Effectiveness of Monetary Policy in Controlling inflation during the period of demand- pull and cost-push inflation: An Application of Non-linear ARDL Model for Pakistan

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2023

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Submitted in partial fulfillment of the requirements for the Master of Philosophy degree in Economics at School of Economics, Faculty of Social Sciences.

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Session (2021-23)

School of Economics

Quaid-I-Azam University, Islamabad

2023

THIS THESIS IS DEDICATED TO MY BELOVED MOTHER AND MY FATHER FOR HER ENDLESS LOVE, SUPPORT AND ENCOURAGEMENET THROUGHOUT MY LIFE


بسم الله الرحمن الرحيم

Declaration

I Habib Ul Hassan bearing Registration number 02092113018 candidate of MPhil Economics at School of Economics, Quaid-I-Azam University, Islamabad, do here by declare that the thesis **"Effectiveness of Monetary Policy in Controlling inflation during the period of demand- pull and cost-push inflation: An Application of Non-linear ARDL Model for Pakistan"** submitted for the fulfillment of Master of Philosophy (MPhil) degree in Economics, is my own work. I have not previously presented any part of this work for any other degree.

Certificate

This is to certify that the thesis title **"Effectiveness of Monetary Policy in Controlling inflation during the period of demand- pull and cost-push inflation: An Application of Non-liner ARDL Model for Pakistan"** by **Habib Ul Hassan** bearing Registration number 02092113018 is accepted in its present form by School of Economics, Quaid-I-Azam University, Islamabad, as satisfying all the requirements for the fulfillment of the degree of Master of Philosophy in Economics.

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Acknowledgment

First, I would like to Praise the almighty Allah, the most gracious and the most merciful, for giving me the strength and motivation to complete this thesis. We offer our humblest thanks from the core of our hearts to the Holy Prophet Hazrat Muhammad (S.A.W) who is forever a torch of guidance and knowledge for humanity.

I would like to acknowledge and give my warmest thanks to my Supervisor **Professor Dr. Muhammad Tariq Majeed** who made this work possible. His guidance and advice carried me through all the stages of writing my dissertation. I extend my deepest appreciation to my mentor and Co-Supervisor **Professor Dr. Eatzaz Ahmad**, for their unwavering guidance, insightful feedback, and invaluable support throughout the research process.

We sincerely and earnestly pay humbles and heartedly thanks to our affectionate parents and sibling, who always prayed for us and supported financially and morally. Secondly, our committee members, everyone, has provided patient advice and guidance throughout the research process. Thank you all for your unwavering support. Special thanks go to my family and friends for their constant encouragement and understanding during the challenges of this academic journey. Your belief in my abilities has been a driving force behind this achievement.

I am grateful to the School of Economics Quaid-i-Azam University Islamabad for providing the necessary resources and conducive environment for research.

Finally, I would like to thank my Allah, for letting me through all the difficulties. I have experienced your guidance day by day. You are the one who let me finish my work. I will keep on trusting you for my future.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller test
ARDL	Auto regressive distributed Lag model
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
SBP	State Bank of Pakistan
WDI	World Development Indictor
OLS	Ordinary least square
SBC	Swartz Bayesian Criterion
CPI	Consumer Price Index
R	Reverse Reop Rate
ER	Exchange rate
M	High-Powered Money
GDP	Gross domestic Product
OP	Crude Oil Price

ABSTRACT

This study evaluates the effectiveness of monetary policy in Pakistan in controlling inflation, particularly during the periods of cost-push and demand-pull inflation. To accomplish this task, the study utilizes the Non-linear Autoregressive Distributed Lags (ARDL) model, making use of quarterly data from the first quarter of 1981 to the fourth quarter of 2022. The study finds that monetary policy through the policy rate is only weakly effective in short run and ineffective in long run in controlling the rate of cost-push inflation. on the other hand, during the periods of demand-pull inflation the monetary policy in the form of increase in the policy rate is counterproductive both in the short and long runs. A tight monetary policy through the instrument of high-powered money appears as an effective tool of controlling price level in the long run irrespective of whether the inflation is associated with the cost-push or demand-pull factors. The tight monetary policy is also effective in controlling inflation rate in the short run, but its effectivity is quite weak and insignificant in case of demand-pull inflation. The study concluded that in case of Pakistan high-powered money is a more effective tool in controlling inflation than the policy rate.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The main purpose of monetary policy is typically to ensure price stability, exchange rate management and economic growth within a country. The effectiveness of monetary policy in managing inflation pertains to regulating and sustaining the overall price level of goods and services in the economy through the manipulation of monetary policy rates and money supply. Monetary policy plays a key role in controlling a country‟s inflation. When there is high inflation in the economy, the central bank implements tight monetary policy by increasing the policy rate and reducing the money supply to curb inflation. Conversely, when inflation is low, the central bank employs expansionary monetary policy by lowering policy rate and increasing money supply.

The central bank employs various measures to enhance the effectiveness of monetary policy, particularly in its role of managing inflation. Globally, Central banks partake in open market operation by trading government securities. When these banks sell securities, they reduce the overall money supply, thus mitigating the upward push on inflation. Conversely, when central bank purchase securities, they infuse money into the economic system, bolstering the available money. Secondly, the central bank employs the policy interest rate to establish or impact the range within which short-term interest rates can fluctuate. This action, in turns, affects the borrowing expenses incurred by businesses and consumers. By lowering interest rates, the central bank encourages spending and borrowing, thereby stimulating economic activity and potentially increasing inflation in the economy. Conversely, if the central bank raises

the interest rates, it curtails spending and borrowing, which can help reduce inflationary pressures.

The transmission channels play a crucial role in the effectiveness of monetary policy. Among these, prominent ones encompass the exchange rate, credit channel, and interest rate dynamics. These channels determine how changes in monetary policy affect borrowing costs, availability of credit, investment decisions, spending, and exchange rate. The level of anticipated by individuals and businesses holds a pivotal role in determining the effectiveness of monetary policy. When there exist beliefs in the central bank competence to manage inflation, it substantially influences the likelihood of individual and businesses adjusting their behaviors in alignments with such expectations.

Monetary policy can be affected by external factors that are beyond the control of the central bank, such as changes in the global commodity prices, crude oil prices, capital flows, and to some extent exchange rate; all of which can impact inflation rate. The effectiveness of monetary policy in controlling inflation depends on these external factors, macroeconomic conditions, inflation expectation, and the transmission mechanism. The central bank continuously adjusts to these factors and tries to maintain price stability and controls inflation within the target range.

The main goal of the State Bank of Pakistan (SBP) is to effectively manage monetary policy. The primary objective of monetary policy in Pakistan is also controlling inflation, maintaining price stability, fostering economic growth, promoting private investment, building foreign exchange reserves, and keeping financial markets stable.

Historical evidence suggested that Pakistan has frequently experienced high interest rates and high inflation due to its inherent weaknesses. The country has

struggled with a rapid increase in prices of goods and services over time, making borrowing money expensive due to elevated interest rates. These issues have persisted due to underlying problems within Pakistan‟s economic system. However, after the financial reforms initiated in the 1990s that continued into the 2000s, the effectiveness of monetary policy had become more apparent and is expected to be more successful in managing the country‟s economic system.

In most developed economies, the central banks set and independently implement an inflation target. However, in Pakistan, the fiscal authorities announce the inflation target (Choudhri and Malik, 2013). The government also borrows money from the banking system, which results in the creation of more money. Nevertheless, this borrowing and the creation of new money contributes to inflation. The state bank of Pakistan (SBP) can be described as having limited control over setting inflation targets. It lacks the freedom to independently choose an inflation target, but it can determine the policies and measures necessary to achieve the target that has been set for it.

To control inflation, two primary techniques are employed: adjusting interest rates or controlling the money supply. The SBP, like many other central banks, focuses mainly on interest rate policies to manage inflation. However, under this approach, the SBP does not possess direct control over the growth of money. On the contrary, the expansion of the money supply is dictated by the economy‟s demand for money. The Taylor principle, a crucial aspect of the rules, stipulates that the interest rate should be adjusted by a larger proportion than the change in the inflation rate.

Inflation expectations among individuals may not adjust rapidly, which can weaken the link between the interest rate determined by the central bank and its actual influence on the economy. Additionally, there might exist obstacles within the credit

market that hinder the complete adjustment of real borrowing costs to changes in real interest rates. Lastly, when the state bank of Pakistan (SBP) attempts to stabilize the exchange rate, it can restrict the effectiveness of the real exchange rate channel.

Nizamani et al (2018) utilized the structural vector autoregressive (SVAR) model to assess the effectiveness of monetary policy, particularly, emphasizing on the interest rate, credit, assets price and exchange rate channels. The finding indicates that the interest rate channel of monetary policy remains effective only in the short run. Consequently, it is recommended for the SBP to depend on the interest rate channel for controlling inflation in the short term. A recent study by Zeshan et al. (2019) has discovered that the contractionary monetary policy in Pakistan has been somewhat effective in controlling inflation, though it also resulted in significant decreases in economic activity. Ahmad et al. (2005) also found that interest rate is an effective tool for controlling inflation in Pakistan, albeit with a lag of five months. Qayyum (2008) also observed similar results and concluded that the monetary policy through interest rate can control inflation. However, Vector Autoregressive model (VAR) analysis in Choudhri et al. (2015) reveals that the effectiveness of monetary policy in influencing macroeconomic variables is limited. This evidence raises concerns regarding the SBP‟s ability in effectively controlling inflation and stabilizing the output.

The existing evidence on the role of monetary policy in controlling inflation in Pakistan does not distinguish between demand-pull and cost-push inflation. This distinction is important because monetary policy is focused on the demand side and a tight monetary policy is supposed to control inflation by effectively curtailing aggregate demand whereas inflation may be the result of rising cost of production. The present study attempts to fill this gap by evaluating the role of monetary policy during the periods of oil price hike viz-a-viz the periods where inflation, if any, is

mainly caused by demand pull factors.

1.2 Problem Statement of the Study

The study attempts to evaluate the effectiveness of monetary policy in controlling inflation. The two tools of monetary policy are policy rate (reverse repo rate) periodically announced by the State Bank of Pakistan and the quantity of high-powered money (the same as base money or M_0). Since the sources of cost-push and demand-pull inflation are different whereas monetary policy targets inflation from demand side only, the effectiveness of monetary policy in controlling the two types of inflation is expected to be different. If this expectation is observed to be valid, it would be necessary to reconsider the way monetary policy is designed. Thus, it is important to measure in quantitative terms the effectiveness of monetary policy in controlling inflation during the periods of cost-push and demand-pull inflation.

1.3 Objective of the Study

The main objective of the study is examining the effectiveness of monetary policy in controlling inflation during the period of cost-push and demand-pull inflation. Since it is practically impossible to disentangle the cost-push and demand-pull components of inflation from the observed data on inflation rate, the study distinguished between the two types of inflation by dividing the period of analysis between the two periods, one when the inflation was mainly associated with the known episodes of oil price hike, and the other one when the oil price was relatively stable and inflation was therefore associated with demand-pull factors.

In this context, we formulate a few hypotheses to be tested, the results of which would indicate whether the monetary policy works symmetrically or asymmetrically with respect to high and low oil price inflation. If the results of hypothesis testing indicate the presence of asymmetry, the next step would be to

determine relative effectiveness of monetary policy during the periods of high and low oil price inflation.

1.4 Hypotheses of the Study

Two main hypotheses to be tested are given below.

H_0^1: The effect of policy rate on inflation is the same during the period of cost-push and demand-pull inflation.

H_1^1: The effect of policy rate in inflation is systematically different during the period of cost-push and demand-pull inflation.

H_0^2: The effect of high-powered money on inflation is same during the period of cost-push and demand-pull inflation.

H_1^2: The effect of high-powered money on inflation is systematically different during the period of cost-push and demand-pull inflation.

Further, since we also include in the analysis other (control variables) the following additional hypotheses are also tested.

H_0^3: The effect of oil price on inflation is same during the period of cost-push and demand-pull inflation.

H_1^3: The effect of oil price on inflation is systematically different during the period of cost-push and demand-pull inflation.

H_0^4: The effect of real GDP on inflation is same during the period of cost-push and demand-pull inflation.

H_1^4: The effect of real GDP on inflation is systematically different during the period of cost-push and demand-pull inflation.

H_0^5: The effect of exchange rate on inflation is same during the period of cost-push and demand-pull inflation.

H_1^5: The effect of exchange rate on inflation is systematically different during the period of cost-push and demand-pull inflation.

It is the first study to investigate the effectiveness of Monetary in controlling inflation during the period during of cost-push and demand-pull inflation. It employs

the Autoregressive Distributed Lags (ARDL) model using quarterly data form the first quarter of 1980 to the fourth quarter of 2022. The remainder of the study is structural as follows. Chapter 2 provides an extensive literature review encompassing both theoretical and empirical perspectives. Chapter 3 consists of details regarding the methodology and analytical framework used in the study. Chapter 4 focuses on the data collection and descriptive analysis. Chapter 5 shows the results and discussions around them. Finally, Chapter 6 concludes the study by summarizing the key finding and drawing overall conclusions.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter examine the previously published works and research pertaining to inflation and interest rate. Section 2.2 focuses on the theoretical background that presents different theories of inflation like Classical, Keynesian, Monetarists, New Classical theories and so on. Section 2.3 reviews empirical techniques or econometrics methods which were used in different studies for the measurement of relationship between inflation and monetary policy variable(s). Section 2.4 discusses the main results of the different studies and examines the association between inflation and interest rates. In section 2.5 we define the monetary policy rules. The last section summarizes the collected literature on inflation and interest rate.

2.2 Theoretical Background

This section will briefly review the major theories of inflation that explain the causes of inflation.

2.2.1 Classical View

The Classical quantity theory of money presented by Fisher (2011) is also called the Classical theory of inflation. According to this theory, the level of output in an economy is fixed at the full employment level and the velocity of money circulation is constant. Hence, the economy‟s aggregate price level is established at the point where money demand and money supply intersect. Other things remain unchanged, there is direct link between quantity of money in circulation, and the price

level, therefore the real value of money remains unchanged. For instance, if the quantity of money doubles, then, the other things remaining unchanged, price level will also be doubled and the real value of money in circulation will remain unchanged.

The main criticism on the Fisher‟s theory is that it relies on the assumptions that real output and velocity of money circulation are fixed as parameters. When an economy is operating below full employment, the Fisher‟s first assumption will not hold and an increase in the quantity of money may also result in increased output along with an increase in price level. As a result, price levels may not increase as much as predicted by the theory.

In the second assumption Fisher considered the velocity of money circulation to be constant; but the velocity can be affected by other factors, especially interest rate. If the interest rate increases, economic agents will hold less money and as a result, for the given number of transactions the velocity of money circulation will increase. The main criticism of the theory is that it neglects the role of interest rates and puts too much emphasis on money supply.

2.2.2 Monetarists View

A modern version of the quantity theory is given by Monetarists led by Friedman. According to Friedman (1956), inflation is always and everywhere a monetary phenomenon. Monetarists do not make rigid assumptions on output and velocity of money circulation but assert that both these quantities are stable in long run. Therefore, supply of money is the key factor to determine the price level and economic activity. Whenever there is excess supply of money, inflation comes into being. To Friedman, the effective tool for spike in aggregate demand is monetary

policy and, in this context, it is more effective than fiscal policy. According to Friedman if the money supply increases at a growth rate that exceeds the growth rate of real GDP, then there will be inflation. And if the money supply increases according to real output, then there will be no inflation. Based on this theory Monetarists also proposed a monetary policy rule that we will discuss later in this chapter.

2.2.3 Keynesian View

The Keynesian theory, led by John Maynard Keynes has classified the causes of inflation into two parts demand-pull inflation and supply-push inflation. Demand-pull inflation means inflation that occurs from the demand side. It states that inflation occurs due to the increase in aggregated demand. Aggregated demand has four components, which are consumption, investment, government expenditures, and net exports. Inflationary conditions can occur in two situations. The first situation is that when the total demand for goods and services surpasses the overall supply in the economy and the economy is not in recession, the excess of demand can exert pressure on prices.

The second situation arises when the supply of money over its demand and as a result excess money is used for the purchase of bonds, which results in reduced interest rate and hence increase in aggregate demand, which may cause inflation if the economy is not in recession. However, if interest rate is already too low, the economy may face liquidity trap. If this happens then the increase in money supply will not reduce interest rate and, as a result, there will be no effect on aggregate demand.

In short, whenever aggregate demand is higher than the aggregate supply, that is, the demand-supply gap exists, Keynesian theory suggests that fiscal measures like a decrease in government expenditures or an increase in taxes would be effective tools for decreasing aggregate demand and ultimately controlling inflation. Thus, any

policy that decreases each of the components of aggregate demand would effectively decrease inflation.

Demand-pull inflation has many sources. The major cause of demand-pull inflation is the interest rate; if monetary authority decreases interest rate, there will be increase in the holding of money, which will result in increased investment expenditure and, therefore increase in goods‟ prices as well. The same process would operate if the monetary authority increased the supply of money through monetary policy.

The second major form of inflation is cost-push inflation, in which there is no change in demand or demand is the same but the cost of production increases. Inflation occurs from the supply side. If Prices rise due to the rising prices of inputs and factors of production, like increase in prices of raw materials that are used as inputs in the production process, wages, oil prices, the producer attempt to shifts this burden of increased cost to the consumers. The production prices increase that take the form of cost-push inflation.

In theory one of the factors attributed to cost-push inflation is the increase in nominal wages of labor forced by labor unions. When labor union pushes employers to increase their wages, this results in a rise in production costs, subsequently causing an upsurge in commodity prices, thus overall prices increase in the economy. Due to higher prices, workers are worse off as their purchasing power is reduced, and they demand more increases in their wages to get better off, thereby leading to further increases in the cost of production. The ultimate effect is on other sectors of the economy, which would lead to an inflation throughout the economy. When prices of imported raw materials also increase, the situation becomes more severe.

After the oil price shocks of the 1970s exogenous increase in oil prices has

also been recognized as a major source of cost-push inflation. This source of cost-push inflation can dominate the increase in wages in the non-oil producing countries where labor unions are absent or weak.

2.2.4 Structuralists View

The Structuralists demand theory of inflation is also known as the Sectoral demand theory of inflation. According to this theory inflation occurs due to internal changes in the demand structure of the economy. Such internal adjustment has little impact on aggregate demand. According to Schultz (1956), structural inflation occurs due to structural changes in the economy as follows.

The demand shifts from one industry to another, that is the component of internal demand change because the taxes and preference of people change. However, the resources do not gradually shift from such industries whose demand shrinks to those industries whose demand expands. If the prices and wages are flexible upward but rigid downward the prices of products of such industries whose demand increases will rise, but the prices of the products of such industries whose demand shrinks will not decline. This will result in increase in the overall (average) price level. Thus, inflation may occur just because of changes in the structure of the economy without any changes in aggregate demand and aggregate supply, that is without the occurrence of any demand-pull or cost-push factors at aggregate level. However, at industry level the structural inflation has both the demand-pull and cost-push components. The demand-pull inflation occurs in those industries in which there is expansion of demand and cost-push inflation can occur in those industries in which the economy shrinks. When the industries whose demand expands have upward flexible price level and wages, while the industries whose demand shrink should have

a downward flexible price level and wages. But this does not happen, the wages and prices are rigid downward in the industries the demand for whose product has down.

The role of interest rate in the Structuralist theory of inflation is the same as in demand-pull inflation. in the presence of inflation in the economy, the central bank raises interest rate as a means of managing and control inflation, which results in decrease in aggregate demand, especially the investment expenditure, which causes counter-inflationary effects.

2.2.5 New Classical View

According to the New Classical theory of inflation when the government increased spending through fiscal or monetary policy then aggregate demand in the economy increases, while aggregate supply is at full employment level. Monetary or fiscal policy has no real effect on the real economy and the overall effect goes to inflation. Rational economic agents know that aggregate demand is higher in the market, but they also know that output is at the full employment level. Expecting an increase in price level stimulated by excess aggregate demand, labor wants to increase the wage rate. Therefore, the cost of production increases, and because of the increase in aggregated demand the aggregate supply curve also shifts upward/backward. The net outcome is increases in the price level and no change in the level of output.

The New Classical theory is an extension of Classical theory but instead of assuming fixed output as in Classical theory, it relies on the assumption of rational expectation according to which economic agents have foresight of future events and therefore know that ultimately rise in aggregate demand will cause inflation and the resulting increase in cost of production will leave the level of output unchanged. And, when these rational agents act on their expectations, output in fact is observed to

remain unchanged and all the impact of expansionary policies falls on prices in the form of inflation.

In the New Classical theory of inflation interest rate is the main instrument used by the central bank to manage inflation. When there is inflation in the economy, monetary authority increases interest rate, which results in reduction is consumption and investment expenditures. The fall in aggregate demand helps control inflation.

2.2.6 New Keynesian

In the New Classical theory of inflation when the aggregate demand shifts upward the workers are fully aware of the expected prices increase, and they want to increase the wage rate. In the New Keynesian theory of inflation, the workers are on overlapping wage contracts and wages for some of them are fixed because their contracts have not expired. Although wages are flexible during contract negotiations, they become partially rigid once the contracts are agreed upon. Wage rigidity in short run arises because of the presence of overlapping contracts wherein a portion of workers is always trapped in contracts. Thus, if aggregate demand increases for any reason, its impact will not entirely fall on prices. Thus, despite the presence of rational expectations, inflation is not fully a monetary phenomenon as asserted in various strands of Classical theory.

In both the New Classical and New Keynesian theories of inflation, the function of interest rate remains consistent. When the interest rate rises, it leads to a reduction in both consumption and investment expenditures, ultimately contributing to a decrease in aggregate demand, which serves as an effective means of inflation control.

2.2.7 Concluding Remarks

In the Classical theory of inflation, there is no relationship between the quantity of money and interest rate that alterations in the money supply have no influence on the interest rate, and there is an excessive focus on the money supply. Keynesian theory is focused on the interest rate, if the central bank increases interest rate, it results in shrinking of aggregate demand and, hence, control of inflation. The Monetarists say that inflation is always and everywhere a monetary phenomenon and there is little role of interest rate. In the Structuralists theory, inflation occurs from both the demand-pull or cost-push inflation sides, and the interest rate plays the same role as in demand-pull inflation. The relatively modern theories involving rational expectations (New Classical and New Keynesian theories) also recognize the crucial role of interest rate in managing inflation.

2.3 Monetary Policy Rules

Based on various theories of inflation, economists have developed certain rules for monetary policy rather than leaving the policy at discretion of decision central banks. Here we shall present a brief review of the well-known monetary policy rules.

2.3.1 Friedman's k-Percent Rule

Friedman‟s k-percent rule of monetary policy, also known as the K Rule, is a monetary policy guideline proposed by American economist Milton Fridman (See Friedman, (1967). The Friedman‟s rule advocated that the central bank should rise the money supply at a constant rate (k percent) over time in all periods irrespective of the state of the economy for short-term economic conditions or fluctuations in the

business cycle (e.g., inflation rate and GDP growth rate). Under this rule, the central bank should set a specific fixed rate of growth in the money supply. For example, if K is set at 10%, the central bank would aim to increase the quantity of money 10% each year. One issue with Friedman‟s rule is its inability to adjust to sudden and unexpected changes in the economy that may change the demand for money. The result may be sudden shocks to employment and income.

2.3.2 McCallum's Rule

In a series of articles McCallum proposed a monetary policy rule that basically targets growth rate of nominal (McCallum, 1987, 1888, 1990). Since nominal GDP is the product of price level and real GDP, the growth rate of nominal GDP is equal to inflation rate plus real GDP growth rate. The rule also takes into account the long-run (secular) variations in the velocity of circulation of high-powered money and the variations in real GDP from its target. The exact equation for the rule is given by:

$$g_m = \pi^* + g_Y^* - V + \lambda\, gap \qquad (2.1)$$

Here, g_m is the growth rate of monetary base or high-powered money, π^* is the target inflation rate, g_Y^* is the target growth rate of real GDP, *V* is the lagged 16-quarter moving average of the velocity of circulation of high-powered money (= nominal GDP/high-powered money) *gap* is the previous quarter‟s relative gap between target and realized levels of nominal GDP.

Unlike Friedman‟s fixed rule of k percent growth in base money, McCallum‟s rule allows a lot more flexibility. The rule allows to increase the growth rate of money when inflation and output growth targets are set high. It also allows higher growth in

money when the velocity of money circulation is low and/or when the target level of nominal output exceeds the realized output in the recent part. Incidentally this relative flexible of the rule is also considered to be its weakness and has come under criticism (See Groushore, 1995).

2.3.3 Taylor's Interest Rate Rule

Taylor‟s monetary policy rule focusses on interest rate as the tool of monetary policy unlike Friedman and McCallum‟s rule that focus on money supply as the tool. For Taylor (1993) interest rate rule serves as a fundamental guideline for central banks in formulating their monetary policies. The main objective of this rule is to strike a balance between inflation control and stabilizing economic output by making appropriate adjustment to interest rates. In the Taylor rule the central bank fixed the interest rate for the short-term period. When there is inflation in the economy and inflation is above the desired rate, the monetary authority should increase the interest rate. On the other hand, if inflation is below the target or the economy is performing below its potential, the monetary authority should lower interest rate. The exact equation followed in this rule is given by:

$$r = \eta + 0.5\,(\pi - \pi^{*}) + 0.5\,gap \qquad (2.2)$$

where *r*, *η*, *π*, *π** and *gap* den Ahmad and Ali (1999) used the Two stage least square method.

otes interest rate, natural growth rate of output (GDP), actual inflation rate, target inflation rate and relative output gap respectively.

The output gap is positive if GDP is above its target level and negative if GDP

is below its target level. If, for example, natural growth rate is two percent, inflation rate is one percent above the target and output gap is minus one percent then the interest rate will be set equal to two percent. If, on the other hand, the natural growth rate is four percent, inflation rate is five percent above the target and output gap is three percent then the interest rate will be set equal to eight percent.

2.4 Empirical Approaches

Empirical approach to analyzing the role of monetary policy in controlling inflation mostly comprises regression analysis. Some of the old studies have used conventional linear regression equations estimated by OLS or two-step iterative methods to tackle autocorrelation. Some of the studies using this conventional analysis for Pakistan include Masood and Ahmad (1980), Ahmad and Ali (1999), Nasim (1995), and Hossian (1990), Hasan et al. (1995), Khan and Qasim (1996), and Khan and Schimmelpfennig (2006).

However, with the development of time-series econometric techniques a number of studies have employed Vector Autoregressive (VAR) models, or their extended version Structural VAR models proposed by Sims (1980) and extended by Bernanke (1986), Blanchard and Watson (1986) and Sims (1986).

There are various advantages of VAR/SVAR models. First, these models allow testing of simple two-way or block causality between a set of variables. Second, SVAR models allow the estimation of structural shocks in various variables in the model and their impacts on any set of variables in the model. Third, the SVAR models also enable to account for the contribution of various structural shocks in the forecast variance of any variable in the model. These two types of analyses are known as Impulse Response Analysis and Variance Decomposition Analysis, which together are also referred to as Innovation Accounting.

Quite a few studies for Pakistan have employed VECM approach. Some of these studies are Shaari et al. (2012), Nizamani et al (2016), Malik et al. (2017), Mangla and Hyder (2017).

The estimation of VAR models requires stationary data, which is often easily achieved by converting non-stationary data to first difference form. However, by doing this all the long-run variation is data is suppressed and the prospects of estimation a long-run relationship are eliminated. To accommodate the existence of long-run association within the VAR framework, VAR models has been extended into Vector Error Correction Model (VECM). The VECM model, originally proposed by Engle and Granger (1987), is simply a VAR model augmented by one or possibly more long-run relationships and the associated error correction processes. The same model has been used by Johansen (1988, 1991), Johansen and Juselius (1990) to develop tests of co-integration.

A few studies for Pakistan that employ VECM approach are Saleem and Ahmad (2015), Hussain, (2009), Khan and Siddiqui (1990) and Anwar et al. (2017).

For the application of VECM approach a strict precondition is that all the variables in the model must be non-stationary an integrated of the same order. In almost all cases where this condition is fulfilled, the variables are integrated of order one. However, in practice this precondition is violated quite often because some economic variables like interest rate, real exchange rate or other ratios turn out to be stationary. In such cases the VECM approach is no more useful.

To overcome the above limitation of VECM approach, Pesaran and his co-authors developed Autoregressive Distributive Lags model for co-integration analysis and testing in a series of article (Pesaran and Shin, 1998; Pesaran and Smith, 1998); and Pesaran, et al, 2001). This s a single equation approach in which the variables can

be integrated of different orders. The approach provides long-run as well as short-run contemporaneous relationships along with lead-lag linkages.

ARDL co-integration approach has gained popularity in Pakistan and several studies have used it in the analysis of monetary policy, inflation and other related issues. A few notable studies are Asghar and Naveed (2015), Chaudhry et al. (2015), Davari and Kamalian (2018), Hassan et al. (2016), Hussain et al. (2022), Nasir et al. (2021) and Subhani et al. (2012).

2.5 Empirical Evidence from Pakistan

Several studies have analyzed the effectiveness of monetary policy in Pakistan. In one of the old studies, Masood and Ahmad (1980) analyzed the relative effectiveness of fiscal and monetary policies in affecting economic activity and concluded that in case Pakistan monetary policy is relatively less effective.

In recent times, with the State Bank of Pakistan taking on more prominent role in the economy, there has been a notable increase in studies assessing the efficiency of monetary policy. Nizamani et al (2016) explored the effectiveness of monetary Policy in the short--term for stabilizing the economic condition in Pakistan. The study finds that monetary is somewhat effective in short run but not effective in the long run. It is concluded that the State Bank should focus on controlling inflation through the management of interest rates.

In a similar study Saleem and Ahmad (2015) investigated the relationship of between inflation with broad money supply and oil prices in Pakistan. The research revealed a clear connection between inflation and the broad money-supply, a relationship that persists in both the short-term and long-term.

Mangla and Hyder (2017) conducted a study to examine the relationship between international oil prices and macroeconomic variables, especially focusing on

monetary policy. The study observed that monetary policy continues to be a tool for managing inflation caused by increase in oil prices, exchange rate depreciation and slowdown in economic growth.

Hussain et al. (2022) the analysis identifies that the exchange rate, money supply, and oil price have a positive and significant impact on inflation. The estimated coefficient indicates that a one percent alteration in money supply leads to a 0.09 percent increase in price level. Chaudhry et al. (2015) also determined a significant and positive correlation between money supply and inflation rate, a relationship that holds true in both short-run and long run. In a more recent study Nasir et al. (2021), it was demonstrated that there exists a positive and statistically significant association between money supply and inflation. Furthermore, the study also observed a positive correlation interest rates and inflation. These results imply that monetary policy can serve as a tool for controlling inflation within of Pakistan.

Ahmad and Ali (1999 demonstrated that the relationship between inflation and exchange rates is neither unidirectional nor simplistic. In the short run, the impact of inflation on devaluation surpasses that of devaluation on inflation. Thus, fluctuations in the exchange rate are primarily caused by the inflationary pressures prevailing in Pakistan.

Nasim (1995) and Hossian (1990) identify the money supply as the principal factor contributing to the escalating inflation rate in Pakistan. On the other hand, alternative viewpoint proposes that the predominant driving forces behind the upward inflationary spiral are food prices, followed by government-administered fuel/ energy costs, and indirect taxation.

According to Hasan et al. (1995) and Khan and Qasim (1996) the escalation of

import prices is a significant factor influencing inflation. In a scenario marked by a depreciating exchange rate, there exists the potential for existing upward pressure on price level. Similarly, some individuals attribute indirect taxes as a primary instigator of inflation. Furthermore, the wheat support price has been identified as a crucial determinant of inflation in Pakistan.

Khan and Schimmelpfennig (2006) argue that while excess money supply remains the primary long-term driver of inflation, it is imperative to acknowledge the concurrent influence of various other factors, including structural issues, on the inflation rate.

Hussain (2009) delved into an examination of the influence exerted by monetary policy on key crucial macroeconomic variables, particularly focus on inflation and output dynamics. To achieve this objective, the author employed an error correction (ECM) model as analytical framework. The finding of this study draws a decisive conclusion: the manipulation of credit money (M1 and M2) and interest rates is important channel to managing inflation and output fluctuations. Moreover, the exchange rate represents notable monetary factor in Pakistan for the purposes of managing inflation and mitigation output fluctuations. In research conducted by Khan and Siddiqui (1990) a unidirectional relationship between was identified, running from income (nominal GDP) to money aggregates (both M1 and M2). Furthermore, a bidirectional causal link was established between money supply M2 and price level in context of Pakistan during the timeframe spanning from the first quarter of 1972 to the fourth quarter 1981.

Anwar et al. (2017) explored the impact of rising oil pricing on inflation within the context of Pakistan. To achieve this objective, the researchers utilized a straightforward ordinary least square (OLS) approach. The study discerned a robust

liner correlation between oil prices and inflation.

CHAPTER 3

ANALYTICAL FRAMEWORK

3.1 Introduction

This chapter starts with theoretical background on the role of monetary policy in controlling inflation during the periods of demand-pull and cost-push inflation. Then, based on this background an econometric model is proposed that allows for asymmetric response of inflation rate to monetary policy variables during the episodes of demand-pull and cost-push inflation.

3.2 Theoretical Background

Tightening of the monetary policy by increasing the policy rate of the central bank is in general considered to be a counter-inflationary policy. However, its effectiveness in controlling inflation rate in practice is questionable. This is especially the case during stagflation when inflation is caused by rising cost of production and, hence, aggregate supply shortages, rather than expansion in aggregate demand. The main argument against the effectiveness of tight monetary policy rests on the role of interest rate in the cost of production. To understand this argument, let us discuss how changes in interest rates affect the goods market.

The role of the interest rate in goods market comes from two channels, which are demand-side and supply-side channels. On the demand side, an increase in interest rate raises the cost of borrowing, which in turn reduces components of aggregate demand, especially aggregate investment, and aggregate consumption. The resulting decrease in aggregate demand reduces the price level. On the supply side an increase in interest rate increases the marginal cost of production by raising the user cost of physical capital and rental cost of operational capital in the credit market. The rising

cost of production reduces aggregate supply and, hence, raises price level. Thus, an increase in interest rate has a counter-inflationary effect through demand side and inflationary effect through supply side.

There are a number of factors that matter in determining which of the two effects will be stronger. First, supply side effect is likely to dominant in the long run because while the resulting decrease in investment has immediate contractionary effect on aggregate demand, its effect on aggregate supply comes through a longer channel from interest rate to investment to stock of capital to production. This is the reason that supply side effects of changes in interest rate are often ignored in standard static macroeconomics models.

The second factor determining the relative strengths of demand and supply side effects of interest rate is the proportion of aggregate demand that is affected by interest rate. In developing countries, especially in Pakistan, home mortgage market is negligible and credit financing of other consumers‟ durables like vehicles, home appliances, etc. has limited coverage. Thus, the demand-side effect of monetary policy is expected to be small and, therefore, tight monetary policy is expected to be either unproductive or counter-productive in controlling inflation rate.

The third factor in the aforementioned context is the producers‟ ability to shift the burden of increase in cost of production to buyers (consumers, investors and exporters) and, hence, contribute to inflation. In case of demand-pull inflation, aggregate demand is in excess of aggregate supply and aggregate supply function is relatively less price elastic because firms are operating close to their production capacity. Therefore, not only the firms are in a good position to shift the burden of additional cost following the increase in interest rate to buyers, but they also have the compulsion to do so. As a result, the supply-side effect of increase in interest rate is

likely to dominate the demand-side effect and the policy of increase in interest rate to cause more inflation.

Furthermore, during demand-pull inflation economic agents including consumers, investors and exporter have optimistic expectations and, therefore, their price elasticities of demand are relatively low, which further enables firms to shift the burden of incremental cost to consumers. This is another reason why during the demand-pull inflation the supply side effect of increase in cost can dominate the demand side effect and as a result tight monetary policy can be ineffective or even counter-productive in controlling inflation.

The above theoretical considerations call for a model of inflation which allows for asymmetry in the response of inflation rate to changes in the monetary policy variables, that is interest rate and money supply, during the periods of demand-pull and cost-push inflation.

3.3 Econometric Model

The foremost task in the construction of our model is to identify the periods of demand-pull and cost-push inflation episodes. If we look at the historic data, we observe that the three major inflationary shocks in Pakistan occurred during the periods 1972 to 1975, 2008 to 2011 and 2022 to 2023 when inflation rate crossed 20% mark. All these periods of high inflation rate coincide with extraordinary increases in world oil prices. For example, during the period of 17 quarters from 2007-I to 2011-IV, Brent oil price per dollar increased by 102% while CPI increased by 77%. More recently, in the past 12 quarters from 2020-III to 2022-III, oil price increased by 142% and the CPI increased by 149%. All these periods of inflation are classified as periods of stagflation. Other such episodes of inflation coupled with oil price hikes are

relatively less prominent.

Since oil price is the main component of production cost that is subject to large fluctuations, it can be argued that the episodes of cost-push inflation can be identified by looking at the pattern of oil price changes over time. Therefore, the inflation during a period when oil price is observed to have increased is classified as the period of cost-push inflation whereas the inflation during a period when oil price is observed to have decreased is classified as the period of demand-pull inflation.

The model follows the standard practice of including both the demand side and supply side variables, including the monetary policy variables, that are expected to cause inflation. On the demand side we include two monetary policy indicators, namely high-powered money, and the Reverse Repo rate (the discount rate) and nominal exchange rate, and on the supply side we include real GDP and world oil price. The inflation rate is represented by quarterly change in the log of CPI (approximately equal to the growth rate of CPI).

The following notations are used for the model.

ΔLP_t = Inflation rate or the growth rate price level

ΔR_t = Change in interest rate

ΔR_t^P = Change in interest rate associated with positive change in oil price

ΔR_t^N = Change in interest rate associated with negative change in oil price

ΔLM_t = Growth rate of base money

ΔLM_t^P = Growth rate of base money associated with positive change in oil price

ΔLM_t^N = Growth rate of base money associated with negative change in oil price

ΔLER_t = Growth rate of exchange rate

ΔLY_t = Growth rate of real GDP

ΔLOP_t = Growth rate of oil price

ΔLOP_t^P = Growth rate of oil price associated with positive change in oil price

ΔLOP_t^N = Growth rate of oil price associated with negative change in oil price

Using the general notation X, the above variables in first difference firm (with or without logs) are constructed as follows.

$$\Delta X_t = X_t - X_{t-1}$$

$$\Delta X_t^P = X_t - X_{t-1} \quad if\ OP_t > OP_{t-1}$$
$$= 0 \qquad\qquad if OP_t \leq OP_{t-1}$$

$$\Delta X_t^N = X_t - X_{t-1} \quad if\ OP_t < OP_{t-1}$$
$$= 0 \qquad\qquad if OP_t \geq OP_{t-1}$$

$$\Delta LX_t = ln\, X_t - ln\, X_{t-1}$$

$$\Delta LX_t^P = ln\, X_t - ln\, X_{t-1} \quad if\ OP_t > OP_{t-1}$$
$$= 0 \qquad\qquad if OP_t \leq OP_{t-1}$$

$$\Delta LX_t^N = ln\, X_t - ln\, X_{t-1} \quad if\ OP_t < OP_{t-1}$$
$$= 0 \qquad\qquad if OP_t \geq OP_{t-1}$$

Once the variables in conditional first difference form are constructed, the level variables are obtained by integration as follows.

$$X_t = \sum_{t=1}^{n} \Delta X_t$$

$$X_t^P = \sum_{t=1}^{n} \Delta X_t^P$$

$$X_t^N = \sum_{t=1}^{n} \Delta X_t^N$$

$$\mathrm{L}X_t = \sum_{t=1}^{n} \Delta \mathrm{L}X_t$$

$$LX_t^P = \sum_{t=1}^{n} \Delta LX_t^P$$

$$LX_t^N = \sum_{t=1}^{n} \Delta LX_t^N$$

It is easy to verify that:

$$X_t = X_0 + X_t^P + X_t^N$$

$$ln\, X_t = ln\, X_0 + ln\, X_t^P + ln\, X_t^N$$

In order to estimate both the short-run and long-run relationships of inflation rate with the monetary policy variables along with other variables we rely on ARDL model. This single-equation model is preferred over the multivariate models like VAR and VECM models because ARDL model also includes contemporaneous short-run relationship between all variables of the model, which is absent in the latter category of model. Further, to allow asymmetry in the relationships, a non-linear version of ARDL model is considered. The specific ARDL model allowing for asymmetry for the present study is given by:

$$DLP_t = \lambda_0 + \lambda_1 LP_{t-1} + \lambda_2^P\, R_{t-1}^P + \lambda_2^N\, R_{t-1}^N + \lambda_3^P\, LM_{t-1}^P + \lambda_3^N\, LM_{t-1}^N$$
$$+\lambda_4\, LER_t + \lambda_5\, LY_{t-1} + \lambda_6^P\, LPOP_{t-1}^P + \lambda_6^N\, LOP_{t-1}^N$$
$$+ \sum_{i=1}^{k_1} \alpha_i\, \Delta LP_{t-1} + \sum_{i=0}^{k_2^P} \beta_i^P\, \Delta R_{t-i}^P + \sum_{i=0}^{k_2^N} \beta_i^N\, \Delta R_{t-i}^N + \sum_{i=0}^{k_3^P} \gamma_i^P\, \Delta LM_{t-i}^P$$

$$+\sum_{i=0}^{k_3^N}\gamma_i^N\,\Delta LM_{t-i}^N+\sum_{i=0}^{k_4^P}\delta_i^P\,\Delta LER_{t-i}^P+\sum_{i=0}^{k_4^N}\delta_i^N\Delta LER_{t-i}^N+\sum_{i=0}^{k_5^P}\theta_i^P\,\Delta LY_{t-i}^P$$

$$+\sum_{i=0}^{k_5^N}\theta_i^N\,\Delta LY_{t-i}^N+\sum_{i=0}^{k_6^P}\pi_i^P\,\Delta LOP_{t-i}^P+\sum_{i=0}^{k_6^N}\pi_i^N\,\Delta LOP_{t-i}^N+\varepsilon_t \qquad (3.1)$$

All the terms in the first two lines of the above equation represent a long-run relationship, from which error-correction model can also be extracted as follows.

$$\begin{aligned}&\lambda_0+\lambda_1 LP_{t-1}+\lambda_2^P\,R_{t-1}^P+\lambda_2^N\,R_{t-1}^N+\lambda_3^P\,LM_{t-1}^P+\lambda_3^N\,LM_{t-1}^N\\&\quad+\lambda_4\,LER_t+\lambda_5\,LY_{t-1}+\lambda_6^P\,LPOP_{t-1}^P+\lambda_6^N\,LOP_{t-1}^N\\&=\lambda_1[LP_{t-1}-\pi_0-\pi_2^P\,R_{t-1}^P-\pi_2^N\,R_{t-1}^N-\pi_3^P\,LM_{t-1}^P-\pi_3^N\,LM_{t-1}^N\\&\quad-\pi_4\,LER_t-\pi_5\,LY_{t-1}-\pi_6^P\,LPOP_{t-1}^P-\pi_6^N\,LOP_{t-1}^N]=\lambda_1\varepsilon_{t-1}\end{aligned} \qquad (3.2)$$

where $\pi_j=\lambda_j/\lambda_1$ and $\pi_j^s=\lambda_j^s/\lambda_1$ for s = P, N.

The rest of the terms in the equation represent short-run relationships including contemporaneous as well as lead-lag relationships. Out of these the terms with lag zero represent short-run-contemporaneous relationship, whereas the terms involving the first lag or higher lags represent lead-lag relationship.

At this point it is important to note that the long-run relationship is between levels of variables, most of which are expected to be not stationary and integrated of order one and contain long-run variation. On the other hand, the short-run relationship is between the first differences of the variables, which are supposed to be stationary. In the present context it means that for the long run our focus is on price level rather than inflation rate and we explore the effectiveness of monetary policy in controlling

price level. On the other hand, for the short run our focus is on inflation rate itself and we explore the effectiveness of monetary policy in controlling inflation rate. The role of other (control) variables for the long and short run analyses are interpretable in the same manner.

We further note that error-correction mechanism refers to correcting/adjustment process of the variables involved when the price level (not the inflation rate) deviates from its „equilibrium path".

For the estimation of the above model, we first apply diagnostic tests on stationarity/order of integration and the number of lags for each variable to be included in the model.

Once the above model is estimated, the next step will be to test for the presence or absence of asymmetry. In this context the following null and alternative hypotheses are set up.

$H_0^2: \beta_i^P = \beta_i^N \qquad for\ all\ i$

$H_1^2: \beta_i^P \neq \beta_i^N \qquad for\ at\ least\ one\ i$

$H_0^3: \gamma_i^P = \gamma_i^N \qquad for\ all\ i$

$H_1^3: \gamma_i^P \neq \gamma_i^N \qquad for\ at\ least\ one\ i$

$H_0^4: \delta_i^P = \delta_i^N \qquad for\ all\ i$

$H_1^4: \delta_i^P \neq \delta_i^N \qquad for\ at\ least\ one\ i$

$H_0^5: \theta_i^P = \theta_i^N \qquad for\ all\ i$

$H_1^5: \theta_i^P \neq \theta_i^N \qquad for\ at\ least\ one\ i$

$H_0^6: \delta_i^P = \pi_i^N \qquad for\ all\ i$

$H_1^6: \pi_i^P \neq \pi_i^N \qquad for\ at\ least\ one\ i$

Rejection of any of these null hypotheses will indicate the presence of asymmetry in the impacts of the corresponding variable, while the non-rejection will indicate the presence of symmetry.

CHAPTER 4

DATA AND DESCRIPTIVE ANALYSIS

4.1 Introduction

In this chapter, we explore the variables, data, and descriptive analysis. Section 4.2 provides definitions of the variables employed in the analysis. The next section describes data sources units of the variables. The last section presents a descriptive analysis.

4.2 Variables and Their Construction

The definitions and construction of various variables used in the analysis are explained below.

Consumer Price Index (CPI)

The consumer price index is the most commonly used measure of general price level in an economy. CPI is a measure that analyze the average price of a representative basket of consumer goods and services. It is calculated by using Laspeyres price index, which is an arithmetic index. In calculating the arithmetic average each price is given weightage equal to the budget share of that good in a base year. In Pakistan the calculation CPI covers more than 400 goods and services.

SBP's Reverse Repo Rate (R)

The Reverse repo rate, also known as the policy rate, refers to the interest rate at which the central bank accepts deposits from commercial banks. This rate allows commercial banks to generate interest income. Additionally, the reserve repo rate is

utilized by the central bank for controlling market interest rates and thereby inflation. The central bank employs two types of monetary policy: expansionary monetary policy and contractionary monetary policy. In case of inflation the central bank increases the reverse repo rate, prompting commercial banks to park more funds with the central bank to earn interest income. As a result, there is less credit creation by commercial banks, leading to a decrease in the broad money supply and the ability to control inflation.

Conversely, in the case of low inflation or deflation, the central bank decreases the reserve repo rate. This results in fewer funds being parked by commercial banks with central banks to generate interest income. Instead, more funds are utilized by commercial banks for credit creation, thereby increasing the money supply and aiding in the control of deflation.

Reserve/High-Powered Money (M0)

Reserve money supply, alternatively referred to as base money or high-powered money, represents the aggregate value of money created by the central bank. It can be held partially by the central bank, commercial banks, federal and provincial governments and ordinary economic agents like firms and households. It encompasses several components, currency in circulation (physical currency like banknotes and coins), cash held in tills, bank deposits, and other deposits with the State Bank of Pakistan. In essence, reserve money consists of the sum of these elements, reflecting the central bank‟s influence on the overall money supply.

In Pakistan reserve money is created by the State Bank of Pakistan. In this sense reserve money is purely in the hand of monetary authority and can be used as a tool of monetary policy. Therefore, reserve money is used in this study as one of the

two instruments of monetary policy.

Exchange Rate (ER)

The Exchange rate refers to the value of one currency in terms of another currency. Although Pakistan has trade with a large number of economies, such as bilateral exchange rates of Pakistan with various currencies. However, following the convention we consider exchange rate of Pakistani rupees with the US dollar, which is considered to be the main currency in the world. Exchange rate is represented by direct quote, that is the price of one US dollar in terms of Pakistani rupees. We use an open market exchange rate, which is the market rate is relevant in relation to price level.

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) represents the total market value of final goods and services produced in a country during a specific period of time. On expenditure side GDP comprises four key components, namely consumption, investment, Government purchases, and net exports. We use GDP at constant prices to measure the aggregate output in Pakistan.

Crude Oil Price (OP)

The term crude oil price refers to the cost of a barrel of crude oil in the global market. Crude oil is a natural occurring fossil fuel that is extracted from underground reservoirs or oil wells. It is an essential commodity due to its extensive utilization in various sectors, including energy production, transportation, and manufacturing and households.

The crude oil price is dependent on various factors including demand and supply dynamics, economic conditions, market speculation, and geopolitical events. Crude oil prices are measured in the US dollars per barrel. Oil prices have a significant impact on various sectors of the economy, as they can affect the profitability of oil companies, transportation costs, production costs, and fuel prices.

4.3 Data Sources

Data on all the variables are available on annual as well as quarterly basis and for some variables data are also available on monthly basis. For the estimation of time series econometric models involving a large number of parameters like the non-linear ARDL model, high frequency data are needed. However, we do not have to option to go beyond quarterly frequency because GDP data are available on annual or quarterly basis only. Therefore, we choose quarterly data frequency for our analysis.

We utilized quarterly time series data for Pakistan from the first quarter of 1980 to the fourth quarter of 2022. Initially, we collected the data for all the variables except GDP on monthly basis and subsequently transformed these data into a quarterly format to make them compatible with the data on GDP, which are available at quarterly basis.

The data for the for the main variables pertaining to Pakistan such as the consumer price index, reserve money, reverse repo rate, monthly average exchange rate and real GDP were sourced from the state bank of Pakistan (SBP) Additionally, the data on crude oil price per barrel data were collected from the *World Development Indicator* (*WDI*). The data description is summarized in Table 4.1 below.

Using these data, we have then constructed the series of various variables following the steps explained in Chapter 3.

Table 4. 1 Variables, Sources, and Units

Variables	Description	Unit	Sources
P	Consumer Price index	Index based on 1980 Q1 base year price	State Bank of Pakistan
R	SBP Reverse Repo Rate (Policy Rate)	Percentage rate per annum	State Bank of Pakistan
M	Reserve Money	Billion rupees	State Bank of Pakistan
ER	Exchange rate	Rupees per US dollar	State Bank of Pakistan
Y	Real Gross domestic product	Billion rupees in 1980 Q1 constant prices	State Bank of Pakistan
OP	Crude oil, Brent	US dollars per barrel	World Bank (WDI)

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Introduction

In this chapter we discuss estimation results based on previous chapter methodology. The chapter consists of various sections on unit root test, lag order selection of the ARDL model, tests of symmetry tests of endogeneity. Bounds test and the interpretation of long-run and short-run parameter estimates.

5.2 Unit Root Tests

Stationarity is the first step in the estimation of ARDL model, although there is no precondition for all the variables to be integrated of the same order. These tests are needed to make a right choice of the critical value of F-statistic in Bounds test if the value of the test statistic falls between the lower and upper bound critical values. Table 5.1 presents the results of the unit root test. The table shows that all the variables are non-stationary and integrated of order one.

5.3 Wald test on symmetry

In Wald test on symmetry, we test whether the effect of two components of a variable corresponding to positive and negative changes in world‟s crude oil price have the same or different effects on CPI. For this we first estimate the non-linear ARDL model given in Chapter 3 and apply Walt test on equality of the corresponding parameters.

The results of the test are given in Table 5.2. These results show that the effect of interest rate on price level is not symmetric, while the effect of crude oil price is

symmetric. As regards high-powered money, the null hypothesis of symmetry cannot be rejected even at 10% level of significance. However, since the probability value is close to 10%, that is 0.11, we allow the presence of asymmetry in this variable as well in order to reduce type-II error so that we can explore any difference in the effectiveness of monetary policy whatsoever in controlling inflation during the periods of cost-push and demand-pull inflation. In case asymmetry is present, it will surface.

Table 5. 1 Results of Unit Root Test

Variable	Test at Level		Test at First difference		Order of Integration
	Test Statistic	Probability	Test Statistic	Probability	
LP_t	0.937902	0.9958	-4.26974	0.0007	one
R_t	-1.99706	0.288	-11.6047	0	one
R_t^P	-1.46632	0.5484	-12.4751	0	one
R_t^N	-1.74931	0.4047	-12.3965	0	one
LM_t	0.146614	0.9683	-5.60143	0	one
LM_t^P	1.022774	0.9967	-15.5366	0	one
LM_t^N	-1.30799	0.6255	-13.8217	0	one
LER_t	-0.3143	0.919	-9.29648	0	one
LY_t	-2.08188	0.2523	-4.84884	0.0001	one
LOP_t	-1.23867	0.6572	-18.2417	0	one
LOP_t^P	1.230882	0.9983	-14.6759	0	one
LOP_t^N	0.438486	0.984	-13.5057	0	one

Table 5. 2 Results of Wald Test on Symmetry

Variables	F- Statistics Value	Probability
R_t	11.218	0.0472
LM_t	8.790	0.1178
LOP_t	3.021	0.6968

5.4 Lag Selection

For making lag selection practice is to estimate the ARDL model with a sufficiently large number of lags and then trim the model on the basis of some criteria. With quarterly variables we consider the lag of eight quarters to be sufficient. Thus, the proposed ARDL model is estimated with eight lags and then lag selection is made with Swartz Bayesian Criterion (SBC). The finally selected lags are shown in Table 5.3.

Table 5. 3 Selected Lags

Variable	Lag
LP_t	3
R_t^P	1
R_t^N	0
LM_t^P	0
LM_t^N	1
LER_t	3
LY_t	2
LOP_t	0

5.5 Tests of Endogeneity

Since monetary policy is specifically designed to control inflation, it is suspected that both the interest rate and high-powered money respond to current inflation rate and hence suffer from endogeneity problem. However, this possibility is unlikely to hold because the State Bank basically responds to past inflation rates and the target inflation rate for the current and future periods.

Nevertheless, we apply block exogeneity test by estimating a VAR model in which all the variables in our model except oil price are treated as endogenous variables and oil price as an exogenous variable. The VAR model is estimated with the number of lags (selected by various performance criteria) set equal to 5. The results of the block exogeneity test are presented in Table 5.4. The results show that all the monetary policy variables are exogenous and therefore, we can apply ARDL based co-integration approach to analyze the effectiveness of monetary policy in controlling inflation.

Table 5. 4 Test of Block Exogeneity

(Excluded Variable is ΔLP_t)

Endogenous Variable	Chi-square Statistic	Probability
ΔR_t^P	7.853287	0.4479
ΔR_t^N	12.46552	0.1316
ΔLM_t^P	6.583457	0.5822
ΔLM_t^N	5.311220	0.7239

5.6 Bounds Test

The bounds test is applied to test the existence of co-integration among the variables involved in the model. The F-statistics value is 15.44, which is much greater

than the upper bound critical value of 3.90 at 1% level of significance, which indicates the presence of co-integration among the variables.

5.6 Estimate of Long-run Relationship

After confirming the existence of a stable and long-run relationship among the variables, we proceeded to estimate the ARDL model to investigate the effectiveness of monetary policy in controlling inflation along with the effects of other (control) variables: exchange rate, output, and oil price on the inflation. Table 5.5 presents the full results of the estimated model.

The tests of serial correlation show absence of autocorrelation in residuals and, therefore, our results of lag selection are confirmed. The value of R^2 is expectedly very high because of time-series data and the inclusion of many explanatory variables in the model.

Table 5. 5 Estimation Results of ALRD Model

Variable	Long-Run Coefficient	Short-Run Coefficient
Intercept	1.1778 (0.56)	0.0946 (0.56)
Reverse repo rate during periods of oil price increase (R_t^P)	0.0025 (0.20)	-0.0036 (-1.65*)
Reverse repo rate during periods of oil price decrease (R_t^N)	0.0393 (5.27***)	0.0032 (5.76***)
High-powered money during periods of oil price increase (LM_t^P)	0.6326 (3.07***)	0.0508 (2.84***)
High-powered money during periods of oil price decrease (LM_t^N)	0.5651 (2.92***)	-0.0146 (-0.52)
Exchange rate (LER_t)	0.1898 (1.17)	0.0687 (2.24**)

Real GDP (LY_t)	-0.2594 (-0.93)	-0.1942 (-4.62***)
Crude oil Price (LOP_t)	0.1839 (4.28***)	0.0148 (4.28***)
One quarter lagged consume price index (LP_{t-1})		0.2578 (3.80***)
Two quarter lagged consumer price index (LP_{t-2})		-0.2084 (-3.18***)
One quarter lagged exchange rate (LER_{t-1})		0.0449 (1.34)
Two quarters lagged exchange rate (LER_{t-2})		-0.0764 (-2.41**)
One quarter lagged real GDP (LY_{t-1})		-0.092 (-2.06**)
ERROR Correction Coefficient		-0.0803 (-12.1***)
Bounds Test (F statistic)	15.44♦	
R^2	0.999	
Serial Correlation LM Tests (Chi-Square Statistic)		
Lag 1	0.12 (0.73)	
Lags 1-4	0.86 (0.83)	

The t-statistics (in brackets) significant at 10% level of significance.
: The t statistic significant at 1% level of significance.
The F value exceeds upper bound critical value at 1% level of significance.

The bounds test is applied to test the existence of co-integration among the variables involved in the model. The F-statistics value is much greater than the upper bound critical value of F statistic (3.90) at 1% level of significance, which indicates the presence of co-integration among the variables.

The estimated error-correction coefficient is negative and highly significant. Its absolute value is less than two, which indicates that any deviations from the estimated long-run relationship tend to be corrected over time. Furthermore, the absolute value of error-correction coefficient is also less than one, indicating that the error-correction process is smooth as it does not involve oscillations or change of direction in the deviations from long-run relationship during the error-correction process. The value estimated coefficient shows that about eight percent of the error in any quarter is corrected in the next quarter. This is a slow adjustment process, which implies that it takes a little more than eight quarters or two years to correct half of the errors.

The slow error-correction process is an indication of the presence of sticky expectations of economic agents regarding price level and therefore limitations on market mechanism to break the cycle of inflation, especially when it is in full swing. In this context the role of monetary policy is crucial because it is the presence of an effective policy that can break the cycle.

Coming to the main results regarding the effectiveness of monetary policy in controlling inflation, we find that during the periods of oil price increases the tight monetary policy in terms of increase in the policy rate is weakly effective in controlling inflation rate (short-run effect) but not in controlling price level (long-run effect). On the other hand, an increase in policy rate appears to be counter-productive to control price level or inflation rate. The relevant estimated coefficients have perverse (positive) sign and are highly significant.

From the above result we can infer that during the periods of demand-pull inflation the supply-side effect of increase in interest rate dominates the demand side effect. The firms are able to shift the burden of additional cost to buyers (consumers

as well as investors) because of the presence of optimistic expectations and, hence, relatively inelastic aggregate demand. Firms are also compelled to shift this burden to buyers because they are operating close to their production capacities.

When it comes to the second tool of monetary policy, that is high-powered money, the results are found to be different. Here tight monetary policy appears to be effective in controlling price levels (in the long run) as well as inflation rate (in short run) during the periods of rising oil prices. According to the parameter estimate, in the long run, every 10% decrease in the supply of high-powered money results in 6.33% decrease in the consumer price index. The short-run effect, though statistically significant, is small in magnitude. For example, a 100-percentage point cut in the growth rate of money results in only 0.51% decrease in inflation rate.

The contractionary monetary policy through high-powered money also appears to be effective in controlling price level in the long run during the periods of oil price decreases, but it appears ineffective in controlling inflation rate in the short run. The long-run effect of tight monetary policy on price level during the periods of oil price decreases is slightly less than the same effect during oil price increases. In the short run the policy of reducing the growth rate of high-powered money has been ineffective as its effect on inflation rate is highly insignificant.

The short-run effects of other (control) variables are consistent with theoretical expectations, while their long-run effects have mixed patterns. In the long run exchange rate depreciation is found cause increase in price level, but the relationship is statistically insignificant. In the short run acceleration of exchange rate depreciation (increase in the percentage rate of depreciation or increase in the growth rate of price of a US dollar in Pakistani rupees) results in a significant instantaneous increase in inflation rate.

Almost the same pattern holds for the relationships of output and output growth rate with price level and inflation rate respectively. The direction of these relationships is consistent with the theory but only the short-run relationship is statistically significant.

Oil price has positive direct correlation with inflation both in the long and short runs. Although the short run instantaneous effect of increases in the rate of oil price inflation (that is increase in the growth rate of oil price) is quite small, the long-run effect of oil price increase on the consumer price index is quite large. For example, a 100% increase in oil pieces results in about 19% increase in consumer price index, that is, it causes 19% inflation. This result confirms that oil is a key input used in the production of goods and services, and changing in the oil price affects the cost of production across various sectors of the economy. When there is a change in the oil price, it leads to significant long run effects on price level. It typically leads to changes in the cost or production starting with its immediate effect on the energy sector.

Finally, the table of results shows the presence of inertia in inflation rate spanning over two quarters. This result is consistent with the observed slow adjustment (error-correction) process in price level when it deviates from its long-run path.

Inflation rate is also observed to respond to growth rate in the rate of exchange rate depreciation with a lag of two quarters, while it responds to output growth o=with a lag of one quarter.

CHAPTER 6

CONCLUDING AND REMARKS

6.1 Summary

This study examines the effectiveness of monetary policy in controlling inflation during the periods of cost-push and demand-pull inflation. Since it is practically impossible to disentangle the cost-push and demand-pull inflation from the observed data, we distinguish between the two periods by the episodes of increase and decrease in oil price. The study utilizes quarterly data from the first quarter of 1981 to the fourth quarter of 2022. Price level and inflation rate are based on consumer price index and monetary policy is represented by the tools of reverse repo rate or policy rate and high-powered money. The other (control) variables included in the relationship are exchange rate, real GDP, and oil price.

The results show that there exists a stable long-run relationship of price level with the two monetary-policy variables along with the other included variables. The long-run relationship is established through a credible error-correction mechanism, wherein the speed of adjustment is quite slow due to the presence of significant inertia in price level.

One of the main findings of the study is that the monetary policy through the reverse repo rate (the policy rate) is only weakly effective in controlling the rate of cost-push inflation in short run but it is ineffective in controlling price level in the long run during the periods of cost-push inflation (when oil price is increasing). On the other hand, during the periods of demand-pull inflation (when oil price is decreasing) the monetary policy in the form of increase in the policy rate is counterproductive both in the long and short run.

The other instrument of monetary policy, that is high-powered money, is

observed to show encouraging results. A tight monetary policy through this instrument appears as an effective tool of controlling price level in the long run irrespective of whether the inflation is associated with the cost-push or demand-pull factors. The tight monetary policy is also effective in controlling the inflation rate in the short run, but its effectiveness is quite weak and insignificant in case of demand-pull inflation.

6.2 Conclusion

The study finds significant evidence against the view that since monetary policy is a demand-side policy and, it is ineffective in controlling the cot-push inflation. Quite contrarily, monetary policy appears to be an effective tool in controlling cost-push inflation, though its effectiveness in the long run is only partial. Thus, curtailing aggregate demand works to control cost-push inflation even though the inflation is caused by demand side factors. Monetary policy works like a medicine when the disease is caused by the factors other than the lack of medicine.

The second conclusion is that only one of the instruments of monetary policy, that is high-powered money, is effective in the long run-in controlling price level during the episodes of demand-pull inflation, but it is ineffective in controlling inflation rate in the short run. The other tool of monetary policy, that is the policy rate, appears to be highly counterproductive in controlling price level or the inflation rate dealing the periods of demand-pull reverse.

Based on these findings, the study recommends reconsideration of the way monetary policy is being formulated by the State Bank of Pakistan. In this regard more in-depth research on the issue needs to be done using diverse statistical tools in order to arrive at more robust conclusions.

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