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Monetary Policy Shock and Inflation Persistence: The Case Study of Pakistan

ABSTRACT

Inflation persistence has been a major stress for economies during the past few decades. Inflation is a monetary phenomenon and the persistence of inflation has broadly attracted the attention of economists all over the world. Inflation persistence shows the degree to which future values of inflation are associated with bygone shocks or, in other words, the speed of adjustment toward its long-run value. Indeed, inflation dynamics and the degree of inflation persistence have been recognized as the most essential parameters for affecting monetary policy's performance. This study estimates the degree of inflation persistence and other macro-economic variables (under a multivariate Approach). Secondly, this study allows the long memory property of inflation persistence to examine the effect of monetary policy shocks on Pakistan's economy. Knowing the degree of inflation, offers vital information, to the central bank, about how to manage the interest rate to attain the targeted rate of inflation. The study employed Structural Fractional Integrated Vector Auto-regressive Model for the monthly data of 2004:07-2019:12. The parametric method is used for the estimation of fractional integration parameters. The result of the study suggests that there is a high but mean-reverting behavior of inflation persistence in Pakistan. Its means that monetary policy shock will affect inflation for a longer period and dissipate slower than it is under the assumption of stationarity. The results show the positive and significant impact of monetary policy shocks on inflation persistence.

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Author's contribution in the article: 1- Conceived and designed the analysis, 2- Reviewed and compiled the literature, 3- Collected the data, 4- Contributed data or analysis tools, 5- Performed the analysis, 6- Wrote the paper, 7- Financial support for the conduct of the study, 8-Other

1. INTRODUCTION

Monetary policy's central mandate is to manage the macro-economic condition with achieving the goal of stable inflation in the economy. One way to determine monetary policy's efficiency is, by determining its role in the management of stable inflation rates by measuring the change in inflation persistence. Inflation persistence indicates the degree to which future values of inflation are associated with bygone shocks or, in other words, the speed of adjustment toward its long-run value (Balcilar, 2004). Indeed, inflation dynamics and the degree of inflation persistence have been recognized as the most essential parameters for affecting monetary policy's performance.

Rudebusch (2002) states that: "...the nature of the inflation process and the degree of structural inertia has been identified as one of the most crucial parameters affecting the performance of monetary policy". So, it is essential to measure the inflation persistence degree for the central bank, to know that if any monetary policy decision will affect the inflation and then how long it will persist. Therefore, the measurement of inflation persistence is a concern among policymakers and economists (Gerlach & Tillman, 2012).

Several countries have experienced very long periods of inflation. The discussion about the degree of inflation persistence has not been limited to developed countries only like US inflation. Rather, it includes different measures of inflation for different countries. For instance, at a theoretical level, the concept of inflation persistence has been linked to the design of robust monetary policy (Benati, 2008).

Pakistan is one of the very typical among these countries, with a very long period of high inflation experience since the late 1970s. In Pakistan's history, fluctuations in inflation have always been a matter of concern. A high and sustained economic growth in combining with low inflation is the significant objective of macroeconomics policy. Low and stable inflation is the indicator of a stable macroeconomic environment (Agha et al., 2005).

In the case of Pakistan, a finite number of studies have focused on the analysis of inflation persistence. Notable studies in this context include: Hanif et al. (2016) did considerable work in this regard, which estimates the intrinsic inflation persistence for Pakistan under a univariate approach. But did not consider establishing a link between monetary policy actions and inflation persistence. The degree of inflation persistence can have significant importance for the economy because of its effects on economic efficiency. Knowing the degree of inflation, offers vital information, to the central bank, about how to manage the interest rate to attain the targeted rate of inflation (Sripinit, 2012).

The uniqueness of this study to the previously mentioned studies includes: Firstly, this study estimates the degree of inflation persistence and other macro-economic variables (under a multivariate Approach). Secondly, this study allowed the long memory property of inflation persistence to examine the effect of monetary policy shocks on Pakistan's economy. Thirdly, this study uses the structural fractional integrated VAR model that did not apply in earlier studies in the context of Pakistan. This provides us margin to fill up this gap in the case of Pakistan. However, such work is quite pronounced in studies at the international level (Lovcha & Laborda, 2018).

This study, mainly concerned about that how much inflation is persistent in Pakistan? How does monetary policy shock affect inflation in presence of long memory? So, the main objectives of the study are to measure inflation persistence by allowing both long and short memory and also examined monetary policy shocks' impact on a high degree of inflation persistence in the economy. The result of this study shows that Pakistan is the country where inflation persistence is so high. Its means that any shock will affect the inflation for a longer period and dissipate slower than it is under the assumption of stationarity. The results show the positive and significant impact of monetary policy shocks on inflation persistence. We estimated

the impulse response function for monetary policy shocks. The results of long memory are also confirmed by IRF results which show high persistence in inflation having a long memory.

The remaining paper is organized as follows. Section 2 is about the literature review; Section 3 discusses the methodology and data. Section 4 and 5 describe the empirical results and conclusion respectively.

2. LITERATURE REVIEW

The effects of monetary policy actions transmit to the economy through different channels called the "Transmission mechanism of monetary policy". Ireland (2005) Monetary policy transmission mechanism is the method with which policy changes in interest rates or the money supply are transmitted into changes in inflation and other variables including output. Monetary policy controls inflation through different channels included the interest rate channel, balance sheet channel, exchange rate channel, and expectation channel. There is evidence in Agha et al. (2005) that the interest rate channel works in the monetary policy transmission mechanism in Pakistan.

According to the interest rate channel decrease in interest rate by adopting contractionary monetary policy through increasing the bank reserve, works in the conventional framework of the macroeconomic model. By changing the interest rate, monetary policy decrease in the interest rate will decrease the savings of consumers. So this will lead to an increase in the proportion of consumption of consumers, as the consumption will increase in the economy so that AD will also increase and according to the demand law increase the demand will lead to an increase in prices or higher inflation. (Romer et al., 1990; Taylor, 1995) believe in the importance of interest rate channel on the investment behavior of consumers and businesses.

Recent literature related to inflation persistence shadows 2 major paths. 1st path deals with the macroeconomic approaches, that attempt to capture inflation persistence in the real world. The 2nd path, which is also the motivation for the present study, seeks out to measures inflation persistence empirically. A common approach is to implement a univariate time series approach, in which inflation persistence is signified by the sum of autoregressive coefficients of the AR model for inflation i.e. Pivetta and Reis (2007).

Fuhrer (2011) comprehensively analyzes the inflation persistence concept in the theory of macroeconomics and suggests that the main source of inflation is an intrinsic factor. A large number of studies indicate high persistence in developed countries, due to changes in the inflation target, structural change, change in the exchange rate, or monetary policy shocks (Levin & Piger, 2004). Mishkin (2007) states that inflation persistence cause to increase in monetary policy cost to stabilize inflation in form of high unemployment.

Benati (2006) analyzed the evolution of inflation persistence in different countries for the different monetary regimes, and measure the degree of inflation persistence. Levin and Piger (2004) demonstrate that the existence of a high degree of inflation persistence might be connected to changes in normal inflation. They proved that inflation persistence, not completely characteristic of only economically developed countries. Franta et al., (2010) analyze the degree of inflation persistence for new members of the EU for 1993-2008. They conclude that intrinsic inflation persistence is higher in some countries i.e Poland and Hungary.

Pincheira (2009) estimated inflation persistence for Chile and concludes that it shows a decreasing trend from the past few years. However, this is a simpler procedure of analyzing variables, which does not consider full dynamics of inflation, since, it only captures intrinsic persistence derived from price and wage inflation. To understand the impacts of monetary policy on prices and output, monetary authorities need to accomplish the key goals of their major policies particularly stabilization of prices which is the chief aim of monetary policy in addition to growth. Central bank adopts different policy tools or disciplines to have

its control over to manipulate money creation in the economy and the reserves of commercial banks. The nature of monetary regimes depends on the behavior of the central bank (Hetzel, 2017).

Bratsiotis et al. (2002) state that the degree of inflation persistence highly depends on monetary policy objective, if monetary policy only goal is to get stabilize inflation we will get a lower degree of inflation persistence after the study on Canada, Australia, Finland, Spain, Sweden and New Zealand for 1980- 1990. Davig and Doh (2014) claim that inflation persistence can be curb by monetary policy by adjusting the interest rate in response to change in inflation. Batini (2006), study the monetary policy impact on inflation for UK and USA and conclude that monetary policy's maximum effect on inflation in reduced form after a year of implementation Oliveria and Petrasi (2010) analyze inflation persistence in 23 industrial and 17 emerging economies. They conclude that the degree of inflation persistence is low in industrial economies than in emerging economies.

Gerlach and Tillmann (2012) examined the relationship between inflation targeting and the persistence of inflation in Asia. They used the autoregressive method for monthly data for 1985:1-2010:1. They found a decrease in inflation persistence after the adoption of inflation targeting. Meller and Nautz (2012) analyzed inflation persistence before and after EMU. They used fractional integration approach for pre (1966 to 1998) and post EMU (1999-2007) the result shows in the euro area inflation persistently decreases after EMU.

Milani and Treadwell (2012) used a small-scale DSGE model to disentangle unanticipated and anticipated monetary policy shocks and study their effects. The estimation used likelihood-based Bayesian methods on US data from 1960:q1 to 2009:q1 on the output gap, inflation, and the federal funds rate as observable variables. They showed that the unanticipated monetary shocks have a smaller and more short-lived impact on output and a large, delayed, and persistent effect due to anticipated policy shocks. The overall fraction of economic fluctuations that could be attributed to monetary policy remained limited.

Pradana and Rathnayaka (2013) established a link between economic growth and inflation, to examine the short-run and long-run correlation between them. The study focused on 3 Asian countries for 1980-2010 using Johansen's cointegration approach, Granger causality, and vector error correction model (VECM). They conclude the negative and long-run significant relationship between inflation and economic growth in Sri Lanka. While for China, they found significant and negative short-run relationships.

Mbutor (2014) evaluates the money supply on inflation in Nigeria. The impulse response function showed a persistent positive relationship between inflation and money supply. However, the variance decomposition of inflation showed that GDP was the strongest contributor to inflationary developments in Nigeria, and that money supply accounts for <50% of aggregate price changes. Umaru and Zubairu (2012) Contend that inflation exerts a positive influence on economic growth by encouraging productivity, output level and promoting total factor productivity.

Bratsiotis et al., (2015) examine that after the adoption of inflation targeting, inflation persistence reduces significantly. They used quarterly data for this purpose (1962:Q2-2001:Q2) and used an autoregressive approach and the result shows that inflation persistence decrease after the adoption of inflation targeting. Canarella and Miller (2016) also examined the effect of inflation targeting on inflation persistence using the Fractional integration approach. The result shows the decrease in inflation persistence after inflation targeting. Lovcha and Laborda (2018) examine the persistence of inflation and other variables for the US. The data used for their analysis include 1979:Q3-2007:Q4 by using VAR and FIVAR. They found inflation persistence remain stable across different sample periods.

Gil-Alana et al. (2019) investigate persistence in inequality persistence in inequality of income for 26 OECD countries for the period 1963-2008 by using fractional integration and found high persistence in income inequality. Zhang (2011) examines the relation between Inflation persistence, inflation expectations, and monetary policy in China by using monthly data for the period of 1979 to 2009 and applied the autoregressive method as a measure of inflation persistence. The study discovers that, structural changes in

Hussain (2009) used the methodology of VAR to analyze the effect of output and inflation in Pakistan. He concludes that from his finding the exchange rate channel is the most significant way for controlling inflation and output as compared to another channel. Khan and Din (2011) studied the Pakistan economy in the context of the dynamics of the Macroeconomics Model. The period was from 1972 to 2009 the main outcome of the analysis is that the important impact on the manufacturing sector in the long run by raw material and industrial machinery.

Hanif et al. (2016) work for the intrinsic nature of inflation persistence for Pakistan's economy using monthly data to capture Inflation persistence through an AR process at the overall and commodity level. Overall inflation exhibit low and insignificant persistence. At group levels, food inflation does not show significant inflation persistence. At the micro-level, they found that the estimated degree of inflation persistence in various categories is found to be relatively higher. Qayyum & Anwar (2019) did noticeable work in this aspect which explores intrinsic inflation persistence for overall inflation on a quarterly and yearly basis and found a high level of intrinsic inflation persistence in Pakistan by using a univariate approach.
Tule et al. (2020) tested for inflation persistence in Nigeria by using the FCVAR methodology. The result of this study shows the high persistence behavior of headline, core, and foo inflation. Balici and Cekin (2020) work to measure inflation persistence for the time 1990-2018, using a time-varying approach. The results of the study show that there is an increasing trend in inflation persistence.

3. DATA AND METHODOLOGY

The study employed a Structural fractional integrated Vector-Auto Regressive model (Structural FIVAR model). A large set of empirical works uses the structure Vector Auto Regressive model in examining the effects of monetary policy shocks. As the Vector Auto Regressive model imposes stationarity assumption, indicates a rapid exponential decrease of the responses of the variables to the monetary policy shock (Taylor, 1995). Because of a high degree of inflation persistence and many different variables were included in these models. High inflation persistence is a widely discussed topic (Pivetta & Reis, 2007). To join the conflicting evidence evolving from testing of unit root, Ball (1993) and Walsh (2003) proposed a fractionally integrated (FI), process.

3.1. Structural FIVAR Estimation Steps:

We followed a two-step estimation method:

- In the first step we estimate the fractional order of integration for all the variables, and make the difference to make them stationary.
- In the second step, we applied the SVAR model to estimate the effect of monetary policy shocks.

3.2. Stationarity Tests:

As, we are dealing with the monthly data so there is a possibility of seasonality; unit root in the data. To check the properties of time series data following tests are used. First, we check variables stationarity through the Augmented Dickey-Fuller (ADF) test.

$$\triangle Y_t = a_1 + a_{2t} + \beta Y_{t-1} + \sum_{i=1}^{n} \gamma_i \triangle Y_{t-1} + \varepsilon_t \quad (1)$$

This ADF test equation applies to test the unit root. Whereas β show the trend term in the model. The above equation shows both trends and intercept. The t-statistics value is used to check the significance of coefficient (β), for this purpose make a null and alternative hypothesis (Gujarati, 2012).

$$H_o: \beta = 0 \; means \; series \; is \; I(1)$$
$$H_1: \beta \neq 0 \; means \; series \; is \; not \; I(1)$$

The Augmented Dickey-Fuller (ADF) test is the power of the test. It is very low if the process is nearly non-stationary which means the process is stationary but with a root close to the non-stationary boundary (Balcilar, 2004).

3.3. Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test:

To avoid the constraint that the ADF test always has low power, Kwiatkowski et al, (1992) suggested an alternative test.

$$Y_t = \beta + \gamma_t + \mu_t \tag{2}$$

$$H_o: \gamma = 0 \; means \; series \; is \; I(0)$$
$$H_1: \gamma \neq 0 \; means \; series \; is \; not \; I(0)$$

If the contradictive results are reached based on both ADF and KPSS tests, often regarded as a symptom of long memory in the data. However, none of the above-mentioned tests have command against FI.

3.3.1. Estimation method of Fractional Integration parameter:

The long memory/short memory property of a series shows that the values of series observed in lags are co-related among themselves or the effect of any event (i.e. shocks) can be determined.

Above mentioned unit root tests (ADF and KPSS), do not have power against the measurement of memory of any shock. In this study, we use the parametric method to estimate the parameter of long memory parameter. The advantage of this approach is that it provides the opportunity to acquire an estimator that has good properties of robustness (Ando & Modigliani, 1963).

This method is based on the statistic,

$$X_{(n)} = \frac{R_{(n)}}{S_{(n)}} = \frac{\max\limits_{1 \leq x \leq n} \sum_{i=1}^{x} (Y_i - \bar{Y}_i) - \min\limits_{1 \leq x \leq n} \sum_{i=0}^{x} (Y_i - \bar{Y}_i)}{n^{-1} \sum_{i=1}^{x} (Y_i - \bar{Y}_i)^2} \tag{3}$$

Where,

$$\bar{Y}_i = n^{-1} \sum_{i=1}^{n} Y_i \tag{4}$$

and n represents the sample size this method allows us to estimate d (fractional integration).

3.3.2. Transformation of series:

So, after estimating the value of d (fractional difference), we make the series stationary to apply SVAR.

$$(1-L)^d x_t = \mu_t$$
$$(1-L)^d = \sum_{k=0}^{\infty} (-1)^k \binom{d}{k} L^k = 1 - dL + \frac{d(d-1)}{2} L^2 - \frac{d(d-1)(d-2)}{6} L^3 + \ldots \tag{5}$$

In equation 5, L shows the lag operator μ_t shows the stationarity term after taking lag of a variable series (x_t). "d" can be any real value.

3.4. Structural Vector-Autoregressive method (SVAR):

For the estimation, we used Structure Vector Auto Regression (SVAR) model. The SVAR model was widely used in empirical works in the past (Bernanke, 1996; Watson & Blanchard, 1994; Sims, 1981; 1986). The SVAR was the response to criticism on the basic VAR.

3.4.1. General equation:

$$AZ_t = B_0 + B_i Z_{t-i} + \varepsilon_t \quad (6)$$

A represents the square matrix (To capture the effect of contemporaneous relation between variables), Z_t represents the vector of endogenous variables (k), and i = 1,…,N; ε_t represents the structural shocks. ε_t should satisfy conditions.

(1): $E(\varepsilon_t)$=0; (2): $E(\varepsilon_t \varepsilon'_t) = \Sigma_t$ *and* (3): $E(\varepsilon_t \varepsilon'_t) = 0$

To get reduce form equation of VAR, pre-multiply A^{-1} with equation (7)

$$Z_t = A^{-1} B_0 + A^{-1} B_i Z_{t-i} + A^{-1} \varepsilon_t \quad (7)$$

$e_t = A^{-1} \varepsilon_t$ = reduce for residual of VAR; satisfies following conditions (1): $E(e_t)$=0, (2): $E(e_t e'_t) = 0$ *and* (3): $E(\varepsilon_t \varepsilon'_{t-k}) = 0$. Structural shocks matrix of variance-covariance:

$$\Sigma_t = E(\varepsilon_i \varepsilon_t) = E(A e_t e'_t A') = AE(e_t e'_t)A' = A\Sigma_e A'$$

To make the system identified, $n^2(n^2-1)/2$ restriction must be imposed for the recovery of all structural shocks of the reduced form VAR (e_t) residuals. The variance-covariance matrix shows the estimated residual.

3.4.2. Structural Model:

Following the formula $n^2(n^2-1)/2$, "3" restriction imposed on A matrix to make the system identified. Contemporaneous effect of variables on each other shows by the "A" matrix. The diagonal of the matrix shows the coefficients that are normalized to "unity". All the "zeros" in matrix A shows the restrictions.

$$AZ_t = \begin{bmatrix} 1 & \delta_{12} & 0 \\ 0 & 1 & \delta_{23} \\ 0 & \delta_{32} & 1 \end{bmatrix} \begin{bmatrix} IPI_t \\ INF_t \\ INT_t \end{bmatrix} \quad (8)$$

The first 2 restrictions ("0") show that inflation and interest rate do not have a contemporaneous relationship with economic growth. 3rd Restriction shows that no relationship exists between interest rate and economic growth.

3.4.3. Reduced- form VAR:

Reduced form equation (8) can be written in matrix form as:

$$\begin{bmatrix} IPI_t \\ INF_t \\ INT_t \end{bmatrix} = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{bmatrix} \begin{bmatrix} 1 & \delta_{12} & 0 \\ 0 & 1 & \delta_{23} \\ 0 & \delta_{32} & 1 \end{bmatrix} \begin{bmatrix} IPI_{t-1} \\ INF_{t-1} \\ INT_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (9)$$

3.5. Empirical Evidence of the relationship between monetary policy and inflation persistence.

In this study, we used the Structural FIVAR model to investigate the relationship between monetary policy shocks and inflation persistence. The structural FIVAR model merges the estimation of Fractional integration and the structural VAR model to examine the link. All variables in the VAR model are treated as endogenous. The current values of variables depend upon the lag values of their own and the lag values of other variables including error terms.

Reduced form VAR can be expressed in equation form as follows.

$$INF_t = \alpha_{31+} \sum_{i=1}^{p} a_{3i} INF_{t-i} + \sum_{i=1}^{p} \beta_{3i} INT_{t-i} + \sum_{i=1}^{p} \gamma_{3i} IPI_{t-i} + \varepsilon_{INFt} \quad (10)$$

In equation (10), INF_t shows the inflation depends on its lag and lag of other variables including the interest rate (INT_{t-i}) and economic growth (IPI_{t-i}).

The interest rate is treated as the proxy of monetary policy shocks. A large number of studies used interest rate as a monetary policy tool i.e. Agha et al. (2005). Any monetary policy shock is expected to have an inverse relation with inflation persistence. A decrease in the interest rate will decrease the savings of consumers. So this will lead to an increase in the proportion of consumption of consumers, as the consumption will increase in the economy so that AD will also increase and according to the demand law increase the demand will lead to an increase in prices or higher inflation (Romer et al., 1990).

Economic growth has a positive association with the level of inflation persistence in the economy. Economic growth is peroxide by industrial production. Most of the studies used industrial production as economic growth i.e. Lo and Piger (2005). Higher economic growth leads to an increase in inflation. If the economy's aggregate demand exceeds supply, it results in high inflation that persists in the economy depends upon the degree of its persistence (Sripinit, 2012).

$$IPI_t = \alpha_{11+} \sum_{i=1}^{p} a_{1i} IPI_{t-i} + \sum_{i=1}^{p} \beta_{1i} INF_{t-i} + \sum_{i=1}^{p} \gamma_{1i} INT_{t-i} + \varepsilon_{IPIt} \quad (11)$$

The above equation (11) shows that the economic growth (EG_t) depends on its lag and lag of other variables including the interest rate (INT_{t-i}) and inflation (INF_{t-i}). Inflation persistence and economic growth have a negative relation. High inflation persistence affects economic growth adversely (Benati, 2008).

Interest rate INT_t and economic growth IPI_{t-1} also exhibit negative relations. Increase in interest rate increase borrowing cost that leads to decrease in investment decrease consumer spending and lead to slow economic growth (Munir, 2018).

$$INT_t = \alpha_{21+} \sum_{i=1}^{p} a_{2i} INT_{t-i} + \sum_{i=1}^{p} \beta_{2i} IPI_{t-i} + \sum_{i=1}^{p} \gamma_{2i} INF_{t-i} + \varepsilon_{INTt} \quad (12)$$

Above equation (12) shows that the interest rate depends on its lag and lags of other variables including economic growth and inflation. According to the theory, Economic growth and interest rate are positively related to each other. Increase in interest rate. On the other hand, inflation and interest rate also have a negative relationship. An increase in inflation persistence cause to decrease in the interest rate and vice versa. Higher inflation means a high level of money supply in the economy so monetary policy increase interest rate. With the increase in interest rate, people start to increase savings which leads to a decrease in aggregate demand. As demand decreases prices also decrease and help to reduce inflation (Mishkin, 2007).

In this study, Akaike information criteria (AIC) and Final prediction error (FPE) criterion is used to choose lags. The lowest values of the above-mentioned criteria are used to select a lag length The Impulse response functions (IRF) are used to identify the reaction of present and future values of each dependent variable, by one unit increase or we can say one-time shock, in the present value of the error term in the VAR system (Gujarati, 2012). It also pre-assuming that, this error turns back to "0" in the later periods, whereas remaining all error terms are zero. The IRF is generally proposed for the VARs model. It creates shocks in error terms. This technique is useful to observe time-series data. However, the effects of structural shocks on the whole period of endogenous structures are produced via the coefficient of the impulse response. Variance decomposition in the frequency domain is used to measure the shock share in each variable. This gives us the percentage contribution of a shock to measure the fluctuations in each variable.

3.6. Data and Variables

For analyzing the effect of monetary policy shocks and inflation persistence on the economy following variables are used: (1). Consumer Price Index *(INF)* as a measure of inflation (2). Discount rate *(DR)* as a proxy for interest rate (3). The industrial production index (*IPI*)s a proxy for economic activity. The data used is time-series monthly data from 2005:09-2019:12 for the Pakistan economy. The data sources include the State Bank of Pakistan (SBP) and International Financial Statistics (IFS).

4. RESULTS AND DISCUSSION

Before application of any test, series graphs plotted, to examine the visual pattern of variables (i.e. Inflation, interest rate, and Industrial Production). It is usually the first step of the analysis of data. The behavior of different variable series is depicted in Figures 1 to 3. Graphs of all variables plotted against the selected sample size.

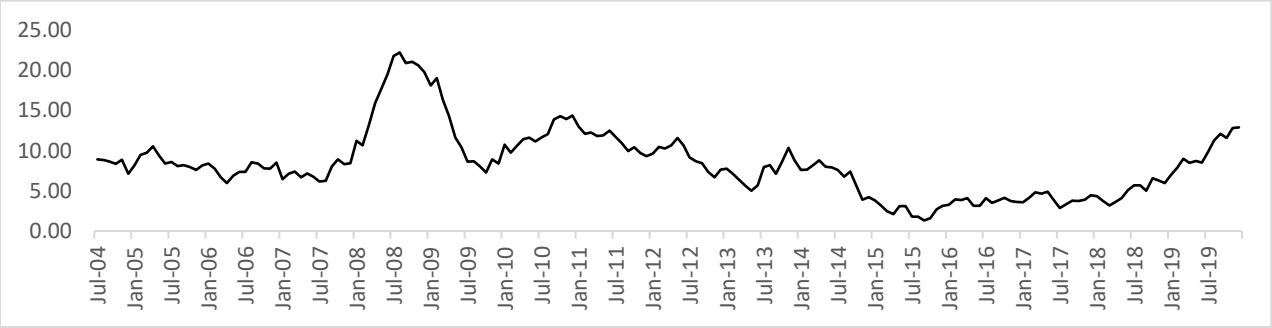

Figure 1: *Trend of Inflation in Pakistan*

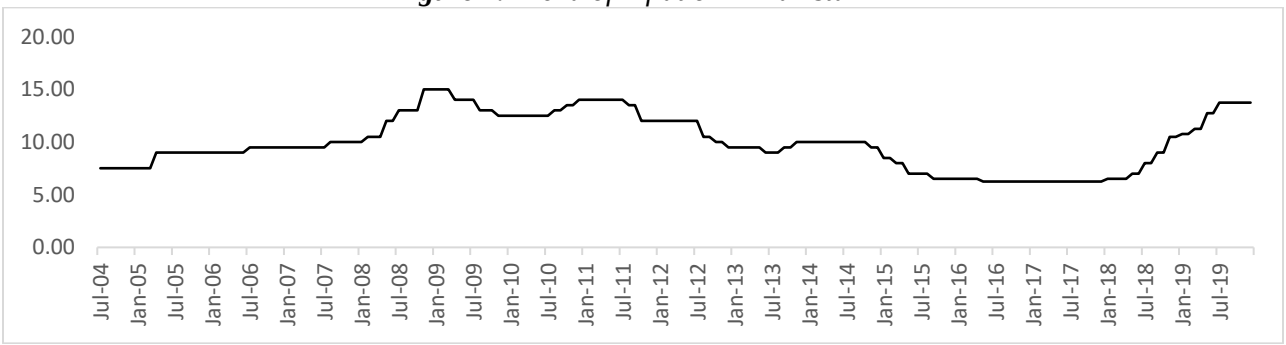

Figure 2: Trend of Discount Rate in Pakistan

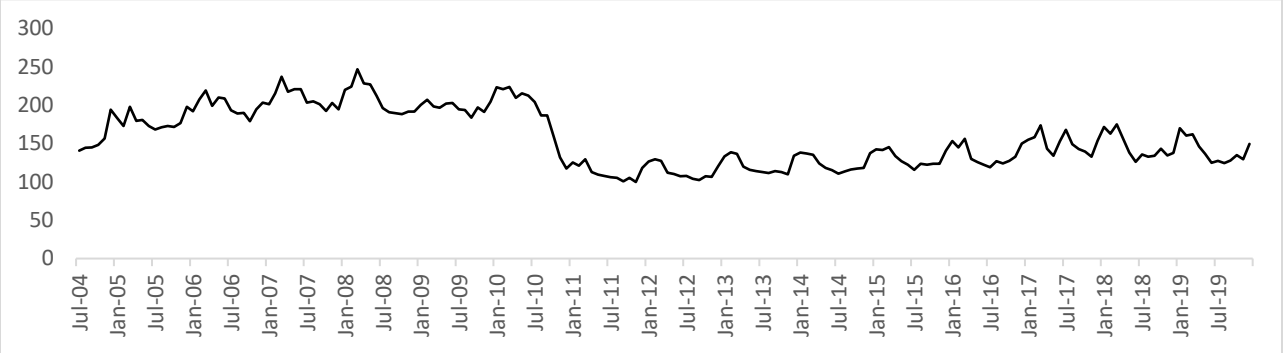

Figure 3: Trend of Industrial Production in Pakistan

The graph of different series showed in Figures 1-3. All the series plots show a persistent behavior, which could be confirmed after applying the statistical test i.e., unit root testing.

4.1. Unit Root Tests:

The different tests can be used to check the stationarity of the data, DF, ADF, KPSS, and PP, etc. But we choose the Augmented Dickey-Fuller test (1979) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test (1992) to test the stationarity. The results of these two tests are presented in Table 1.

The table shows the unit root results of different variables (i.e.; discount rate, industrial production, and inflation). Both the ADF and KPSS tests were applied with drift and with drift +trend. The underlined figures of the table show the t-statistics values while other figures in brackets show the critical values at a 5% significance level. All the above-mentioned figures in bold show the rejection of the Null hypothesis at 5% significance. The null hypothesis of ADF and KPSS is, series is integrated of order one, i.e. I(1), and series is stationary I(0), respectively.

Table 1: Results of the Unit Root Tests

Null Hypothesis	**Ho: series is I(1)**		**Ho: series is I(0)**	
Variables	**ADF(1)** **With drift**	**ADF(2)** **With drift and trend**	**KPSS(1)** **With drift**	**KPSS (2)** **With drift and trend**
Interest rate	**-1.92**	**-1.96**	**0.37**	0.23
	(-2.88)	(-3.43)	(0.46)	(0.14)
Economic Growth	**-1.86**	**-2.27**	0.91	0.20
	(-2.87)	(-3.43)	(0.46)	(0.14)
Inflation	**-1.22**	**-1.28**	0.59	0.16
	(-2.88)	(-3.44)	(0.46)	(0.14)

4.2. Estimation of Fractional Integration Parameter:

The limitation of both the test (ADF and KPSS) is that they don't have the power to test the degree of the Fractional Integration parameter. Results from unit root tests didn't tell much. Therefore, for appropriate assessment of memory behavior of any variable, we moved further than the traditional approach of the unit root by employing the technique of fractional integration.

The parameter "d" directs the long-run dynamics of a variable. Time-series data, with different values of fractional integration, provide different interpretations. Gadea et al. (2006) discussed several features of the "d" measurement of persistence.

i) The I(d) method permits the comparison of extremely persistent series.

ii) The parameter of "d" doesn't affect the short-run dynamics of data. An autoregressive approach for the measurement of long-run dynamics closely relates to the first-order autocorrelation of data, that responds to both short-run & long-run dynamics. Unlike the local unity parameter, in the unit-root model, estimation of "d" consistently. Christiano (1992) describes characteristics of the I(d) process. The different test used to estimate the FI parameters "d", that plays an important role in the evaluation of persistence in inflation as it estimates dependence level of series (Gil-Alana, 2008). The higher the value of d, the higher will be the level of association and degree of persistence. Possible cases of d are presented in Table 2.

Table 2: Values of Fractional Integrated Parameter and its implications

D	***Duration of shock***	***Stationarity***
d=0	Short memory	Stationarity
-0.5 < d < 0	short-memory with fast mean-reversion	Stationarity
0 < d < 0.5	Long-memory with slow mean-reversion	Non-stationarity
d =1	Long memory	Non- stationarity
d > 1	Long memory with non-mean reversion	Non- stationarity

We applied the parametric method to estimate the Fractional integration parameter (d). The following table shows that estimated values of the order of integration are estimated with the method of Exact Maximum Likelihood, which is the most common method used in the literature (Das et al., 2014).

Table 3 shows the estimated values for the order of fractional integration for the selected sample. All the above-mentioned variables (economic growth, inflation, and interest rate) show the Long-memory property but mean reversion with estimated values for the order of integration (FI) of 0.38, 0.21, and 0.31, respectively. This is the indication of high persistence, which means that the shock effect will persist for a longer time in the case of Pakistan. The result is consistent with the study of Hanif et al. (2016) and Agha et al. (2005) Tule et al. (2020).

Table 3: Estimation of Fractional Integration Parameter

Variables	**Fractional integration parameter (d)**	**Range of "d"**	**Duration of Shock**	**Stationarity**
Economic Growth	0.38	0 < d > 0.5	Long memory with mean reversion	Non-Stationarity
Inflation	0.21	0 < d > 0.5	Long memory with mean reversion	Non-Stationarity
Interest Rate	0.31	0 < d > 0.5	Long memory with mean reversion	Non-Stationarity

Long memory specifies that the series exhibits strong dependence between observations. Unit root in interest rate cannot be rejected partly because of the reason that interest rates are being used in developing countries as a stabilizing policy, with the shocks being long-term instead of transitory (Gil-Alana, 2008). While the presence of long memory in inflation and economic growth (peroxide by industrial production) is due to the reason that quite a big number of firms set their prices based on past information (Gali & Gertler, 1999). In Pakistan, 71% of manufacturers use past information, while price setting. This gives an increase to inflation persistence because when a big number of firms use past information when setting a price, inflation cannot easily transmit to a (new) lower steady-state as an outcome of any monetary policy shock. This causes a high level of inflation persistence in the economy (Hanif et al., 2016).

4.3. Transformation of series:

After estimating the fractional Integration for different series. We transform all the series by taking the difference of each variable series with the estimated fractional integrated parameter value.

4.4. Estimation of Structural VAR:

After taking the difference, we applied VAR on the transformed series. As to investigate the effect of monetary policy action on the economy under inflation persistence Structural Vector Auto-regressive model is employed. But it is not possible to directly estimate the structural VAR. so we followed the standard method, Firstly, we estimate the VAR model and then imposed restrictions to get the innovation through structural VAR.

Therefore, we estimate a reduced form VAR, and for the estimation of reduced-form VAR, the first step is the estimation of optimal lag length. After that, we applied the Granger Causality test, impulse response function (IRF), and variance error decomposition.

4.4.1. Determination of Lags:

Before estimation of VAR, the first step is to estimate the optimal lag length of all variables. A general mechanism for the selection of optimal lag length used AIC and SIC etc. the results from the lag selection criteria are shown in Table 4.

Table 4: Lag Selection Criteria for VAR

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	-3875.540	NA	1.69e+15	43.5791	43.6327	43.6008
1	-3148.204	1421.981	5.29e+11	35.5079	**35.7224***	35.5949
2	-3125.572	43.4838	4.54e+11	35.3547	35.7301	**35.5069***
3	-3112.977	23.7751	4.36e+11	35.3143	35.8506	35.5318
4	-3098.830	26.2276	4.12e+11	35.2565	35.9536	35.5392
5	-3082.601	29.5411	**3.80e+11***	**35.1752***	36.0333	35.5232
6	-3074.814	13.9111	3.85e+11	35.1889	36.2078	35.6021
7	-3068.872	10.4145	3.99e+11	35.2232	36.4030	35.7017
8	-3057.468	**19.6062***	3.90e+11	35.1962	36.5369	35.7399

Above table 4 shows the determination of Lag that is based on the minimum values of Final prediction error (FPE) and Akaike information criterion (AIC). Based on FPE and AIC we select 5 lags for this study.

4.4.2. Vector Auto-regression:

Regression results for reduced form VAR show in table 5. As, before the estimation of structural VAR, estimation of reduced form VAR is required and lag length choose through lag selection criteria i.e. 5 lag. The results show that interest rate and inflation show an inverse relationship at a 5% level of significance with lags, consistent with the theory. As the interest rate is used as the proxy of monetary policy so any change in monetary policy affects the inflation rate prevailing in the market. In the case of expansionary monetary policy (interest rate decreases), people save less and consume more, which leads to an increase in the demand for goods. An increase in demand will cause to increase the prices (law of demand) and hence the inflation will increase (Mishkin, 2007).

Table 5: FI Vector Autoregression Estimates

	EG	INF	INT
EGI(-1)	0.9200*****	9.95E-05	-0.0001
	(0.0773)	(0.0003)	(0.0001)
EG(-2)	0.1079	0.0005	0.0002
	(0.1033)	(0.0004)	(0.0002)
EG(-3)	0.0577	0.0002	-0.0003
	(0.1041)	(0.0005)	(0.0002)
EG(-4)	-0.2808**	-0.0002	0.0005**
	(0.1043)	(0.0005)	(0.0002)
EG(-5)	0.1583**	-0.0002	-0.0002
	(0.0800)	(0.0003)	(0.0001)
INF(-1)	-19.0130	1.0889*	0.1103*
	(15.9256)	(0.0757)	(0.0317)
INF(-2)	24.8261	-0.0605	-0.1514*
	(23.6088)	(0.1122)	(0.0470)
INF(-3)	-22.9766	0.1004	0.0615
	(24.6064)	(0.1170)	(0.0490)
INF(-4)	30.6651	-0.0482	0.0726
	(24.7234)	(0.1175)	(0.0492)
INF(-5)	-12.0813	-0.2120**	-0.0786**
	(16.8020)	(0.0799)	(0.0334)
INT(-1)	-35.3893	0.2263	0.9081**
	(37.9729)	(0.1806)	(0.0756)
INT(-2)	24.5741	-0.0102	0.2547**
	(50.0090)	(0.2378)	(0.0996)
INT(-3)	19.0528	0.0562	-0.2287**
	(49.8372)	(0.2370)	(0.0993)
INT(-4)	-33.3644	-0.5567**	0.1871**
	(48.1939)	(0.2292)	(0.0960)
INT(-5)	18.0211	-0.4073**	-0.1568**
	(35.5159)	(0.1689)	(0.0707)
C	1602.419	-9.9434	1.1878
	(961.435)	(4.5729)	(1.9159)
R-squared	0.9115	0.9626	0.9797
Adj. R-squared	0.9034	0.9592	0.9778
F-statistic	113.3030	283.7167	531.4588

*Standard errors in ( ) & *, **, *** shows the level of significance at 1, 5 and 10%.*

Inflation shows a positive relationship with an interest rate with a 5% level of significance at first lag. Higher inflation in the economy leads to an increased interest rate (contractionary monetary policy), to reduce the inflation prevailing in the economy. As monetary policy work with lag so situation of price puzzle will prevail in the economy (Khan, 2008).

Inflation shows a negative and significant impact on monetary policy decisions with lags at 5%. With time, people realize that a higher interest rate means a high cost of borrowing. This leads to a decrease in borrowing, make lesser availability of money supply in the economy so that people will have less money to spend, the demand for goods and services will decrease. As demand decreases prices decrease so this will cause a decrease in inflation. These results are consistent with the study of Hussain (2009).

4.5. Granger Causality:

The results of Granger causality are presented in Table 6. In this study, to examine the causality Granger causality / Block Exogeneity Wald test was applied. The outcomes show that industrial production (IPI) is a Granger caused by discount rate and inflation at 5% level of significance, its means both the Interest rate and inflation help us to forecast the economic growth. Inflation does not granger caused by IPI (proxy of economic growth) but significant causality present between interest rate and inflation means an increase in inflation will affect the interest rate. Similarly, there is no granger causal effect of IPI on the interest rate (monetary policy decisions) but monetary policy decision is Granger caused by inflation.

Table 6: VAR Granger Causality / Block Exogeneity Wald Tests

Excluded	Chi-sq	df	Prob.
Dependent variable: EG			
INF	3.7652	5	0.5837
INT	1.5122	5	0.9117
All	5.9306	10	0.8211
Dependent variable: INF			
EG	13.0483	5	0.0229
INT	16.7144	5	0.0051
All	28.2203	10	0.0017
Dependent variable: INT			
EG	9.4831	5	0.0913
INF	27.4744	5	0.0000
All	42.8542	10	0.0000

4.6. Impulse Response Function:

Diebold and Inoue (2001) explained that IRFs "tends to trace out the response of current and future values of each of the variables to one–unit increase in current values of one of the VAR residual, assuming that the error returns to zero in subsequent periods and all other errors are equal to zero. The implied thought experiment, of changing one error while holding the others constant, makes the most sense when the errors are uncorrelated across equations". IRF presents behaviors of variables due to any shock in other variables. To find more accurate results, structural restrictions are applied.

Figure (4, a) shows the response of inflation in the economy because of monetary policy shock i.e. interest rate. Monetary policy shock looks like to die off for inflation in a longer period, suggesting its high degree of inflation persistence is consistent with the study of Qayyum and Anwar (2018). FIVAR response shows a positive sign of inflation and is statistically significant. Consistent with estimated orders Fractional Integration, convergence to zero is very slow, which remains significant for a longer period. Provide evidence of a high degree in inflation persistence.

Due to monetary policy shock, inflation diverges from its steady-state level saving increase consumption decrease so the prices decrease and level of inflation decrease in the economy. This result is in line with the interest rate-setting mechanism in Pakistan where monetary authorities set interest rates and then the money supply is adjusted and not otherwise.

Figure (4, b) shows the FIVAR response of IPI to monetary policy shock (shock in interest rate). IRF shows that positive shock in interest rate leads to deviation in IPI in the initial period as an increase in interest rate decrease the IPI. This shows the long high degree of persistence property in IPI with a high degree memory of shock effect on the output level i.e. IPI in the economy. These finding findings are consistent with the Fractional degree estimates of IPI consistent with the study of Hussain (2019).

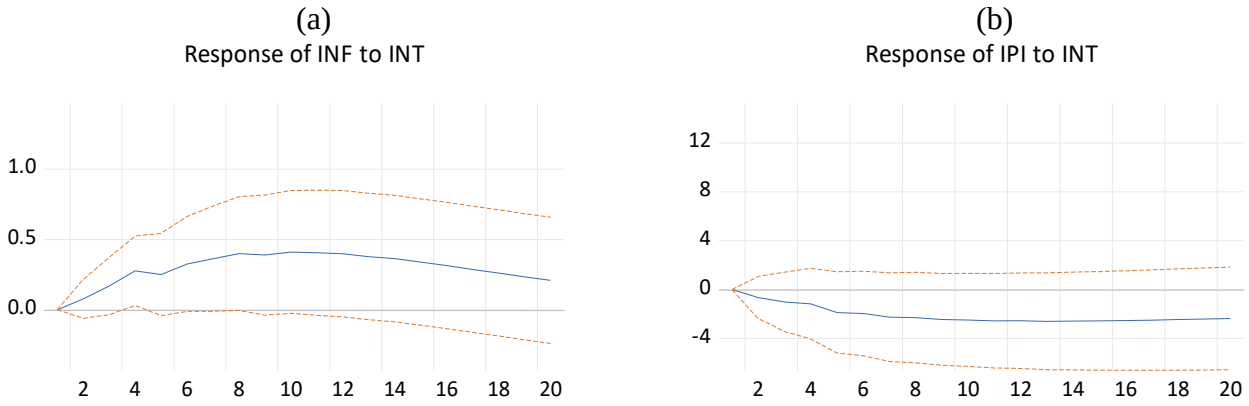

Figure 4: Impulse Response of Industrial production, Inflation to Interest rate

4.7. Variance Error Decomposition:

IRF shows the reaction of the variables in response to monetary policy shock but is not an appropriate method to analyze the contribution of each shock. VED allows measuring the share of shock. Table contributes to the monetary policy shock

Table 7 explains the variance decomposition of IPI, it shows that the maximum proportion of error variance forecast of IPI is explained by IPI itself 77% in month 6. Only 1% attributed to DR. (monetary policy shocks, and 8 % attributed to inflation greater than monetary policy shock. The contribution of discount rate and prices in explaining the variances of IPI increases after 4 months and that of IPI itself decreases to a certain degree. This suggests that due to tight monetary policy has the potential to reduce IPI if tight monetary policy is persistent. This also provides support for our a priori decision to exclude asset prices from the money supply rule in the macroeconomic model.

Table 7: Variance Decomposition of IPI

Period	S.E.	IPI	INF	DR
1	2795.168	99.5109	9.6110	0.4890
2	3649.131	98.5020	1.1972	0.3006
3	4356.420	93.7826	5.6760	0.5413
4	4951.408	90.2814	8.5332	1.1853
5	5563.609	82.0433	16.8277	1.1288
6	5881.786	77.8929	21.0732	1.0337
7	6182.879	75.9579	22.4525	1.5895
8	6356.704	75.7633	22.2986	1.9380
9	6450.901	75.8588	21.8133	2.3278
10	6528.236	76.0807	21.5677	2.3514

The result in table 8 shows that monetary policy shocks have a high effect on inflation. These outcomes interestingly suggest that, even in the 6th month, a major portion of error forecasting in inflation can be recognized due to monetary policy shock consistent with findings of (Chuku, 2009).

Table 8: Variance Decomposition of Inflation

Period	S.E.	IPI	INF	DR
1	16.24202	0.000000	1.97E-07	100.0000
2	26.47921	0.344072	1.170421	98.48551
3	34.87414	0.436344	1.665065	97.89859
4	43.90203	0.781291	2.328260	96.89045
5	52.44520	1.054836	1.920802	97.02436
6	58.38997	1.502170	1.605013	96.89282
7	63.23050	2.235655	1.401978	96.36237
8	67.19946	2.789836	1.275300	95.93486
9	70.06003	3.072377	1.183808	95.74382
10	72.45145	3.673339	1.412089	94.91457

Table 9 shows the results of Variances decomposition for interest rates is presented. These results are of high interest as it's directly associated to one of the main objectives of the study. It can be seen that high variance in DR is because of inflation and then dissipate slowly with time, and increase slowly with an interest rate as an increase in time horizon but not as IPI and INF. These results are consistent with the studies of Khan et al. (2011) and Balici and Cekin (2020).

Table 9: Variance Decomposition of Interest Rate

Period	S.E.	IPI	INF	INT
1	7.5427	0.0000	98.3718	1.6281
2	10.7575	0.0485	93.4500	6.5014
3	13.8347	0.1747	93.2117	6.6134
4	16.1785	0.1343	92.6975	7.1681
5	18.7898	0.4720	88.3326	11.1952
6	21.0053	0.3908	84.2514	15.3577
7	23.3510	0.6552	81.6431	17.7016
8	25.7695	0.5551	78.3108	21.1339
9	28.2560	0.6675	75.4496	23.8827
10	30.4959	0.7856	74.0565	25.1577

5. CONCLUSION AND POLICY RECOMMENDATIONS

Understanding the monetary policy shocks' effects on the economy is the most crucial element to achieve the objective of stable inflation and higher economic growth. To achieve these objectives, policymakers are required to have a better understanding of the dynamic properties of inflation persistence. As high persistence in inflation can increase the monetary policy cost to keep it low. To the best of my knowledge, this is the first study that estimates the monetary policy shocks' effect on the economy in presence of inflation persistence by using the structural FIVAR model.

The result of this study shows that Pakistan is the country where inflation persistence is so high. Its means that any shock will affect the inflation for a longer period and dissipate slower than it is under the assumption of stationarity. The results show the positive and significant impact of monetary policy shocks on inflation persistence. We estimated the impulse response function for monetary policy shocks. The results of long memory are also confirmed by IRF results which show high persistence in inflation having a long memory.

The degree of inflation persistence can have significant importance for the economy, because of its impact on the distribution of wealth and efficiency of the economy. The vital properties of inflation have influential

implications for the behavior of private agents. It is essentials to be highlighted that monetary policy decisions must be controlled if it causes to long-lasting rise in the rate of inflation in the economy is to be avoided. Forecast's accuracy depends greatly on the forecaster's capability to effectively forecast the pattern of shock absorption. Major policy implications which are drawn from the study are:

- In policy terms, the central banks that pursue inflation-targeted monetary policy should also bring under consideration the possible impacts of monetary policy shocks and in addition to that implement interest rate smoothing policy to prevent large fluctuations in macroeconomic variables.
- In upcoming researches, it will be helpful to provide a clear consideration to the obligations and different incentives of the central bank and to examine different ways to enhance the reliability of the monetary policy regime and make it more transparent.
- A deflationary policy is reliable if it is put into immediate action to lower inflation and vice versa. The degree of inflation persistence shows the velocity of inflation in response to a change in monetary policy. Nevertheless, those measures of reliability that do not take into account the persistence might not be sufficient. As a sound variable, the persistence of inflation discloses the reliability of the central bank. The credibility allows the central bank to regulate the inflation regarding expectations of the public and to achieve its disinflation target more quickly. As a result, a decline in inflation persistence indicates that the credibility of the central bank has been achieved.

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REFERENCES

Agha, A. I., Ahmed, N., Mubarik, Y. A., & Shah, H. (2005). Transmission mechanism of monetary policy in Pakistan. *SBP-Research Bulletin*, *1*(1), 1-23.

Ando, A., & Modigliani, F. (1963). The" life cycle" hypothesis of saving: Aggregate implications and tests. *The American Economic Review*, *53*(1), 55-84.

Balcilar, M. (2004). Persistence in inflation: Does aggregation cause long memory?. *Emerging Markets Finance and Trade*, *40*(5), 25-56.

Ball, L. (1993). What causes inflation?. *Business Review*, (Mar), 3-12.

Bilici, B., & Çekin, S. E. (2020). Inflation persistence in Turkey: A TVP-estimation approach. *The Quarterly Review of Economics and Finance*, *78*, 64-69.

Batini, N. (2006). Euro area inflation persistence. *Empirical Economics*, *31*(4), 977-1002.

Benati, L. (2008). Investigating inflation persistence across monetary regimes. *The Quarterly Journal of Economics*, *123*(3), 1005-1060.

Bratsiotis, G. J., Madsen, J., & Martin, C. (2002). Inflation targeting and inflation persistence.

Bratsiotis, G. J., Madsen, J., & Martin, C. (2015). Inflation targeting and inflation persistence. *Economic and Political Studies*, *3*(1), 3-17.

Canarella, G., & Miller, S. M. (2016). Inflation persistence and structural breaks: The experience of inflation targeting countries and the USA. *Journal of Economic Studies*.

Christiano, L. J., & Eichenbaum, M. (1992). *Liquidity effects and the monetary transmission mechanism* (No. w3974). National Bureau of Economic Research.

Chuku, C. A. (2009). Measuring the effects of monetary policy innovations in Nigeria: A structural vector autoregressive (SVAR) approach. *African Journal of Accounting, Economics, Finance and Banking Research*, *5*(5).

Das, S., Gupta, R., Kanda, P. T., Reid, M., Tipoy, C. K., & Zerihun, M. F. (2014). Real interest rate persistence in South Africa: evidence and implications. *Economic Change and Restructuring*, *47*(1), 41-62.

Davig, T., & Doh, T. (2014). Monetary policy regime shifts and inflation persistence. *Review of Economics and Statistics*, *96*(5), 862-875.

Diebold, F. X., & Inoue, A. (2001). Long memory and regime switching. *Journal of Econometrics*, *105*(1), 131-159.

Fuhrer, J. C. (2011). *The role of expectations in US inflation dynamics* (No. 11-11). Working Papers.

Franta, M., Saxa, B., & Smidkova, K. (2010). The role of inflation persistence in the inflation process in the new EU member states. *Finance a Uver*, *60*(6), 480.

Gadea, L., Mayoral, L., & Sabate, M. (2006, May). The Persistence of Real Exchange Rate and the PPP puzzle. In *10th International Conference on Macroeconomic Analysis and International Finance*.

Galı, J., & Gertler, M. (1999). Inflation dynamics: A structural econometric analysis. *Journal of Monetary Economics*, *44*(2), 195-222.

Gerlach, S., & Tillmann, P. (2012). Inflation targeting and inflation persistence in Asia–Pacific. *Journal of Asian Economics*, *23*(4), 360-373.

Gil-Alana, L. A., Škare, M., & Pržiklas-Družeta, R. (2019). Measuring inequality persistence in OECD 1963–2008 using fractional integration and cointegration. *The Quarterly Review of Economics and Finance*, *72*, 65-72.

Gil-Alana, L. A. (2008). Fractional integration and structural breaks at unknown periods of time. *Journal of Time Series Analysis*, *29*(1), 163-185.

Gujarati, D. (2012). Econometrics by example. Macmillan.

Hanif, M. N., Malik, M. J., & Iqbal, J. (2016). Intrinsic inflation persistence in a developing country. *SBP Research Bulletin*, *12*(1), 19-42.

Hetzel, R. L. (2017). A proposal to clarify the objectives and strategy of monetary policy. *Journal of Macroeconomics*, *54*, 72-89.

Hussain, K. (2009). Monetary policy channels of Pakistan and their impact on real GDP and inflation. *CID Research Fellow and Graduate Student Working Paper Series*.

Khan, M. U. H. (2008). Short run effects of an unanticipated change in monetary policy: Interpreting macroeconomic dynamics in Pakistan. *State Bank of Pakistan Working Paper*, *22*.

Khan, M. A., ud Din, M., & ud Din, M. (2011). A dynamic macroeconometric model of Pakistan's economy. *Working Papers & Research Reports*, *2011*.

Levin, A. T., Natalucci, F. M., & Piger, J. M. (2004). The macroeconomic effects of inflation targeting. *Review-Federal Reserve Bank of Saint Louis*, *86*(4), 51-8.

Lo, M. C., & Piger, J. (2005). Is the response of output to monetary policy asymmetric? Evidence from a regime-switching coefficients model. *Journal of Money, Credit and Banking*, 865-886.

Lovcha, Y., & Perez-Laborda, A. (2018). Monetary policy shocks, inflation persistence, and long memory. *Journal of Macroeconomics*, *55*, 117-127.

Mbutor, M. O. (2014). Inflation in Nigeria: How much is the function of money?. *Journal of economics and international finance*, *6*(1), 21-27.

Meller, B., & Nautz, D. (2012). Inflation persistence in the Euro area before and after the European Monetary Union. *Economic Modelling*, *29*(4), 1170-1176.

Milani, F., & Treadwell, J. (2012). The effects of monetary policy "news" and "surprises". *Journal of Money, Credit and Banking*, *44*(8), 1667-1692.

Mishkin, F. S. (2007). *Housing and the monetary transmission mechanism* (No. w13518). National Bureau of Economic Research.

Munir, K. (2018). Dynamic effects of monetary policy on output and prices in Pakistan: a disaggregate analysis. *Journal of the Asia Pacific Economy*, *23*(1), 99-118.

De Oliveira, F., & Petrassi, M. (2010). Is inflation persistence over?. *Central Bank of Brazil Working Paper*, *230*.

Jayathilake, P. M. B., & Rathnayake, R. M. K. T. (2013). Testing the link between inflation and economic growth: Evidence from Asia.

Pivetta, F., & Reis, R. (2007). The persistence of inflation in the United States. *Journal of Economic Dynamics and Control*, *31*(4), 1326-1358.

Pincheira, P., & Alvarez, R. (2009). Evaluation of short run inflation forecasts and forecasters in Chile. *Money Affairs*, *22*(2), 159-180.HETZ

Qayyum, W., & Anwar, A. (2019). Inflation persistence: Evidence from Pakistan.

Romer, C. D., Romer, D. H., Goldfeld, S. M., & Friedman, B. M. (1990). New evidence on the monetary transmission mechanism. *Brookings papers on economic activity*, *1990*(1), 149-213.

Rudebusch, G. D. (2002). Term structure evidence on interest rate smoothing and monetary policy inertia. *Journal of monetary economics*, *49*(6), 1161-1187.

Sripinit, T. (2012). How much do we understand about asymmetric effects of monetary policy?.

Taylor, J. B. (1995). The monetary transmission mechanism: an empirical framework. *Journal of Economic Perspectives*, *9*(4), 11-26.

Tule, M. K., Salisu, A. A., & Ebuh, G. U. (2020). A test for inflation persistence in Nigeria using fractional integration & fractional cointegration techniques. *Economic Modelling*, *87*, 225-237.

Umaru, A., & Zubairu, A. A. (2012). Effect of inflation on the growth and development of the Nigerian economy (An empirical analysis). *International Journal of Business and Social Science*, *3*(10).

Walsh, C. (2003). Speed limit policies: the output gap and optimal monetary policy. *American Economic Review*, *93*(1), 265-278.

Zhang, C. (2011). Inflation persistence, inflation expectations, and monetary policy in China. *Economic Modelling*, *28*(1-2), 622-629.