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ECONOMY-WIDE EFFECTS OF MONETARY POLICY SHOCKS: EVIDENCE FROM PAKISTAN

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ABSTRACT

Monetary policy plays an effective role in affecting output, employment, prices, interest rate and exchange rate. The goal of a sustainable economic growth and employment is attainable only if the prices in an economy are stable because stable prices lead to an efficient allocation of resources and also encourage households to save more and investors to invest more, thus contributes in capital formation by minimizing the risk of erosion of assets value.There isa wide range of transmission channels through whichmonetary policy affects the macroeconomic indicators. Keeping in view the financial crisis of 2008 and considering the exchange rate channel, this paper is an attempt to assessthe effects of monetary policy shocks on major macroeconomic variables.Vector Autoregressive model is used in this study to trace out the effects of monetary policy shocks on output, prices and exchange rate. Our findings show that monetary policy shockstransmit into inflation and exchange rate thus affects output in the long run.

Key words: Monetary Policy, Exchange Rate,VAR, Sustainable Economic Growth.
JEL Classification: E52, E1.

1. INTRODUCTION

The financial crisis of late 2008 hit many economies and increased the risk of economic downturn. The effect of such a crisis was not confined to developed world but ithas also stricken the developing and emerging economies. In developing countries, the financial crisis led the economy towards more unsustainable growth and brought a huge decline in output and unemployment by flattening the economic activities(Lin, 2008). The effect of such a crisis was more conspicuous in those developing countries where the investment rate was already low.In case of Pakistan, it caused a reduction in exports by affecting the textile industry and also affected the trading in stock exchange unfavorably (Abbas et al, 2012). Such a situation along with political instability became a root cause of losing the trust of investors and MNCs and caused a sharp decline in the business activities followed by low unemployment rate.Policy makers, in both developed and developing countries, suggested many policy tools to help fight the adverse implications of financial crisis. Many economists proposed expansionary monetary policy in order to mitigate the effect of such crises on investment(Svensson, 2011 and Labonte & Makinen, 2008)

Both the academia and policy makers agree that monetary policy helps in sustaining growth by fostering price stability. Following this, the central banks,in many countries, have set price stability as the primaryobjective of monetary policy. The central banks in these countries do not control prices directly for the reason that prices are

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determined by the demand and supply of many goods and services in the market. Monetary policy actions affect the price determination process through monetary policy transmission mechanism(George *et al.*,1999).

Monetary policy tools have a significant effect on short-term interest rates.The change in the short-term interest rate brings changes in both the demand and supply, which in turn affects the price. The short-term interest rate can also affect interest rates of medium and long term because these two depend on the expected value of short-term interest rate.These changes in medium- and long-terminterest rate have an effect on cost of the capital that is requiredfor the funding of investment projects and thus changeseconomy's aggregate demand.Interest rate has also a potential to affect credit availability since an increase in the rate of interest causes the risk involved in unrecovered portfolio to increase and the financial intermediaries act in response to such a risk by making the credit of the economy to contract and thus, results in a decrease in the availability of credit causing the cost of credit to increase further. The overall effect of these changes discourages the level of consumption and investment and causes the aggregate demand to decrease and brings a significant change in prices.

Keeping in view the above discussion this paper attempts to find the impact of monetary policy shocks on output,inflation and exchange rate.

This section of paper is about the introduction of topic. Section two discusses past literature whereas the third section is about methodology in which the model and the variables and estimation methodology have been discussed in detail. Results have been discussed in detail in section four while section five is about the conclusion and policy implication.

2. LITERATURE REVIEW

Literature provides a lot of studiesabout monetary policy and its effect on other macroeconomic variables. Among these studies, the relationship between monetary policy and prices has been discussed the most. According to the study by Gerlach (2004), anrise in the growth of money is found to affect consumer prices in the long run but its effect was not significant in the short run. Olivei and Tenreyro (2006) worked on quarterly data and concluded that for a monetary shock taking place in the first or second quarter of the year, output shows a quick response and also the effects die out after a short time period whereas for the monetary shock taking place in the last two quarter, output shows a slight response. This difference in the response of output due to monetary policy is because of the uneven staggering of the wage contracts.Miranda-Agrippin and Ricco (2021) found that tight monetary policy deteriorates not only aggregate demand but also affects asset prices and credit market. On the other hand, Caraiani&Călin (2020) also found that monetary policy shocks affect the asset prices heterogeneously.

Changes in the supply of money affect many macroeconomic aggregates. Friedman and Schwartz (1963), in their work, concluded that there is a strong correlation between money supply, prices and output. They explained that this correlation is due to the fact that a change in monetary aggregates has a potential to affect the private sector performance. The monetary policy shocks spur economic growth by stimulating the investors in the private sector because a monetary policy shock has a strong effect on the interest rate.Sims (1992) illustrates that innovation in interest rate puts an upward pressure on economy's price level. The change in the price level affects the aggregate demand and thus influences the economy's output. Cambazoglu and Karaalp (2012) using a VAR model analyzed the effect of monetary policy shock on output and employment and concluded that shocks through credit stock affect employment and output.

Providing empirical evidence, Leeper et al (1996) concluded that the influence of shocks to monetary on macroeconomic aggregatesand the degree of the response of these variables depends on the monetary instruments used whereas Cochrane (1998) argued that this difference in response depends on anticipation or un-anticipation by the economic agents. Starr(2005) believed in the theory given by new Keynesians and explained that the difference in the responses is due to flexible and sticky nature of prices.Lovcha& Perez-Laborda(2018) found that shocks to monetary policy affects the persistence of inflation.

Mishkin(2002) and Mallick(2008)are of the view that the effect of monetary policy shocks on macroeconomic parameters is significant in the case of developed economies whereas in developing economies these effects are weak (Balolgun, 2007). Ganev et al. (2002), in his study, provided empirical evidence that the effect of these monetary policy shocks in middle income economies is modest. On the other hand, Cushman and Zha (1997) examinedthose small economies are more responsive to shocks in monetary policy.

3. THEORETICAL MODEL:

This study employs a simple model used by Svensson (1997) which captures the framework used to analyze the effect of monetary policy. The model assumes that change in current inflation depends on one year lag output gap.

$$\Delta\Pi_t = \beta Y_{t-1} + u_t \quad (1)$$

Whereas the output gap depends on one year lag output gap and real rate of interest.

$$Y_t = \theta Y_{t-1} - \eta(i_{t-1} - \Pi_{t-1}) + \varepsilon_t \quad (2)$$

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The random term u_t is referred as aggregate supply shock and ε_t is aggregate demand shock.
While conducting monetary policy, the focus is to set the interest rate so as to reduce the intertemporal loss

$$E_t \sum_{i=t}^{\infty} \lambda^{i-t} L_r \quad (3)$$

Where $\lambda < 1$ is the discount rate. The period specific loss function is given by

$$L_r = [(\Pi_r - \Pi^*)^2]/2 + \phi\, Y_t^2/2 \quad (4)$$

Thus Taylor rule governs the setting of optimal level of interest rate

$$i_t = \Pi_t + \alpha_1(\Pi_t - \Pi^*) + \alpha_2 Y_t \quad (5)$$

Equation (5) shows that interest rate depends on both the output gap and inflation gap. In equation (4), if $\phi=0$ then there is a need to design monetary policy in such a way that we could attain the target of inflation within the policy horizon. If $\phi>0$, then the policymakers will be also focusing on output fluctuation.
The above model helps in determining the reaction function of monetary policy. The basic idea is that monetary policy shocks affect output and inflation. This study however also assumes that monetary policy affects exchange rate and also therefore assess the exchange rate transmission mechanism.

4. METHODOLOGY:

This study estimates the reaction function of the monetary policy for Pakistan. Model assumes that monetary policy shocks affect prices, exchange rate and output. In order to analyze the reaction of macroeconomic variables to monetary policy shock, literature has provided a lot of techniques such as OLS, GMM, TSLS, and VAR. But Vector Autoregressive (VAR) model has been used frequently by the economists in which the response of macroeconomic variables to shocks is analyzed using impulse response function (IRF) and variance decompositions (Chang, 2000 and Amonde, 2006). The general form of a VAR model is as follows.

$$Y_t = c + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \theta_3 Y_{t-3} + \ldots\ldots\ldots\ldots + \theta_p Y_{t-p} + \nu_t \quad t=1,2\ldots\ldots T \quad (1)$$

Y_t is the vector having time series variables as vector elements it has the dimension nx1. θ_i are the coefficient matrices and ν_t is the vector of white noise error term (also known as shocks). Hung and Wade (2009) conducted a VAR analysis to explain transmission mechanism of monetary policy and defined three transmission channels namely interest rate channel, exchange rate channel and credit channel. Among these channels, the exchange rate channel is considered to have a potential to transmit the monetary policy shock effectively (Chow, 2004) and according to Cushman and Zha (1997), for small open economies, it is important to include exchange rate as endogenous variable in the VAR model. Mishkin(2006) explained that an increase in the supply of money causes a decrease in the real interest rate. Such a reduction in the domestic rate of interest induces depreciation in the domestic currency. Such depreciation causes a rise in net exports which thus results in an increase in output. Therefore, this study uses an exchange rate channel to analyze the effect.
This study assumes that our economy is illustrated by a system of four equations: monetary reserve equation, an exchange rate equation, equation of price and an equation of output level. Thus we have following VAR model with the vector of four endogenous variables:

$$Z_t = (M_t, E_t, P_t, Y_t) \quad (2)$$

The endogenous variables have been arranged in the order (reserves, cpi, ex, gdp) with the assumption that a monetary shock brings variations in the rate of inflation, the effect of which is then transmitted to exchange rate and thus affects output. The unstructured VAR model of this study takes the following form.

$$\begin{bmatrix} M_t \\ P_t \\ E_t \\ Y_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} M_{t-1} \\ P_{t-1} \\ E_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \end{bmatrix} \quad (3)$$

These error terms are composites of the structural innovations.

4.1. Data Source

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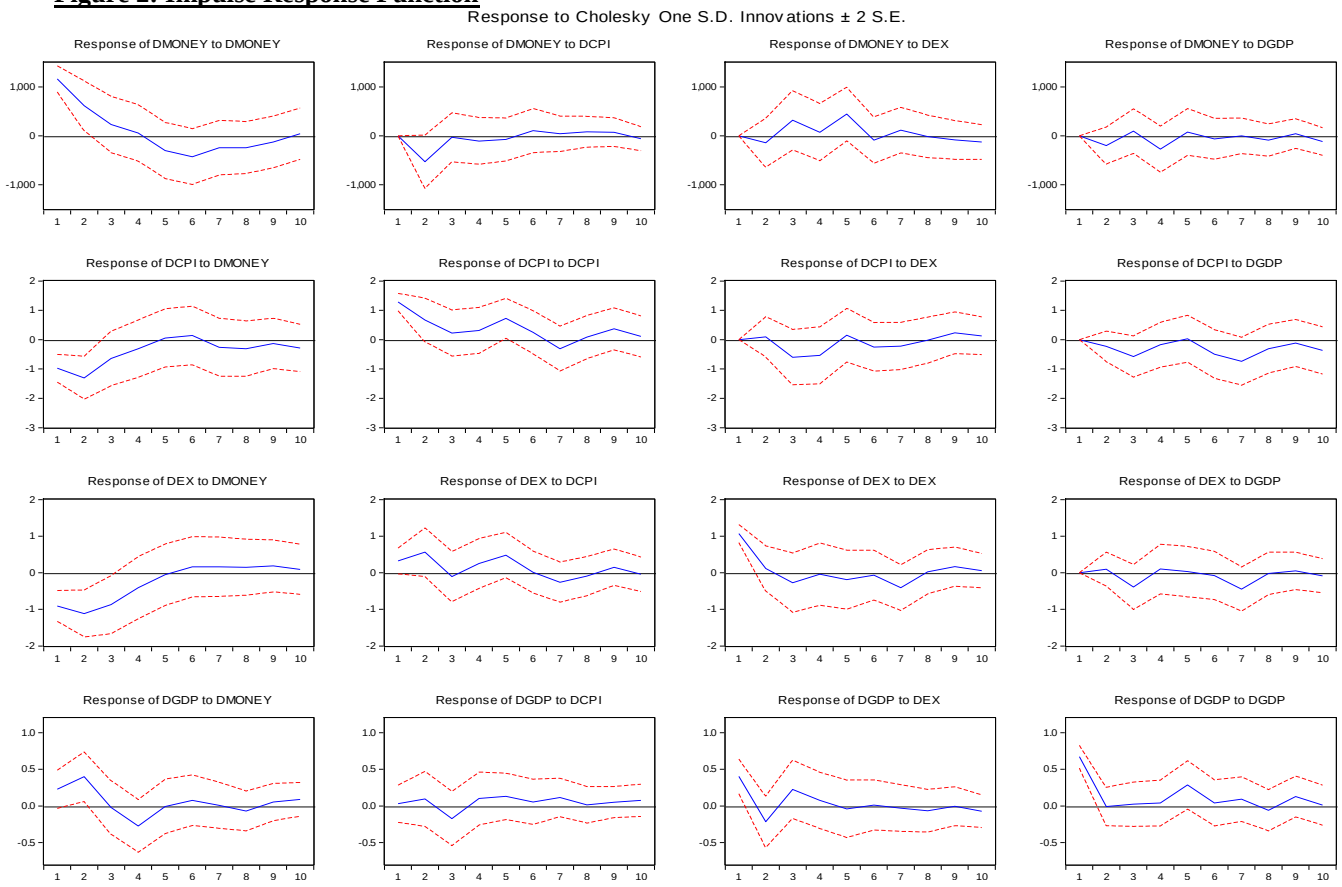
Data have been collected for the period of 2002Q1 to 2019Q4. Data on reserves, inflation and exchange rate have been collected from IFS whereas data on GDP has been taken from World Bank whereas it has been converted into quarterly data using quarter weights.[1] Data on all the variables have been detrended.

5. EMPIRICAL RESULTS

In order to apply VAR, Unit root test has been applied on the detrended data. All the variables have been found to be stationary at their level. Akaike Information Criteria (AIC) has been used to define the lag length of the VAR model. The AIC values for different lags have been shown in the table 1 in Appendix. The value of AIC is minimum for lag 4;therefore, a VAR model having the lag length 4 has been estimated[2].

The impulse response function given in the Figure 2 demonstrates that response of inflation to a positive shock to money supply is negative in the first two quarters then it shows a significant positive response in next four quarters, which is in accordance with theory. After sixth quarter, the effect of shock eliminates. Figure depicts that a positive shock in inflation causes exchange rate to increase in the first quarter, but this effect is not significant while exchange rate responds negatively and significantly in next quarter. A positive shock to the exchange rate affects output negatively in the first and second quarter whereas output responds positively in the third and again negatively in the fourth quarter and next quarter. Output responds positively in the first two quarters to a positive shock in money whereas its effect is negative in next three quarters.

Figure 2: Impulse Response Function



[1] Kemal and Arby (2005) calculated quarterly GDP for the period 1972 to 2003Q2.This study uses data from 2002Q1 to 2019Q4. The data is calculated by multiplying GDP by the average of quarter weights (over the whole period).

[2]The findings of estimated VAR model is given in the table 2 in Appendix.

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In order to check the stability of VAR model, Normality test, serial correlation LM test is applied and the results are given in table 2 and table 3 respectively.

TABLE 2: NORMALITY TEST

Component	Jarque-Bera	Df	Prob.
1	1.097751	2	0.5776
2	1.305159	2	0.5207
3	0.237423	2	0.8881
4	1.004816	2	0.6051
Joint	3.645149	8	0.8876

TABLE 3: SERIAL CORRELATION LM TEST

Lags	LM-Stat	Prob
1	23.24866	0.1072
2	10.17214	0.8575
3	12.83720	0.6846
4	33.54955	0.0862

Results show that the probability value of Jarque-Bara statistic is greater than 0.05 leading to the acceptance of null hypothesis that residuals are normally distributed whereas serial correlation LM test shows that we do not have the problem of autocorrelation.

The results of Granger causality test are given in Table 4. According to result, money supply granger cause inflation which is in accordance with the theory whereas output and exchange rate did not granger cause inflation. Inflation granger causes exchange rate at 10% level of significance while other two did not granger cause exchange rate. Results also show that money supply and exchange rate granger cause output at 10 % level of significance whereas inflation does not granger cause output. Thus, it confirms the transmission mechanism that a shock in monetary policy affects inflation which causes a change in exchange rate and as a result output changes due to change in current account.

TABLE 4: GRANGER CAUSALITY TEST

Null Hypothesis	Probability value
DGDP does notCause DMoney	0.06
DMoney does notCause DCPI	0.09
DCPI does not Cause DEX	0.10
DMoney does not Cause DGDP	0.10
DEX does not Cause DGDP	0.09

6. CONCLUSION

On the basis of results discussed above, it can be concluded that there is a strong relationship between money supply, inflation, exchange rate and output. The results show that the effects of shocks are not significant in the first two quarters while the effects become significant in the long run.In this study, results support the channel of exchange rate and thus this transmission mechanism plays a vital role in transmitting the monetary policy shock to output. The understanding of transmission mechanism helps the policy makers in understanding how inflation and capital and foreign reserves of the country changes and thus they can make the economic strategies accordingly.

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