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Response of Macro Economy of Pakistan to External and Internal Shocks

Abstract

This study assesses external business cycle shocks to the economy of Pakistan using a Structural Vector Autoregressive (SVAR) framework consisting of five variables: gross domestic product, public investment, exchange rate, CPI, and openness of trade. The real exchange rate shock seems to be most volatile, and is responsible for significant movement in the rest of the variables in the system. The results indicate that terms of trade and exchange rate shocks have profound impacts on the system, and it can be generally concluded that external shocks have a strong bearing on the economy of Pakistan in both the short and long run. The study found that GDP is positively affected by public spending and terms of trade. Therefore, in general, we conclude that the economy of Pakistan is prone to be affected by external events.

Key Words: *E32 Business Fluctuations; Cycle; F31 Foreign Exchange; H5 National Government Expenditures and Related Policies.*

INTRODUCTION

Business cycle fluctuations in Pakistan have been assessed with respect to numerous internal factors like macroeconomics policy management, political stability and conflicts of different nature especially the war against terrorism. But external factors like exchange rate movements, climate change, technological innovations, international quality standards and financial crises also have profound impact on internal economic decision-making at every level of the economy. Governments in Pakistan face perpetual revenue scarcity and trade deficit making it difficult to manage expenditures and taxes in good and not so good times. The variations in exchange rate impact significantly the overall economy since most of the electricity production depends on imported petroleum. At the same time, the perpetual trade deficit is a permanent source of stress for an appreciation of the exchange rate -

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directly (Iqbal, Din, & Ghani, 2017). The volatile trend in exchange rate due to non market factors has an adverse impact on exports demand and trade flows. This not only causes upward pressure on aggregate prices but also on interest rates and business investments. Therefore, the discretion against rules based macroeconomic policy has been the phenomenon in Pakistan where the will and intuition of policy makers drive the decisions mainly due to uncertainty about the way external factors may influence the domestic economy.

This study is an effort to understand the behavior of GDP of Pakistan when unanticipated shocks of important macroeconomic variables hit the economy. Structural vector auto-regression provides the methodology to first identify the shocks and then trace their impact over the future forecast horizon. The information so generated can help modify the policy response to a particular shock when it strikes the system. The study will be an addition to existing literature as it incorporates internal as well as external factors while the previous studies either considered fiscal or monetary factors.

LITERATURE REVIEW

In the Classical school of thought it is the deficient domestic demand in comparison with aggregate supply that causes stagnation in the economy (Sim, 2021). This fall in domestic demand is attributed to external factors that cause fluctuations in the business cycle, otherwise markets are always clear. Subsequent schools of thought, i.e. Keynesians and Monetarists focused mostly on supply side effects to explain the unanticipated cyclical movements in the economy (Hussain & Khan, 2020;Cheng, 2003). The actions of the macroeconomic policy to target inflation and/or expansion in aggregate output in the short run have profound impact on targets of planning over the long run mainly through improving factor markets in terms of their efficiency and optimal use (Naveed & Mahmood, 2019). The response of aggregate output due to alterations in government expenditure in neoclassical models has a multiplier almost equal to zero whereas that of consumption is negative (Sayed, 2014). Similarly in the New Keynesian framework, improvements in the labor market result in inflexibility in real wages for the involuntarily unemployed and prevents the private consumption to rise due to increase in government expenditure. In the Keynesian framework, productive investments create higher demand for labor that leads to a rise in private consumption. Empirical evidence for the US economy supports that shocks in planned public expenditures become a source of higher aggregate consumption expenditure which is not in line with the predictions of Neoclassical and New Keynesian models (Sabrowaski, & Weber, 2013).

For Pakistan, interest rates and aggregate output do not significantly affect the exchange rate especially when the target goal is defined over a short run in the

presence of a permanent trade deficit and continuous debt creation by the federal government - domestically and internationally (Ashfaq & Padda, 2020).. Although this results in depreciation of currency, it is not proved to have boosted exports to the extent that might make up for the trade deficit. Therefore, inflation has become a perpetual policy problem especially due to the volatile exchange rate regime for the past so many decades. All together the maintenance of foreign exchange reserves has been problematic and continuous borrowing and issuance of Eurobonds are putting pressure on long term sustainability of the economic progress (Rahman et al., 2020). This study therefore, considered the behavior of these variables over the past three decades i.e. from 1990 to 2019, and tried to assess the dynamics of these variables in Pakistan with reference to her growth potential.

RESEARCH METHODOLOGY

The study employs a Structural Vector Auto Regression (SVAR) to model the link of aggregate output, public investment, exchange rate, openness of trade and CPI for Pakistan. SVAR uses the restrictions as described by the economic theory and attains structural shocks from the identified reduced form shocks. This helps the system to interpret the impulse response functions depicting the future forecasts aligned logically with economic theory. Another advantage of using SVAR is that it does not require too many restrictions as in other complex simultaneous equation models and still can generate results that are easy to understand and can make viable predictions (Enders, 2003).

Unit Root Test

The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests help to ascertain the presence of unit root and order of integration on the bases of following relationships:

(1)… $\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{n} \alpha_1 \Delta Y_1 + e_t,$

(2)… $\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{n} \alpha_1 \Delta Y_1 + T_t + e_t,$

and Phillips and Perron (1988) test is:

(3)… $\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + e_t$

Where Y_t is a time series, *n* is lags of dependent variable and e_t is the stochastic error term. Equation (3) includes only the drift but (4) includes both the drift and a linear time trend.

VAR Cointegration Test

Co-integration traces the presence of long-run relationships between economic variables that are stable and stationary and helps to avoid incidence of spurious regression. A combination of two or more non-stationary variables explained in a linear relation may turn out to be stationary or co-integrated (Engel and Ranger, 1987). Johansen (1991, 1995) developed the VAR based cointegration test as:

(4)… $Y_t = \mu + \Delta_1 Y_{t-1} + \cdots + \Delta_p Y_{t-p} + \varepsilon_t$

Where $Y_t$is $(n \times 1)$ vector of variables that are integrated of order $I(0)$ and $\varepsilon_t$is $(n \times 1)$ vector of innovations. Thus:

(5)… $\Delta Y_t = \mu + \eta Y_{t-1} + \sum_{i=1}^{p-1} \tau_i \Delta Y_{t-1} + \varepsilon_t$, where $\eta = \sum_{i=1}^{p} A_{t-1}$, and $\tau_i = -\sum_{j=i+1}^{p} A_j$.

Two test statistic: trace and maximum eigen-value, tests the null hypothesis that the number of cointegrating vectors is less than or equal to 'q' (where the alternative is: $q = r$). It is calculated as: $\lambda trace(r) = -T \sum_{i=r+1} ln(1 - \widehat{\lambda_t})$. The other statistical tool is the maximum eigenvalue test (ë max) that is defined as: $max(r, r + 1) = -Tln(1 - \lambda r + 1)$, where '$T$' is the number of observations, and the 'λ_t' are the estimated eigen-values from the matrix of coefficients.

SVAR Analysis

Sims and Zha (1999) and Blanchard and Perotti (2002) are of the view that it should be economic theory that describes the structure of the system instead of data driven diagnostics. Such diagnostics generate different results even for the same data when frequency is changed from, say, annual to quarter. Therefore, the study followed economic theory to determine the order of variables entering the system. The first variable is assumed to be the most endogenous variable and the last to be most exogenous with variables having no simultaneous contemporaneous impact on each other. The VAR has the ordering of variables as: aggregate output, public investment, exchange rate, openness of trade and the CPI, and considered data from 1995-2020. The following is set of equations describes the SVAR:

(6) …
$$\begin{bmatrix} 1 & \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} \\ \alpha_{21} & 1 & \alpha_{22} & \alpha_{23} & \alpha_{24} \\ \alpha_{31} & \alpha_{32} & 1 & \alpha_{33} & \alpha_{34} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & \alpha_{44} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ gec_t \\ rex_t \\ tot_t \\ cpi_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \\ b_{50} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \gamma_{35} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \gamma_{45} \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & \gamma_{55} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ gec_{t-1} \\ rex_{t-1} \\ tot_{t-1} \\ cpi_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{y_t} \\ \varepsilon_{gect} \\ \varepsilon_{rext} \\ \varepsilon_{tott} \\ \varepsilon_{cpit} \end{bmatrix}$$

The exogenous error terms (ε_{yt}, ε_{GPt}, ε_{EXt}, ε_{OTt} and ε_{CPIt}) are structural innovations and independent of each other having standard econometric assumptions.

And

(7) … $BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \cdots + \Gamma_k X_{t-k} + \varepsilon_t$

(8) … $B^{-1}BX_t = B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + \cdots + B^{-1}\Gamma_k X_{t-k} + B^{-1}\varepsilon_t$

(9) … $X_t = A_0 + A_1 X_{t-1} + \cdots + A_k X_{t-k} + e_t$

Where $X = [Y_t, GP_t, EX, OT_t, CPI_t]'$, and

(10) … $\{A_0 = B^{-1}\Gamma_0\ A_1 X_{t-1} = B^{-1}\Gamma_1 X_{t-1}\ e_t = B^{-1}\varepsilon_t$

The system in equation (9) is the standard VAR that has only the lag values of all the variables on the right hand side. The 'B' matrix captures the contemporaneous effect of variables, 'Γ_0' is a vector and 'Γ_1' and 'Γ_k' matrices capture the lagged effects of

variables on each other. The errors of system are represented in the vector 'e_t' and these errors have standard attributes i.e. zero mean, constant variance and no serial correlation, but may be having contemporaneous correlations.

$$\begin{bmatrix} \varepsilon_{y_t} \\ \varepsilon_{gpt} \\ \varepsilon_{rext} \\ \varepsilon_{ot_t} \\ \varepsilon_{cpi_t} \end{bmatrix} \approx \text{iid}\left(\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \delta_1 & 0 & 0 & 0 & 0 \\ 0 & \delta_2 & 0 & 0 & 0 \\ 0 & 0 & \delta_3 & 0 & 0 \\ 0 & 0 & 0 & \delta_4 & 0 \\ 0 & 0 & 0 & 0 & \delta_5 \end{bmatrix}\right) = iid(0, D) \quad \text{(11) …}$$

But

$$\begin{bmatrix} e_{Y_t} \\ e_{GPt} \\ e_{EXt} \\ e_{OT_t} \\ e_{CPI_t} \end{bmatrix} \approx \text{iid}\left(\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \omega_{11} & \omega_{12} & \omega_{13} & \omega_{14} & \omega_{15} \\ \omega_{21} & \omega_{22} & \omega_{23} & \omega_{24} & \omega_{25} \\ \omega_{31} & \omega_{32} & \omega_{33} & \omega_{34} & \omega_{35} \\ \omega_{41} & \omega_{42} & \omega_{43} & \omega_{44} & \omega_{45} \\ \omega_{51} & \omega_{52} & \omega_{53} & \omega_{54} & \omega_{55} \end{bmatrix}\right) = iid(0, \Omega) \quad \text{(12) …}$$

But $Cov(e_{jt}, e_{jt-1})$ may or may not be equal to zero. It is important to note that the error terms (e_{Yt}, e_{GPt}, e_{EXt}, e_{OTt} and e_{CPIt}) are composites of the five shocks (ε_{yt}, ε_{GPt}, ε_{EXt}, ε_{OTt} and ε_{CPIt}) and since $e_t = B^{-1} \varepsilon_t$, with some restrictions imposed on B, the structural innovations can be attained from the estimated VAR. The variance-covariance matrix of the e_{1t}, e_{2t}, e_{3t}, e_{4t} and e_{5t} shocks as:

(13) … $\boldsymbol{\Sigma}$ =

$$\begin{bmatrix} \text{var}(e_{1t}) & cov\,ar(e_{1t}, e_{2t}) & cov\,ar(e_{1t}, e_{3t}) & cov\,ar(e_{1t}, e_{4t}) & cov\,ar(e_1t, e_5t) \\ cov\,ar(e_{1t}, e_{2t}) & \text{var}(e_{2t}) & cov\,ar(e_{2t}, e_{3t}) & cov\,ar(e_{2t}, e_{4t}) & cov\,ar(e_2t, e_5t) \\ cov\,ar(e_1t, e_3t) & cov\,ar(e_3t, {}_2t) & \text{var}(e_3t) & cov\,ar(e_{3t}, e_{4t}) & cov\,ar(e_3t, e_4t) \\ cov\,ar(e_{1t}, e_{4t}) & cov\,ar(e_{4t}, e_{2t}) & cov\,ar(e_4t, e_3t) & \text{var}(e_4t) & cov\,ar(e_4t, e_5t) \\ cov\,ar(e_{1t}, e_{5t}) & cov\,ar(e_{5t}, e_{2t}) & cov\,ar(e_{5t}, e_{3t}) & cov\,ar(e_{5t}, e_4t) & \text{var}(e_5t) \end{bmatrix}$$

In general, the shocks can be mutually correlated but this can be controlled only if the contemporaneous effect of variables in X is controlled. Once the uncorrelated shocks are extracted, the system stability can be shown in particular solution as:

(14) … $X_t = \mu + \sum_{i=0}^{\infty} A_i e_{t-i}$, where $\mu = (I - A)^{-1} B$

This presents the Vector Moving Average (VMA) form of the structural system and helps determine the Impulse Response Functions (IRF). IRFs are especially helpful in predicting the behavior of the variables when the system experiences unanticipated shocks over the forecast horizon.

The study used Cholesky decomposition to identify the system and assumed that government consumption does not have a contemporaneous effect on rest of the variables (i.e. $b_{12} = 0$, $b_{13} = 0$, $b_{14} = 0$,$b_{23} = 0$, $b_{24} = 0$, and $b_{34} = 0$) and finally the structure of the errors become upper triangular. It follows that $e_t = B^{-1} \varepsilon_t$.

$[e_{Yt}\ e_{GPt}\ e_{EXt}\ e_{oTt}\ e_{CPIt}\ ] = B^{-1}[\varepsilon_{Yt}\ \varepsilon_{GPt}\ \varepsilon_{EXt}\ \varepsilon_{oTt}\ \varepsilon_{CPIt}\ ]$, and

$B = [1\ 0\ 0\ 0\ 0\ b_{21}\ 1\ 0\ 0\ 0\ b_{31}\ b_{32}\ 1\ 0\ 0\ b_{41}\ b_{42}\ b_{43}\ 1\ 0\ b_{51}\ b_{52}\ b_{53}\ b_{54}\ 1\ ]$,

and it also implies that $\Sigma\varepsilon_t = \left[\delta_1^2\ 0\ 0\ 0\ 0\ \delta_2^2\ 0\ 0\ 0\ 0\ \delta_3^2\ 0\ 0\ 0\ 0\ \delta_4^2\ \right]$, and thus:

$var(e_t) = B^{-1}\Sigma(B^{-1})'$,

e.g. the structural innovations of aggregate output (ε_{yt}) do not directly affect ε_{GPt}, ε_{EXt}, ε_{oTt} and ε_{CPIt} instead the impact is indirect working through lag values of the variables in the system. But Sims (1991) and Blanchard (1990) do not support Chowlsky's decomposition for identification of the system as it is mechanical in nature devoid of economic reasoning. Therefore, generally, this approach is utilized for short-run dynamic analysis. They support imposing restrictions that are based on economic reasoning even if the system becomes over-identified. Therefore, the study imposes the long run restrictions using the insight from the economic theory as:

$[e_{Yt}\ e_{GPt}\ e_{EXt}\ e_{oTt}\ e_{CPIt}\ ] = B^{-1}[\varepsilon_{Yt}\ \varepsilon_{GPt}\ \varepsilon_{EXt}\ \varepsilon_{oTt}\ \varepsilon_{CPIt}\ ]$, and

$B = [1\ b_{12}\ b_{13}\ b_{14}\ b_{15}\ b_{21}\ 1\ 0\ 0\ 0\ 0\ 0\ 1\ b_{34}\ 0\ b_{41}\ 0\ b_{43}\ 1\ 0\ b_{51}\ 0\ 0\ b_{54}\ 1\ ]$

Public investment is presumed independent of exchange rate movements, terms of trade and state of inflation in the economy. Terms of trade are affected by the domestic income and exchange rate but public spending and inflation does not influence it in the long run. Inflation is affected by aggregate income and the exchange rate whereas in the long run public spending and terms of trade do not affect it. It can be understood from the above formulation that the exchange rate is independent of all the variables in the system except terms of trade over a long run. The system is exactly identified with these long run restrictions and thus studied the behavior for short run (Chowlsky's decomposition) as well as long run forecast of the system.

Impulse Response Functions

IRFs plot of the effect of structural innovations ($\varepsilon_{x,t}$) on existing and future values of the variables in the system and capture how different shocks affect the behavior of these variables over the forecast horizon. The VMA formulation helps to transform the system to get the impulse responses or variables and path the behavior of variables with respect to the effect of structural shocks.

VAR can be written in VMA formulation with the standard VAR error terms as:

$$\begin{bmatrix} Y_t \\ GP_t \\ EXx_t \\ OT_t \\ CPI_t \end{bmatrix} = \begin{bmatrix} \overline{Y_t} \\ \overline{GP_t} \\ \overline{EX_t} \\ \overline{OTt} \\ CPI_t \end{bmatrix} + \sum_{i=0}^{\infty} A^i e_t \quad \text{(15) …}$$

But as $e_t = B^{-1}\varepsilon_t$, therefore, the final form of impulse responses is:

$$\begin{bmatrix} Y_t \\ GP_t \\ EXx_t \\ OT_t \\ CPI_t \end{bmatrix} = \begin{bmatrix} \overline{Y_t} \\ \overline{GP_t} \\ \overline{EX_t} \\ \overline{OTt} \\ CPI_t \end{bmatrix} + \sum_{i=0}^{\infty} \underbrace{\frac{A^i}{|B|} B^{-1}}_{\Phi_i} \varepsilon_{t-1} \quad \text{(16) …}$$

$$= \begin{bmatrix} \overline{Y_t} \\ \overline{GEC_t} \\ \overline{EX_t} \\ \overline{ToTt} \\ CPI_t \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \Phi_{11}^{(i)} & \Phi_{12}^{(i)} & \Phi_{13}^{(i)} & \Phi_{14}^{(i)} & \Phi_{15}^{(i)} \\ \Phi_{21}^{(i)} & \Phi_{22}^{(i)} & \Phi_{23}^{(i)} & \Phi_{24}^{(i)} & \Phi_{25}^{(i)} \\ \Phi_{31}^{(i)} & \Phi_{32}^{(i)} & \Phi_{33}^{(i)} & \Phi_{34}^{(i)} & \Phi_{35}^{(i)} \\ \Phi_{41}^{(i)} & \Phi_{42}^{(i)} & \Phi_{43}^{i)} & \Phi_{44}^{(i)} & \Phi_{45}^{(i)} \\ \Phi_{51}^{(i)} & \Phi_{52}^{(i)} & \Phi_{53}^{(i)} & \Phi_{54}^{(i)} & \Phi_{55}^{(i)} \end{bmatrix}^i \varepsilon_{t-1}$$

or

$$\begin{bmatrix} Y_t \\ GP_t \\ EXx_t \\ OT_t \\ CPI_t \end{bmatrix} = \begin{bmatrix} \overline{Y_t} \\ \overline{GP_t} \\ \overline{EX_t} \\ \overline{OTt} \\ CPI_t \end{bmatrix} + \sum_{i=0}^{\infty} \underbrace{\frac{A^i}{|B|} B^{-1}}_{\Phi_i} = \overline{X} + \sum_{i=0}^{\infty} \Phi_i \varepsilon_{t-i} \quad \text{(17) …}$$

Each impact multiplier represents the outcome of a unit change in a structural innovation on a corresponding variable in the system at time *t*. The IRFs represent the change occurring due to a unit change in Y_t but the magnitude of this effect is measured by impact multipliers with respect to time (i.e. $\Phi_{12}(0), \Phi_{12}(1), \Phi_{12}(2)$, ….). and their accumulated effect is summed (i.e.$\sum_{i=0}^{n} \Phi_{12}(i)$). Similarly, over a longer period of future time horizon the accumulated multiplier effect of each time period is given as: $\sum_{i=0}^{n} \Phi_{12}(i)$. But practically these responses cannot be assessed empirically if the SVAR system is unidentified.

RESULTS & DISCUSSION

Before conducting the SVAR analysis the study conducted the diagnostics testing to ascertain the stability of the system. Given the results of unit root test all the variables are stationary at first difference and optimal lag order selection condition reveals that

the system is stable at two lags. Co-integration analysis reveals that a long run equilibrium relationship between the variables exists and the system can be supportive of viable policy implications.

The impulse response function of GDP shows that the own shock produces a positive response upon impact for short and long runs (see Appendix A.1 and A.2). These shocks have a volatile impact on GDP of Pakistan that are corrected over next two to three periods and restored to equilibrium. There is a negative response of GDP generated due to public investment, exchange rate and terms of trade for short and long runs, but the magnitude of impact multipliers are relatively larger for the long run. The findings of the study are different from those of Awan and Gulzar (2020) and Rabnawaz, Jafar and Sohail (2015) that found public investment in Pakistan to influence GDP growth rate positively but they found a reverse causality between these variables as well. When there occurs improvement in terms of trade it indicates the improvement in returns to capital and labour productivity (Ulrich, 2004). But in Pakistan GDP shows a negative response to terms of trade shock in short as well as long run indicating the pressure of continuous trade deficit that is hampering capital and labor productivity (Aron & Muellbauer, 2001). This also indicates that technological progress in real terms is also not happening in Pakistan which is a grave concern for overall progress of the country. GDP affects exchange rate in multiple ways: if real GDP increases it strengthens the currency and exchange rate improves; growth in real GDP induces more foreign direct investment as well expansion of existing investment, and; central banks alter interest rates given the state of the economy. A persistent negative response of GDP due to exchange rate shock is due to dismal growth performance and heavy reliance on imported petroleum products that are the main source of energy production in Pakistan.

The GDP shock does not generate any response in public investment for the short run but produces a positive impact in the long run that does not revert to equilibrium. This non-response of public investment in the short run is an indication of sluggish response of policy to any issue resulting in generating GDP shock. Public investment is not affected by the exchange rate shocks in short as well as in the long run. There is almost a similar positive response of public investment to terms of trade and produces a positive response over the entire forecast horizon. An important finding is that inflation shock does not cause public investment to change over the short run but there is a positive response in the long run which is generally expected (Hsing, 2010). The results are indicative that due to inflation shock public policy management in Pakistan causes a permanent rise in it that does not return to its equilibrium level which is in line with findings of previous researches (Ramey, 2011). Generally public investment is expected to have a positive impact on GDP as it increases the capital stock in an economy (Afsono & Aubyn, 2008; Marattin, Paesani & Salotti, 2011).). The literature establishes that the most productive public investment is in health and

education that produces long run sustainable positive effects (Chen, 2011; Fournier, 2016). The response of public investment to variables in the system is mixed and caution needs to be exercised to make any specific predictions.

Exchange rate shock produces a negative response of GDP upon impact and adjustment to equilibrium is relatively faster in the short run as compared to long run. Exchange rate shock also produces a positive response of public investment in short and long runs but the response is not volatile over the forecast horizon. Own shock produces a large positive response in the exchange rate that is then corrected over two years. This response is less volatile in the short run but in the long run the volatility is relatively larger. But due to exchange rate shock the response of terms of trade is almost similar for short and long runs and it causes the trade to become regressive and this negative response adjusts to equilibrium with a lag. Exchange rate shock produces a similar positive response of inflation upon impact for short and long runs and it takes almost two years to correct for this shock. Friedman (1953) proposed using a flexible exchange rate policy instead of fixed in order to hedge against real shocks to the economy. There is ample empirical evidence that establishes that flexible exchange rate policy prevents large losses to the GDP when there is negative movement of terms of trade for an extended period of time (Broda, 2002; Aisen & Hauner, 2008). As Pakistan follows a managed floating exchange rate regime, policy makers face the challenge of managing it where there is upward pressure on it (Aqeel & Nishat, 2000). Past few governments have issued eurobonds to cover for the dearth of foreign exchange reserves.

For the short run terms of trade shock produces a negative response of GDP upon impact but it is corrected within a year and then remains around equilibrium over the forecast horizon. The response of GDP to shocks in terms of trade for the long run takes into effect after a lag and then produces a positive response in it. This impact remains in effect for three periods before it settles around equilibrium for the remainder of the forecast horizon. Terms of trade shock produce a positive impact on exchange rate over the entire forecast horizon for short and long runs. Terms of trade shock produce a larger response of inflation for the long run as compared to short run (Broda, 2002). The impact died out after four periods but afterwards remained non-volatile. Di Pace et al. (2020) conducted a cross country analysis and found that the shocks of terms of trade have different effects for different economies. The impact is not prominent on the overall performance of economies where the ratio of exports and imports prices is not too volatile. Therefore, in countries like Pakistan where trade balance is perpetually negative, the terms of trade shock significantly affects the economy and it can be seen in the impulse responses (Rahman et al., 2020). Kiran, Zakria and Fida (2014) found a negative effect of terms of trade on inflation but the results of this study found inflation not to respond immediately to it at impact. After a

lag the effect starts to appear and inflation rises in the long run as compared to the short run. The long run magnitude of these dynamics may be due to uncertainty attached to the movement of exchange rate in Pakistan and agents tend to overestimate these movements that result in increasing inflation.

The impact of inflation shock is prominent in the long run but its impact does not cause variables in the system to deviate from equilibrium in the short run. In the long run inflation shock generates a positive response in GDP upon impact that dies out quickly and becomes volatile before settling back to equilibrium from fourth year onwards. The negative response of public investment due to inflation shock is corrected over two years and afterwards remains around equilibrium. Inflation shock causes a negative movement in the exchange rate that then settles to equilibrium over a period of two years (Ullah, et al., 2020). Inflation shocks affect the economy in different ways as it alters the expectations of the agents causing a change in investment decisions, interest rates, and varying policy responses (Elsheikh, 2011). The shocks of inflation are more prominent in the long run in Pakistan as compared to the short run.

CONCLUSION

Due to the data limitation the study used the VAR model to trace the impact of one off innovations for the same data generating process mimicking the shocks arising due to changes in the policy rules. The results indicate that in terms of trade and exchange rate shocks have profound impact on the system, and it can be generally concluded that external shocks have a strong bearing on the economy of Pakistan for short and long run. Furthermore, to correct for the disequilibrium in the economy, there is an active government spending spree that exists not only for short but also for the long run. But this continuous rise in public investment due to these shocks in Pakistan is not in line with the Keynesian perspective that requires adjustments of public investment according to the relative position on the business cycle (Dejthamrong, 1993). The continuous trade deficit and unforeseen contingencies like natural disasters and war against terrorism make it a struggle to maintain foreign direct investments and exchange reserves, and public spending is sometimes independent of signals from the business cycle. Therefore, to maintain this balance, the government must have sufficient revenue to support its spending so that it does not disrupt the credit availability to the private sector activities especially related to exports. The study found that GDP is positively affected by public spending and the terms of trade, therefore, the exports related sector must be paid special attention to generate growth effects. Although Pakistan has shown improvement in the index of ease of doing, exports continue to be low. The high energy cost and non-availability of technical labor hampers the innovation lead growth. Both these issues can be addressed in the long run but a strong policy framework independent of political inspirations needs to be in place. Some large scale projects especially in the cement

sector have imported technical labor due to non-availability of labor of the same skills domestically. Vibrant and relevant effort is required to build skills at the level of engineering universities and technical education boards. The inadequacy of time series data over shorter spans of time (i.e. daily, weekly and monthly) limits the scope of analysis to track the changes occurring in economic variables resulting from unanticipated policy changes.

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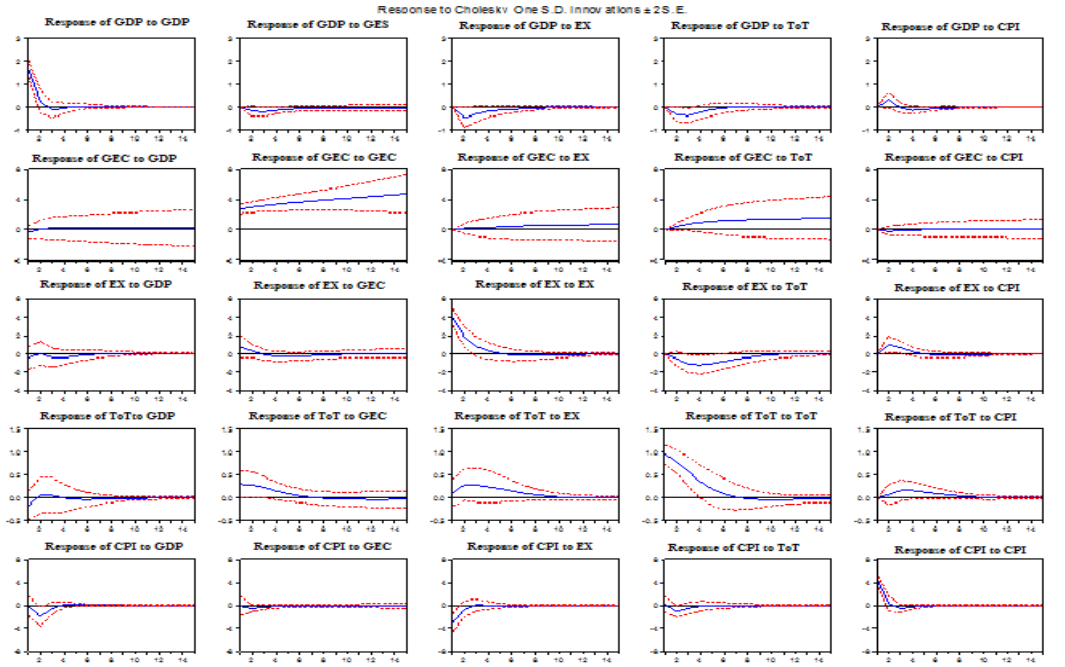
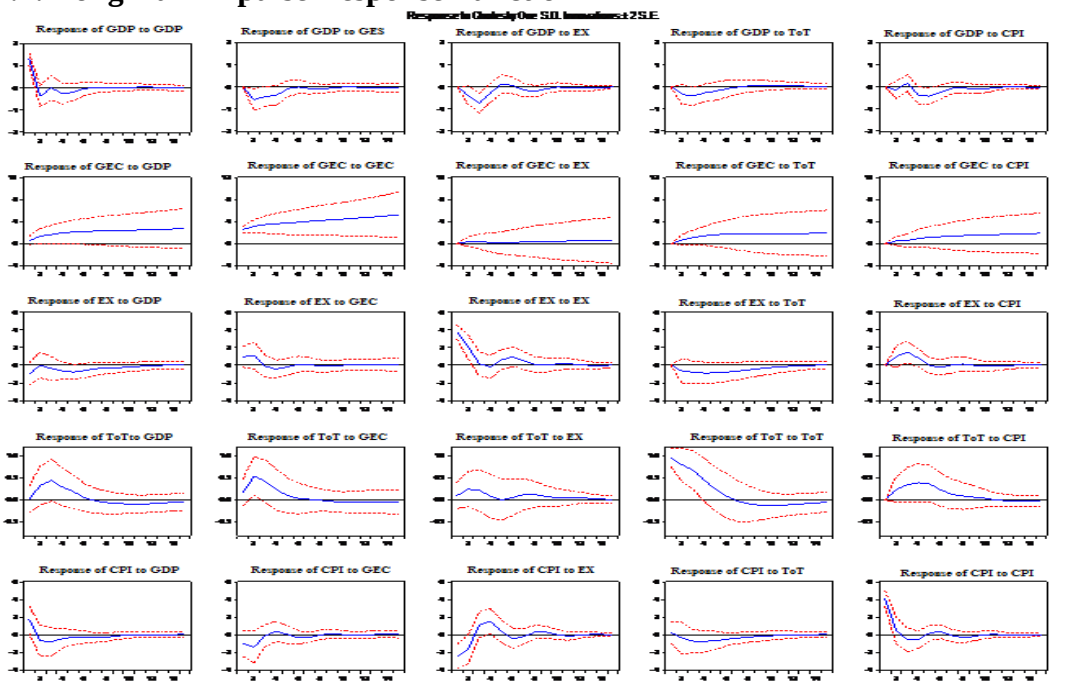
Appendix:

A.1: Short Run Impulse Response Function



A.2: Long Run Impulse Response Function



A.3. Unit Root (Augmented Dicky Fuller Test)

Variables	Order of Integration	t-statistics		Decision
GDP	I(1)	ADF	-6.99	Stationary at 1st difference, level and intercept
		1%	-3.60	
		5%	-2.93	
		10%	-2.60	
Public investment	I(1)	ADF	-5.49	Stationary at 1st difference, trend and intercept
		1%	-4.19	
		5%	-3.53	
		10%	-3.12	
Exchange Rate	I(1)	ADF	-5.72	Stationary at 1st difference, level and intercept
		1%	-3.87	
		5%	-2.93	
		10%	-2.60	
Openness of Trade	I(1)	ADF	-5.98	Stationary at 1st difference, level and intercept
		1%	-3.59	
		5%	-2.18	
		10%	-2.67	
CPI	I(1)	ADF	-7.48	Stationary at 1st difference, level and intercept
		1%	-3.63	
		5%	-2.92	
		10%	-2.67	

A.4. Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-617.29	NA	5095393.	29.63	29.85	29.70
1	-457.82	273.38	8519.54	23.66	24.46*	23.61*
2	-430.63	40.18*	8090.72*	23.39*	25.40	23.95

A.5. Johnson Co-integration Test

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.897362	122.28	70.81	0.0000
At most 1 *	0.376564	55.23	51.85	0.0087
At most 2	0.391675	28.38	31.79	0.0785
At most 3	0.128197	6.17	17.49	0.6393
At most 4	0.031779	1.09	2.84	0.2949

Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.812362	67.04	32.76	0.0000
At most 1*	0.512564	27.18	26.84	0.0561
At most 2 *	0.398675	21.57	23.31	0.0434

At most 3	0.119197	5.37	15.64	0.6935
At most 4	0.023779	1.09	2.41	0.2949