.8543)	0.1618 (0.1131)	-0.1022 (0.2061)
Unemployment Rate	-0.0151 (0.8677)	0.0196 (0.8575)	-0.0195 (0.7962)	0.0480 (0.6327)	0.0931 (0.4769)	-0.0032 (0.9737)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0307 (0.6414)	0.0364 (0.6091)	-0.0616 (0.5591)	0.0161 (0.8508)	0.0167 (0.8618)	0.0629 (0.5630)
Foreign Exchange Reserve	-0.0986 (0.3714)	-0.0517 (0.6705)	-0.0339 (0.7902)	0.0636 (0.5718)	0.0529 (0.7807)	0.1475 (0.3742)
Manufacturing Production Index	-0.0647 (0.4689)	0.0040 (0.9642)	0.0065 (0.9635)	0.0442 (0.6610)	0.0627 (0.6278)	0.0935 (0.4765)

	0.1226	0.0420	-0.0918	0.0418	0.0990	0.0266
Money Supply	(0.1349)	(0.6611)	(0.2979)	(0.7088)	(0.3518)	(0.7988)
	-0.1415	0.0474	-0.0485	0.5950 *	-0.0985	-0.0473
Net Financial Asset	(0.4631)	(0.8150)	(0.7232)	(0.0839)	(0.7755)	(0.7918)
	0.1310	0.0362	0.1094	0.1467	-0.0933	-0.0036
Repo Rate	(0.4591)	(0.7314)	(0.1209)	(0.4240)	(0.6035)	(0.9739)
	-0.0244	-0.00074	0.0438	-0.0114	0.0980	0.0349
Trade Balance	(0.5952)	(0.9914)	(0.5786)	(0.9133)	(0.4065)	(0.7160)
Wholesale Price	-0.0046	-0.0387	0.0424	-0.0663	0.0682	-0.0039
Index	(0.9524)	(0.5961)	(0.6314)	(0.2923)	0.4173)	(0.9592)
	$\Psi_{3,o}$	$\Psi_{3,1}$	$\Psi_{3,2}$	$\Omega_{3,0}$	$\Omega_{3,1}$	$\Omega_{3,2}$
	0.0272	0.0380	0.0415	-0.0687	-0.0358	0.0221
Order Flow	(0.9391)	(0.9179)	(0.8795)	(0.8741)	(0.9506)	(0.9491)
	$\Phi_{3,k,0}$	$\Phi_{3,k,1}$	$\Phi_{3,k,2}$	$\Psi_{3,k,0}$	$\Psi_{3,k,1}$	$\Psi_{3,k,2}$
Japanese Macroeconomic News Announcements						
All Industries	0.0010	0.0012	-0.0018	0.0030	0.0053	0.0130
Activity Index	(0.9998)	(0.9999)	(0.9995)	(0.9993)	(0.9988)	(0.9959)
Consumer Price	0.0061	0.0072	-0.0099	-0.0121	-0.0135	-0.0103
Index	(0.9982)	(0.9977)	(0.9965)	(0.9956)	(0.9966)	(0.9962)
Industrial	0.0048	-0.0102	-0.0017	-0.0032	-0.00059	-0.0017
Production	(0.9979)	(0.9926)	(0.9988)	(0.9978)	(0.9997)	(0.9990)
	0.0091	0.0030	-0.0017	-0.0161	-0.0151	-0.0046
Machinery Orders	(0.9970)	(0.9989)	(0.9993)	(0.9857)	(0.9923)	(0.9965)
	-0.00015	-0.0046	-0.0028	-0.0123	-0.0111	-0.0123
Money Supply	(0.9999)	(0.9992)	(0.9994)	(0.9951)	(0.9982)	(0.9977)
Producer Price	-0.0017	0.00064	-0.0031	-0.0087	-0.0099	-0.0041
Index	(0.9997)	(0.9999)	(0.9993)	(0.9981)	(0.9974)	(0.9981)
	-0.00025	0.00032	-0.000009	0.00080	0.00068	0.00052
Repo Rate	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
	0.0038	0.0070	-0.0256	0.0181	0.0312	0.0491
Retail Sales	(0.9989)	(0.9961)	(0.9884)	(0.9929)	(0.9890)	(0.9706)
	-0.0032	-0.0028	-0.0089	0.0028	0.0052	0.0009
Trade Balance	(0.9988)	(0.9989)	(0.9954)	(0.9986)	(0.9984)	(0.9996)
	0.0079	0.0018	-0.0015	-0.0012	-0.0014	-0.0115
Unemployment Rate	(0.9972)	(0.9995)	(0.9996)	(0.9997)	(0.9998)	(0.9970)
Pakistan Macroeconomic News Announcements						
Consumer Price	0.0074	0.0015	-0.0121	-0.0193	-0.0129	-0.0041
Index	(0.9974)	(0.9982)	(0.9898)	(0.9836)	(0.9956)	(0.9981)
Foreign Exchange	-0.00068	-0.0010	-0.00077	-0.0083	-0.0071	-0.0041
Reserve	(0.9999)	(0.9999)	(0.9999)	(0.9982)	(0.9987)	(0.9991)
Manufacturing	-0.0044	0.0093	0.0084	-0.0328	-0.0226	-0.0168
Production Index	(0.9982)	(0.9920)	(0.9912)	(0.9656)	(0.9848)	(0.9856)
	-0.0017	0.0024	-0.0042	0.0457	0.0716	0.1071
Money Supply	(0.9979)	(0.9992)	(0.9970)	(0.9719)	(0.9626)	(0.9296)
	0.0024	-0.00048	-0.00035	0.0737	-0.0187	-0.0201
Net Financial Asset	(0.9989)	(1.0000)	(1.0000)	(0.9888)	(0.9975)	(0.9955)
	0.0021	0.00053	0.0042	0.00029	-0.0098	-0.0058
Repo Rate	(0.9995)	(0.9999)	(0.9986)	(1.0000)	(0.9982)	(0.9982)
	-0.0046	0.00519	-0.0014	0.0062	0.0071	0.0110
Trade Balance	(0.9982)	(0.9985)	(0.9996)	(0.9981)	(0.9986)	(0.9971)
Wholesale Price	-0.0014	0.0145	-0.0015	0.0135	0.0317	-0.0025
Index	(0.9997)	(0.9932)	(0.9986)	(0.9910)	(0.9773)	(0.9983)

α_1 ARCH-Co	0.1045*** (0.0000)
β_1 GARCH-Co	0.7369*** (0.0001)
Log-likelihood	-2957.65
LM-ARCH 1-2	0.0126 (0.9875)
LM-ARCH 1-5	0.5379 (0.7476)
LM-ARCH 1-10	0.4984 (0.8921)
LB- Q(10)	4.3733 (0.6262)
LB- Q(20)	11.2814 (0.7917)
LB- $Q(10)^2$	5.0137 (0.6582)
LB- $Q(20)^2$	7.9425 (0.9677)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.46: Dynamic Effects of News via Order Flow for PKR/EURO Exchange Rates

News Announcements	PKR/EURO					
	Returns			Volatility		
	$\theta_{4,k,0}$	$\theta_{4,k,1}$	$\theta_{4,k,2}$	$\vartheta_{4,k,0}$	$\vartheta_{4,k,1}$	$\vartheta_{4,k,2}$
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.1010 (0.1412)	0.0184 (0.7387)	0.0999 (0.1688)	0.0243 (0.6323)	-0.0163 (0.7340)	0.1165* (0.0693)
Industrial Production	-0.1817*** (0.0034)	-0.1042 (0.1680)	-0.0695 (0.3272)	0.0156 (0.7336)	0.0823 (0.4043)	-0.1013 (0.1643)
Money Supply	-0.0262 0.7558	-0.0211 0.7917	0.0365 0.6641	0.1287 (0.1053)	0.0386 (0.7080)	-0.0130 (0.8814)
Producer Price Index	0.0493 (0.4477)	-0.1081 (0.1223)	0.0466 (0.6068)	0.0674 (0.2671)	0.0342 (0.7416)	0.0463 (0.6512)
Repo Rate	0.1871** (0.0120)	0.1020** (0.0349)	-0.0879 (0.1433)	0.0078 (0.9100)	0.0844 (0.1523)	-0.1091*** (0.0084)
Retail Sales	0.0188 (0.8190)	-0.0189 (0.8324)	0.0840 (0.2676)	0.0277 (0.7213)	0.1157 (0.2561)	-0.0362 (0.6440)
Trade Balance	0.1086* (0.0913)	-0.0329 (0.5024)	-0.0017 (0.9828)	0.0816 (0.1267)	-0.1317*** (0.0034)	0.0874* (0.0831)
Unemployment Rate	-0.1051 (0.5570)	0.0480 (0.7576)	0.0286 (0.7588)	0.2045 (0.3126)	0.0625 (0.7759)	-0.2292* (0.0579)
Pakistan Macroeconomic News Announcements						
Consumer Price Index	0.0058 (0.9265)	-0.0039 (0.9473)	0.1080* (0.0599)	-0.0134 (0.8419)	-0.0456 (0.4442)	0.0051 (0.9117)
Foreign Exchange Reserve	0.0599 (0.4132)	-0.1163 (0.1704)	0.0016 (0.9869)	-0.0393 (0.5310)	-0.0322 (0.5757)	0.0544 (0.4199)
Manufacturing Production Index	-0.0312 (0.5959)	0.0440 (0.5033)	-0.0198 (0.7322)	0.0276 (0.7018)	-0.0381 (0.5766)	-0.0537 (0.2824)

Money Supply	0.2495*** (0.0009)	0.0073 (0.9218)	-0.0775 (0.1704)	0.0601 (0.5883)	-0.0809 (0.3909)	0.0307 (0.6139)
Net Financial Asset	-0.1686 (0.1601)	-0.0235 (0.5150)	-0.0909 (0.3237)	0.1940** (0.0112)	-0.1549** (0.0262)	0.0273 (0.6426)
Repo Rate	0.1158 (0.2738)	-0.0149 (0.8907)	0.1250 (0.3050)	0.2458*** (0.0023)	-0.1069 (0.2287)	0.1153 (0.1493)
Trade Balance	-0.0274 (0.6862)	0.0589 (0.5388)	0.0417 (0.5537)	0.0406 (0.5130)	0.1190 (0.1301)	0.0479 (0.3911)
Wholesale Price Index	0.0255 (0.7005)	0.0603 (0.4122)	0.0712 (0.3387)	-0.0095 (0.7569)	0.0653 (0.1448)	-0.0218 (0.6910)
	$\Psi_{4,o}$	$\Psi_{4,1}$	$\Psi_{4,2}$	$\Omega_{4,0}$	$\Omega_{4,1}$	$\Omega_{4,2}$
Order Flow	0.0315 (0.8688)	-0.0030 (0.9890)	0.0616 (0.7640)	-0.0503 (0.7874)	-0.0230 (0.9333)	0.0413 (0.8595)
	$\Phi_{4,k,0}$	$\Phi_{4,k,1}$	$\Phi_{4,k,2}$	$\Psi_{4,k,0}$	$\Psi_{4,k,1}$	$\Psi_{4,k,2}$
Euro Zone Macroeconomic News Announcements						
Consumer Price Index	0.0208 (0.9898)	0.0202 (0.9876)	-0.0240 (0.9792)	0.0541 (0.9367)	0.0076 (0.9940)	0.0193 (0.9861)
Industrial Production	0.0024 (0.9985)	-0.00079 (0.9997)	0.0021 (0.9992)	-0.0220 (0.9956)	0.00026 (0.9999)	-0.0075 (0.9954)
Money Supply	-0.0070 (0.9966)	0.0220 (0.9901)	-0.0025 (0.9992)	-0.0662 (0.9389)	-0.0425 (0.9842)	-0.0311 (0.9896)
Producer Price Index	0.0033 (0.9992)	-0.0154 (0.9930)	0.0042 (0.9986)	-0.0161 (0.9857)	-0.0151 (0.9923)	-0.0046 (0.9965)
Repo Rate	0.00059 (1.0000)	0.00067 (1.0000)	0.0014 (0.9999)	0.0012 (1.0000)	0.0015 (1.0000)	0.0010 (1.0000)
Retail Sales	-0.0031 (0.9991)	-0.0013 (0.9996)	-0.0065 (0.9969)	-0.0147 (0.9938)	0.0039 (0.9987)	0.0102 (0.9956)
Trade Balance	0.0052 (0.9961)	0.0097 (0.9932)	0.0147 (0.9924)	0.0343 (0.9715)	0.0231 (0.9838)	-0.0074 (0.9947)
Unemployment Rate	-0.0063 (0.9994)	0.0028 (0.9997)	0.0033 (0.9993)	0.0190 (0.9971)	0.0025 (0.9997)	-0.0042 (0.9992)
Pakistan Macroeconomic New Announcements						
Consumer Price Index	-0.0113 (0.9937)	-0.0042 (0.9979)	0.0062 (0.9973)	-0.0029 (0.9980)	-0.0101 (0.9943)	-0.00008 (1.0000)
Foreign Exchange Reserve	-0.0073 (0.9977)	-0.0090 (0.9981)	-0.0031 (0.9975)	0.0088 (0.9962)	0.0507 (0.9682)	0.0962 (0.8855)
Manufacturing Production Index	-0.0530 (0.9291)	0.0618 (0.9144)	-0.1109 (0.7023)	-0.0361 (0.9583)	-0.0164 (0.9702)	0.0182 (0.9355)
Money Supply	-0.0198 (0.9881)	-0.0101 (0.9957)	0.0224 (0.9815)	-0.0567 (0.9825)	-0.0665 (0.9711)	-0.0703 (0.9181)
Net Financial Asset	-0.0153 (0.9928)	-0.0074 (0.9956)	-0.0093 (0.9969)	0.0352 (0.9666)	0.0033 (0.9981)	0.0037 (0.9981)
Repo Rate	0.0166 (0.9946)	-0.00087 (0.9997)	0.0040 (0.9991)	-0.0041 (0.9996)	-0.0181 (0.9971)	-0.0070 (0.9962)
Trade Balance	-0.0019 (0.9993)	0.0080 (0.9975)	0.0011 (0.9996)	-0.0168 (0.9932)	-0.0132 (0.9960)	-0.0204 (0.9931)
Wholesale Price Index	0.00095 (0.9998)	0.0164 (0.9910)	-0.0123 (0.9908)	-0.0054 (0.9972)	0.0205 (0.9910)	0.0366 (0.9779)
α_1 ARCH-Co				0.1111*** (0.0000)		
β_1 GARCH-Co				0.6074*** (0.0001)		

Log-likelihood	-2861.31
LM-ARCH 1-2	0.7343 (0.4799)
LM-ARCH 1-5	0.3399 (0.8889)
LM-ARCH 1-10	0.5327 (0.8681)
LB- Q(10)	8.1577 (0.5183)
LB- Q(20)	20.2447 (0.3799)
LB- $Q(10)^2$	5.3485 (0.6175)
LB- $Q(20)^2$	12.734 (0.7537)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

The analysis firstly shows the news effects of foreign and domestic macroeconomic indicators on Pak rupee exchange rate returns and their volatilities during and after announcements periods. It points outs average effects correspond to the direct channel for price impact, which is reflected in exchange rates immediately and is consistent with Andersen *et al.* (2003). The analysis shows that only few foreign and domestic macroeconomic news affect Pak rupee exchange rate returns during announcements periods. Many of the macroeconomic news announcements are redundant during announcements periods However, most of the foreign and domestic macroeconomic news affects Pak rupee exchange rate volatility during announcements periods. The macroeconomic indicators also have an announcement period effect on Pak rupee exchange rates even after taking into account the news impact. Furthermore, the announcement period effects exist not only for Pak rupee exchange rate returns but also for Pak rupee exchange rate volatility. Moreover, most of Pak rupee exchange rate returns and Pak rupee exchange rate volatility adjust to most of the foreign and domestic macroeconomic news

announcements immediately i.e full response to news occurs in a day. The pattern of the significance of news is strong only in PKR/USD exchange rates. There are persistence patterns associated with announcements of few news on PAK/USD exchange rate returns and volatility only. The very short-term reaction to the news is drowned very rapidly in subsequent random fluctuations of the exchange rates. The Pak rupee exchange rates react to both real activity and monetary news. The Pak rupee exchange rate returns and their volatilities are responsive to foreign and domestic macroeconomic news announcements with different magnitudes for all the currency pairs.

Secondly, the analysis shows that order flow drives movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. It indicates the role of trade signals and trading strategies of currency traders affecting exchange rates. These results align with Evans and Lyons (2002a) and Marsh and O'Rourke (2005). Further, there are a positive momentum in order flows of PKR/USD and PKR/JPY exchange rate returns i.e positive flows follow positive flows. Whereas a negative momentum in order flows of PKR/USD exchange rate volatility i.e negative flows follow negative flows. The order flow has instantaneous and significant effects on PKR/USD exchange rate returns as well as on PKR/USD exchange rate volatility corresponding to after news announcements. Whereas the order flow has no instantaneous and significant effects on PKR/GBP, PKR/JPY, and PKR/EURO exchange rate returns and their volatilities.

Thirdly, the findings show that releases of foreign and domestic macroeconomic news trigger trading which reveals dispersed information affecting Pak rupee exchange rate returns and their volatilities indirectly during and after announcements periods. It

points outs total effects correspond to the indirect channel for price impact, which is reflected in exchange rates. They also show that the order flow effect varies to the macroeconomic news announcements. Further, the finding also reveals that order flow intensifies the effects of macroeconomics news substantially which is in line with Evans and. Lyons (2008) and Savaser (2011). Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes the foreign exchange market, it affects the decisions of market makers, influencing order flow, and then exchange rates. Moreover, information asymmetry in the foreign exchange market among the market agents affects the speed of order flow to incorporate the news. Therefore, the role of order flow to convey private/ incremental information with the release of public news which increases information asymmetry among market agents is identified in Pak rupee exchange rate returns only.

The results suggest that both macroeconomic news and order flow explain movements in exchange rates especially in PKR/USD exchange rates. Both direct and indirect information channels work during news announcements periods for Pak rupee exchange rate movements. Moreover, they show that macroeconomic news announcements play an important role in predicting Pak rupee exchange rates. Investors can formulate expectations by observing these news in order to take advantage of changes in exchange rates that will affect their portfolio returns.

5.4- The Interdependencies between Exchange Rates and Macroeconomic News Announcements

With the integration of foreign exchange markets, foreign exchange activities are accelerated in the last two decades. The factors such as rapid globalization, speedy trade liberalization, deregulation of financial markets, increased cross-border capital flows, and adoption of a floating exchange rate system increase exchange rate risk and uncertainty in foreign exchange markets. These factors also indicate the occurrence of exchange rates spillovers and transmissions among exchange markets. In recent years, portfolio investments in currencies make the task of understanding the interdependencies between exchange rates of currencies very important (Greenwood-Nimmo *et al.,* 2016; Rajhans & Jain, 2015). The nature of the interdependencies in terms of exchange rate return and volatility spillovers provide information on the impact of shocks that influence exchange rates. The interdependencies between exchange rates of currencies affect the decision-making of foreign currency market participants like investors, traders, and business firms. It also significantly affects the decisions of policy-makers in formulating appropriate economic policies (Kavli & Kotzé, 2014).

In recent years, rapid and frequent exchange rate fluctuations have been observed. The volatility of exchange rates is also increasing. Further, the foreign exchange market participants particularly investors on one hand, who are investing in currencies in a foreign exchange market, make adjustments in currencies' portfolios according to fluctuations in exchange rates of currencies. The dealers on the other hand, who follow trends in different exchange rates in a foreign exchange market, buy and sell currencies according to fluctuations in exchange rates of currencies. The volatility in exchange rates affects the

level of trade in a country which in turn creates risk for exporters and importers. Moreover, the movement in one exchange rate of currencies affects other exchange rates of currencies which in turn affect the economic and financial performance and competitiveness of the country (Rajhans & Jain, 2015).

For the last decade, the Pak rupee depreciates from `62.03 against USD (in Jan 2008) to 154.263 against USD (in Feb 2020). However, the Pak rupee also significantly falls against major currencies. The main reasons behind the depreciation in PKR against major currencies are macroeconomic factors like huge current and trade accounts deficits. The depreciation in PKR against major currencies largely impacts the key sectors like manufacturing and industrial in the economy. Due to increasing cross-border transactions and trade links with other economies, there exist linkages between Pak rupee exchange rates. The uncertainty in the foreign exchange market makes market participants to suffer because of their exposure to different currencies.

This study also examines spillovers both returns and volatility between exchange rates (Pak rupee to US dollar, UK pound, Japanese yen, and Euro exchange rates). It examines the effect of changes or variations in one exchange rate of PKR on other exchange rates of PKR. Further, it investigates the effects of shocks from one exchange rate of PKR to other exchange rates of PKR. Moreover, it also examines the effects of macroeconomic news announcements on Pak rupee exchange rate returns and volatility.

5.4.1- Returns and Volatility Spillovers

To examine the interdependencies between Pak rupee exchange rates, multivariate GARCH (1, 1) with VAR (p) specification (equations 4.27 and 4.28) is estimated. Table 6.1 presents ML estimates of VAR (p) - MGARCH – BEKK (1, 1) model with macroeconomic news announcements. For the mean equations, VAR (p) model with p=1 is selected for incorporating serial correlation with $J = 0$ lag of each of the K standardized macroeconomic news announcements. For the variance-covariance equations, MGARCH-BEKK (1,1) model is selected for capturing the volatility in Pak rupee exchange rates with $J' = 0$ lag of each of the K standardized macroeconomic news announcements.

The results in the conditional mean equations in Table 6.1 indicate that all Pak rupee exchange rate returns are influenced by their own past returns, indicating the existence of their own spillovers over time as δ_{ii} are statistically significant. The PKR/USD exchange rate returns are significantly affected by past returns of PKR/GBP and PKR/EURO exchange rates, showing return spillovers from PKR/GBP and PKR/EURO to PKR/USD exchange rates. The PKR/GBP exchange rate returns are significantly affected by past returns of PKR/USD and PKR/EURO exchange rate, indicating return spillovers from PKR/USD and PKR/EURO to PKR/GBP exchange rates. The PKR/JPY exchange rate returns are significantly affected by past returns of PKR/USD and PKR/GBP exchange rates, showing return spillovers from PKR/USD and PKR/GBP to PKR/JPY exchange rates. The PKR/EURO exchange rate returns are significantly affected by past returns of PKR/USD exchange rates, indicating return spillovers from PKR/USD to PKR/EURO exchange rates. In addition, there are bidirectional return spillovers between PKR/USD and PKR/GBP, and between PKR/USD and PKR/EURO exchange rates. The Pak rupee

exchange rate returns exhibit interdependences on their own past returns and on other exchange rate returns indicating that the Pak rupee exchange rate market is not completely weak-form efficient.

The results in conditional variance-covariance equations in Table 5.47 indicate the volatility persistence of all Pak rupee exchange rates. The diagonal coefficients in matrix A (a_{11}, a_{22}, a_{33}, a_{44}) are statistically significant, implying the volatility of each exchange rate reacts significantly to its own past squared shocks. The PKR/USD has the largest own ARCH effect while PKR/JPY has the smallest own ARCH effect. The diagonal coefficients in matrix B (b_{11}, b_{22}, b_{33}, b_{44}) are statistically significant, implying the volatility of each exchange rate reacts significantly to its own past volatility. The PKR/JPY has the largest own volatility spillover while PKR/USD has the smallest own volatility spillover.

The off-diagonal coefficients in the matrix A (a_{12}, a_{13}, a_{14}, a_{21}, a_{24}, a_{32}, a_{34}, a_{41}, a_{42}, a_{43}) are statistically significant, implying the volatility of each exchange rate reacts significantly to other exchange rates past shocks. The bidirectional ARCH effects is present in all exchange rates. The volatility of PKR/USD exchange rates is significantly affected by past shocks of PKR/EURO, PKR/GBP, and PKR/JPY exchange rates. The volatility of PKR/GBP is significantly affected by past shocks of PKR/USD and PKR/EURO exchange rates. The volatility of PKR/JPY exchange rates is significantly affected by past shocks of PKR/GBP and PKR/EURO, exchange rates. The volatility of PKR/EURO exchange rates is significantly affected by past shocks of PKR/USD PKR/GBP, and PKR/JPY exchange rates. The bidirectional ARCH effects are found between PKR/USD and PKR/GBP, between PKR/USD and PKR/EURO, between PKR/GBP and PKR/EURO, PKR/JPY, and PKR/EURO exchange rates.

The off-diagonal coefficients in the matrix B (b_{12}, b_{13}, b_{14}, b_{24}, b_{32}, b_{42}) are statistically significant, implying the volatility of each exchange rate also reacts significantly to other exchange rates past volatility. The volatility of PKR/USD exchange rates is significantly affected by past volatilities of PKR/GBP, PKR/JPY, and PKR/EURO exchange rates. The volatility of PKR/GBP is significantly affected by the past volatility of PKR/EURO exchange rates. The volatility of PKR/JPY exchange rates is significantly affected by the past volatility of PKR/GBP exchange rates. The volatility of PKR/EURO exchange rates is significantly affected by the past volatility of PKR/GBP exchange rates. The bidirectional volatility spillovers exist between PKR/GBP and PKR/EURO exchange rates. The results also show that own spillovers are always much larger than the cross spillovers. These findings are consistent with the findings of Kumar (2014) and Kumar *et al.* (2016).

These findings show the existence of positive and negative spillovers (returns and volatility) between Pak rupee exchange rates. The positive spillovers are due to monetary factors and negative spillovers are due to fiscal factors. The reason behind the existence of stronger interdependencies in terms of returns and volatility spillovers between Pak rupee exchange rates is the trading behavior of foreign exchange dealers who follow trends in different exchange rates. The adjustment of portfolios by the investors on the basis of exchange rates volatility causes spillovers between the exchange rates. Moreover, political and macroeconomic events exhibit spillover effects from one exchange rate to other exchange rates.

Table 5.47: Returns and Volatility Spillovers between Pak Rupee Exchange Rates

Parameters	PKR/USD	PKR/GBP	PKR/JPY	PKR/EURO
Mean Equations				
	(1, .)	(2, .)	(3, .)	(4 ,.)
	0.0781***	0.0882**	0.1009***	0.0771***
δ(.,1)	(0.0000)	(0.0003)	(0.0076)	(0.0004)
	0.0168***	0.0105**	0.0273***	0.0110
δ(.,2)	(0.0004)	(0.0268)	(0.0363)	(0.2603)
	-0.0029	-0.0119	-0.0377**	0.0045
δ(.,3)	(0.5580)	(0.2839)	(0.0121)	(0.6618)
	-0.0265***	-0.0393***	-0.0187	-0.0556***
δ(.,4)	(0.0000)	(0.0006)	(0.1973)	(0.0000)
Variance Equations				
	1.2799***	0.0061*	-0.0046	0.0190***
a(.,1)	(0.0000)	(0.0958)	(0.1855)	(0.0000)
	1.1385***	0.2448***	-0.0550***	-0.0417**
a(.,2)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	1.1546***	-0.0057	0.1557***	0.0106**
a(.,3)	(0.0000)	(0.4801)	(0.0000)	(0.3397)
	1.0904**	0.0438***	-0.0206***	0.1281***
a(.,4)	(0.0000)	(0.0000)	(0.0137)	(0.0000)
	0.3446**	0.0024	0.0015	-0.0036
b(.,1)	(0.0000)	(0.1807)	(0.4836)	(0.1243)
	-0.6301***	0.9385***	0.0132**	0.0221***
b(.,2)	(0.0000)	(0.0000)	(0.0314)	(0.0012)
	-0.6209***	-0.0112	0.9650***	0.0076
b(.,3)	(0.0000)	(0.1243)	(0.0000)	(0.2826)
	-0.5922***	-0.0158***	0.0016	0.9771***
b(.,4)	(0.0000)	(0.0077)	(0.7680)	(0.0000)
Log-Likelihood	-5574.1198			

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

Table 5.48 shows the diagnostic tests for the multivariate GARCH models. The diagnostic tests, Ljung-Box Q Test, and McLeod-Li Test on standardized residuals and squared standardized residuals show no ARCH effects. The Q-statistic for standardized residuals indicates no sign of serial autocorrelation in standardized residuals at 10 and 20 lags. The Q^2-statistic for squared standardized residuals indicates no sign of serial autocorrelation in squared standardized residuals at 10 and 20 lags.

Table 5.48: Diagnostic Tests

Ljung-Box Q Test on Standardized Residuals	
Q(10)	106.299 (1.000)
Q(20)	1200.984 (1.000)
McLeod-Li Test on Squared Standardized Residuals	
Q^2(10)	9590.020 (1.000)
Q^2(20)	23652.21 (1.000)

5.4.2- Macroeconomic News Announcement Effects

Table 5.49 presents the estimated contemporaneous effects of all of the news of macroeconomic indicators on Pak rupee exchange rate returns and their volatilities during announcement periods. The magnitudes of estimated coefficients of macroeconomic news announcements indicate a surprise of one standard deviation in macroeconomic indicators causes appreciation/depreciation of Pak rupee exchange rates. The results show macroeconomic news announcements from currency pair areas affect Pak rupee exchange rate returns and their volatilities during announcement periods. These findings are consistent with the findings of Andersen *et al.* (2007) and Omrane and Hafner (2015).

In return equation, the positive coefficient of macroeconomic news announcement indicates positive effects on Pak rupee exchange rate returns implying good news (positive surprise) leads to an appreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). The negative coefficient of macroeconomic news announcement indicates negative effects on Pak rupee exchange rate returns implying good news (positive surprise) leads to depreciation of Pak rupee exchange rates and vice versa for bad news (negative surprise). Further, for foreign macroeconomic news announcements, the positive

coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to an appreciation of foreign currencies and vice versa for bad news (negative surprise). The negative coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to depreciation of foreign currencies and vice versa for bad news (negative surprise). For domestic macroeconomic news announcements, the positive coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to depreciation of Pak rupee and vice versa for bad news (negative surprise). While the negative coefficient indicates that good news (positive surprise) representing a higher/stronger than expected announcement leads to an appreciation of the Pak rupee and vice versa for bad news (negative surprise).

In the variance equation, the positive coefficient indicates that good news (positive surprise) representing higher/stronger than expected announcement leads to raise Pak rupee exchange rate volatility while the negative coefficient indicates that good news (positive surprise) representing higher/stronger than expected announcement leads to reduce Pak rupee exchange rate volatility.

Most of the estimated coefficients of news of macroeconomic indicators are correctly signed as anticipated by the response of the reaction function to news and exchange rate determination models. The direction of contemporaneous effects of news of macroeconomic indicators depends on "*the market's belief about both the appropriate exchange rate determination model and the likely reaction of the monetary authorities*"(Almeida *et al.*, 1998).

The results show that only a few foreign and domestic news of macroeconomic indicators have significant contemporaneous effects on Pak rupee exchange rate returns during announcements periods. The news of business inventories and industrial production from the US causes USD appreciation against PKR. The durable goods orders news from the US causes GBP appreciation against PKR. The news of retail sales from Japan leads to JPY appreciation against PKR. These are coherent with the monetary models of Frenkel (1976) and Mussa (1977) that the higher foreign real activity (output) leads to a rise in foreign demand for money which results in appreciation of the foreign currency. It is also consistent with the market belief about the monetary authority's reaction function for an unanticipated monetary tightening that leads to the foreign currency appreciation against PKR. This is because the higher than expected real activity will increase inflation and to curb these inflationary pressures, the monetary authority is likely to raise interest rates causing an appreciation of the foreign currency against PKR. These findings are in line with the results of Almeida *et al.* (1998), Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), and Pearce and Solakoglu (2007), Cai *et al.* (2008), Fatum *et al.* (2012), Cheung *et al.* (2019), and Ben Omrane *et al.* (2020).

The average earnings index and retail sales news from the UK, all industries activity index, industrial production, and retail sales news from Japan cause GBP depreciation against PKR. The news of industrial production from the US and Japan leads to JPY depreciation against PKR. The industrial production news from the UK and Japan and the Euro Zone induces EURO depreciation against PKR. These are coherent with the Mundell-Fleming model that the higher foreign real activity (output) tends to improve the current account which results in depreciation of the foreign currency.

The USD appreciates against PKR with consumer index news from Japan. The GBP appreciates against PKR with news of consumer price index from the UK and producer price index from the US, Japan, and Euro Zone. The news of the consumer price index from Euro Zone and producer price index from the US cause JPY appreciation against PKR. The consumer price index news from Euro Zone and producer price index news from the US and Euro Zone induce an appreciation of EURO against PKR. The appreciation of the foreign currency is caused via the capital account by the higher foreign price level. These are consistent with the market belief about the monetary authority's reaction function that the higher than expected inflation will raise expectations of monetary policy tightening by the monetary authority for price stability which leads to an appreciation of foreign currency against PKR. These findings are aligned with the results of Almeida *et al.* (1998), Andersen *et al.* (2003) Cai *et al.* (2008), Fatum *et al.* (2012), and Cheung *et al.* (2019).

However, the news of consumer index and producer price index from the UK induces USD depreciation against PKR. The consumer price index news from the US leads to the depreciation of GBP against PKR. The producer price index news from the UK causes EURO depreciation against PKR. These are consistent with the monetary model that a higher foreign price level decreases foreign demand for money and thus results in appreciation of the foreign currency. Also, conforms with the findings of Ehrmann and Fratzscher (2005), and Pearce and Solakoglu (2007), and Ben Omrane *et al.* (2020).

The USD appreciates against PKR with employment rate news from Japan and the Euro Zone. The news of employment rates from the US, the UK, and Euro Zone induces appreciation of GBP against PKR. The JPY appreciation against PKR with news of employment rate from the US and Euro Zone. The news of the employment rate from Japan

causes EURO appreciation against PKR. These are consistent with the Keynesian model that higher foreign unemployment decreases foreign consumer spending and decreases foreign price level which results in appreciation of the foreign currency. These conform with findings of Andersen *et al.* (2003), Pearce and Solakoglu (2007), Cai *et al.* (2008), and Omrane *et al.* (2018). However, employment rate news from the Euro Zone leads to depreciation EURO against PKR. These are coherent with the Mundell-Fleming model and findings of Almeida *et al.* (1998), Ehrmann and Fratzscher (2005), and Cheung *et al.* (2019).

The appreciation of USD, GBP, JPY, and EURO against PKR is induced by news of repo rate from Euro Zone which is coherent with sticky- price monetary model that increases in foreign interest rate leads to capital inflows and causes an appreciation of the foreign currency. This is also consistent with the market belief about the reaction function of monetary authority that the higher than expected interest rates may raise expectations of monetary policy tightening by the monetary authority which leads to appreciation of the foreign currencies against PKR. These findings are similar to the results of May *et al.* (2018), and Mpofu and Peters (2017). However, repo rate news from the US causes depreciation of USD, GBP, JPY, and EURO against PKR which is in line with the flexible-price monetary model that increases in foreign interest rate reduces foreign demand for money and causes depreciation of the foreign currency and also with findings of Ehrmann and Fratzscher (2005), Hayo and Neuenkirch (2012).

The JPY appreciation against PKR is caused by the money supply news from the UK which is consistent with monetary models and also with findings of Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), and Omrane *et al.*

(2020). This is also consistent with the market belief about the reaction function of monetary authority that the higher than expected monetary growth may raise expectations of monetary policy tightening by the monetary authority to reduce money demand which leads to an appreciation of the foreign currencies against PKR.

The news of trade balance from Japan and Euro Zone induces EURO appreciation against PKR. The trade balance news from Japan causes an appreciation of USD and GBP against PKR, respectively. The JPY appreciates against PKR with trade balance news from the UK. These are consistent with the balance of payment approach that an improvement in foreign trade balance tends to an appreciation of foreign currency via the current account. These results are conforming with the findings of Andersen *et al.* (2003), Ehrmann and Fratzscher (2005), Pearce and Solakoglu (2007), Cai *et al.* (2008), Fatum *et al.* (2012), and Cheung et al. (2019).

The appreciation of PKR against GBP, JPY, and EURO is caused by money supply news from Pakistan. The trade balance news from Pakistan leads to PKR appreciation against the EURO. The PKR appreciates against USD, GBP, and JPY with wholesale price index news from Pakistan. The repo rate news from Pakistan leads to an appreciation of PKR against USD. These are not consistent with any of the fundamentals models.

The Pak rupee exchange rate volatility reacts significantly to most of the foreign macroeconomic news as well as domestic macroeconomic news during announcement periods. The US federal budget balance news raises PKR/USD exchange rate volatility. As large foreign budget deficit surprises raise real foreign interest rates, which cause capital outflow and thus increases Pak rupee exchange rate volatility. The news of trade balance from the US raises PKR/USD and PKR/EURO, from the UK increases PKR/GBP and

PKR/EURO, from Japan raises PKR/USD, PKR/JPY, PKR/GBP, and PKR/EURO, and from Euro Zone raises PKR/GBP and PKR/JPY exchange rate volatilities. The large foreign trade deficit surprises tend to increase Pak rupee exchange rate volatility via the current account. These results are conforming with the findings of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Andersen *et al.* (2003), Evans and Speight (2010), Neely (2011), and Ben Omrane *et al.* (2020). However, trade balance news from the UK reduces PKR/USD and PKR/JPY, and from Euro Zone reduces PKR/USD exchange rate volatilities.

The unemployment rate news from the US raises PKR/USD, from the UK increases PKR/EURO, and from Euro Zone raises PKR/USD and PKR/GBP exchange rate volatilities. As higher foreign unemployment surprises decrease foreign consumer spending and decrease foreign price level and thus increase Pak rupee exchange rate volatility. These results are aligned with the findings of Andersen and Bollerslev (1998), Evans and Speight (2010), and Ben Omrane *et al.* (2020). However, the news of the unemployment rate from the US reduces PKR/JPY and PKR/EURO, from the UK unemployment rate reduce PKR/GBP, and from Japan employment rate reduces PKR/JPY exchange rate volatilities.

The PKR/USD and PKR/GBP exchange rate volatilities are increased by news of consumer price index from the UK and PKR/GBP exchange rate volatility is raised by consumer price index news from Euro Zone. The higher foreign consumer price index surprises tend to increase Pak rupee exchange rate volatility via capital account. These confirm the findings of Neely (2011), and Omrane and Hafner (2015). However, the consumer price index news from the US decreases PKR/USD and PKR/GBP, from the UK

decreases PKR/EURO, from Japan decreases PKR/JPY exchange rate volatilities. As higher foreign consumer price index surprises decrease foreign demand for money and thus decreases Pak rupee exchange rate volatility. Ben Omrane *et al.* (2020) find the same results.

The business inventories news from the US raises PKR/EURO exchange rate volatility. The news of retail sales from the US increases PKR/USD, PKR/GBP and PKR/EURO, from the UK increase PKR/GBP and PKR/JPY, from Japan raises PKR/JPY, from Euro Zone raises PKR/USD, PKR/GBP, and PKR/EURO exchange rate volatilities. The PKR/GBP and PKR/EURO exchange rate volatilities are increased by housing price index news from the UK. The PKR/USD exchange rate volatility is increased by news of all industries activity index and machinery orders from Japan. The producer price index news from the UK raises PKR/GBP, from Japan increases PKR/GBP and PKR/JPY, from Euro Zone raises PKR/GBP and PKR/EURO exchange rate volatilities. The PKR/GBP, PKR/JPY, and PKR/EURO exchange rate volatilities are raised by industrial production news from Japan. The higher foreign real activity surprises lead to an increase in Pak rupee exchange rate volatility via an increase in foreign demand for money. These findings support the results of Ederington and Lee (1994, 1995), Andersen and Bollerslev (1998), Evans and Speight (2010), Neely (2011), and Ben Omrane *et al.* (2020).

However, volatilities of PKR/USD, PKR/GBP, and PKR/JPY exchange rates are decreased by business inventories news from the US. The PKR/GBP exchange rate volatility is reduced by news of the average earnings index from the UK. The PKR/GBP exchange rate volatility is decreased by durable goods orders news from the US. The news of retail sales from the UK reduces PKR/USD, from Japan reduces PKR/GBP, and from

Euro Zone reduces PKR/JPY exchange rate volatilities. The producer price index news from the US and UK reduces PKR/USD, and from Euro Zone reduces PKR/USD and PKR/JPY exchange rate volatilities. The news of industrial production index from the US decreases PKR/USD, PKR/GBP, from the UK decreases PKR/GBP, from Japan reduces PKR/USD, and from Euro Zone reduces PKR/USD exchange rate volatilities. The higher foreign real activity surprises lead to a decrease in Pak rupee exchange rate volatility via improvement in the current account. These confirm the findings of Neely (2011), and Ben Omrane *et al.* (2020).

The money supply news from the UK reduces PKR/GBP and from Japan decreases PKR/GBP and PKR/JPY exchange rate volatilities. However, the money supply news from Euro Zone raises PKR/USD and PKR/GBP exchange rate volatilities. The news of repo rate from the US increases PKR/USD and PKR/GBP, from the UK raises PKR/GBP, and from Euro Zone increases PKR/JPY and PKR/EURO exchange rate volatilities. A high foreign interest rate leads to capital outflow and thus increases Pak rupee exchange rate volatility. Hayo and Neuenkirch (2012), May *et al.* (2018), and Mpofu and Peters (2017) find similar results. Whereas, repo rate news from Japan reduces PKR/USD exchange rate volatility.

The PKR/USD and PKR/GBP exchange rates volatilities are increased by news of the consumer price index from Pakistan. As higher domestic consumer price index surprises cause an increase in domestic demand for money and thus increases Pak rupee exchange rate volatility. These findings support the results of Omrane & Savaşer (2017), and Maserumule and Alagidede (2017).

The foreign exchange reserves news from Pakistan raises PKR/USD and PKR/GBP, and PKR/JPY exchange rates volatilities. As higher foreign exchange reserves surprises cause an increase in the monetary base which leads to a rise in domestic price level and thus increases Pak rupee exchange rate volatility. The volatilities of PKR/USD and PKR/JPY and PKR/EURO exchange rates increase from the news of the manufacturing production index of Pakistan. As higher domestic real output/income surprises cause increase imports which worsen trade balance and thus increases Pak rupee exchange rate volatility. These results are in line with the findings of Omrane and Hafner (2015), Omrane & Savaşer (2017), and Cheung *et al.* (2019).

The volatilities of PKR/USD and PKR/EURO exchange rates are raised by news of money supply from Pakistan. The higher domestic money supply surprises lead to an increase in Pak rupee exchange rate volatility via a rise in the domestic price level. This is consistent with Cai *et al.* (2008). The net financial assets news of Pakistan increases PKR/USD exchange rates volatilities. As higher net financial assets surprises increase risk premium or expected rate of return and thus increase Pak rupee exchange rate volatility.

The news of the repo rate from Pakistan raises PKR/USD and PKR/GBP exchange rates volatilities. The higher domestic interest rate surprises lead to an increase in Pak rupee exchange rate volatility via the reduction in domestic demand for money. Hayo and Neuenkirch (2012), May *et al.* (2018), and Mpofu and Peters (2017) find the same results. The PKR/USD exchange rate volatility reduces from the news of the wholesale price index and trade balance of Pakistan. The decrease is associated with improvement in the capital account and trade balance surprises which increase net foreign demand for domestic goods and thus reduce Pak rupee exchange rate volatility.

In the analysis, "*the contribution of volatility spillovers from other rates caused by the news announcement, which is explained by the endogenous part of the volatility model, i.e., the significant off-diagonal elements of the parameter matrix D are ignored*" Omrane and Hafner (2015).

Table 5.49: Contemporaneous Effects of News for Pak Rupee Exchange Rates

News Announcements	PKR/USD	PKR/GBP	PKR/JPY	PKR/EURO
Mean Equation				
US Macroeconomic News Announcements				
Business Inventories	0.0169* (0.0754)	0.0371 (0.3966)	0.0485 (0.3274)	-0.0108 (0.7862)
Consumer Price Index	0.0015 (0.7437)	-0.0580** (0.0135)	0.0485 (0.2976)	0.0081 (0.8424)
Durable Goods Orders	-0.0077 (0.5345)	0.0727* (0.0519)	-0.0267 (0.6761)	0.0156 (0.7338)
Federal Budget Balance	0.0101 (0.2915)	0.0345 (0.5022)	0.0182 (0.7054)	0.0294 (0.5628)
Industrial Production	0.0106** (0.0250)	-0.0331 (0.3796)	-0.1171** (0.0120)	-0.0228 (0.6657)
Producer Price Index	-0.0058 (0.7145)	0.0862* (0.0657)	0.1130** (0.0281)	0.0967** (0.0423)
Repo Rate	-0.1046*** (0.0000)	-0.1072*** (0.0066)	-0.2605*** (0.0000)	-0.1552*** (0.0060)
Retail Sales	-0.0081 (0.5372)	-0.0154 (0.6483)	-0.1849*** (0.0000)	-0.0494 (0.1418)
Trade Balance	0.0067 (0.7153)	-0.0053 (0.8763)	0.0797 (0.1136)	0.0142 (0.7156)
Unemployment Rate	0.0085 (0.4413)	0.0880** (0.0146)	0.0763* (0.0727)	-0.0084 (0.7741)
UK Macroeconomic News Announcements				
Average Earnings Index	0.0031 (0.6755)	-0.1041** (0.0403)	-0.0385 (0.5651)	-0.0365 (0.4608)
Consumer Price Index	-0.0187** (0.0453)	0.0489** (0.0110)	-0.0230 (0.6207)	0.0106 (0.6828)
Housing Price Index	0.0108 (0.4034)	-0.0029 (0.7949)	0.0275 (0.5962)	-0.0138 (0.7245)
Industrial Production	0.0056 (0.5002)	-0.0335 (0.3188)	-0.0019 (0.9710)	-0.0403* (0.0911)
Money Supply	-0.0077 (0.5027)	-0.0277 (0.5847)	0.0935* (0.0864)	0.0023 (0.9659)
Producer Price Index	-0.0175* (0.0825)	-0.0090 (0.8429)	0.0084 (0.8570)	-0.0619* (0.0562)
Repo Rate	0.01126 (0.4342)	0.0250 (0.5054)	0.0092 (0.9129)	-0.0145 (0.8213)
Retail Sales	-0.0004 (0.9800)	0.1300*** (0.0001)	0.0212 (0.5582)	0.02712 (0.3748)
Trade Balance	0.0070 (0.6486)	0.0154 (0.7392)	0.0598* (0.0916)	-0.0210 (0.6091)

Unemployment Rate	0.0088 (0.3822)	-0.0708* (0.0558)	-0.0279 (0.5493)	0.0060 (0.8797)
Japanese Macroeconomic News Announcements				
All Industries Activity Index	0.0272 (0.1907)	-0.0770** (0.0206)	-0.0595 (0.3024)	0.0227 (0.5789)
Consumer Price Index	0.0169* (0.0898)	0.0377 (0.5131)	-0.0131 (0.8238)	0.0592 (0.2681)
Industrial Production	-0.0180 (0.1393)	-0.0783* (0.0572)	-0.1140* (0.0806)	-0.1286*** (0.0048)
Machinery Orders	0.0065 (0.7044)	-0.0267 (0.5879)	-0.0402 (0.4781)	-0.0148 (0.7370)
Money Supply	0.0080 (0.5542)	0.0048 (0.9357)	-0.0137 (0.8417)	0.0262 (0.5058)
Producer Price Index	0.0031 (0.8751)	0.0428* (0.0854)	-0.0294 (0.5292)	-0.0211 (0.5671)
Repo Rate	0.0066 (0.6853)	-0.0290 (0.6308)	0.0067 (0.9326)	-0.0626 (0.3475)
Retail Sales	-0.0054 (0.6942)	-0.0766* (0.0847)	0.0765** (0.0413)	-0.0221 (0.6334)
Trade Balance	0.1238*** (0.0000)	0.1739*** (0.0008)	-0.0565 (0.4176)	0.1030** (0.0461)
Unemployment Rate	0.0359*** (0.0002)	0.0443 (0.3189)	-0.0493 (0.4226)	0.0873** (0.0147)
Euro Zone Macroeconomic New Announcements				
Consumer Price Index	0.0104 (0.2912)	0.0456 (0.2471)	0.0979* (0.0790)	0.0797** (0.0447)
Industrial Production	0.0068 (0.5323)	-0.0617 (0.2162)	-0.1743*** (0.0051)	-0.1028** (0.0301)
Money Supply	0.0196 (0.1423)	-0.0048 (0.9210)	0.0024 (0.9717)	-0.0246 (0.5608)
Producer Price Index	0.0065 (0.5718)	0.0610* (0.0576)	0.0178 (0.6552)	0.0534** (0.0254)
Repo Rate	0.0519*** (0.0005)	0.0979* (0.0830)	0.1569*** (0.0045)	0.1335*** (0.0022)
Retail Sales	-0.0084 (0.6114)	-0.0387 (0.4231)	0.0010 (0.9851)	0.0174 (0.6809)
Trade Balance	-0.0082 (0.3604)	0.0051 (0.8796)	0.0053 (0.9176)	0.0819** (0.0168)
Unemployment Rate	0.2114*** (0.0000)	0.1496 *** (0.0003)	0.3340*** (0.0000)	-0.1664*** (0.0000)
Pakistan Macroeconomic News Announcements				
Consumer Price Index	0.0044 (0.6495)	0.0071 (0.8503)	0.0064 (0.8980)	0.0011 (0.9722)
Foreign Exchange Reserves	-0.0058 (0.7553)	-0.0383 (0.5712)	-0.0619 (0.2960)	0.0840 (0.2500)
Manufacturing Production Index	0.0047 (0.8130)	-0.0408 (0.3718)	-0.0671* (0.0907)	-0.0195 (0.6308)
Money Supply	-0.0027 (0.8057)	0.1404*** (0.0029)	0.0889* (0.0867)	0.1746*** (0.0000)
Net Financial Assets	-0.0073 (0.3278)	-0.0177 (0.7286)	-0.0205 (0.7035)	-0.0148 (0.7122)
Repo Rate	0.0118*** (0.0226)	0.0138 (0.8051)	0.0318 (0.6435)	0.0087 (0.8435)
Trade Balance	0.0206 (0.2566)	0.0308 (0.4335)	-0.0191 (0.7574)	0.0413* (0.0592)

Wholesale Price Index	0.0128** (0.0386)	0.0625** (0.0167)	0.0631* (0.0627)	0.0403 (0.2140)
Variance Equation				
US Macroeconomic News Announcements				
Business Inventories	-0.0336* (0.0786)	-0.0810** (0.0301)	-0.0612 ** (0.0441)	0.0618** (0.0189)
Consumer Price Index	-0.0235*** (0.0000)	-0.0407* (0.0781)	-0.0464 (0.1450)	-0.0237 (0.5411)
Durable Goods Orders	-0.0201 (0.3865)	-0.0471*** (0.0000)	-0.0141 (0.8117)	-0.0043 (0.8945)
Federal Budget Balance	0.0192*** (0.0052)	0.0070 (0.8745)	0.0101 (0.8040)	-0.0127 (0.7514)
Industrial Production	-0.0720*** (0.0000)	-0.0434* (0.0960)	0.0411 (0.2222)	-0.0043 (0.9296)
Producer Price Index	-0.0850*** (0.0001)	-0.0561 (0.1765)	-0.0274 (0.5437)	-0.0253 (0.5690)
Repo Rate	0.1092*** (0.0000)	0.1294*** (0.0001)	0.0360 (0.4956)	0.0154 (0.4391)
Retail Sales	0.1959*** (0.0000)	0.1674*** (0.0000)	0.0234 (0.6891)	0.0374** (0.0129)
Trade Balance	0.0694*** (0.0000)	-0.0199 (0.4157)	-0.0039 (0.9322)	0.0394** (0.0154)
Unemployment Rate	0.0545*** (0.0000)	-0.0201 (0.4075)	-0.0579* (0.0556)	-0.0562*** (0.0000)
UK Macroeconomic New Announcements				
Average Earnings Index	0.00834 (0.5331)	-0.0914*** (0.0085)	-0.0264 (0.3843)	-0.0074 (0.8633)
Consumer Price Index	0.0420** (0.0302)	0.1504*** (0.0000)	-0.0647* (0.0975)	-0.0327*** (0.0031)
Housing Price Index	-0.0015 (0.7668)	0.1019*** (0.0003)	0.0218 (0.5754)	0.0556* (0.0561)
Industrial Production	-0.0186 (0.2941)	-0.1053*** (0.0000)	0.0114 (0.8022)	-0.0132 (0.3822)
Money Supply	0.0017 (0.9053)	0.0443 (0.2605)	0.0643** (0.0165)	-0.0305 (0.2631)
Producer Price Index	-0.0184** (0.0470)	0.0764** (0.0484)	-0.0205 (0.5218)	0.0115 (0.7579)
Repo Rate	-0.0218 (0.2745)	0.0396*** (0.0054)	0.0614 (0.1899)	-0.0038 (0.8646)
Retail Sales	-0.0447** (0.0253)	0.0984*** (0.0025)	0.0574*** (0.0071)	-0.0043 (0.7649)
Trade Balance	-0.0105** (0.0236)	0.0478* (0.0574)	-0.0421** (0.0374)	0.0469* (0.0827)
Unemployment Rate	-0.0315 (0.1619)	-0.0731*** (0.0004)	-0.0102 (0.7013)	0.0761** (0.0212)
Japanese Macroeconomic News Announcements				
All Industries Activity Index	0.0382* (0.0571)	-0.0401 (0.4938)	-0.0524 (0.4731)	-0.0126 (0.7215)
Consumer Price Index	-0.0139 (0.4428)	-0.0183 (0.7137)	-0.1415** (0.0242)	-0.0482 (0.4183)
Industrial Production	-0.0590*** (0.0000)	0.0464* (0.0588)	0.1125** (0.0390)	0.0634* (0.0702)
Machinery Orders	0.0402*** (0.0000)	0.0250 (0.5949)	-0.0371 (0.4314)	0.0288 (0.5462)

Money Supply	-0.0466** (0.0428)	-0.0226 (0.6316)	-0.0798 (0.1786)	-0.0397* (0.0604)
Producer Price Index	-0.0244 (0.2566)	0.0675** (0.0150)	0.1247*** (0.0064)	0.0460 (0.2508)
Repo Rate	-0.1091*** (0.0000)	0.0315 (0.4482)	-0.0677 (0.2036)	-0.0294 (0.4791)
Retail Sales	-0.0795*** (0.0000)	0.1026* (0.0529)	-0.0877** (0.0359)	-0.0125 (0.7279)
Trade Balance	0.1203*** (0.0055)	0.1418*** (0.0036)	0.1388*** (0.0088)	0.1388** (0.0390)
Unemployment Rate	-0.0029 (0.7533)	-0.0128 (0.7896)	-0.1575*** (0.0052)	0.0211 (0.4527)
Euro Zone Macroeconomic News Announcements				
Consumer Price Index	-0.0293 (0.1995)	0.0513** (0.0427)	-0.0177 (0.6428)	0.0102 (0.8443)
Industrial Production	-0.0708*** (0.0000)	-0.0301 (0.5928)	-0.0388 (0.5427)	-0.0211 (0.6356)
Money Supply	0.1766*** (0.0000)	0.0702** (0.0401)	-0.0751 (0.2212)	-0.0423 (0.4437)
Producer Price Index	-0.0201* (0.0936)	0.0286* (0.0942)	-0.1803*** (0.0000)	0.0488* (0.0548)
Repo Rate	0.0194 (0.1646)	-0.0547 (0.2836)	0.1147*** (0.0005)	0.0808*** (0.0000)
Retail Sales	0.0177 *** (0.0047)	0.1067*** (0.0000)	-0.1239*** (0.0000)	0.0787*** (0.0006)
Trade Balance	-0.0885*** (0.0000)	0.1079** (0.0000)	0.0739 * (0.0739)	-0.0404 (0.4462)
Unemployment Rate	0.4907*** (0.0000)	0.0909*** (0.0098)	-0.0265 (0.6305)	-0.0123 (0.4383)
Pakistan Macroeconomic New Announcements				
Consumer Price Index	0.0744*** (0.0000)	0.0905*** (0.0056)	0.0139 (0.7721)	0.0183 (0.5880)
Foreign Exchange Reserves	0.0376*** (0.0308)	0.0807** (0.0152)	0.0915 (0.1507)	0.0241 (0.6634)
Manufacturing Production Index	0.1054*** (0.0000)	0.0151 (0.6487)	0.0724 ** (0.0135)	0.0818** (0.0260)
Money Supply	0.0652*** (0.0000)	0.0360 (0.2882)	0.0491 (0.1422)	0.0458** (0.0368)
Net Financial Assets	0.2012*** (0.0000)	0.0207 (0.6170)	0.0087 (0.7378)	0.0036 (0.8506)
Repo Rate	0.2234*** (0.0000)	0.0397* (0.0957)	0.0152 (0.7585)	0.0154 (0.6507)
Trade Balance	-0.0904*** (0.0000)	-0.0455 (0.1600)	-0.0204 (0.7207)	0.0143 (0.2351)
Wholesale Price Index	-0.1042*** (0.0000)	0.0217 (0.4976)	-0.0122 (0.7417)	0.0071 (0.6952)

Note: In parentheses p – values are given, *** showing 1%, ** showing 5%, and * showing 10% significance.

The analysis shows return spillovers from PKR/GBP and PKR/EURO to PKR/US exchange rates, from PKR/US and PKR/EURO to PKR/GBP exchange rates, from PKR/US and PKR/GBP to PKR/JPY exchange rates, and from PKR/US to PKR/EURO exchange rates. In addition, there are bidirectional return spillovers between PKR/US and PKR/GBP, and between PKR/US and PKR/EURO exchange rates. Pak rupee exchange rate returns exhibit interdependences on their own past returns and on other exchange rate returns indicating that the Pak rupee exchange rate market is not completely weak-form efficient. Further, the bidirectional ARCH effects is found between PKR/US and PKR/GBP, between PKR/US and PKR/EURO, between PKR/GBP and PKR/EURO, PKR/JPY and PKR/EURO exchange rates. Moreover, volatility spillovers from PKR/GBP, PKR/JPY, and PKR/EURO to PKR/USD exchange rates, from PKR/EURO to PKR/GBP exchange rates, from PKR/GBP to PKR/JPY exchange rates, from PKR/GBP to PKR/EURO exchange rates. The bidirectional volatility spillovers exist between PKR/GBP and PKR/EURO exchange rates.

The analysis also shows that foreign and domestic macroeconomic news affects Pak rupee exchange rate returns during announcements periods. The Pak rupee exchange rates react to both real activity and monetary news. The Pak rupee exchange rate returns and their volatilities are responsive to foreign and domestic macroeconomic news announcements with different magnitudes for all the currency pairs. A large number of US macroeconomic news immediately affect Pak rupee exchange rate returns and their volatilities as compared to other foreign and domestic macroeconomic news. Moreover, PKR/USD exchange rate returns and their volatility are mostly affected by foreign and domestic macroeconomic news.

Among the news, the news of industrial production, producer price index, repo rate, and unemployment rate from the US, consumer price index and producer price index from the UK, industrial production, retail sales, trade balance, and unemployment rate from Japan, consumer price index, industrial production, the repo rate, and unemployment rate from the Euro Zone, and money supply and wholesale price index from Pakistan affect the Pak rupee exchange rate returns. It means that market participants are taking these news seriously so that they trigger the significant movements in the Pak rupee exchange rates.

Similarly, the Pak rupee exchange rate volatilities are affected by the news of business inventories, consumer price index, industrial production, repo rate, retail sales, trade balance and unemployment rate from the US, consumer price index, producer price index, retail sales, trade balance and unemployment rate from the UK, industrial production, producer price index, retail sales, trade balance, from Japan, money supply, retail sales, trade balance and unemployment rate from the Euro Zone, and consumer price index, foreign exchange reserves, manufacturing production index, and money supply from Pakistan. It implies that market participants are taking these news seriously so that they trigger the significant variations in the Pak rupee exchange rates.

5.5- Summary of Results

The main results of this research study are summarized in the given tables.

Table 5.50: Macroeconomic News Effects on Exchange Rates Returns and Exchange Rate Volatility

PKR/USD	PKR/GBP	PKR/JPY	PKR/EURO
Exchange Rate Returns			
US Federal Budget Balance (+)			
	UK Consumer Price Index (+)	JP Consumer Price Index (-)	
US Industrial Production (+)			EZ Industrial Production (-)
US Producer Price Index (-)			
		JP Retail Sales (+)	
	PAK Money Supply(+)		PAK Money Supply(+)
PAK Foreign Exchange Reserves(-)			
		PAK Repo Rate(+)	
PAK Net Financial Assets (-)			PAK Net Financial Assets (-)
PAK Consumer Price Index (+)			
PAK Wholesale Price Index (+)			
Exchange Rate Volatility			
US Business Inventories (-)			
		JP All Industries Activity Index (-)	
	UK Average Earnings Index (-)		
US Consumer Price Index (-)	UK Consumer Price Index (+)	JP Consumer Price Index (-)	EZ Consumer Price Index (+)
	UK Housing Price Index (+)		
US Durable Goods Orders (-)			
US Federal Budget Balance (+)			
US Industrial Production (-)	UK Industrial Production (-)		EZ Industrial Production (-)
	UK Money Supply(-)	JP Money Supply(-)	
US Producer Price Index (-)	UK Producer Price Index(+)		EZ Producer Price Index (-)

			EZ Repo Rate (+)
US Retail Sales(+)	UK Retail Sales (+)	JP Retail Sales(+)	EZ Retail Sales (+)
US Trade Balance(+)	UK Trade Balance(+)		
US Unemployment Rate (+)	UK Unemployment Rate (-)		EZ Unemployment Rate (-)
PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)
PAK Foreign Exchange Reserves(+)	PAK Foreign Exchange Reserves(+)	PAK Foreign Exchange Reserves(+)	
PAK Manufacturing Production Index (+)	PAK Manufacturing Production Index (+)	PAK Manufacturing Production Index (+)	PAK Manufacturing Production Index (+)
PAK Money Supply(+)	PAK Money Supply(+)	PAK Money Supply(+)	PAK Money Supply(+)
PAK Net Financial Assets(+)	PAK Net Financial Assets(+)	PAK Net Financial Assets(+)	PAK Net Financial Assets(+)
PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)
PAK Trade Balance (-)	PAK Trade Balance (-)		PAK Trade Balance (+)
PAK Wholesale Price Index (-)	PAK Wholesale Price Index (+)	PAK Wholesale Price Index (-)	PAK Wholesale Price Index (-)

Table 5.51: Macroeconomic News Effects with Order Flow on Exchange Rates Returns and Exchange Rate Volatility

PKR/USD	PKR/GBP	PKR/JPY	PKR/EURO
Exchange Rate Returns			
US Federal Budget Balance (+)			
UK Consumer Price Index (+)	UK Consumer Price Index (+)	JP Consumer Price Index (-)	
			EZ Industrial Production (-)
US Trade Balance (+)			
US Unemployment Rate (+)			
		JP Retail Sales (+)	
PAK Consumer Price Index (+)			
	PAK Money Supply(+)		PAK Money Supply(+)
PAK Foreign Exchange Reserves(-)			
		PAK Repo Rate(+)	
PAK Net Financial Assets (-)		PAK Net Financial Assets (-)	PAK Net Financial Assets (-)

PAK Wholesale Price Index (+)			
Exchange Rate Volatility			
US Business Inventories (-)			
		JP All Industries Activity Index (-)	
	UK Average Earnings Index (-)		
US Consumer Price Index (-)	UK Consumer Price Index (+)	JP Consumer Price Index (-)	EZ Consumer Price Index (+)
		JP Machinery Orders(+)	
US Durable Goods Orders (-)			
US Federal Budget Balance (+)			
US Industrial Production (-)			
	UK Money Supply(-)	JP Money Supply(-)	
US Producer Price Index (-)	UK Producer Price Index(+)		EZ Producer Price Index (-)
US Repo Rate (+)			EZ Repo Rate (+)
US Retail Sales(+)	UK Retail Sales (+)	JP Retail Sales(-)	EZ Retail Sales (+)
		JP Trade Balance (-)	
	UK Unemployment Rate (-)		EZ Unemployment Rate (-)
PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)
PAK Foreign Exchange Reserves(+)	PAK Foreign Exchange Reserves(+)	PAK Foreign Exchange Reserves(+)	
PAK Manufacturing Production Index (+)		PAK Manufacturing Production Index (+)	PAK Manufacturing Production Index (+)
PAK Money Supply(+)	PAK Money Supply(+)	PAK Money Supply(+)	PAK Money Supply(+)
PAK Net Financial Assets(+)	PAK Net Financial Assets(+)	PAK Net Financial Assets(+)	PAK Net Financial Assets(+)
PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)
PAK Trade Balance (-)			PAK Trade Balance (+)
PAK Wholesale Price Index (-)	PAK Wholesale Price Index (+)	PAK Wholesale Price Index (-)	PAK Wholesale Price Index (+)

Table 5.52: Macroeconomic News Effects Via Order Flow on Exchange Rates Returns and Exchange Rate Volatility

PKR/USD		PKR/GBP		PKR/JPY		PKR/EURO	
Exchange Rate Returns							
Direct Effect	**Indirect Effect**	**Direct Effect**	**Indirect Effect**	**Direct Effect**	**Indirect Effect**	**Direct Effect**	**Indirect Effect**
US Federal Budget Balance (+)	US Federal Budget Balance (+)						
					All Industries Activity Index (+)		
US Consumer Price Index (+)	US Consumer Price Index (-)	UK Consumer Price Index (+)		JP Consumer Price Index (-)			
US Industrial Production (+)						EZ Industrial Production (-)	
US Trade Balance (+)							
				JP Retail Sales (+)			
					JP Unemploy-ment Rate (+)		
PAK Consumer Price Index (+)	PAK Consumer Price Index (-)						
		PAK Money Supply (+)				PAK Money Supply (+)	
PAK Foreign Exchange Reserves(-)	PAK Foreign Exchange Reserves(-)						
PAK Repo Rate (+)				PAK Repo Rate (+)			
PAK Net Financial Assets (-)	PAK Net Financial Assets (+)		PAK Net Financial Assets (-)	PAK Net Financial Assets (-)	PAK Net Financial Assets (+)	PAK Net Financial Assets (-)	PAK Net Financial Assets (-)
PAK Wholesale Price Index (+)							

Exchange Rate Volatility							
US Business Inventories (-)	US Business Inventories (-)						
				JP All Industries Activity Index (-)	JP All Industries Activity Index (-)		
		UK Average Earnings Index (-)	UK Average Earnings Index (+)				
US Consumer Price Index (-)	US Consumer Price Index (-)	UK Consumer Price Index (+)	UK Consumer Price Index (-)	JP Consumer Price Index (-)	JP Consumer Price Index (-)	EZ Consumer Price Index (+)	EZ Consumer Price Index (-)
		UK Housing Price Index (+)	UK Housing Price Index (+)				
				JP Machinery Orders (+)	JP Machinery Orders (-)		
US Durable Goods Orders (-)	US Durable Goods Orders (-)						
US Federal Budget Balance (+)	US Federal Budget Balance (+)						
US Industrial Production (-)	US Industrial Production (-)		UK Industrial Production (-)	JP Industrial Production (+)	JP Industrial Production (-)	EZ Industrial Production (-)	EZ Industrial Production (-)
		UK Money Supply (-)		JP Money Supply (-)			EZ Money Supply (+)
US Producer Price Index (-)	US Producer Price Index (-)	UK Producer Price Index (+)	UK Producer Price Index (-)		JP Producer Price Index (-)	EZ Producer Price Index (+)	
						EZ Repo Rate (+)	EZ Repo Rate (-)
US Retail Sales (+)	US Retail Sales (-)		UK Retail Sales (-)	JP Retail Sales (-)	JP Retail Sales (+)	EZ Retail Sales (+)	
	US Trade Balance (+)			JP Trade Balance (-)	JP Trade Balance (-)		EZ Trade Balance (-)

US Unemploy-ment Rate (+)	US Unemploy-ment Rate (-)		UK Unemploy-ment Rate (-)			EZ Unemploy-ment Rate (-)	
PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (+)	PAK Consumer Price Index (-)	PAK Consumer Price Index (+)	PAK Consumer Price Index (-)
PAK Foreign Exchange Reserves (+)	PAK Foreign Exchange Reserves (+)	PAK Foreign Exchange Reserves (+)	PAK Foreign Exchange Reserves (-)	PAK Foreign Exchange Reserves (+)	PAK Foreign Exchange Reserves (-)	PAK Foreign Exchange Reserves (+)	
PAK Manufactur-ing Production Index (+)	PAK Manufactur-ing Production Index (-)			PAK Manufactur-ing Production Index (+)	PAK Manufactur-ing Production Index (-)	PAK Manufactur-ing Production Index (+)	PAK Manufactur-ing Production Index (+)
PAK Money Supply (+)	PAK Money Supply (+)	PAK Money Supply (+)	PAK Money Supply (+)	PAK Money Supply (+)	PAK Money Supply (+)	PAK Money Supply (+)	
PAK Net Financial Assets (+)	PAK Net Financial Assets (-)	PAK Net Financial Assets (+)	PAK Net Financial Assets (+)	PAK Net Financial Assets (+)	PAK Net Financial Assets (-)	PAK Net Financial Assets (+)	PAK Net Financial Assets (+)
PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)	PAK Repo Rate (+)		PAK Repo Rate (+)	PAK Repo Rate (-)
PAK Trade Balance (-)	PAK Trade Balance (+)	PAK Trade Balance (+)	PAK Trade Balance (-)		PAK Trade Balance (-)	PAK Trade Balance (+)	PAK Trade Balance (+)
PAK Wholesale Price Index (-)	PAK Wholesale Price Index (-)	PAK Wholesale Price Index (+)		PAK Wholesale Price Index (-)		PAK Wholesale Price Index (+)	PAK Wholesale Price Index (+)

CHAPTER 6
CONCLUSION

This study explores the exchange rate dynamics with respect to macroeconomic news announcements. It examines the exchange rate behavior explain by the news about macroeconomic fundamentals. It discovers the role of macroeconomic news and order flow in the process of price discovery in emerging economies' foreign exchange markets. It modifies the information-based models for modeling exchange rates in the emerging economy by incorporating the dynamics of the emerging foreign exchange market. This chapter presents the summary of the thesis which includes research objectives, research methodology, data, and findings. It also discusses the policy recommendations derived from this research study.

6.1- Research Objectives

The core objective of the study is to examine the effects of macroeconomic news announcements on exchange rate returns and exchange rate volatility in the Pak rupee which includes a broad set of macroeconomic news announcements (both foreign and domestic) well-known in the economic literature. It analyzes three sources of exchange rate movements: i) macroeconomic news announcements which are immediately and directly affect exchange rates, ii) order flow which affect exchange rates but is unrelated to macroeconomic news announcements, iii) an indirect effect of macroeconomic news announcements that operates via order flow. It also investigates the joint reaction of

different exchange rates of the Pak rupee to news announcements in a multivariate framework.

Specifically, the study intends:

1. To examine the direct impact of macroeconomic news announcements on exchange rate returns and exchange rate volatility. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.
2. To examine the direct impact of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.
3. To examine the indirect impact of macroeconomic news announcements on exchange rate returns and exchange rate volatility via order flow with heterogeneous market participants and dispersed information. Specifically, it explores contemporaneous effects, dynamic effects, and pure effects.
4. To examine the dynamic dependencies between different exchange rates of the same currency and their joint reaction to news announcements in a multivariate framework.

6.2- Research Methodology

This study investigates the effects of macroeconomic news announcements and order flow on exchange rate returns and exchange rate volatility of Pak rupee by using Autoregressive Moving Average (ARMA) with Univariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models. It is well-known that ARMA-GARCH

models are able to capture stylized facts in the exchange rates. They are skewness, fat tails, and volatility clustering.

It uses the data of Pak rupee daily exchange rates, Pak rupee daily foreign exchange transactions between dealers in terms of traded contracts, and foreign and domestic monthly news announcements from January 2008 to December 2018.

6.3- Summary of Findings

This study examines the joint response of exchange rate returns and volatility to order flow and macroeconomic news announcements in an integrated framework. It analyzes not only both direct and indirect information channels during and after news announcements periods for exchange rate movements but also exchange rate volatility. It also explores the nonlinear relationship between macroeconomic news and order flow through interaction between macroeconomic news and order flow which identifies indirect channel by which macroeconomic news affects exchange rates.

The analysis firstly shows that foreign and domestic macroeconomic news affects Pak rupee exchange rate returns and their volatilities during and after announcements periods. It points out average effects correspond to the direct channel for price impact, which is reflected in exchange rates immediately which is in line with Andersen *et al.* (2003). It finds out persistence patterns associated with announcements of news on Pak rupee exchange rate returns and volatility. Secondly, analysis shows that order flow drives movements in Pak rupee exchange rates and induce portfolio-balance effects on exchange rates which are unrelated to macroeconomic information. It indicates the role of trade signals and trading strategies of currency traders affecting exchange rates. These results

are in line with Evans and. Lyons (2002a) and Marsh and O'Rourke (2005). Thirdly, the findings show that the release of foreign and domestic macroeconomic news triggers trading which reveals dispersed information affecting Pak rupee exchange rate returns and their volatilities indirectly during and announcements periods. It points out the total effects correspond to the indirect channel for price impact, which is reflected in exchange rates. They also give evidence that the price impact of order flow varies according to the macroeconomic news announcements. Further, the results also show that order flow intensifies the impact of macroeconomics news considerably which is in line with Evans and Lyons (2008) and Savaser (2011). Hence, as part of an aggregated economic component and means of public and private information, macroeconomic news and order flow impact Pak rupee exchange rates as an integrated determinant. When macroeconomic news strikes the foreign exchange market, it affects the decisions of market makers, influencing order flow and then exchange rates. Moreover, information asymmetry in the foreign exchange market among the market agents affects the speed of order flow to incorporate the news. Therefore, the role of order flow to convey private/ incremental information with the release of public news which increases information asymmetry among market agents is identified in Pak rupee exchange rates.

Fourthly, findings show return spillovers from PKR/GBP and PKR/EURO to PKR/US exchange rates, from PKR/US and PKR/EURO to PKR/GBP exchange rates, from PKR/US and PKR/GBP to PKR/JPY exchange rates, and from PKR/US to PKR/EURO exchange rates. Also, there are bidirectional return spillovers between PKR/US and PKR/GBP, and between PKR/US and PKR/EURO exchange rates. The Pak rupee exchange rate returns exhibit interdependences on their own past returns and on other

exchange rate returns indicating that the Pak rupee exchange rate market is not completely weak-form efficient. Further, the bidirectional ARCH effects are found between PKR/US and PKR/GBP, between PKR/US and PKR/EURO, between PKR/GBP and PKR/EURO, PKR/JPY, and PKR/EURO exchange rates. Moreover, the finding also shows volatility spillovers from PKR/GBP, PKR/JPY, and PKR/EURO to PKR/USD exchange rates, from PKR/EURO to PKR/GBP exchange rates, from PKR/GBP to PKR/JPY exchange rates, from PKR/GBP to PKR/EURO exchange rates. The bidirectional volatility spillovers exist between PKR/GBP and PKR/EURO exchange rates.

The findings also show the existence of positive and negative spillovers (returns and volatility) between Pak rupee exchange rates. The positive spillovers are due to monetary factors and negative spillovers are due to fiscal factors. The reason behind the existence of stronger interdependencies in terms of returns and volatility spillovers between Pak rupee exchange rates is the trading behavior of foreign exchange dealers who follow trends in different exchange rates. The adjustment of portfolios by the investors based on exchange rates volatility causes spillovers between the exchange rates. Moreover, political and macroeconomic events exhibit spillover effects from one exchange rate to other exchange rates.

6.4- Policy Implications and Recommendations

The findings of this study reveal the importance of macroeconomic news announcements and order flow for Pak rupee exchange rates. The results suggest that both macroeconomic news and order flow explain movements and variations in Pak rupee exchange rates. Both direct and indirect information channels works during and after news announcements periods for Pak rupee exchange rates. Therefore, the macroeconomic

approach and microstructure approach should be applied in modelling Pak rupee exchange rates.

This study focuses on explaining exchange rate behavior by macroeconomic news announcements and order flow which would help in trade analysis and decision making by market participants and policymakers. Thus, the results of this study possibly help to guide traders and regulators so that they are expected to utilize the models. Moreover, the analysis is useful in shaping appropriate exchange rate policies in Pakistan.

The findings have important implications for investors and traders holding and trading foreign assets. By analyzing exchange rates behavior, this study helps investors and traders in improving their returns and risks analysis linked with their foreign assets that are exposed to foreign exchange rates fluctuations. Further, the investors, traders, and managers that are exposed to foreign exchange risk find it beneficial for considering the time-varying effects of macroeconomic news on exchange rate returns and volatility while developing and designing strategies to enhance the risk management and return on foreign transactions.

The findings have important implications for policy and decision-makers who design and develop exchange rates and monetary policies. By analyzing exchange rates behavior, this study helps policy and decision-makers to provide the exchange rate market with good strategic policies and build strategies for dealing with different shocks.

The economic outlook news announcements originating from major economies that affect Pak rupee exchange rates reflect the monetary authorities' anticipated policy reaction to the release of news. This shows the market's response to news is influenced by their

perception of monetary authorities' reactions. Those responses, if triggered, will influence short-term money market interest rates. Thus, a reaction function, having a dominant market's response, would suggest that in turn exchange rates would respond predominantly to unexpected changes in such interest rates.

The findings recommend that looking at real-time data reflecting information already accessible to market participants, market participants should understand and track the important movements and variations in exchange rate fundamentals to make their investment and trading decisions. These findings also recommend that the market interprets news as information about future changes in the economy.

The findings recommend that in addition to monetary policy, the policymakers should consider real economic developments, before deciding exchange rate policies. The State Bank of Pakistan should set interest rates based on domestic conditions. Hence, through this channel, Pakistan's domestic conditions have a direct influence on financial markets.

The findings recommend that policy and decision-makers in Pakistan should plan and implement policies and instruments for stabilizing the exchange rates and making foreign exchange markets efficient. The efficient foreign exchange markets lead to efficient intermediation of trading flows and news. For making financial markets efficient, efforts should be taken for the organization and regulation of trading in foreign exchange markets which in turn has important implications for the price formation process.

The findings also recommend that trading mechanisms and rules in foreign exchange markets which include the direct market and the indirect market should be

explicitly defined. The centralized trading arrangement should coexist in foreign exchange markets in Pakistan to liquidate foreign exchange transactions.

6.5- Future Direction

For future work, it would be interesting to extend the analysis to look at the Pak rupee's bilateral returns and volatilities as they respond to macroeconomic announcements of other Emerging Market countries. In addition, the role of political risk and government policies on the rupee would be worthy of analysis. Finally, the study could be extended to look at how pre and post-announcements affect exchange rates.

References

Abbas, Z., Khan, S., & Rizvi, S: T. H. (2011). Exchange rates and macroeconomic fundamentals: linear regression and cointegration analysis on emerging Asian economies. *International Review of Business Research Papers, 7*(3), 250-263.

Aggarwal, R., & Schirm, D. C. (1992). Balance of trade announcements and asset prices: influence on equity prices, exchange rates, and interest rates. *Journal of International Money and Finance, 11*(1), 80-95.

Aggarwal, R., & Schirm, D. C. (1998). Asymmetric impact of trade balance news on asset prices. *Journal of International Financial Markets, Institutions and Money, 8*(1), 83-100.

Almeida, A., Goodhart, C., & Payne, R. (1998). The effects of macroeconomic news on high frequency exchange rate behavior. *Journal of Financial and Quantitative Analysis, 33*(3), 383-408.

Amihud, Y., & Mendelson, H. (1980). Dealership market: Market-making with inventory. *Journal of financial economics, 8*(1), 31-53.

Andersen, T. G., & Bollerslev, T. (1998). Deutsche mark–dollar volatility: intraday activity patterns, macroeconomic announcements, and longer run dependencies. *The journal of Finance, 53*(1), 219-265.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Vega, C. (2003). Micro effects of macro announcements: Real-time price discovery in foreign exchange. *American Economic Review, 93*(1), 38-62.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Vega, C. (2007). Real-time price discovery in global stock, bond and foreign exchange markets. *Journal of international economics, 73*(2), 251-277.

Anifowose, A. D., Ismail, I., & Sukor, M. E. A. (2018). Currency order flow and exchange rate determination: Empirical evidence from the Malaysian foreign exchange market. *Global Business Review, 19*(4), 902-920.

Antonakakis, N. (2012). Exchange return co-movements and volatility spillovers before and after the introduction of euro. *Journal of International Financial Markets, Institutions and Money, 22*(5), 1091-1109.

Bacchetta, P., & Van Wincoop, E. (2006). Can information heterogeneity explain the exchange rate determination puzzle? *American Economic Review, 96*(3), 552-576.

Baillie, R. T., & Bollerslev, T. (1991). Intra-day and inter-market volatility in foreign exchange rates. *The Review of Economic Studies, 58*(3), 565-585.

Balduzzi, P., Elton, E. J., & Green, T. C. (2001). Economic news and bond prices: Evidence from the US Treasury market. *Journal of Financial and Quantitative Analysis, 36*(4), 523-543.

Baruník, J., Kočenda, E., & Vácha, L. (2017). Asymmetric volatility connectedness on the forex market. *Journal of International Money and Finance, 77*, 39-56.

Beck, S. E. (1993). The Ricardian equivalence proposition: Evidence from foreign exchange markets. *Journal of International Money and Finance, 12*(2), 154-169.

Ben Omrane, W., Welch, R., & Zhou, X. (2018). The Dynamic Effect of Macroeconomic News on the Euro/US Dollar Exchange Rate. *Journal of Forecasting*.

Ben Omrane, W., Welch, R., & Zhou, X. (2020). The dynamic effect of macroeconomic news on the euro/US dollar exchange rate. *Journal of Forecasting, 39*(1), 84-103.

Bilson, J. F. (1978). The monetary approach to the exchange rate: some empirical evidence. *Staff Papers, 25*(1), 48-75.

Bjønnes, G. H., & Rime, D. (2005). Dealer behavior and trading systems in foreign exchange markets. *Journal of financial economics, 75*(3), 571-605.

Black, A. J., & McMillan, D. G. (2004). Long run trends and volatility spillovers in daily exchange rates. *Applied Financial Economics, 14*(12), 895-907.

Bollerslev, T. (1990). Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model. *Review of Economics and statistics, 72*(3), 498-505.

Boudt, K., Neely, C. J., Sercu, P., & Wauters, M. (2019). The response of multinationals' foreign exchange rate exposure to macroeconomic news. *Journal of International Money and Finance, 94*, 32-47.

Breedon, F., & Ranaldo, A. (2013). Intraday patterns in FX returns and order flow. *Journal of Money, Credit and Banking, 45*(5), 953-965.

Bubák, V., Kočenda, E., & Žikeš, F. (2011). Volatility transmission in emerging European foreign exchange markets. *Journal of Banking & Finance, 35*(11), 2829-2841.

Cagliesi, G., & Tivegna, M. (2006). 13. Rationality, behavior and switching idiosyncracies in the euro-dollar exchange rate. *Long-run Growth and Short-run Stabilization: Essays in Memory of Albert Ando*, 338.

Cai, Howorka, & Wongswan. (2008). Informational linkages across trading regions: Evidence from foreign exchange markets. *Journal of International Money and Finance, 27*(8), 1215-1243.

Caporale, G. M., Spagnolo, F., & Spagnolo, N. (2018). Exchange rates and macro news in emerging markets. *Research in International Business and Finance, 46*, 516-527.

Cheung, Y.-W., Fatum, R., & Yamamoto, Y. (2019). The exchange rate effects of macro news after the global financial crisis. *Journal of International Money and Finance, 95*, 424-443.

Chinn, M. D., & Moore, M. J. (2011). Order flow and the monetary model of exchange rates: Evidence from a novel data set. *Journal of Money, Credit and Banking, 43*(8), 1599-1624.

Conrad, C., & Lamla, M. J. (2010). The high-frequency response of the EUR-USD exchange rate to ECB communication. *Journal of Money, Credit and Banking, 42*(7), 1391-1417.

Cornell, B. (1982). Money supply announcements, interest rates, and foreign exchange. *Journal of International Money and Finance, 1*, 201-208.

Deravi, K., Gregorowicz, P., & Hegji, C. E. (1988). Balance of trade announcements and movements in exchange rates. *Southern Economic Journal*, 279-287.

Deravi, K., Gregorowicz, P., & Hegji, C. E. (1989). Deficit financing announcements and asset prices. *Journal of Economics and Business, 41*(2), 171-183.

Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of political Economy, 84*(6), 1161-1176.

Dornbusch, R. (1982). Exchange rate economics: where do we stand? *International Economics Policies and their Theoretical Foundations* (pp. 557-599): Elsevier.

Doukas, J. (1985). The Rationality of Money Supply Expectations and the Canadian-Us Exchange Rate Response to Money Supply Announcements. *Financial Review, 20*(2), 180-194.

Duffuor, K., Marsh, I. W., & Phylaktis, K. (2012). Order flow and exchange rate dynamics: An application to emerging markets. *International Journal of Finance & Economics, 17*(3), 290-304.

Ederington, L. H., & Lee, J. H. (1994). The response of the dollar/yen exchange rate to economic announcements. *Financial Engineering and the Japanese Markets, 1*(2), 111-128.

Ederington, L. H., & Lee, J. H. (1995). The short-run dynamics of the price adjustment to new information. *Journal of Financial and Quantitative Analysis, 30*(1), 117-134.

Edwards, S. (1982). Exchange rate market efficiency and new information. *Economics Letters, 9*(4), 377-382.

Ehrmann, M., & Fratzscher, M. (2005). Exchange rates and fundamentals: new evidence from real-time data. *Journal of International Money and Finance, 24*(2), 317-341.

Engel, C., & Frankel, J. (1984). Why interest rates react to money announcements: An explanation from the foreign exchange market. *Journal of Monetary Economics, 13*(1), 31-39.

Engel, C., & West, K. D. (2004). Accounting for exchange-rate variability in present-value models when the discount factor is near 1. *American Economic Review, 94*(2), 119-125.

Engel, C., & West, K. D. (2005). Exchange rates and fundamentals. *Journal of political Economy, 113*(3), 485-517.

Engle , R. F., Ito, T., & Lin, W.-L. (1988). Meteor showers or heat waves? Heteroskedastic intra-daily volatility in the foreign exchange market: National Bureau of Economic Research Cambridge, Mass., USA.

Engle, R. F., Ito, T., & Lin, W.-L. (1990). Meteor showers or heat waves? Heteroskedastic intra-daily volatility in the foreign exchange market (Vol. 58, pp. 525–542.): Econometrica,.

Evans. (2005). Foreign exchange market microstructure. *Georgetown University, typescript*.

Evans, & Lyons. (2002a). Order flow and exchange rate dynamics. *Journal of political Economy, 110*(1), 170-180.

Evans, & Lyons. (2002b). Time-varying liquidity in foreign exchange. *Journal of Monetary Economics, 49*(5), 1025-1051.

Evans, & Lyons. (2005). Do currency markets absorb news quickly? *Journal of International Money and Finance, 24*(2), 197-217.

Evans, & Lyons. (2008). How is macro news transmitted to exchange rates? *Journal of financial economics, 88*(1), 26-50.

Evans, & Rime. (2019). Microstructure of Foreign Exchange Markets.

Evans, & Rime, D. (2016). Order flow information and spot rate dynamics. *Journal of International Money and Finance, 69*, 45-68.

Evans, & Speight, A. (2010). International macroeconomic announcements and intraday euro exchange rate volatility. *Journal of the Japanese and international economies, 24*(4), 552-568.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The journal of Finance, 25*(2), 383-417.

Farrell, G. (2001). *Capital controls and the volatility of South African exchange rates*: South African Reserve Bank.

Fatum, R., Hutchison, M., & Wu, T. (2012). Asymmetries and state dependence: The impact of macro surprises on intraday exchange rates. *Journal of the Japanese and international economies, 26*(4), 542-560.

Faust, J., Rogers, J. H., Wang, S.-Y. B., & Wright, J. H. (2007). The high-frequency response of exchange rates and interest rates to macroeconomic announcements. *Journal of Monetary Economics, 54*(4), 1051-1068.

Frenkel, J. A. (1976). A monetary approach to the exchange rate: doctrinal aspects and empirical evidence. *The scandinavian Journal of economics*, 200-224.

Frenkel, J. A. (1982). Flexible exchange rates, prices and the role of 'news': Lessons from the 1970s *Exchange Rate Policy* (pp. 48-100): Springer.

Froot, K. A., & Ramadorai, T. (2005). Currency returns, intrinsic value, and institutional-investor flows. *The journal of Finance, 60*(3), 1535-1566.

Galati, G., & Ho, C. (2003). Macroeconomic news and the euro/dollar exchange rate. *Economic notes, 32*(3), 371-398.

Gau, Y.-F., & Wu, Z.-X. (2017). Macroeconomic announcements and price discovery in the foreign exchange market. *Journal of International Money and Finance, 79*, 232-254.

Glosten, L. R., & Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of financial economics, 14*(1), 71-100.

Goodhart, C. A., Hall, S. G., Henry, S. B., & Pesaran, B. (1993). News effects in a high-frequency model of the sterling-dollar exchange rate. *Journal of Applied Econometrics, 8*(1), 1-13.

Gradojevic, N., & Neely, C. J. (2009). The dynamic interaction of trading flows, macroeconomic announcements and the CAD/USD exchange rate: Evidence from disaggregated data. *Macroeconomic Announcements and the CAD/USD Exchange Rate: Evidence from Disaggregated Data (August 17, 2009)*.

Greenwood-Nimmo, M., Nguyen, V. H., & Rafferty, B. (2016). Risk and return spillovers among the G10 currencies. *Journal of Financial Markets, 31*, 43-62.

Hakkio, C. S., & Pearce, D. K. (1985). The reaction of exchange rates to economic news. *Economic Inquiry, 23*(4), 621-636.

Han, Y. W. (2004). Quantitative analysis of macroeconomic shocks and the Euro currency in high frequency perspective: Working paper, Hallym University, October 2004.

Harada, K., & Watanabe, T. (2009). News effects on high frequency Yen/Dollar exchange rate and its volatility behavior. *Chuo University*.

Hardouvelis, G. A. (1984). Market perceptions of Federal Reserve policy and the weekly monetary announcements. *Journal of Monetary Economics, 14*(2), 225-240.

Hardouvelis, G. A. (1988). Economic news, exchange rates and interest rates. *Journal of International Money and Finance, 7*(1), 23-35.

Harvey, C. R., & Huang, R. D. (1991). Volatility in the foreign currency futures market. *The Review of Financial Studies, 4*(3), 543-569.

Hashimoto, Y., & Ito, T. (2010). Effects of Japanese macroeconomic statistic announcements on the dollar/yen exchange rate: High-resolution picture. *Journal of the Japanese and international economies, 24*(3), 334-354.

Hayo, B., & Neuenkirch, M. (2012). Domestic or US news: What drives Canadian financial markets? *Economic Inquiry, 50*(3), 690-706.

Hayo, B., & Neuenkirch, M. (2013). Does the currency board matter? US news and Argentine financial market reaction. *Applied Economics, 45*(28), 4034-4040.

Hendry, D. F., & Doornik, J. A. (1994). Modelling linear dynamic econometric systems. *Scottish Journal of Political Economy, 41*(1), 1-33.

Hogan, K., Melvin, M., & Roberts, D. J. (1991). Trade balance news and exchange rates: Is there a policy signal? *Journal of International Money and Finance, 10*, S90-S99.

Hong, Y. (2001). A test for volatility spillover with application to exchange rates. *Journal of Econometrics, 103*(1-2), 183-224.

Irwin, D. A. (1989). Trade deficit announcements, intervention, and the dollar. *Economics Letters, 31*(3), 257-262.

Ito, T., & Roley, V. V. (1987). News from the US and Japan: which moves the yen/dollar exchange rate? *Journal of Monetary Economics, 19*(2), 255-277.

Jabeen, M., & Khan, S. A. (2014). Modelling exchange rate volatility by macroeconomic fundamentals in pakistan. *International Econometric Review, 6*(2), 58-76.

Jansen, D.-J., & De Haan, J. (2005). Talking heads: the effects of ECB statements on the euro–dollar exchange rate. *Journal of International Money and Finance, 24*(2), 343-361.

Karfakis, C., & Kim, S.-J. (1995). Exchange rates, interest rates and current account news: some evidence from Australia. *Journal of International Money and Finance, 14*(4), 575-595.

Kavli, H., & Kotzé, K. (2014). Spillovers in exchange rates and the effects of global shocks on emerging market currencies. *South African Journal of Economics, 82*(2), 209-238.

Kearns, J., & Manners, P. (2006). The impact of monetary policy on the exchange rate: A study using intraday data. *International Journal of Central Banking, 2*(4), 157-183.

Keim, D. B., & Madhavan, A. (1998). The cost of institutional equity trades: an overview. *Rodney L. White Center for Financial Research Working Paper Series*, 8-98.

Kemal, M. A., Haider, R. M., & Khalid, A. M. (2004). Exchange Rate Behaviour after Recent Float: The Experience of Pakistan [with Comments]. *The Pakistan Development Review*, 829-852.

Khan, Saeed, M., Ibrahim, T. O., & Rizwan, M. (2018). Financial Cointegration of Emerging Economies: Evidence from Bivariate Cointegration and Granger Causality. *Empirical Economic Review, 1*(1), 49-70.

Khan, M. A., & Qayyum, A. (2011). Exchange Rate Determination in Pakistan: Role of Monetary Fundamentals. *Journal of Economic Cooperation & Development, 32*(2).

Killeen, W. P., Lyons, R. K., & Moore, M. J. (2006). Fixed versus flexible: Lessons from EMS order flow. *Journal of International Money and Finance, 25*(4), 551-579.

Kim, S.-J. (1998). Do Australian and the US macroeconomic news announcements affect the USD/AUD exchange rate? Some evidence from E-GARCH estimations. *Journal of Multinational Financial Management, 8*(2-3), 233-248.

Kim, S.-J., McKenzie, M. D., & Faff, R. W. (2004). Macroeconomic news announcements and the role of expectations: evidence for US bond, stock and foreign exchange markets. *Journal of Multinational Financial Management, 14*(3), 217-232.

Kitamura, Y. (2010). Testing for intraday interdependence and volatility spillover among the euro, the pound and the Swiss franc markets. *Research in International Business and Finance, 24*(2), 158-171.

Klein, M., Mizrach, B., & Murphy, R. G. (1991). Managing the dollar: Has the Plaza Agreement mattered? *Journal of Money, Credit and Banking, 23*(4), 742-751.

Kraus, A., & Stoll, H. R. (1972). Price impacts of block trading on the New York Stock Exchange. *The journal of Finance, 27*(3), 569-588.

Kumar. (2014). Correlations, return and volatility spillovers in Indian exchange rates. *Global Business Review, 15*(1), 77-91.

Kumar, Dublish, P., & Haque, M. M. (2016). Volatility spillovers between foreign exchange markets of India and China. *Asia-Pacific Journal of Management Research and Innovation, 12*(2), 134-144.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, 1315-1335.

Laakkonen, H. (2007). The Impact of Macroeconomic News on Exchange Rate Volatility. *Finnish Economic Papers, 20*(1), 23-40.

Laakkonen, H. (2008). *Asymmetric news effects on exchange rate volatility*: University of Jyväskylä.

Laakkonen, H. (2009). *Essays on the asymmetric news effects on exchange rate volatility*: University of Jyväskylä.

LaakkOnen, H., & Lanne, M. (2013). The relevance of accuracy for the impact of macroeconomic news on exchange rate volatility. *International Journal of Finance & Economics, 18*(4), 339-351.

Loeb, T. F. (1983). Trading cost: the critical link between investment information and results. *Financial Analysts Journal, 39*(3), 39-44.

Love, R., & Payne, R. (2003). Macroeconomic News. *Order Flow and Exchange Rates, LSE Financial Markets Group Discussion Paper, 475*.

Love, R., & Payne, R. (2008). Macroeconomic news, order flows, and exchange rates. *Journal of Financial and Quantitative Analysis, 43*(2), 467-488.

MacDonald, R., & Torrance, T. S. (1988). Exchange rates and the" news": some evidence using UK survey data. *The Manchester School of Economic & Social Studies, 56*(1), 69-76.

Madhavan, A., & Smidt, S. (1993). An analysis of changes in specialist inventories and quotations. *The journal of Finance, 48*(5), 1595-1628.

Marsh, I. W., & O'Rourke, C. (2005). Customer order flow and exchange rate movements: is there really information content? *Cass Business School Research Paper*.

Maserumule, T., & Alagidede, P. (2017). Impact of macroeconomic announcements on foreign exchange volatility: Evidence from South Africa. *South African Journal of Economics, 85*(3), 405-429.

Maveé, N., Perrelli, M. R., & Schimmelpfennig, M. A. (2016). *Surprise, surprise: What drives the rand/US dollar exchange rate volatility?* : International Monetary Fund.

May, C., Farrell, G., & Rossouw, J. (2017). Do monetary policy announcements affect foreign exchange returns and volatility? Some evidence from high-frequency

intraday South African data. *Economic Research Southern Africa Working Paper No. 672.*

May, C., Farrell, G., & Rossouw, J. (2018). Do Monetary Policy Announcements Affect Exchange Rate Returns and Volatility of Returns? Some Evidence from High-Frequency Intra-Day South African Data. *South African Journal of Economics, 86*(3), 308-338.

McIntyre, K., & Harjes, K. (2016). Order flow and the bitcoin spot rate. *Applied Economics and Finance, 3*(3), 136-147.

McMillan, D. G., & Speight, A. E. (2010). Return and volatility spillovers in three euro exchange rates. *Journal of Economics and Business, 62*(2), 79-93.

Meese, R. A., & Rogoff, K. (1983). Empirical exchange rate models of the seventies: Do they fit out of sample? *Journal of international economics, 14*(1-2), 3-24.

Melvin, M., & Melvin, B. P. (2003). The global transmission of volatility in the foreign exchange market. *Review of Economics and statistics, 85*(3), 670-679.

Melvin, M., Saborowski, C., Sager, M., & Taylor, M. P. (2009). Bank of England interest rate announcements and the foreign exchange market.

Moorthy, V. (1993). Efficiency aspects of exchange rate response to news: Evidence from US employment data: Federal Reserve Bank of New York.

Mpofu, & Peters. (2017). The impact of monetary policy announcements and political events on the exchange rate: the case of South Africa.

Mundell, R. A. (1964). Exchange rate margins and economic policy. *J. Carter.*

Mussa, M. (1977). The exchange rate, the balance of payments and monetary and fiscal policy under a regime of controlled floating *Flexible Exchange Rates and Stabilization Policy* (pp. 97-116): Springer.

Neely, C. J. (2011). A survey of announcement effects on foreign exchange volatility and jumps. *Federal Reserve Bank of St. Louis Review, 93*(5), 361-385.

Neely, C. J., & Dey, S. R. (2010). A survey of announcement effects on foreign exchange returns. *Federal Reserve Bank of St. Louis Review, 92*(5), 417-463.

O'Hara, M., & Oldfield, G. S. (1986). The microeconomics of market making. *Journal of Financial and Quantitative Analysis, 21*(4), 361-376.

Omrane, W. B., & Hafner, C. (2015). Macroeconomic news surprises and volatility spillover in foreign exchange markets. *Empirical Economics, 48*(2), 577-607.

Omrane, W. B., & Savaşer, T. (2017). Exchange rate volatility response to macroeconomic news during the global financial crisis. *International Review of Financial Analysis, 52*, 130-143.

Payne, R. (1996). Announcement effects and seasonality in the intra-day foreign exchange market: Financial Markets Group.

Payne, R. (2003). Informed trade in spot foreign exchange markets: an empirical investigation. *Journal of international economics, 61*(2), 307-329.

Pearce, D. K., & Solakoglu, M. N. (2007). Macroeconomic news and exchange rates. *Journal of International Financial Markets, Institutions and Money, 17*(4), 307-325.

Petralias, A., & Dellaportas, P. (2015). Volatility prediction based on scheduled macroeconomic announcements. *Canadian Journal of Statistics, 43*(2), 199-223.

Rajhans, R. K., & Jain, A. (2015). Volatility spillover in foreign exchange markets. *Paradigm, 19*(2), 137-151.

Raputsoane, L. (2008). *Exchange rate volatility spillovers and the South African currency*: South African Reserve Bank.

Rime, D., Sarno, L., & Sojli, E. (2010). Exchange rate forecasting, order flow and macroeconomic information. *Journal of international economics, 80*(1), 72-88.

Ruiz, I. (2009). Common volatility across Latin American foreign exchange markets. *Applied Financial Economics, 19*(15), 1197-1211.

Sager, M. J., & Taylor, M. P. (2004). The impact of European Central Bank Governing Council announcements on the foreign exchange market: a microstructural analysis. *Journal of International Money and Finance, 23*(7-8), 1043-1051.

Savaser, T. (2011). Exchange rate response to macronews: Through the lens of microstructure. *Journal of International Financial Markets, Institutions and Money, 21*(1), 107-126.

Simpson, M. W., Ramchander, S., & Chaudhry, M. (2005). The impact of macroeconomic surprises on spot and forward foreign exchange markets. *Journal of International Money and Finance, 24*(5), 693-718.

Stoll, H. R. (1978). The supply of dealer services in securities markets. *The journal of Finance, 33*(4), 1133-1151.

Taylor, M. P. (1995). The economics of exchange rates. *Journal of Economic literature, 33*(1), 13-47.

Wong, Y. M., Ariff, M., & Ahmad, R. (2014). *Exchange Rates Responses to Macroeconomic Surprises: Evidence from the Asia-Pacific Markets.* Paper presented at the World Finance Conference.

Zakaria, M., Ahmad, E., & Iqbal, M. M. (2007). Nominal Exchange Rate Variability: A Case Study of Pakistan. *Journal of Economic Cooperation Among Islamic Countries, 28*(1).

Zhang, G., Marsh, I., & MacDonald, R. (2016). A hybrid approach to exchange rates. *Studies in Economics and Finance.*