Journal of Economic Cooperation and Development, **44**, 2 (2023), 131-157

External Shocks, Stock Market Volatility, and Macroeconomic Performance: An Empirical Evidence from Pakistan

Abdul Rashid[1], Zainab Jehan[2], Nazish Kanval[3]

Abstract

This paper investigates the relative importance of internal and external shocks for macroeconomic performance (both real and nominal sectors) of a small open economy, namely Pakistan. The study used various external sector shocks (world oil price shocks, world commodity price shocks, and world interest rate shocks) to assess the relative importance of each shock in determining macroeconomic performance of Pakistan. Moreover, the study considered stock market volatility to measure the impact of internal sector shocks on macroeconomic performance of the country. The findings portray that the impact of external sector shocks significantly differ in the real and nominal sectors. Specifically, oil-price shocks and commodity-price shocks remain the dominant source of external sector shocks for both nominal and real sectors, whereas stock market volatility appears prevailing source of fluctuations for both industrial production index and nominal money supply. The study suggests that to minimize the severity of shocks, Pakistan needs to build up a solid shock absorptive capacity, which can be obtained by improving value-added exports capacities, strengthening the financial sector, and reducing dependence on oil imports.

ملخص

يستكشف هذا البحث الأهمية النسبية للصدمات الداخلية والخارجية لأداء الاقتصاد الكلي (القطاعان الحقيقي والاسمي) لباكستان باعتباره اقتصاد صغيرو مفتوح. ويدرس البحث صدمات مختلفة للقطاع الخارجي (صدمات أسعار النفط العالمية، وصدمات أسعار السلع الأساسية العالمية، وتلك المتعلقة بأسعار الفائدة العالمية) لتقييم الأهمية النسبية لكل صدمة في تحديد أداء الاقتصاد الكلي لباكستان. وعلاوة على ذلك، نظرت الدراسة في تقلبات سوق الأوراق المالية لقياس تأثير صدمات القطاع الداخلي على أداء الاقتصاد الكلي للبلد. وتُبين النتائج أن تأثير صدمات القطاع الخارجي يختلف اختلافا كبيرا في القطاعين الحقيقي والاسمي. فعلى سبيل المثال، تعتبر صدمات أسعار النفط وصدمات أسعار السلع الأساسية المصدر المهيمن لصدمات القطاع الخارجي بالنسبة للقطاعين الاسمي والحقيقي على حد سواء، في حين يبدو أن تقلب أسواق الأوراق المالية هو المصدر السائد لتقلبات كل من مؤشر الإنتاج الصناعي والعرض النقدي الاسمي. وتشير الدراسة إلى أن باكستان يمكنها أن تقلل من شدة الصدمات إلى أدنى حد عن طريق تطوير قدرة استيعابية قوية في وجه الصدمات من خلال تحسين قدرات الصادرات ذات القيمة المضافة، وتعزيز القطاع المالي، وتقليل الاعتماد على واردات النفط.

ABSTRAITE

Ce document étudie l'importance relative des chocs internes et externes pour les performances macroéconomiques (secteurs réel et nominal) d'une petite économie ouverte, à savoir le Pakistan. L'étude a utilisé différents chocs externes (chocs des prix mondiaux du pétrole, chocs des prix mondiaux des matières premières et chocs des taux d'intérêt mondiaux) pour évaluer l'importance relative de chaque choc dans la détermination des performances macroéconomiques du Pakistan. En outre, l'étude a pris en compte la volatilité du marché boursier pour mesurer l'impact des chocs sectoriels internes sur les performances macroéconomiques du pays. Les résultats montrent que l'impact des chocs sectoriels externes diffère significativement dans les secteurs réels et nominaux. Plus précisément, les chocs des prix du pétrole et des matières premières restent la source dominante des chocs du secteur externe pour les secteurs nominaux et réels, tandis que la volatilité du marché boursier apparaît comme la

[1] Department of Economics and Finance, International Institute of Islamic Economics, International Islamic University (IIU), Islamabad, Pakistan
Email: Abdulrashid@iiu.edu.pk
[2] Department of Economics, Fatima Jinnah Women University, Rawalpindi, Pakistan
Email: Zainabjehan.fjwu@gmail.com
[3] Female Department of Economics, Intentional Institute of Islamic Economics (IIIE),International Islamic University (IIU), Islamabad, Pakistan
Email: Nazishkanwal1991@gmail.com

source dominante des fluctuations de l'indice de la production industrielle et de la masse monétaire nominale. L'étude suggère que pour minimiser la gravité des chocs, le Pakistan doit se doter d'une solide capacité d'absorption des chocs, ce qui peut être obtenu en améliorant les capacités d'exportation à valeur ajoutée, en renforçant le secteur financier et en réduisant la dépendance à l'égard des importations de pétrole.

JEL Classification: B22; C32; E02; F41.

Keywords: Internal shocks; External shocks, Stock market volatility; Macroeconomic performance; Real Sector; Nominal sector

1. Introduction

Since the early 1990s, many developing and emerging economies have experienced a remarkable process of financial liberalization and thus, witnessed a considerable increase in financial and economic integration with the rest of the world. Various factors such as international trade, international capital flows, and technological revolution have substantially contributed to the higher and improved alignment between real and financial sectors of different countries (Chan, Karceski, and Lakonishok, 1998). On the one hand, the economic and financial integration has benefited these economies on various grounds. On the other hand, it has made hedging more complex, specifically against external risks and brought several new types of risks such currency risks, foreign reserve risks, and balance of payment crises risks. It is well established that developing countries are more prone to external shocks because of relatively weak economic and financial structures, political unrests, and volatile financial markets (Canova, 2005).

Economic and financial integrations across different economies open several new and interesting avenues for researchers to re-investigate the association between financial markets and the performance of macroeconomy. The pioneer work by Officer (1973) has established the link between stock price volatility and business cycle by considering uncertainty in industrial production. After that, there is significant evidence in the literature that stock price volatility/shock affects economic activities (Schwert, 1989; Campbell et al., 2001; Beetsma and Giuliodori, 2012). Moreover, the volatility of share prices plays a crucial role in predicting future economic performance (Leahy and Whited, 1995; Levine and Zervos, 1998; Bloom, Bond, and Reenen, 2007). Alexopoulos and Cohen (2009) revealed that around 6% of the total variation in industrial production is illustrated by stock market volatility.

On the flip side, with increasing world integration, the importance of external factors affecting macroeconomic performance cannot be ignored. In this regard, two key variables have gained considerable attention, namely, variations in world commodity prices and world oil prices. For instance, changes in commodity prices are highly associated with the real exchange rate, particularly in commodity-dependent countries. The increased commodity prices lead to higher wages in commodity sectors, which also makes variations in relative prices of non-tradable goods, leading to appreciations in real exchange rates (RER) (Cashin, Cespedes and Sahay, 2004). Similarly, global food prices also adversely affect economic growth of an economy. The transmission channel works in a way that higher food prices will affect imports bills, which decreases net exports and causes deteriorations in terms of trade and rapid depletions of foreign exchange reserves, consequently, slowing down economic growth (Alom, 2011). Besides, the interest rate and demand for domestic money rise with an increase in food and oil prices, which further produces adverse effects on both real and nominal exchange rates.

Researchers also argue that macroeconomic performance is influenced by oil-price shocks in several ways. Brown andYücel (2002) have stated that higher oil prices result in an increase in money demand. If monetary authorities do not fully anticipate sudden changes in oil prices and fail to increase required amount of money supply, the interest rate will increase, which, in turn, will adversely impact economic growth of the economy. Similarly, higher oil prices cause inflation in the economy and monetary authorities generally respond to higher inflation by increasing the interest rate (tightening of monetary policy), which discourages investment and slows down the economy (Tang, Wu, and Zhang 2010). Likewise, Maćkowiak (2007) shows that external shocks create fluctuations in the emerging markets and are an important source of disturbance in these economies.

Pakistan being a small open economy has also endeavored to integrate with world financial and real markets. Like many other developing countries, Pakistan has adopted the liberalization of its equity market (aka Pakistan Stock Exchange, PSX) in the early1990s. The liberalization of the stock market is carried out by allowing foreign portfolio investment, lifting restrictions on holding foreign currency, permitting transfer of dividends and capital gains, and allowing foreign companies to engage in the PSX. Morgan Stanley Capital International (MSCI) has classified Pakistan as an emerging market (June, 2016), which has made its financial markets as an attractive place for investments in the last few years.

Moreover, the PSX has also been categorized as best in the Asia and the fifth best-performing stock market in the world by Bloomberg in 2016. Similarly the process of liberalization encouraged several corporations to get registered on the PSX. On the contrary, the post-liberalization period has exhibited an enormous increase in the volatility of stock prices, which transmits an adverse impact on macroeconomic performance. For instance, Bekaert and Harvey (2002) reported a decline in GDP and negative investment growth in the post-liberalization period (Figure 1). In particular, the PSX has experienced crunch in 2005, the sharpest fall in the history of the PSX and termed as the KSE crash of 2005. This crash caused a major drop in market capitalization and foreign portfolio investments. However, the market shows an increasing trend in 2006 (Akhtar and Khan, 2016). The PSX index follows a declining trend in 2008 due to political instability and global financial turmoil. Interestingly, the PSX-100 index again gained momentum and reclassified as an emerging market by Morgan Stanley Capital International (MSCI) in 2016.

Figure 2 displays the monthly trend of returns of the PSX-100 index, which shows high persistence in return volatility over the period 1991-2017. Large spikes are observed for the year 1998 and 2008 as the market performed below-average and the economy also faced huge financial crunch and political instability during that period.

As far as the external factors are concerned, like other developing countries, Pakistan's economic performance is highly sensitive to external shocks such as variations in oil prices and commodity prices. The top imports of the country include refined petroleum, which represents 12.6% of the total imports and crude petroleum, account for 5.17%. Therefore, any variation in oil prices significantly influences the balance of payment (BoP) position of the country, input prices, transportation costs, fuel charges, and thus, overall economic activities in the country. Pakistan's export performance is highly dependent on the international commodity prices. Therefore any fluctuation in world commodity prices considerably affects the foreign exchange earnings and in turn, foreign capital inflows, which ultimately adversely affects the BoP position of the country, term of trade (TOT), and economic growth.

Figure 1: Monthly KSE-100 Index (November 1991 - December 2017)

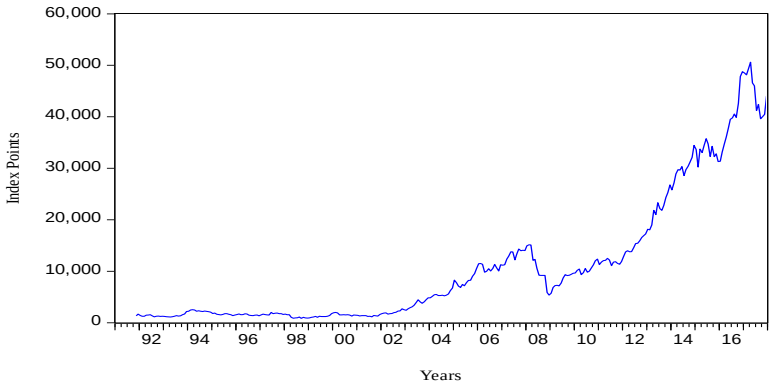
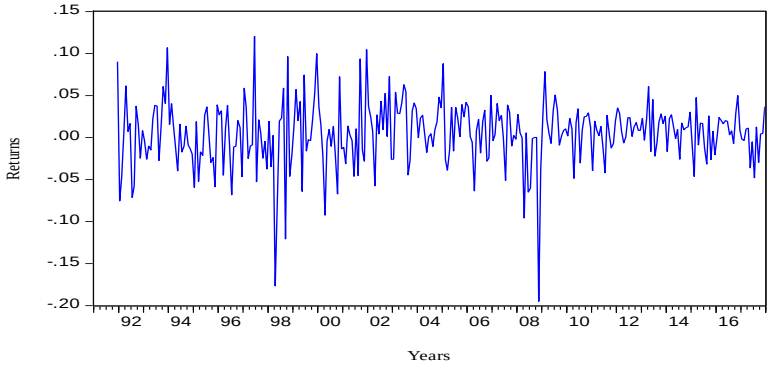


Figure 2: Monthly returns on KSE-100 Index (November 1991-December 2017)



As mentioned above, there is a bulk of literature available on the impact of external sector shocks (oil-price shocks and commodity-price shocks) on macroeconomic performance for different groups of countries. However, the literature has not yet identified the differential impact on real and nominal sectors. In addition, there is a vast literature that has established the impact of stock market shocks on macroeconomic performance. However, we are unable to find any study that examines the implications of stock market shocks on macroeconomic performance in the presence of external sector shocks. Therefore, to abridge these gaps in the existing literature, this study examines the response of real and nominal sectors to internal and external shocks. In this regard, we used stock-price volatility and stock market-value index to capture internal sector shocks, whereas oil-price shocks, commodity-price shocks, and world interest-rate shocks are used to capture external sector shocks. We used monthly data ranging from January 1991 to December 2017. By employing Johanson's co-integration technique, we reported the long-run co-integrating relationship of stock market and external sector with nominal and real sectors of Pakistan. Moreover, we found a strong explanatory power of stock market volatility and external shocks to forecast future variations in both real and nominal sectors.

This paper is structured into 5 sections. Section 1 introduces the study while Section 2 presents the review of the existing literature. Section 3 explains the methodology and data employed by the study. Section 4 discusses the empirical results. Section 5 concludes the study and suggests some policy implications based on the empirical findings.

2. Literature Review

It is widely documented fact that the macroeconomic performance of small open economies is not only determined by internal sector fluctuations but also by external sector shocks. In this regard, a considerable attention has been devoted to explore the impact of stabilization policies, functioning of financial and stock markets, inflationary pressures, government structure, fluctuations in world oil prices and world commodity prices on aggregated and disaggregated macroeconomic performance. These factors affect the economic performance through various channels depending upon the nature of relationship between the former and the latter, type and intensity of the shock. For instance, on theoretical grounds, Keynesians ruminate that macroeconomic performance can be affected in two important ways: variations in aggregate demand due to changes in investment spending, and variations in aggregate supply due to unfavorable shocks such as any artificial shortage of some key resources or wars (Sameti, 2012).

Moreover, two important channels are highlighted which can transmit the effect of oil price shocks to the exchange rate of a country, namely, the TOT channel and the wealth effect channel. These channels identified differential impacts of oil-price shocks in oil-importing countries and oil-exporting countries. The TOT channel propagates an appreciation of exchange rate in response to a positive TOT shock, leading to the Dutch Disease effect. The similar mechanism is explained in the Balassa-Samuelson effect. However, without incorporating the income effect, the positive TOT effect leads to difference in productivity of tradable and non-tradable sectors, which appreciates the exchange rate. On the other hand, the impact of oil prices on the exchange rate is also explained through the wealth effect channel by Golub (1983) and Krugman (1983). The former focused on the portfolio choice while the latter used the current account imbalances to explain the relationship. In particular, the portfolio choice model explains that an increase in oil prices shifts the wealth from oil-importing countries to oil-exporting countries. However, in the long run, the oil-exporting countries experience a decline in productivity mainly due to two reasons. Firstly, higher oil prices encourage production and increases real wages in the oil sector and ultimately bring equalization of real wages by labor movements across the tradable and non-tradable sectors. Secondly, higher real wages appreciate the exchange rate and deteriorates competitiveness that ultimately lowers economic growth. Krugman (1983), while focusing on the current account imbalances, explained that oil-exporting countries use their accumulated wealth for increasing imports from other countries. Therefore, the effect on RER depends on geographic distribution of imports of oil-exporting countries and not on the portfolio choices.

The impact of stock market volatility on economic performance (exchange rates, interest rates, and money supply) can be expressed through the portfolio balance approach. Increases in stock prices increase domestic investors' wealth, which, in turn, causes expansions in money demand, puts upward pressure on the interest rate, and encourage capital inflow leading appreciations of domestic currency. Furthermore, Fama (1990) and Schwert (1990) documented that stock returns have considerable predictive power for future real economic activities. Similarly, Choi et al. (1999) found that stock market has significant predictive powers on industrial production growth rate.

Empirically, many researchers have documented that oil prices and variations in oil prices play significant roles in the macroeconomic performance of both oil-importing and oil-exporting countries. The pioneer work in this regard has been done by Krugman (1983), Golub (1983), McGuirk (1983), and Rogoff (1991) and reported a strong relationship between the two variables. Moreover, Bénassy-Quéré, Mignon, and Penot (2007) asserted that the direction of causality is from oil prices to the exchange rate. Similarly, Chen and Chen (2007) and Lizardo and Mollick (2010) reported that oil prices and the exchange rate have a co-integrating relationship. They further explained that oil prices are the main contributor to fluctuations in the exchange rate. Korhonen and Juurikkala (2009) also explained that oil

prices directly influence the equilibrium exchange rate. Kin and Courage (2014) also reported an appreciation in the exchange rate of developing countries in response to oil-price shocks. Ferraro, Rogoff, and Rossi (2015) reported a weak correlation, whereas Eryiğit (2012) found no impact of oil prices on the exchange rate. However, they substantiated that oil-price shocks have an adverse impact on exchange rates and interest rates. Another study by Djebbouri (2018) confirmed the significant impact of world oil prices on movements of the exchange rate. The findings postulated an appreciation in the exchange rate in response to oil-price shocks. However, Drachal (2018) reported that spot oil prices have a negative impact on exchange rates.

As far as the impact of oil price shocks on internal sector is concerned, Nazir and Hameed (2015) concluded that oil prices have positive impacts on the GDP of Pakistan in the short run, whereas in the long run, oil prices have a negative impact on the GDP. Kurihara (2015) explained that the impact of oil prices on economic growth is different for oil-exporting and oil-importing countries. Specifically, they concluded that although a rise in oil price benefits oil-exporting countries, it hurts oil-importing countries by deteriorating their economic growth. In contrast, Khan et al., (2019) found no long-run impact of oil price changes on the GDP of selected Asian countries. However, oil-price shocks impart significant but limited implications for the GDP growth of most of the Asian economies. Moreover, small economies face a larger impact on their GDP in response to oil-price shocks. Riman, Akpan, and Offiong (2013) revealed that the response of private investment and industrial production to oil-price shocks is negative. Similarly, the study of Eryiğit (2012) reported an adverse impact of oil-price shock on domestic interest rates. Daramola et al., (2019) documented that due to decline in oil prices, developing oil-producing countries experienced decline in GDP. More recently, Yildirim and Arifli (2021) also reported that a negative oil-price shock results in worsening of the trade balance, weakening of the currency, increases the rate of inflation, hence decline in overall economic activity of oil-exporting countries. Further, the findings postulated an appreciation in the exchange rate in response to oil-price shocks. Drachal (2018) reported that spot oil prices have a negative impact on exchange rates. In contrast, Khan, Husnain, Abbas, and Shah (2019) found no long-run asymmetries concerning the impact of oil-price changes on the GDP of selected Asian countries. However, oil-price shocks portray a significant asymmetric for the GDP growth of most of the Asian economies. Tian, Li, and Wen (2021) investigated the dynamic effects of changes in the oil implied volatility index on changes in the stock implied volatility index and changes in the implied volatility index for the exchange rate in China. The findings stated that oil volatility index appear as a dominant factor affecting the stock market and exchange rate. Moreover, the exchange-rate volatility index plays substantial role in the relationship of oil-price volatility and stock market volatility. Mukhtarov, Humbatova, Mammadli, and Hajiyev (2021), using the structural vector autoregressive (SVAR) approach examined the impact of oil-price shocks on macroeconomic performance of a small oil-exporting country and documented a favorable impact of oil-price shock on GDP and trade, whereas an adverse impact on the exchange rate is observed. Moreover, the study recommended that oil-exporting countries should reduce the dependence of GDP and other macroeconomic variables on oil exports.

Commodity prices are also considered an important external factor affecting the macroeconomic performance of developing countries. Chileshe, Chisha, and Ngulube (2018) found that the monetary policy of a developing country is pro-cyclical to external shocks such as commodity-price shocks and financial shocks. In addition, they reported a significant response of macroeconomic variables such as output and exchange rates to commodity-price shocks, whereas prices and exchange rates are more responsive to financial shocks. Kohlscheen, Avalos, and Schrimpf (2017) argued that commodity prices play significant role in determining the exchange rate of commodity-exporting countries. Earlier studies have also confirmed that commodity prices have a significant impact on real exchange rates (Chen and

Rogoff, 2003; MacDonald and Ricci, 2004; Cashin, Cespedes and Sahay, 2004; Sidek and Yussof, 2009; de Gregorio and Labbé, 2011; Kohlscheen, 2014; Hambur et al., 2015). In the similar vein, the impact of commodity prices on GDP is also examined by various researchers. For instance, Emara, Simutowe, and Jamison, (2015) explained a favourable impact of the improvement in commodity terms of trade (CTOT) on GDP per capita growth of developing countries. De. V. Cavalcanti, ., Mohaddes, and Raissi, (2015) investigated the impact of the level and volatility of CTOT on economic growth, TFP, and physical and human capital accumulation. The study concluded that an increase in CTOT triggers economic growth. However, the volatility of CTOT hampers economic growth as well as reduces physical and human capital accumulation. Nikonenko et al., (2020) studied the level and volatility impact of commodity prices on income (by using GDP and industrial production index) dynamics. The estimates identified that an increase in world commodity prices improves the dynamics of income, whereas higher volatility in world commodity prices imparts adverse impact on both measures of income. Katoka and Dostal (2022) explored the link between commodity exports and economic performance in African countries and concluded that oil-exporting countries experience higher economic growth as compared to countries rich in other types of natural resources.

As far as the internal sector is concerned, a considerable attention is paid to investigate the impact of stock market prices and volatility in stock market on various macroeconomic variables. In this regard, Aslam (2014) found negative but weak bidirectional causality between stock market and the exchange rate. Ghufran, Awan, Khakwani, and Qureshi, (2016) analyzed the potential factors that create volatility in the stock market. They identified political situation as the key factor in creating disturbance in the stock market, whereas herd behaviour appears as another important factor in creating turbulence. They further concluded that the stock market volatility has unfavourable implications for the Pakistan economy. Specifically, it distorts economic growth and discourages business investment. Omoregie, Eromosele, and Edo (2016) asserted a positive impact of stock market volatility on economic growth. Nzomo and Dombou-Tagne (2017) examined the implications of stock market return volatility and stock market development for economic growth, inflation, and money supply. The study does not find any significant impact of stock market development on economic growth. However, it does find a significant impact on inflation and money supply. Drachal (2018) provided evidence of an adverse impact of stock market prices on the exchange rate.

Onakoya (2013) reported bidirectional relationship between stock market volatility and economic growth and substantiated an adverse impact of the former on the later. Ogboi and Oladipo (2012) stated that uplift in stock market activities ensures a healthy business environment and the availability of funds to investors, which delivers a favorable impact on economic growth. Similarly, a favorable impact of stock market development on economic growth is reported by Chizea (2012). Oseni and Nwosa (2011) revealed bidirectional relationship between stock market volatility and GDP volatility. However, interest rate volatility and inflation volatility does not maintain any relationship with stock market volatility. Ewah, Essang, and Bassey (2009) asserted that the stock market impact on economic growth is conditional on various factors such as market capitalization, absorptive capacity, and liquidity in the economy. Riman, Esso, and Eyo, (2008) reported a uni-directional relationship extending from the stock market towards GDP growth. Frimpong and Oteng-Abayie (2006) explained that stock market volatility affects economic growth by increasing the cost of capital and changing investor's portfolio preferences. Liljeblom and Stenius (1997) concluded that stock market volatility is an important conjecturer of macroeconomic volatility. Specifically, the study has used consumer price index, industrial production index, and money supply as a major indicator of macroeconomic performance. The study reported that stock market volatility considerably hoists volatility in the macroeconomic indicators. Samuel, Abner,

Inim, and Ndubuaku (2019) studied the impact of Nigeria's stock market volatility on economic growth and reported an adverse impact of the former on the latter. The study also explained that stock market volatility is the main reason behind financial and economic recession in Nigeria. Dabwor, Iorember, and Yusuf Danjuma (2022) explained that shocks to stock market returns in Nigeria are likely to be permanent. The study found insignificant impact of stock market returns on GDP, whereas a favourable and significant impact of globalisation is observed for GDP.

Overall, the review of the past studies has identified an important gap in the existing literature that macroeconomic performance has been examined separately for internal and external sector shocks. However, it is a well-established fact that internal and external sectors operate in parallel. Therefore, it is pertinent to assess the simultaneous impact of internal and external sector shocks on macroeconomic performance. Such type of empirical analysis is important to recognize whether, how, when, and what type of shocks have more adverse impacts on macroeconomic performance.

3. Data and Methodology

As mentioned above, this study aims to empirically assess the impact of external shocks and stock market volatility on the performance of nominal and real macroeconomic sectors Pakistan. To compute stock market volatility, we estimate the GARCH model. Moreover, we employed a restricted vector autoregressive (VAR) model to estimate the potential interaction between stock market volatility (SMV) and selected macroeconomic indicators. For doing so, we focused on variance decomposition and impulse response function. The VAR model is considered a more appropriate method to identify the interrelations between the economic variables. Sims (1980) introduced it as a method that could be used by macroeconomists to characterize the joint dynamic behavior of a collection of variables without requiring strong restrictions to identify underlying structural parameters. By using restricted VAR, we test the following hypothesis;

$$H_1: \text{SMV and External Shocks affect the real and nominal sectors of Pakistan.}$$

The VAR model used in this study is expressed as follows:

$$X_t = \alpha_0 + \sum_{p=1}^{k} \beta_p X_{t-1} + \varepsilon_t \qquad (1)$$

where $X_t = [X_t^{macro}, X_t^{stockmarket}, X_t^{externalshocks}]$, $X_t^{macro} = \left[X_{1t}^{Realsector}, X_{2t}^{Nominalsector}\right]$ is a group of macroeconomic variables consisting real and nominal sectors. The selection of the macroeconomic variable in this research is closely related to the study of Schwert (1989). However, we have segregated macroecnomic performance into real and nominal sector to guage the resposne of each sector, seperately, towards external and internal shocks. In particular, Real sector variables include industrial production index (IPI), the real effective exchange rate (REER) and the real interest rate (RIR). The real interest rate is computed by fusing fisher equation; $i - \pi$ where i is the nominal interest rate and π is the inflation rate. Nominal sector is measured through the nominal effective exchange rate (NEER), the nominal interest rate (NIR), nominal money supply (NMS), and consumer price index (CPI). $X_t^{externalshocks}$ is a group of global variables, which includes 3-month US treasury bills rate (USTBR), world commodity price index (WCPI) i.e. commodity non-fuel prices index (2005=100), which comprises food, beverages, and industrial input price indices. World oil price index (WOPI) is based on

the West Texas spot crude oil in dollars term. k indicates the lag length and ε_t is the vector of innovations and does not have any correlation with past values.

$X_t^{stockmarket} = \left[X_{3t}^{Returns}, X_{4t}^{Volatility}\right]$ is a group of stock market variables consisting of stock market returns (SMR) and stock market volatility (SMV). Stock returns are constructed by the conversion of closing of KSE-100 index points as $R_t = \ln(\rho_t / \rho_{t-1})$.

3.1. Johanson Cointegration Technique

For assessing the longrun relationship among internal and external shocks, and macroeconomic performance of real and nominal sectors, the study employed Johansen co-integration developed by by Johansen (1988), Johansen (1991), and Johansen and Juselius (1990). One of the important precondition for applying Vector Error Correction Model (VECM) is that the variables must be integrated of order one or the variables should appear stationary at the first differenced. Alternatively, VAR model is applicable if the variables appear non-stationary at the level. Furthermore, in order to examine the transmission effect, we have also used Variance decomposition and Impulse response function (IRFs).

The study uses monthly data ranging from December 1991 to December 2017, based on the availability of data. The data is accessed from the State Bank of Pakistan, Pakistan Stock Exchange, and the International Financial Statistics (IFS). All the variables are in log form.

3.2. Measuring Stock Market Volatility

The study evaluates the impact of internal and external uncertainty on real and nominal sectors of Pakistan. Stock market volatility is being used as a source of internal shocks. For this, first, we convert the closing of stock prices into returns and then calculated volatility of returns. There are different methods to calculate return volatility. The ARCH/GARCH model has been widely used to capture the volatility in financial series. Therefore, we employed the ARCH/GARCH model to calculate volatility of stock returns and used conditional variance as a measure of volatility, which is an exogenous variable in our model. Table 1 shows the result of the GARCH model for stock market returns, where α shows the ARCH term, β indicates the GARCH term and ω represents the constant term. It can be observed that all coefficients are statistically significant at one percent significance level. However, the value of β (GARCH term) is slightly higher than α (ARCH term), which indicates that there exists persistent volatility and it is more sensitive to its lagged value. The time series volatility is determined by the size of the parameters α and β. The sum of these coefficients $(\alpha + \beta)$ is 0.96, which is less than one, showing that the shock will persist in many future periods, and is mean-reverting.

The estimated value of Akaike Information Criterion (AIC) and Schwarz information criterion (SIC) values indicate the fitness of models. Lower values of AIC and SIC indicate the best-fitted model. Furthermore, the ARCH-LM test is estimated on the residuals to check the ARCH effect for the authentication of the variance equation. The results revealed, based on the p-value (0.59), that the null hypothesis of the "No ARCH effect" is not rejected. In other words, the test statistics do not provide any evidence for the remaining ARCH effects in the model.

Table 1: GARCH Estimates for Volatility

Estimates	**ARCH GARCH**
Mean Equation	
ω [Constant]	0.01(0.00)***

Variance Equation	
ω [Constant]	0.01(0.00)***
α [ARCH estimate]	0.07(0.00)***
β [GARCH estimate]	0.89(0.00)***
$(\alpha + \beta)$	0.96
Log likelihood	330.4
Akaike information criterion [AIC	-2.08
Schwarz information criterion [SIC]	-2.03
ARCH-LM test for heteroscedasticity	
ARCH-LM test statistics	0.03(0.59)

Note: *** shows significance at the 1% level. AIC and SIC give information about the authenticity of the estimates in the model. However, lower value of both criterions indicate better-fitted model p- values are given in ( ) parenthesis.

4. Empirical Results

4.1.Descriptive Statistics

Table 2 reports the descriptive statistics of all the variables included in the study. The mean of stock returns is positive specifying that stock prices have increased on average over the course of time. Whereas, the value of skewness is negative, which implies that the average investor in the equity market tends more towards the negative asymmetry over the positive asymmetry. Furthermore, the mean value of other variables such as IPI, REER, WCPI, OPI, NMS, and CPI is positive and statistically significant showing an increasing trend over time. While the mean values of RIR, NEER, NIR, and USTBR are negative and statistically significant showing a decreasing trend over time. In terms of skewness, NEER, NIR, RIR, WCPI, OPI, and REER are negatively skewed. While IPI, CPI, NMS, and USTBR are positively skewed. In general, the skewness values show a lack of normality in all the variables. All variables have higher kurtosis (more than 3) which shows that all series are hefty tailed and have leptokurtic distribution. Similarly, the results of the JB test and the probability values suggest the rejection of H_0 (series is normal) at one percent for all variables. Variability, measured as the standard deviation, in stock returns REER, RIR, NEER, WCPI, OPI, and NIR is higher than variability in IPI, CPI, NMS, and USTBR. Hence, the descriptive statistics exhibit non-normality, skewness and leptokurtic distributions in the data set of stock market volatility, external shocks, and macroeconomic nominal and real sectors.

Table 2: Descriptive Statistics

Var	Mean	Max	Min	S.D	Skewness	Kurtosis	JB	Obs
Stock Returns	0.010	0.277	-0.448	0.087	-0.790	6.995	239.2 (0.000)***	311
IPI	0.003	0.909	-0.485	0.109	1.652	18.64	3312.3 (0.000)***	311
REER	0.0001	0.051	-0.063	0.016	-0.573	4.756	57.03 (0.000)***	311
RIR	-0.003	0.848	-1.070	0.181	-0.606	11.12	875.1 (0.000)***	311
CPI	0.006	0.032	-0.015	0.007	0.383	3.576	11.93 (0.000)***	311
NEER	-0.004	0.044	-0.067	0.016	-0.794	5.355	104.6	311

							(0.000)***	
NIR	-0.002	0.301	-0.422	0.068	-1.058	11.55	1007.1	311
							(0.000)***	
NMS	0.011	0.073	-0.029	0.017	0.489	3.394	14.41	311
							(0.000)***	
USTBR	-0.003	1.791	-1.845	0.288	0.245	17.79	2858.9	311
							(0.000)***	
WCPI	0.001	0.451	-0.508	0.045	-1.528	78.85	75165.6	311
							(0.000)***	
OPI	0.003	0.213	-0.366	0.081	-0.668	4.474	51.64	311
							(0.000)***	

Note: JB (Jarque Bera) test used for evidence of normality in the data. P-values are displayed in braces () which show the non-acceptance of the H_0 of normality at 1% level of significance. Kurtosis shows the peakedness of data. For normal distribution the value of Kurtosis should be 3. In normal distribution, symmetry /asymmetry is described by skewness.

4.2. Empirical Findings

4.2.1.Unit Root Test

Table 3 reports the estimates of the ADF unit root test for stationarity. The ADF test is employed with constant (c), and with constant and a linear trend (c + t) terms. The lag length is selected based on the AIC. It can be observed from Table 3 that all the variables are non-stationary at their levels. However, their first differences appear stationary. Thus, we can conclude that variables are I(1) or obtain first order integration.

Table 3: Augmented Dickey-Fuller Test

Variables	**Augmented Dickey-Fuller test statistics**			
	Level		First Difference	
	(c)	(c+t)	(c)	(c+t)
Index Points	0.024	-2.102	-16.95***	-16.98***
IPI	-0.775	-2.102	-12.59***	-12.57***
REER	-1.910	-1.784	-13.00***	-13.10***
RIR	-0.004	-0.077	-13.12***	-13.10***
CPI	-0.901	-1.183	-6.995***	-7.030***
NEER	-1.359	-1.750	-12.25***	-12.30***
NIR	-2.338	-2.450	-13.79***	-13.77***
NMS	1.375	-1.497	-12.26***	-12.35***
WCPI	-1.675	-2.536	-15.40***	-15.39***
WOPI	-1.593	-2.386	-13.87***	-13.86***
USTBR	-1.505	-2.536	-15.85***	-15.87***

Note: *** symbolizes significance at the 1% level.

4.2.2. Johansen Co-integration Tests

As stated above, all selected variables are stationary at their first differences. Therefore, to test the long-run relationship among the selected variables, by following Johansen(1988), Johansen (1991), and . Johansen and Juselius (1990), Johansen co-integration tests are employed. The results in Table 4 explain the long-run relationship between external shocks, stock market variables, and macroeconomic real sector performance. The findings reveal that maximum Eigen values and trace test values reject the H_0 of "No

co-integration" at the 5% significance level. Hence, we infer that there is a long-run relationship between the selected variables.

Table 4: Johansen Test Results for Co-integration (Real Sector)

Null hypothesis	V_{trace}	0.05 Critical value	$V_{max-Eigen}$	0.05 Critical value
$\mathbf{r^* = 0}$	233.2 (0.00)***	159.5	92. 47 (0.00)***	52.36
$\mathbf{r \leq 1}$	140.8 (0.00)***	125.6	43.36 (0.09)	46.23
$\mathbf{r \leq 2}$	97.44 (0.03)**	95.75	35.49 (0.15)	40.07
$\mathbf{r \leq 3}$	61.94 (0.18)	69.82	23.76 (0.47)	33.87
$\mathbf{r \leq 4}$	38.17 (0.29)	47.85	17.61 (0.52)	27.58
$\mathbf{r \leq 5}$	20.55 (0.38)	29.79	13.95 (0.36)	21.13
$\mathbf{r \leq 6}$	6.602 (0.62)	15.74	6.217 (0.58)	14.26
$\mathbf{r \leq 7}$	0.384 (0.53)	3.841	0.384 (0.53)	3.841

Note: p-values are given in parenthesis. ** and *** show significance level at 5% and 1% respectively. Trace test statistics show 3 while Max-eigen value test indicates one co-integrating equations.

Next, Table 5 provides the results of the Johansen co-integration test for the long-run relationship among external shocks, macroeconomic nominal sector, and stock market variables. Both the maximum Eigen values and trace test values reject the null hypothesis of "No co-integration" at five percent significance level. Therefore, from the empirical estimates, we conclude that there exists a long-run association among CPI, NEER, NIR, NMS, volatility and returns on PSX-100 index, USTBR, WCPI, and WOPI shocks. Specifically, the trace test indicates nine co-integrated equations while maximum Eigen values show 3 co-integrated equations.

Table 5: Johansen Test Results for Co-integration (Nominal Sector)

Null hypothesis	V_{trace}	0.05 Critical value	$V_{max-Eigen}$	0.05 Critical value
$\mathbf{r^* = 0}$	421.4 (0.00)***	197.3	112.2 (0.00)***	58.43
$\mathbf{r \leq 1}$	309.1 (0.00)***	159.5	99.93 (0.00)***	52.36
$\mathbf{r \leq 2}$	209.2 (0.00)***	125.6	77.40 (0.00)***	46.23
$\mathbf{r \leq 3}$	131.5 (0.00)***	95.75	34.86 (0.17)	40.00
$\mathbf{r \leq 4}$	96.93 (0.00)***	69.81	33.47 (0.05)**	33.87
$\mathbf{r \leq 5}$	63.19 (0.00)***	47.85	27.79 (0.04)**	27.58
$\mathbf{r \leq 6}$	35.39 (0.01)***	29.79	19.49 (0.08)	21.13

r ≤ 7	15.90 (0.04)**	15.49	11.14 (0.14)	14.26
r ≤ 8	4.75 (0.02)**	3.841	4.75 (0.02)**	3.841

Note: p-values are given in parenthesis ( ). ** and *** show significance level at 5% and 1%, respectively. Trace test statistics show 9 while max-eigen values estimates indicate 3 co-integrating equations.

4.2.3. Response of Real Sector to Stock Market Volatility and External Shocks

We separately estimated VECM for real and nominal sectors and calculated variance decomposition and IRF. The main focus of the study is on the forecast variance and to trace out the IRF. In this regard, as stated above, there are certain criteria to estimate the VECM. Firstly, to select appropriate lag length for the model. Secondly, to check order of integration among all the selected variables. If the variables are cointegrated of the same order then we can run VECM: a restricted vector auto regression model.

The estimated results provide evidence that we have fulfilled the prerequisites to measure VECM. Furthermore, by using lag length selection criteria, we selected 12^{th} order lag as suggested by AIC. Our work is also similar with Schwert (1989) who analyzed the relationship of stock market volatility with real and nominal macroeconomic volatility. He estimated 12^{th} order lagged VAR separately for real and nominal sectors and divided data into three sub periods 1891-1987, 1891-1919 and 1920- 1952. Nominal macroeconomic varaibles including money supply, inflation and interst rate are affected by the stock volatility, while during the last sub-period, the evident relatioship is not strong. However, our model is different/superior in two fundamental ways. First, we used VECM approach, which enables us to test the long-run and short-run effects. Second, we used external sector variables along with internal sector variables to measure macroeconomic performance, which is a broader measure of economic performance.

The VECM and variance decomposition based on Cholesky decomposition have been employed while choosing 24-months horizon Monte Carlo simulation based on 1000 replications. Notably, ordering within the real variables is inconsequential since all these variables are placed before the stock market volatility (Christiano, Eichenbaum, and Evans, 1999). Table 6 reports variance decomposition of IPI, REER, RIR. The variance decomposition shows the relative importance/contribution of one standard deviation shock to each external as well as internal macroeconomic indicator for real and nominal sectors of Pakistan.

Starting with IPI, we see that after 24 months, around 10% of the variance in IPI is explained by the volatility of stock prices, which is more than the returns on the stock market. Moreover, 9.95 % of the variance is explained by world oil prices after twenty-four months. In addition, 2.35% variance is explained by the world commodity prices and 2.10% variance in IPI is explained by the US Treasury bill rates (used as world interest rate proxy for external shocks) after twenty-four months. We can observe that strongest transmission effect in explaining the variance of IPI is of stock price volatility followed by oil price shocks while the least contributor is USTBR. The variation in IPI due to stock market returns is half of what is generated by volatility of stock returns. These findings infer that the variance of IPI is highly sensitive to stock market volatility and oil prices. Alternatively, it can be concluded that the stock market shocks are contagious for real sector macroeconomic performance as the stock market shocks create fluctuations in IPI. Pakistan is heavily dependent on oil imports. Therefore, oil prices have a major role in explaining the performance of the industrial sector. If we look at the time horizon, as we move from shorter to longer time span, the relative importance of stock market volatility as well as oil prices increases. Similarly, the impulse response function reveals that huge fluctuations in IPI occur due to WCPI and WOPI shocks, whereas there is weak support for the role of shocks in USTBR to create

fluctuations in IPI. The response of IPI is strongest towards one standard deviation shock in WOPI followed by stock market volatility and WCPI shocks. Hence, there is a spillover effect over time from both the internal and external sector shocks towards macroeconomic performance. Our findings are closely related to Alexopoulos and Cohen (2009).

The variance decomposition of REER indicates that only 0.29% variance in the real effective exchange rate can be explained by the stock market volatility at the end of six months. This percentage remains significant by the end of the twenty-four months reaching 2.50%. About 1.19% of the REER variations is caused by stock price returns at the end of six months period and increased to 1.75% at the end of the twenty-four months. About 0.53% variance in REER is explained by the USTBR at the end of six months, which further increases to 1.16 % at the end of the twenty-four months. World commodity prices cause 0.53% fluctuations in the variance of REER by the end of the six-month period and shows a slight increase to 0.56% by the end of the twenty-four months. Finally, 10.8% of the variance in REER is explained by the world oil prices at the end of the six months period and declined to 10.7% by the end of the twenty-four months. By looking closely at the estimates, we can observe that variance in the REER is highly sensitive to changes in oil prices implying that the oil price shocks are highly contagious towards REER followed by USTBR. The major proportion of Pakistan's imports are oil, therefore, any change in oil prices instantly affect the exchange rate. The spillover effect of oil prices in the forecast error of REER increases over time, however, is showing some fluctuating trend. As far as internal sector shocks are concerned, stock market volatility also contributes to the REER fluctuations. However, the contribution is much less than oil prices. The lowest contribution is by world commodity prices. Pakistan is a commodity exporter in the world market; however, the share in world exports is not significant. This can explain the meager role of WCPI in explaining the variance of REER. Zhou (1995) also explains that the real exchange rate of a small open economy is highly sensitive to world oil prices. In addition, the impulse response function captures depreciation in REER followed by an appreciation in response to shocks in world commodity prices. Moreover, WOPI shocks create steep appreciation in REER in the beginning while the extent of appreciation weakens in the longer time frame. REER shows no response to shocks in stock market volatility in the short run while it appreciates slightly in the medium to long run. Similar to variance decomposition analysis, the response of REER towards shocks to USTBR is negligible.

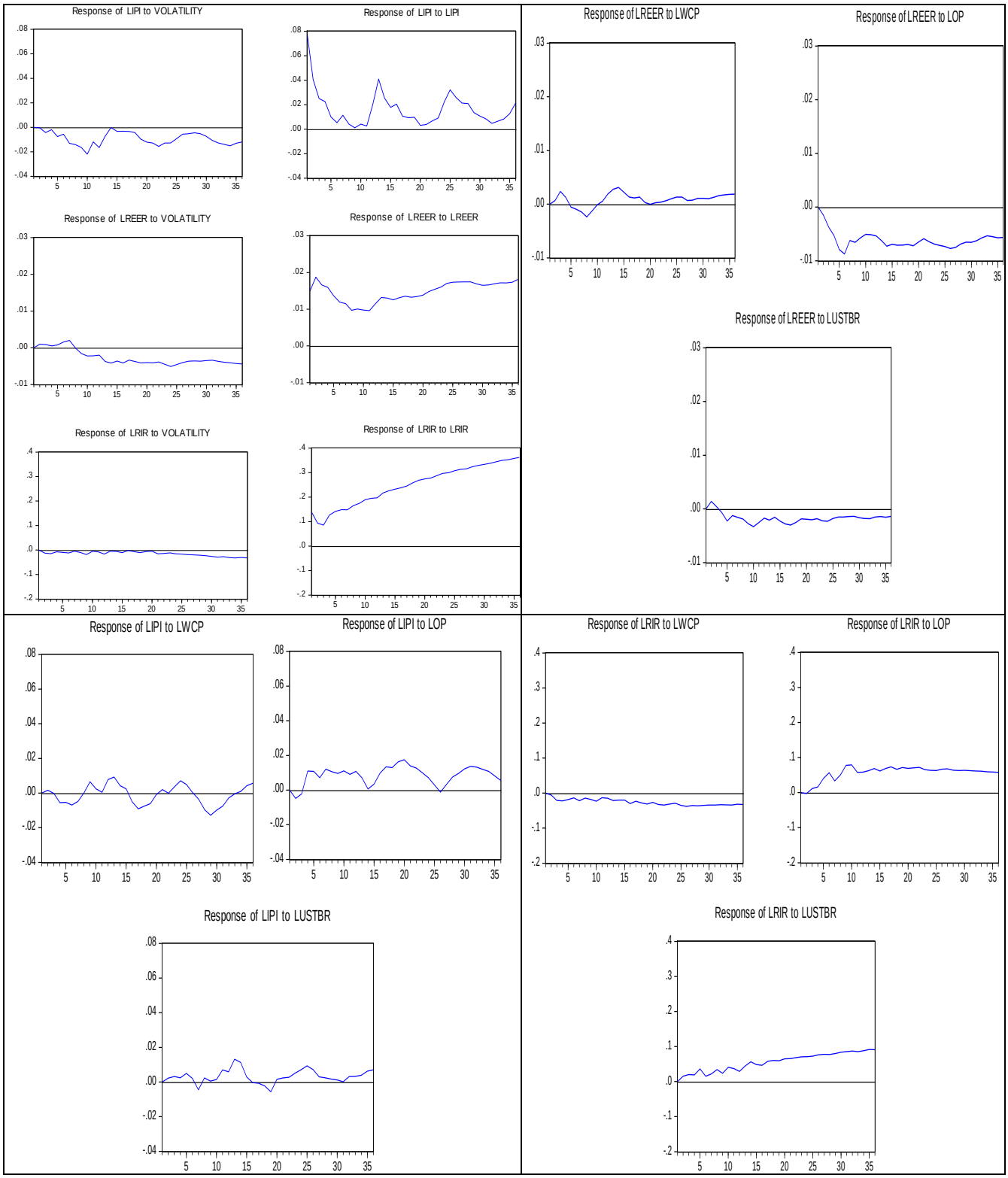
The variance decomposition of the real interest rate (RIR) shows that around 0.19% of the variance is explained by the volatility in the stock market, which is comparatively less than the returns on the stock market. Around 2.11% of the variance in RIR is explained by the USTBR after six months. This percentage increases to 3.45% by the end of the twenty-four months. About 1.18% variance is explained by the world commodity prices after six months period while it declines to 0.75% by the end of the twenty-four months horizon. Finally, 4.62% variance is explained by the world oil prices after the six-months that significantly increases to 6.08% at the end of the twenty-four months horizons. The maximum contribution in explaining the forecast error of RIR is from stock market returns followed by the world oil price index. Both variables show an increasing trend from the short run to the long run. The next important variable that creates fluctuations in RIR is USTBR. Though the variation caused by USTBR is small it stays positive and the size increases with the passage of time. This finding indicates co-movement in the monetary policy of Pakistan and the USA. The impulse response function reveals weak support for the WCPI and WOPI to create fluctuations in RIR. On the other hand, the shocks to US monetary policy are significantly transmitted towards monetary policy of Pakistan as explained by the significant the contagion effect of USTBR shock to variation in RIR. The IRF shows an increase in RIR in response to one standard deviation shock to USTBR, once again showing co-movement in the

monetary policy of Pakistan with USTBR. The positive and increasing trend of RIR in response to the shocks in USTBR reflects that US monetary policy plays an important role in determining the monetary policy of Pakistan. Alternatively, we can say that RIR follows the path of USTBR.

Table 6: Variance Decomposition (Real Sector)

Industrial Production Index				
After	3M	6M	12M	24M
Stock price volatility	0.21	1.06	10.25	10.35
Stock price Return	0.54	3.24	5.17	5.79
WCPI	0.03	1.01	1.50	2.35
WOPI	0.32	3.03	6.20	9.95
US treasury bill rates	0.17	0.46	1.00	2.10
Real Effective Exchange Rate				
After	3M	6M	12M	24M
Stock price volatility	0.18	0.29	1.17	2.50
Stock price Return	1.31	1.19	1.22	1.75
WCPI	0.67	0.53	0.75	0.56
WOPI	1.78	10.8	13.03	10.7
US treasury bill rate	0.23	0.53	1.17	1.16
Real Interest Rate				
After	3M	6M	12M	24M
Stock price volatility	0.92	0.58	0.40	0.19
Stock price Return	7.53	9.27	9.79	9.08
WCPI	1.05	1.18	0.91	0.75
WOPI	0.35	4.62	7.76	6.08
US treasury bill rate	1.59	2.11	2.29	3.45

Figure 3: Impulse Response to Cholesky One S.D. Innovations


Response of LIPI to VOLATILITY
Response of LIPI to LIPI
Response of LREER to LWCP
Response of LREER to LOP
Response of LREER to VOLATILITY
Response of LREER to LREER
Response of LREER to LUSTBR
Response of LRIR to VOLATILITY
Response of LRIR to LRIR
Response of LIPI to LWCP
Response of LIPI to LOP
Response of LRIR to LWCP
Response of LRIR to LOP
Response of LIPI to LUSTBR
Response of LRIR to LUSTBR

4.2.4. Response of Nominal Sector to Stock Market Volatility and External Shocks

Table 7 reports the variance decomposition of nominal sector variables namely CPI, NEER, NIR, and NMS. Starting from the response of CPI, it can be observed that after 24-month horizon, around 1.62% of the variance in CPI is explained by volatility in the stock market, 1.01% variance is explained by the USTBR after twenty-four months, 25.88% variance is explained by the world commodity prices, and 8.80% variance is explained by the world oil prices. The findings portray a huge variation caused by world commodity prices followed by world oil prices. In other words, WCPI shocks are highly contagious for CPI. This is justified on the grounds that Pakistan's exports are mainly comprised of commodities while imports by crude oil. Therefore, both these external sector variables have a major influence on domestic prices. Among stock market variables, stock-price returns contribute more to price fluctuations than stock market volatility. However, the role of the stock market variable is quite less as compared to external sector variables. As far as IRFs are concerned, the shocks to WCPI create huge fluctuations in CPI across all periods implying the domestic price level is highly sensitive towards shocks in WCPI. It can be concluded that there are significant spillover effects from external sector shocks to nominal sector in Pakistan. The other variables remain less important in creating any fluctuation in the CPI of Pakistan.

The variance decomposition of NEER shows that about 0.34% variance is explained by the stock market volatility at the end of six months that significantly increases to 1.21% at the end of twenty-four months. Moreover, 0.75% variance in NEER is caused by stock price returns at the end of six months period, which is reduced to 0.34% at the end of the twenty-four months. In addition, 0.87% variance in NEER is explained by the USTBR at the end of six months while it decreases to 0.65% at the end of the twenty-four months. World commodity prices cause 1.05% fluctuations in forecast error of NEER by the end of the six months period and further increases to 2.69% by the end of the twenty-four months. Finally, 6.61% of the variance in NEER is explained by the world oil prices at the end of the six months period while it reaches to 12.10% by the end of twenty-four months. Similar to REER, the maximum contribution for creating fluctuations in NEER is of world oil price index followed by the world commodity price index while the lowest contributor is by stock price returns. The IRF of NEER explains appreciation in NEER in response to WOPI and WCPI. However, the impact of WOPI is stronger than that of WCPI. The response of NEER to USTBR shocks and stock market volatility is weak. Hence, it can be inferred that spillover effect of external sector shocks is strongest for exchange rate movements irrespective of the type of exchange rate.

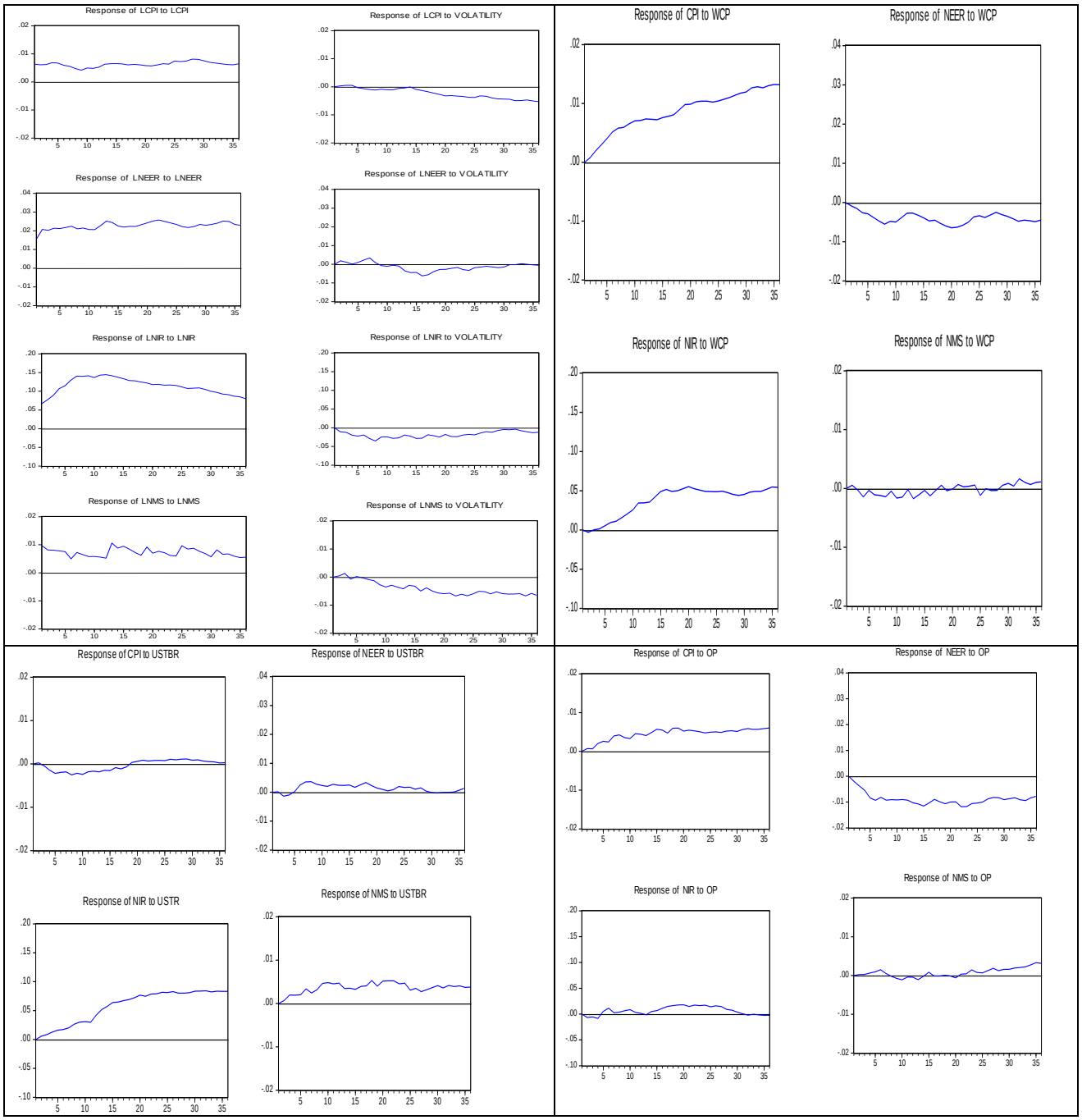
The variance decomposition of nominal interest rate reveals that about 2.08% variation is explained by the stock market volatility at the end of six months and reaching at 1.77% by the end of twenty-four months. Only 0.75% of variation in the forecast error of NIR is caused by stock price returns at the end of six months period that is further decreased to 0.34 percent at the end of the twenty-four months. Around 1.12% variance in the nominal interest rate is explained by the USTBR at the end of six months and 9.45% at the end of the twenty-four months. World commodity prices cause 0.17% fluctuations in the nominal interest rate by the end of six months period that reaches to 4.73% by the end of the twenty-four months. Only 0.41% of the variance in the nominal interest rate can be explained by the world oil prices at the end of the six months period and remains the same by the end of the twenty-four months. By looking at the major cause of fluctuation in NIR, we can report that USTBR is the major contributor in the NIR followed by stock price return and world commodity prices. The IRFs show that stock market volatility and WOPI create minor fluctuation in NIR while the WCPI shocks have a significant impact on NIR. Notably, the impact of USTBR is huge on NIR. This implies that the monetary policy of Pakistan is extremely responsive to the US monetary policy. Moreover, the positive trend shows the co-movement in NIR and USTBR.

The variance decomposition of the nominal money supply shows that around 10.43% variation is explained by volatility in the stock market after twenty-four months. About 10% variation in NMS is explained by the USTBR after twenty-four months and only 0.54% variance is explained by the world commodity prices. Finally, 0.31% variance in the forecast error of NMS is explained by the world oil prices after the twenty-four months. The strongest spillover effect is witnessed from the shocks of stock price returns, stock price volatility and USTBR, to fluctuations in nominal money supply. The IRF explains that USTBR creates moderate level fluctuations in NMS while one standard deviation shock to WCPI and WOPI create weak responses from NMS. The stock market volatility shock leads to a decrease in nominal money supply in the medium to long run whereas no significant response is observed in the short run. Hence, among stock market variables, stock-market return is the most important variable to ponder on while examining the macroeconomic performance. Among the external sector, spillover effect from world oil prices appear as the most important followed by world commodity prices and USTBR.

Table 7: Variance Decomposition

Consumer Price Index				
After	3M	6M	12M	24M
Stock price volatility	0.26	0.27	0.50	1.62
Stock price Return	0.10	0.39	1.10	5.41
WCPI	3.22	13.02	24.02	25.88
WOPI	0.67	4.08	8.59	8.80
US treasury bill rate	0.19	2.57	2.83	1.01
Nominal Effective Exchange Rate				
After	3M	6M	12M	24M
Stock price volatility	0.37	0.34	0.36	1.21
Stock price Return	0.15	0.75	0.58	0.34
WCPI	0.26	1.05	2.30	2.69
WOPI	1.57	6.61	10.12	12.10
US treasury bill rate	0.15	0.29	0.87	0.65
Nominal Interest Rate				
After	3M	6M	12M	24M
Stock price volatility	1.30	2.08	2.55	1.77
Stock price Return	0.09	0.04	2.26	6.26
WCPI	0.04	0.17	1.58	4.73
WOPI	0.37	0.41	0.18	0.41
US treasury bill rate	0.49	1.12	2.59	9.45
Nominal Money Supply				
After	3M	6M	12M	24M
Stock price volatility	0.75	0.52	3.88	10.43
Stock price Return	0.47	2.03	6.90	11.36
WCPI	0.14	0.79	1.03	0.54
WOPI	0.05	0.77	0.51	0.31
US treasury bill rate	1.72	4.90	10.55	10.00

Figure 4: Impulse Response to Cholesky One S.D. Innovations



5. Conclusions and Policy Recommendations

It is a widely accepted that the macroeconomic performance of developing economies is highly influenced by external as well as internal sector shocks. Particularly, in a small open economy, the response of real and nominal sectors to various macroeconomic shocks depend on the degree of openness, external sector dependence, diversification of an economy, and effectiveness of stabilization policies.

Being a small open economy, Pakistan's exports are mostly primary and semi-manufactured goods. Thus, it is assumed that any changes in world commodity prices affect the export performance of the economy. On one hand, the largest proportion of imports comprises crude oil imports which affect not only the import bills but also become a source of fluctuation in the industrial sector performance. On the other hand, the internal sector shocks particularly stock market volatility is reported to be one of the significant contributors in affecting the macroeconomic real and nominal sectors.

This study is an empirical effort to examine the impact of external and internal sector shocks on the real and nominal sectors' of Pakistan's economy. In doing so, the study has taken monthly data from December 1991 to December 2017. To capture external sector shocks, world commodity price index, world oil price index, US-treasury bills rates are used. For internal sector shocks, stock market returns and stock market volatility are used. The findings of the study reveal that external shocks and stock market volatility have long-run relationships with both nominal and real sectors of Pakistan. The variance decomposition and IRFs show the highest contribution by stock market volatility in IPI as well as in NMS. Oil price shocks appear a significant contributor in the variation of REER and NEER followed by world commodity price shocks. Real and nominal interest rates are significantly influenced by the USTBR. Any shock in USTBR increases the real as well as nominal interest rate in Pakistan. This implies that the interest rate in Pakistan follows the path of the world interest rate. World commodity price shocks appear as the dominant source of fluctuation in CPI.

These findings have important implications for policymakers as well as researchers. For instance, we have observed that each indicator of the real and nominal sector is differently affected by both internal and external shocks. This finding is crucial in order to make appropriate policies. It is observed that external sector shocks are dominant in creating disturbance in both the real and nominal sector implying that Pakistan's shock absorption capacity is low for the external sector shocks. Therefore, appropriate steps may be taken in order to reduce the external sector dependence. For instance, on one hand, the reliance on external sector may be minimized by reducing oil imports which is only possible if alternate energy sources are explored. This helps not only in reducing import bills and also in minimizing the concentration on one source of energy, thus improves the shock absorptive capacity of the country. The implications of external sector shocks may also be reduced by increasing the export diversification, increasing value addition in exports, and increasing production of import substitutes. These steps will enable the country to improve the position foreign exchange reserves and minimizing exchange rate fluctuations. In the similar vein, stock market volatility may be controlled by improving the screening mechanism to ensure the credit worthiness of investors.

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Table A 1: Variables Definitions, Construction and Sources

Variables	Definition and construction	Source
KSE-100 Index	KSE-100 index is a market price index it encompasses the depiction of all the sections on KSE barring open-ended mutual funds. KSE 100 index contain the top-notch companies registered on the KSE base on market capitalization.	PSX
Stock Price Volatility	Variance or standard deviation of the returns on KSE-100 index.	estimated
Stock Price Returns	Constructed through the conversion of KSE-100 index points into following formula: $R_t = \ln(\rho_t / \rho_{t-1})$ Where ρ_t represents monthly stock prices of KSE-100 index.	constructed
IPI	Industrial production Index taken as a proxy for the real activity in economy.	IFS
REER	Real effective exchange rate based on consumer price index.	IFS
RIR	Constructed by using fisher equation: $i - \pi$ where i is the nominal interest rate and π is the inflation rate.	constructed
Inflation rate(π)	Inflation rate is calculated by using consumer price index into following formula: $\pi = \frac{CPI_{t-}CPI_{t-1}}{CPI_{t-1}} \times 100$	constructed
NMS	M_2 Used as proxy (defined as currency in circulation +demand deposits + savings deposits + time deposits) between home and foreign country.	IFS
CPI	A consumer price index (CPI) is a measure estimating the average price of consumer goods and services.	IFS
NEER	The Pak Rupee/U.S. Dollar nominal exchange rate is taken based on consumer price index.	IFS
NIR	Short term nominal interest rate 3- months treasury bill rates)	IFS
WCPI	World commodity price index used commodity non fuel prices index 2005=100 includes food, beverages and industrial input price indices.	IMF
OPI	Oil price index based on West Texas spot crude oil in dollars term.	IMF
USTBR	Short term nominal interest rate (3-months treasury bill rates).	IFS