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The Effectiveness of Monetary Policy Transmission Channels: An Empirical Investigation of SAARC Countries

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ABSTRACT

This paper empirically investigates the transmission mechanism of monetary policy in south Asian association of regional cooperation (SAARC) countries for the period of 2005Q1-2020Q4. For this purpose, structural vector auto regression approach (SVAR) is used. We considered four pertinent channels through which monetary policy transmits its impact to the real economy (GDP and Inflation) namely interest rate channel, credit channel, exchange rate channel and asset price channel. The objective of this paper is to identify the relative importance of each channel in SAARC countries. Based on the empirical estimates obtained by employing Structural Vector Auto regression (SVAR), we find the effectiveness of monetary policy to influence the aggregate output of the economy in SAARC countries i.e., GDP and prices. The study also finds that the exchange rate channel is the most important channel in Pakistan and Sri Lanka whereas interest rate channel and the credit channel are the dominant source of fluctuation in India and Bangladesh, respectively. The identification of transmission channels of MP is very important to set an effective MP with an efficient set of policy instruments by the central banks in SAARC countries. The study also provides the important policy implication for the central banks of respective countries to set an effective monetary policy.

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ملخص

تبحث هذه الدراسة آلية انتقال السياسة النقدية في دول رابطة جنوب آسيا للتعاون الإقليمي (SAARC)خلال الفترة من الربع الأول لعام 2005 حتى الربع الرابع لعام 2020، من خلال نموذج الانحدار الذاتي الهيكلي .(SVAR) تم التركيز على أربع قنوات رئيسية تؤثر من خلالها السياسة النقدية على الاقتصاد الحقيقي (الناتج المحلي الإجمالي والتضخم)، وهي: قناة سعر الفائدة، قناة الائتمان، قناة سعر الصرف، وقناة أسعار الأصول. تهدف الدراسة إلى تحديد الأهمية النسبية لكل قناة من قنوات الانتقال في دول الرابطة. أظهرت النتائج أن للسياسة النقدية تأثيرا فعالا على الناتج الكلي والأسعار. كما تبين أن قناة سعر الصرف هي الأهم في باكستان وسريلانكا، في حين أن قناة سعر الفائدة تهيمن في الهند، وقناة الائتمان في بنغلاديش. تعد هذه النتائج ذات أهمية بالغة في تمكين البنوك المركزية من وضع سياسة نقدية فعالة باستخدام أدوات مناسبة.

RÉSUMÉ

Cet article examine de manière empirique le mécanisme de transmission de la politique monétaire dans les pays de l'Association sud-asiatique de coopération régionale (ASACR) pour la période allant du premier trimestre 2005 au quatrième trimestre 2020. A cet effet, nous avons utilisé une approche de régression vectorielle auto-régressive structurelle (SVAR). Nous avons pris en compte quatre canaux pertinents par lesquels la politique monétaire transmet son effet sur l'économie réelle (PIB et inflation), à savoir le canal des taux d'intérêt, le canal du crédit, le canal du taux de change et le canal des prix des actifs. L'objectif de cet article est de déterminer l'importance relative de chaque canal dans les pays de l'Association sud-asiatique de coopération régionale. À partir des estimations empiriques obtenues à l'aide d'un modèle vectoriel auto-régressif structurel (SVAR), nous avons constaté que la politique monétaire avait une incidence significative sur le produit total de l'économie dans les pays de l'ASACR, c'est-à-dire le PIB et les prix. L'étude a également conclu que le canal du taux de change est le plus important au Pakistan et au Sri Lanka, tandis que les canaux des taux d'intérêt et du crédit sont les principales sources de volatilité en Inde et au Bangladesh, respectivement. Il est essentiel de déterminer les canaux de transmission de la PM afin que les banques centrales des pays de l'ASACR puissent mettre en place une PM efficace à l'aide d'un ensemble d'instruments monétaires performants. L'étude présente également des

implications politiques importantes pour les banques centrales des pays concernés afin qu'elles puissent mettre en place une politique monétaire efficace.

Keywords: Monetary policy; Credit channel; Interest rate channel; Exchange rate channel; Asset price channel; Monetary Transmission mechanism;

JEL Classification: E52; E42; G21; E44; O16

1. Introduction

After the seminal contribution of Milton Friedman (1960), monetary policy (MP) has been evolved into a key policy tool of central bank to meet economy's desired objectives. The contribution of Friedman is encapsulated in his famous aphorism "*inflation is always and everywhere a monetary phenomenon".* To achieve this monetary phenomenon, central bank makes decisions which are executed under certain institutional arrangement often referred as MP framework and the process through which central bank transmits these decisions into the real economy is known as monetary policy transmission mechanism (MPTM) (Taylor, 1995).

Regardless of the selection of the MP framework, the current debate to understand the "black box" of MPTM in emerging economies and the evaluation of different transmission channels is important for researchers and policy makers to conduct an effective MP. Although, there are different views among different schools about the channels of MPTM but the most common views which have been accepted by most of the macroeconomists are "money view" and "credit view" of MPTM. The traditional "money view" operates through the interest rate channel and exchange rate channel; the "credit view" operates through the credit channel of MPTM. The credit channel further operates via two other channels in credit market "the bank lending channel" and "the balance sheet channel" (also termed as net worth channel) (Bernanke & Gertler, 1995); the asset price channel is also identified through which MP transmits its impact to the real economy (Yemba *et al,* 2020). These channels generally vary from country to country and react differently depending on the financial structure, comparative environment among

financial institutions and the efficiency of economic system (Li, Adam & Breg, 2016).

The literature on the traditional channels of MP is extensive. Bernanke & Gertler (1995) have explored that the theoretical underpinnings go back to seminal contribution of Brumberg & Modigliani (1954), Friedman (1957), Ando & Modigliani (1963) and Tobin (1969), who developed the models and identified the MPTM channels. Although most of the macroeconomic models are designed to capture the traditional channels of MP but the empirical evidence about the strength of these channels is mixed. Loayza & Schmidt-Hebbel (2002) have examined that MP transmits through different channels and affects the series of variables. In this context, the identification of transmission channels, the speed of adjustment and intensity of the change in MP is very important to set an effective MP.

The common mistake in MPTM analysis is the fallacy of composition, the error of attributing what applies in the case of one to the case of many because the role and nature of MP varies across the countries according to their structure and level of development. So, it is a very complex assignment to trace the exact channel which transmits the MP actions properly to meet the desired macroeconomic objectives. Due to these complex facts, Bernanke & Gertler (1995) declared MPTM a "black box". In literature, several applied studies have identified and explicated the importance of each channel in MPTM (Christiano & Eichenbaum, 1992; Fuerst, 1992; Bernanke & Gertler, 1995; Taylor, 1995; Obstfeld & Rogoff, 1995; Mishkin, 1995; Dhar & Millard, 2000; Bayoumi & Morsink, 2001; Mishkin & Schmidt-Hebbel, 2006; Mohanty & Turner, 2008; Mishra & Montiel, 2012; Montes & Machado, 2013; Shah & Rashid, 2019; Anwar & Nguyend, 2018 and Li *et al.*, 2021) but there is little academic consensus either the precise working of each channel or their relative importance (Mishkin, 1995). The study set the stage for discussion that how MPTM - the famous "black box"- works in SAARC countries and how different channels of MPTM contribute to achieve MP objectives.

With the signing of charter in 1985, the South Asian Association for Regional Cooperation (SAARC) was formed with an aim to enhance the

regional cooperation in cultural, scientific, social and economic spheres. It has eight member countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri-Lanka). Similarly, under the umbrella of SAARC, SAARCFINANCE network was also established in 1998 which provides the platform to discuss the economic policies and share the mutual ideas in the region. In SAARC countries, there is heterogeneity in terms of MP practices and channels of MPTM, no country has confirmed the best practice and best channel of MPTM. So, like many developing countries, SAARC countries can also improve the effectiveness of MP by filling the gaps of MPTM suggested in the literature.

Unlike the developed countries, the interest rate channel is not the main transmission channel of MP in emerging economies. They rely on credit channel, especially the bank lending channel (Olivero *et al.,* 2011; Amidu & Wolfe, 2013; Afrin, 2017). Further, credit channel of MPTM also gives way to interest rate channel due to the increasing financial marketization level in emerging economies (Kim, 1995). Moreover, lack of non-banking sources of finance is the key reason behind the prominent role of bank lending channel in emerging economies (Agha *et al.,* 2005). Similarly, Morales & Raei, (2013) found that the exchange rate channel of MPTM is more significant in those countries where financial markets are not perfectly working. So, it can be clearly observed that there is no specific channel suggested by researchers and policy makers in the literature.

In this context, the identification of transmission channels in SAARC countries, the speed of adjustment, and intensity of the change is very important to set an effective MP. It facilitates the central banks to select an efficient set of policy instruments. On the other hand, weak monetary transmission will limit the MP and it may misguide the central banks to perform the primary responsibility to stabilize the domestic markets (Mishra & Montiel, 2012). Therefore, assessing the effectiveness of MPTM channels empirically is an important task prior to take any MP stance.

The objective of this study is to identify the importance and contribution of each MP channel in selective SAARC countries that may lead central

banks to devise an appropriate policy action depending on the effectiveness of each channel. More specifically, the study contributes to the existing literature by exploring the cross-country differences of MP transmission channels in SAARC countries. The study also fills the vacuum of existing body of knowledge through identification of MP channels, their speed of adjustment and the intensity of change in developing countries. The study designs the research problems in structural VAR model for quarterly data of Bangladesh, India, Pakistan, and Sri Lanka over the time period of 2005Q1-2020Q4.

The remaining part of the paper is organized as follows; In section 2, the literature review of each channel is presented. The econometric methodology and the data sources are discussed in section 3. Section 4 discusses the empirical results and potential findings. The conclusions and policy recommendations are presented in section 5.

2. Literature Review

This section can be classified into the following strands: MPTM and interest rate channel, MPTM and credit channel, MPTM and asset price channel, MPTM and the exchange rate channel. A brief review of each strand is discussed underneath.

2.1 MPTM and Interest Rate Channel

The dynamics of interest rate channel are not only important for developed countries but also have profound implications in developing countries (Disyatat & Vongsinsirikul, 2003; Amarasekara, 2008; Boivin *et al.,* 2010; Mukherjee & Bhattacharya, 2011; Kabundi & Nonhlanhla, 2011). Theoretically, the idea of interest rate channel in MPTM has been explored by Keynes (1936). In "The General Theory of Employment, Interest and Money", Keynes described the role of interest rate channel in the transmission mechanism of monetary policy. Keynesian economists believe that the MP objectives are achieved through the interest rate channel (Nyumuah, 2018). The transmission mechanism of MP through interest rate channel ideally takes the short period of time (Goodfriend,1991). He believed that the faster transmission ideally strengthens the impact of MP on real output. Similarly, Taylor (1995) presented the simple framework of MPTM. He believes that the interest

rate effects the investment behavior of firms and consumption behavior of household. Furthermore, Bernanke & Gertler (1995) and Mojon & Peersman (2001) also produced the empirical evidence that support the importance of interest rate channel in MPTM.

This notion about the role of interest rate channel has been testified for several countries and regions during the last two decades. Considering the findings, these studies are classified into two bunches in our study. The first bunch lists the important studies that verified the importance of interest rate channel in developed countries i.e., euro area countries (Smets & Wouters, 2002; Angeloni *et al*., 2003), 6- open economies including Australia, Canada, Chili, United Kingdom, Israel, and South Africa (Loayza & Hebbel, 2002), Japan (Iwata & Wu, 2006), Canada (Bhuiyan & Lucas,2007), US (Ramey, 1993; Boivin *et al.,* 2010), dollarized and non-dollarized economies including Chili, New Zealand, Peru and Uruguay (Ormaechea & Fernandez, 2011), USA (Endut *et al.*, 2018). Similarly, the second bunch lists the important studies that verified the importance of interest rate channel in developing countries i.e., Thailand (Disyatat & Vongsinsirikul, 2003), Croatia (Vizek, 2006), Sri Lanka (Amarasekara, 2008; Vinayagathasan, 2013, Perera, 2013), South Africa (Kabundi & Nonhlanhla, 2011; Iddrisu & Alagidede, 2020), emerging economies (Mohanty & Turner, 2008; Kapur & Patra, 2010; Mukherjee & Bhattacharya, 2011; Hoang *et al.*, 2020; Asian economies (Jain-Chandra & Unsal, 2014; Shah et al., 2021).

Apart of all these studies, some studies, on the other hand, have argued that interest rate channel is less important in emerging and low-income countries (Angeloni *et al*, 2003; Abate *et al.*, 2019; Shah & Bano, 2020). Similarly, a study conducted by Wulandari (2012) contradicts with aforementioned studies and supports the results with empirical evidence that interest rate channel has significant role in MPTM to maintain inflation but has inadequate role in economic growth. Recently, a study conducted by Li *et al.,* (2021) examined the individual effect of each channel in China. They found that interest rate channel is less important in China due to the strict control of central bank over lending rates. Similarly, after the seminal contribution of researchers on credit channel of MPTM, researchers and policy makers have indicated that

conventional interest rate channel is no more appropriate in MPTM (Bernanke & Blinder, 1988).

2.2 MPTM and Credit Channel

The second strand of literature analyzed the importance of credit channel in MPTM. Bernanke and Blinder (1988) are the first to have put forward this theoretical and empirical idea about the role of banks in MPTM. They reviewed the New-Keynesian framework and introduced the credit channel in the traditional IS-LM framework. Bernanke & Gertler (1995) explained that the credit channel is not an alternate but the extension of IS-LM model. Therefore, it is also considered as the extension of "Interest rate channel". They defined how banks play their role in transmitting the monetary policy through credit channel.

Over the past few decades, there has been a notable number of studies in the literature taking into consideration the role of financial institutions in MPTM more precisely banks (Bernanke & Blinder, 1988; Bernanke & Blinder, 1992; Kashyap & Stein, 1994; Cecchetti, 1999; Kashyap & Stein, 2000; Kishan & Opiela, 2000; Ehrmann & Smets, 2003; Suzuki, 2004; Rashid & Shah, 2019; Shah & Rashid, 2020). In these studies, they illustrate the importance of credit channel in MPTM. In recent times, especially following the financial crisis of 2007-08, the credit channel of monetary policy is considered the most important channel and has gained considerable attention from the researchers and policy makers. It shows how monetary policy transmits its effect to the real economy through the credit supply of banks. Jimenez *et al.,* (2012), Santis & Surico (2013); and Evgenidis & Salachas (2019) further supported the significant evidence regarding the presence of credit channel of MPTM in European countries. Furthermore, Carrera (2011), Aysun & Hepp (2013), Evans *et al.,* (2015), Auclert (2017), Erdogdu (2017), Anwar & Nguyend (2018), Endut *et al.,* (2018). Jermann (2019), Rashid *et al.,* (2020), and Morales *et al.,* (2021) also found the significant evidence of bank lending channel in MPTM.

An important and renowned set of authors and researchers inducted the pioneer contribution to the literature and discussed the presence of credit channel in developed countries. However, in the past two decades the credit channel of MPTM has also become the most researched topic in

the developing economies as well. In recent times, Caballero & Krishnamurthy (2004), Agha *et al.,* (2005), Pandit *et al.,* (2006), Catao & Pagan (2010), Bhaumik *et al.,* (2011), Karim & Saini (2011), Montes & Machado (2013), Asbeig & Kassim (2014), Hussain (2014), Janjua *et al.,* (2014), Ekimova *et al.,* (2017), Olmo *et al.,* (2018), Farajnezhad *et al.,* (2019); Mercan & Canbay (2020), Iddrisu & Alagidede (2020) and Hameed *et al.,* (2024) have extended this debate in the context of developing economies. Karim & Saini (2011) also explained the significance of liquidity to influence the banks' credit supply. Agha *et al.,* (2005) also explained that the lack of non-banking sources of finance is the key reason behind the prominent role of bank lending channel in Pakistan.

On the flip side, Romer *et al.,* (1990) and Ramey (1993) supported with some empirical evidence that credit channel plays an insignificant role in MPTM. By the same token, Ludi & Ground (2006) investigated the bank lending channel in South Africa by using VAR model, they found the strong empirical evidence about the inadequate role of bank lending channel in MPTM.

2.3 MPTM and Asset Price Channel

The third strand of literature analyzed the importance of asset price channel in MPTM. Asset price channel is highlighted by Tobin's q (1969) theory of investment and Ando & Modigliani (1963) lifecycle theory of consumption. Meltzer (1995) pointed out that the asset market performs the role of starting point in MPTM. According to monetarist, an unexpected change in monetary policy has a liquidity effect that causes a change in the prices of domestic and foreign assets (Christiano & Eichenbaum, 1992 and Meltzer, 1995). Blanchard (1981) analyzed the interaction between aggregate output and stock market. He provided the empirical evidence that MP affects the aggregate output of the economy through its impact on asset price. Similarly, Disyatat & Vongsinsirikul (2003) outlined that an expansionary MP creates a preference of liquidity over bonds that causes a change in aggregate demand. Furthermore, the asset price channel is not only limited to bond prices but also have implications on equity prices and real estate prices (Li *et al.,* 2021).

In recent past, the economic implications of asset price channel in MPTM have been gained lot of attention from academia and monetary authorities. Some exemplary contributions in the literature are Goodhart & Hofmann (2007), Mishkin (2007), Nastansky & Strohe (2010), Ajaz *et al.,* (2017). The importance of asset price channel can be attributed to the development of stock exchange market and real estate market. (Ajaz *et al.,* 2017). Similarly, the asset price channel affects the aggregate output of the economy through bank balance sheet because property prices influence the banks or financial institutions' willingness to provide loan (Gerlach & Peng, 2005; Goodhart & Hofmann, 2007).

2.4 MPTM and Exchange Rate Channel

The fourth strand of literature analyzed the importance of exchange rate channel in MPTM. The channel came into play after the Mundell-Fleming model which defined the link between MP and exchange rate. The model outlined the positive relationship between interest rate parity and exchange rate. The exchange rate channel works when changes in monetary policy affects the current and capital account, resulting into the appreciation and depreciation of exchange rate. During the last two decades, number of empirical studies have analyzed the importance of exchange rate channel in MPTM (Cushman & Zha, 1997; Kim & Roubini, 2000; Ahmed & Islam, 2004; Mishkin, 2007; Fetai & Izet, 2010; Arratibel & Michaelis, 2014; Abate *et al.,* 2019; Hoang *et al.,* 2020). Similarly, Catao & Pagan, (2010) found that the dynamics of exchange rate plays an important role in MPTM.

The effectiveness of exchange rate channel in MPTM depends upon the degree of economic openness, the sensitivity of exchange rate to MP shocks and the response of net export to exchange rate fluctuation (Disyatat & Vongsinsirikul, 2003). This channel was more significant in MPTM during the phase of formation of European monetary union (Khozeimeh *et al.,* 2018). By the same token, Morales & Raei, (2013) found that the exchange rate channel of MPTM is more significant in those countries where financial markets are not perfectly working. Similarly, a study conducted by Hussain (2009) analyzed the importance of each channel by using VAR methodology. The study concluded that

exchange rate channel is the most appropriate channel in Pakistan for regulating inflation and reducing output variance in the economy.

Most recently, a study conducted by Zahid *et al.*, (2021) analyzed the significance of MPTM in the sustainable development of SAARC countries and highlighted the importance of exchange rate channel and credit channel in SAARC countries. Similarly, Afrin (2017) found that the exchange rate channel is less effective in Bangladesh as compared to bank lending channel, reflecting the high-level degree of intervention by the bank of Bangladesh.

None of study is found on exploring the cross-country differences of MP transmission channels in SAARC countries. The effectiveness of MPTM channels empirically, is an important task prior to take any MP stance. This study designs the research problems in structural VAR model to meet the objectives of study. We intend to bridge this gap through identification of effective transmission channels of MP, the speed of adjustment, and intensity of the change Bangladesh, India, Pakistan, and Sri-Lanka over the time period of 2005Q1-2020Q4.

3. Research Design

3.1 Modeling of Structural VAR

Following Bernanke & Blinder (1992), Christiano *et al.* (1999) and Enders (2015) the relationship between macroeconomic variables, foreign variables, monetary policy instruments and channel variables of MPTM can be represented in the following VAR model:

$$\boldsymbol{B y_t = C(L) y_t + D(L) x_t + \varepsilon_t} \qquad (\mathbf{1})$$

Where y_t represents a vector of endogenous variables and x_t is a vector of exogenous variables. *B*, *C* and *D* are vector of estimated coefficients. *L* is a polynomial Lag operator matrix and ε_t is the vector of structural innovation. Further, it is assumed that ε_t is mutually uncorrelated *(E ( ) = 0)*, this assumption helps to assess the dynamic impact of each structural shocks in isolation. The rationale for incorporating the vector of exogenous (foreign) variables in the model is to consider the external constraints and also control for international economic events. The

reduced form of VAR model can be obtained by rearranging and excluding the vector of exogenous variables from equation (3.1):

$$\boldsymbol{y_t = A(L)y_t + \nu_t} \qquad (\mathbf{2})$$

Where $A(L) = B^{-1}C(L)$ for all $L = 1 \ldots$ P and $\nu_t = B^{-1}\boldsymbol{\varepsilon_t}$

Equation (3.2) gives an estimated form of VAR model. By estimating and using various postestimation econometric techniques i.e., impulse response function and variance decomposition analysis, we can analyze the statistical linkages among policy variables and macroeconomic output (Bernanke & Gertler, 1995). It provides number of advantages as compared to univariate time series models (Brook, 2008). VAR model is more flexible, and the forecast of VAR model provides better information than traditional structural models. VAR model solves the problem of simultaneity that is most often faced in multi-equation model by using the lesser number of variables with high frequency data and relatively fewer restrictions. Similarly, it helps to identify the impact of MP shocks without determining the complete structure of the economy (Oliner & Rudebusch, 1996).

However, the reduced form of VAR model has the lack of ability to provide robust and conclusive findings as it does not impose theoretical restriction based on economic theory. Similarly, the endogenous variables in the VAR model are solely explained by their own history and that makes it difficult to conclude the economic interpretation of the estimated parameters which is the subject matter of the famous "Lucas critique". By acknowledging all these drawbacks and limitations, SVAR model was developed as a standard tool for testing and evaluating the effectiveness of monetary policy over the time (Bernanke,1986; Sims, 1986). This model provides valuable advice for policy making and economic decisions as it allows imposing ad-hoc structure that prevents to reach the wrong conclusion. Similarly, SVAR model provides avenues through which policy makers can pin down the impact of MP shocks and detects the complicated linkages and interaction among policy variables and macroeconomic indicators (Bjomland & Jacobensen, 2010). The model also represents the salient features of small open economies more properly (Elbourne & Haan, 2006) and that makes this approach a best fit for SAARC countries as well. The SVAR model is presented as follows:

$$\boldsymbol{A0yt = A1yt-1 + A2yt-2 + \cdots APyt-P + \alpha xt + \varepsilon_t} \ (\mathbf{3})$$

Where y_t is the (n × 1) vector of endogenous variables, A_0 is the (n × n) matrix of structural parameters such as i = 0,1…. p, x_t is the (n × 1) vector of exogenous variables and ε_t is the (n × 1) vectors of structural innovation. It is assumed that the vector of structural innovation or shocks is independent and identically distributed. Similarly, these structural shocks are mutually uncorrelated. After solving equation 3.3, we get the following equation.

$$\boldsymbol{yt = A0-1A1yt-1 + A0-1A2yt-2 + A0-1APyt-P + \alpha x_t + A_0^{-1}\varepsilon_t} \ (\mathbf{4})$$

The reduced form of equation 3.4 is written as follows:

$$\boldsymbol{y_t = (L) + (L) + \mu_t} \qquad (5)$$

Where **is** (endogenous variables), X_t **is** (exogenous variables), A and B are vector of estimated coefficients. L is a polynomial Lag operator matrix and μ_t is the vector of reduced form innovation and it describes the movement of shocks in VAR model with certain economic restrictions. It is assumed that these shocks are mutually uncorrelated. Following Bernanke & Blinder (1992), Christiano et al., (1999) and Enders (2015), the theoretical representation of the reduced form of structural VAR model (equation 3.5) is as follows:

$$A\begin{bmatrix} MP_t \\ X_t \\ Y_t \end{bmatrix} = \Gamma 1 \begin{bmatrix} MP_{t-1} \\ X_{t-1} \\ Y_{t-1} \end{bmatrix} + \ldots\ldots \Gamma p \begin{bmatrix} MP_{t-P} \\ X_{t-P} \\ Y_{t-P} \end{bmatrix} + A Z_{qt} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \qquad (6)$$

Where Γ1… Γp are coefficient matrices, MP_t is the monetary policy variables, X_t is the proxy variables of all monetary policy channels, Y_t is the macroeconomic variables, Z_t is the vector of exogenous variables, q is the number of exogenous variables in the model and μ_t is the vector of the reduced form innovations in the structural VAR model, μ_t fulfills the property of *iid* independent and identically distributed. Eq. 3.6 represents the correlation between reduced form innovation and structural shocks. It also satisfies:

$$A\mu_t = B\boldsymbol{v_t} \qquad (7)$$

From eq. 3.7, we can obtain the following:

$$A\Sigma A` = BB` \qquad (8)$$

3.2 Econometric Methodology and Methods

The study incorporates the following empirical tests to estimate and reach the objectives of the paper:

3.2.1 Unit Root Test

As the study incorporates time series analysis, the standard econometric practice to check the stationarity of the data in time series is unit root test followed by Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Philips and Perron (PP) (Philips & Perron, 1988) test. The examination of unit root test is a basic condition to avoid any fallacious regression in time series analysis. The study adopts the following equations for unit root test.

$$\boldsymbol{\Delta y_t} = \boldsymbol{\alpha} + \beta_t \, \emptyset \boldsymbol{y_t} + \rho_1 \boldsymbol{\Delta y_{t-1}} + \rho_{p-1} \boldsymbol{\Delta y_{t-p+1}} + \mu_t \qquad (9)$$

Where β, t, $\boldsymbol{\Delta}$, $\boldsymbol{y_t}$ and μ_t intercept, time period, the difference operator, selected time series and the error term respectively. Please see Appendix 1 for the results of the Unit Root Test of all for countries.

3.3 Identification and contemporaneous restrictions

In identifying the eq. (3.7) of SVAR model, the study chooses the short-term identification method based on the recent studies of Christiano *et al.*, (1999) Aleem, (2010). The study assigns the values to the elements in matrix A and B or both in AB matrixes. Apart from zero restrictions of all diagonal elements in matrix $\boldsymbol{B}^{-1}$ A, the coefficients representing contemporaneous relationship between MP variables and macroeconomic indicators are denoted by the stars (*). We assume that the constructed model is recursive. In the recursive identification scheme, we use recursive order of variables in the SVAR system. Similarly, in order to avoid excessive recognition, we perform Choleski decomposition for identification purposes based on some economic reasons. First, we perform the ordering of variables in our benchmark model:

Table 1: Identification Matrix of Extended SVAR Model

Gross Domestic Product (GDP)	1	0	0	0
Consumer Price Index (CPI)	*	1	0	0
Interest Rate (IR)	*	*	1	0
Money Supply (M)	*	*	*	1

The ordering of the endogenous variables completely depends on the dynamic structure of SAARC economies. These variables are known as business cycle variables in literature. GDP and CPI are ordered before the interest rate because it contemporaneously responds to shocks in GDP and CPI. Money supply is ordered after the interest rate because central bank sets the interest rate based on the innovations in GDP and CPI while money supply only accommodates it. Later on, channel variables of MPTM like deposit rate, exchange rate, stock exchange index, credit are included in the specification and are denote by "F" as financial variables. They are added one by one in our benchmark model to identify the impact of each channel in MPTM. Now the identification scheme of our extended SVAR model will be:

Table 2: Identification Matrix of Extended SVAR Model

Gross Domestic Product (GDP)	1	0	0	0	0
Consumer Price Index (CPI)	*	1	0	0	0
Interest Rate (IR)	*	*	1	0	0
Money Supply (M)	*	*	*	1	0
Financial Variables (F)	*	*	*	*	1

To identify the impact of each channel, MPTM variables (F) are ordered after the money supply because money supply has a contemporaneous impact on financial variables. Similarly, financial variables are ordered after the MP variables because any change in MP variables gives the trends in economic environment and both banks and enterprises determine the demand and supply of credit according to the trend in economic environment (Afrin, 2017).

In our model, foreign variables i.e., *wop (world oil price), ffr (federal fund rate))* are purely exogenous factors and they have significant impact on domestic variables but domestic variables in SAARC economies are unlikely to have a meaningful impact on these foreign variables even

with a lag. Herein, *wop* is a proxy of negative inflationary supply shocks (Kim & Roubini, 2000). This study has also reported the impact of foreign MP shocks on US federal fund rate. The study uses "blocked" and "unblocked" conditions to analyze the individual impact of each channel by comparing the impulse response function. When we add the variable related to MPTM channels in our benchmark model as an endogenous variable, we obtain the impulse response function of GDP and CPI to MP shock given the disturbance from this variable fixed. However, when we add the variable related to MPTM channel as an exogenous variable, it relatively blocks off all interaction between it and basic SVAR model. The comparison of these two impulse response functions helps us to identify the individual impact of each channel.

3.4 Data Sources and Variables

The study incorporated secondary data on quarterly basis for the period of 2005Q1 to 2020Q4. The study uses quarterly data because it has lower volatility as compared to monthly data. The data of all selected macroeconomic and financial variables is assembled from the official website of international financial statistics (IFS) and the data of world oil price is taken from the website of EIA (US Energy Information Agency). Similarly, the data of stock exchange index is obtained from the official websites of particular countries and https://www.investing.com/. The study utilizes the data of 4 major SAARC countries including Pakistan, India, Bangladesh, and Sri Lanka. The selection of these countries purely depends on the availability of the data. To make data comparable, all-time series data are seasonally adjusted using the X-11 process (De Dios Tena & Tremayne, 2009). The quarterly data of GDP of Pakistan and Bangladesh is not available; we convert the annual data into quarterly available; we convert the annual data into quarterly by using Denton's (1971) methodology. The lag length for the reduced form model is set at $P = 2$. (Please see Appendix 2 for the variables' definitions and data sources).

4. The Benchmark SVAR Model

The study has compared the outcomes of basic SVAR model with the extended SVAR model. The vector of endogenous variables in our benchmark model are *gdp, cpi, ir* and *ms.* The proxy variables of all MPTM channels i.e., *Credit, dr (deposit rate), st. index (stock exchange*

index), *er (exchange rate)* and foreign variables i.e., *wop* and *ffr* are set as exogenous in our benchmark model. In X axis we have number of periods in quarterly form and in Y axis we have percentage change. The estimated results of Fig.1 are given below:

An increase in interest rate causes a significant contraction in GDP of all SAARC economies. A positive shock in interest rate causes a significant contraction in real GDP by more than 0.15% (Pakistan), 0.1% (India), 0.06% (Bangladesh) and 3% (Sri Lanka) respectively, before it moves towards the baseline. A fall in real GDP after the contractionary MP shock also confirms the presence of interest rate channel in SAARC countries. Although the overall response of MP shock to real GDP is negative in all SAARC countries but the structural impulse response function shows that the response of output is quite different among these countries i.e., the output response of Pakistan and Bangladesh is less severe as compared to India and Sri Lanka. The result is also in line with the stylized fact of MPTM theory which indicates the initial fall in aggregate output after the contractionary MP (Favero,2001; Disyatat & Vongsinsirikul, 2003; Agha *et al.,* 2005; Aleem, 2010; Vinayagathasan, 2013). The further likely explanation about the initial fall in real GDP is that the economic agents in SAARC economies respond rapidly after the change in MP. Furthermore, a contractionary MP shock also delivers some guideline to the household and businesses to cut down their borrowing in anticipation of high borrowing cost. Similarly, contractionary MP shock causes a significant negative impact on inflation. The results show that the "price puzzle" phenomenon is not obvious in SAARC economies except India. In case of India, inflation shows a rising response to the MP shock till 2nd quarter. Later on, it tends to decline. The similar outcome is observed as price puzzle in the literature (Favero, 2001). The price puzzle disappears after adding more information in the model. An addition of stock exchange index in the model helps to improve the price puzzle. The result is also in line with the literature (Sims, 1992; Disyatat & Vongsinsirikul, 2003; Vinayagathasan, 2013) which specifies that the induction of more information in the model can effectively avoid the price puzzle. The study further explains that inflation rate declines by more than 0.2% (Pakistan), 0.1% (Bangladesh) and 0.2% (Sri Lanka) before it returns to the initial level. The impulse response function shows a V shaped decline followed

by increase in inflation after the 2nd and 3rd quarter. As a whole in our model, a contractionary MP causes the output and inflation to decline in the short run as predicted by the theory before it moves toward the baseline to demonstrate the zero effect.

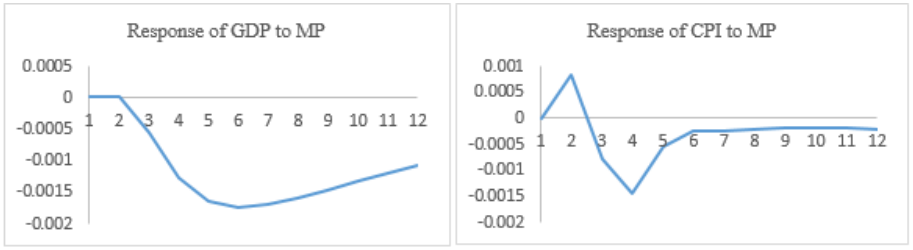
4.1 Interest Rate Channel

The interest rate channel is the primary mechanism of macroeconomic models. At the first stage, any fluctuation in policy rate affects the short-term money market rates that influence the decision of people to consume, save or borrow and this causes the fluctuations in economic activities (output and prices). However, the working of interest rate channel rests on two assumptions (Ramey, 1993). First, interest rate channel solely depends on monetary assets. Therefore, it is termed as "Money view" of MPTM. Secondly, there is no close substitute of money for transaction in the economy. The interest rate channel is also important because it directly influences the real economy through private consumption and investment (Li *et al.,* 2016; Shah *et al*., 2023; Rehman Shah *et al*., 2024). In the extended SVAR model, it is examined by including *dr* (deposit interest rate) as an endogenous variable in our benchmark model. By this method, the nexus between interest rate channel and aggregate output is blocked. All other setting is similar to our basic SVAR model. The results are presented in Fig. 2.

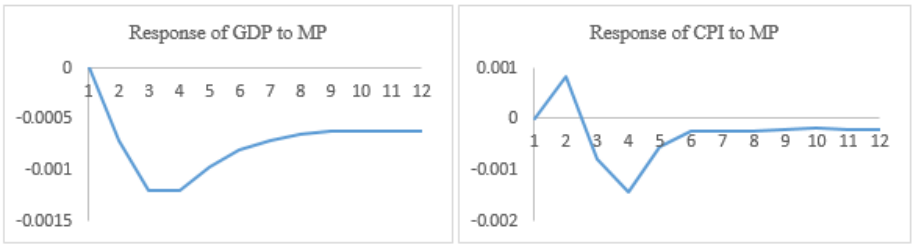
The left panel of Fig.2 shows the estimated response of real output to the interest rate channel over the whole sample period. The orange line depicts the estimated response of GDP to contractionary MP shock when *dr* is treated endogenously along with basic SVAR model where *dr* is treated exogenously (blue line). The latter effectively blocks off the MP effect through interest rate channel. The comparison of impulse response functions (basic vs extended SVAR) of GDP to MP shocks provides the rough picture of the strength of interest rate channel in MPTM. In the 1st quarter of Fig. 2 (a), the response of GDP to contractionary MP shocks is quite similar taking *dr* as exogenous variable, suggesting that the interest rate channel starts to work from the 2nd quarter after the MP tightening in Pakistan. The response of GDP (without the exogenous variable *dr*) starts to dissipate quickly thereafter. The difference between the response of GDP to MP shocks in both models' accounts for 36% in 1st year, 34% in

the 2nd year and 29% in the 3rd year. Moreover, the impact of interest rate channel also persists until the 12th period in the extended SVAR model, which is quite similar to our benchmark model. By the same token, the left panel of Fig. 2(b) illustrates the impulse response of GDP to contractionary MP shock in Indian context. In the 1st quarter the response of GDP to contractionary MP shocks with and without exogenous variable (*dr)* is quite similar as in case of Pakistan, suggesting that the interest rate channel starts to work from the 2nd quarter after the MP tightening in India as well. Later on, GDP rapidly responds to the contractionary MP shock. The result shows that the difference in the response of GDP to MP shock in both models' accounts for 32% in the 1st year, 36% in the 2nd year and 37% in the 3rd year. Similarly, the left panel of Fig. 2(c) illustrates the impulse response function in the context of Bangladesh with and without given exogenous variable. In the first 3 quarters, the response of GDP to MP shocks in both models (with and without exogenous factor *dr*) is quite similar, suggesting that the interest rate channel starts to work from the 4th quarter after the MP tightening in Bangladesh. The fluctuations in GDP after the contractionary MP shock is around 7% in the 1st year 15% in the 2nd year and 20% in the 3rd year. Similarly, the left panel of Fig. 2(d) shows the impulse response of GDP to MP shock in the context of Sri Lanka. The extended SVAR model shows that the response of GDP to contractionary MP shock is quite different to our benchmark SVAR from the very 1st quarter, suggesting that interest rate channel starts to work from the 1st quarter in case of Sri Lanka. The response of GDP to contractionary MP shock shows that the total fluctuation due to interest rate channel is 30% in the 1st year 67% in the 2nd year and 30% in the 3rd year. Further, the results show that the magnitude of interest rate channel in case of Pakistan, India and Sri Lanka is far higher than that in Bangladesh. The right panel of Fig 2 (a-d) depicts that after endogenizing *dr* in our benchmark model, CPI reacts to MP shock in a same pattern except Bangladesh. In case of Bangladesh, CPI shows a V shape response to MP shock, and it rises quickly after the 2nd quarter. Similarly, the evidence of price puzzle is still not obvious in SAARC economies. Moreover, in case of India there is no improvement in price puzzle for the first two quarters as well. The results are in line with the previous studies of (Disyatat & Vongsinsirikul, 2003; Agha *et al.,* 2005; Aleem, 2010).

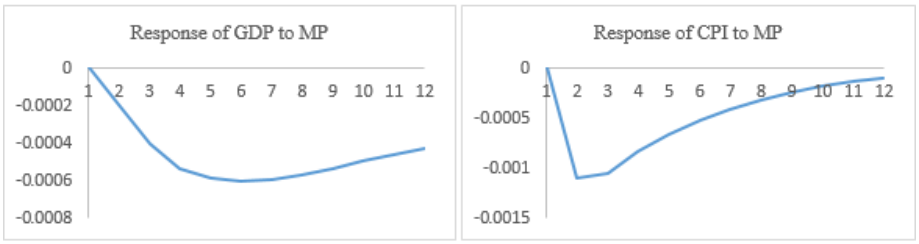
Fig.1: Pakistan (a)



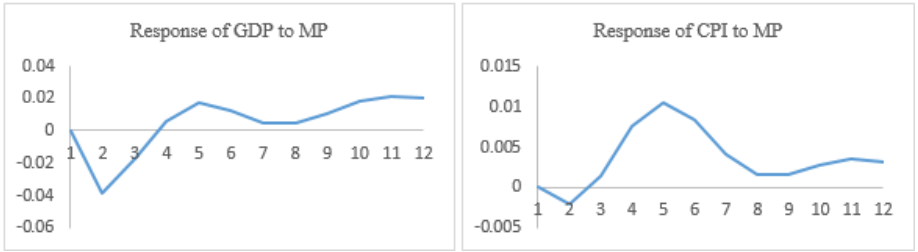
India (b)



Bangladesh (c)



Sri Lanka (d)



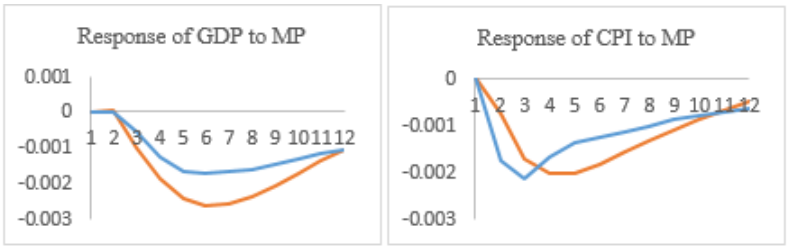
4.2 Credit Channel

The traditional "Money view" of MPTM emphasizes on liability side of bank balance sheet i.e., bank deposits. On the other hand, the credit channel also known as the "credit view" of MPTM focused on asset side of bank balance sheet i.e., bank loans. The credit channel further operates via two other channels in credit market "the bank lending channel" and "the balance sheet channel" (also termed as net worth channel) (Bernanke & Gertler, 1995). These two channels of MPTM arise as a result of asymmetric information in credit market (Kabir *et al*., 2022). After the financial crises of 2007-08, the discussion on the presence of credit channel of MPTM in different economies has mounted. The credit channel of monetary policy mainly highlights the role of banks in MPTM. However, the effectiveness of banks in the process of MPTM mainly depends on three aspects: (1) the extent to which banks depend on their deposits, (2) the sensitivity of monetary policy shocks to the credit expansion of the banks, (3) how much the consumers and investors depend on the borrowing of the banks.

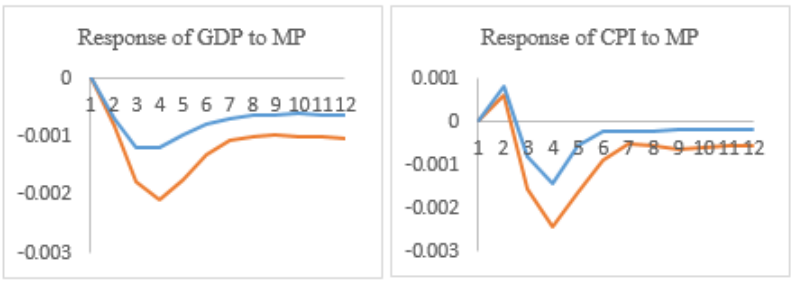
Bernanke & Blinder (1988) formalized and reviewed the New-Keynesian framework with credit channel. Basically, it was the extension of IS-LM framework. They defined how banks play their part in transmitting the monetary policy through credit supply. According to them, borrowers and creditors take the decision of choosing bonds or loans according to the mobility of interest rate. In this framework, they explained the demand for loan as a function of interest on loans, interest on bonds and aggregate output. Credit is assumed as an endogenous variable in our benchmark model. The endogenous variables in the extended SVAR model are *gdp, cpi, credit, ir,* and *ms* while exogenous variables are *wop, ffr, dr, er* and *st. index.* By this method, all the interaction between credit channel and aggregate output is blocked. The other setting is similar to basic SVAR model. The results are presented in in Fig. 3.

The left panel of Fig.3 depicts the estimated response of GDP to MP shock when bank credit is treated as endogenous in the extended SVAR (orange line) and exogenous in the basic SVAR model (blue line) over the period 2005Q1-2020Q4 in the left panel of Fig.3. The latter effectively blocks off the MP effect through credit channel.

Fig.2:Pakistan (a)

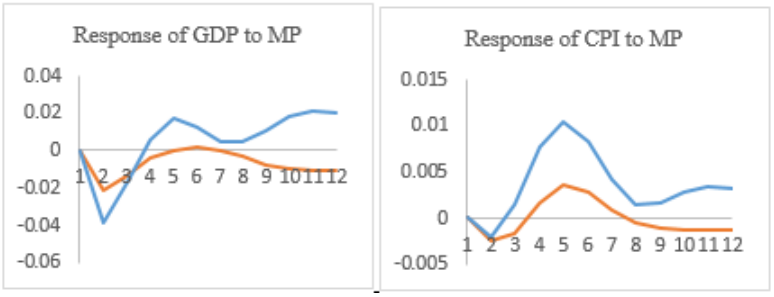


India (b)



Bangladesh (c)

Sri Lanka (d)



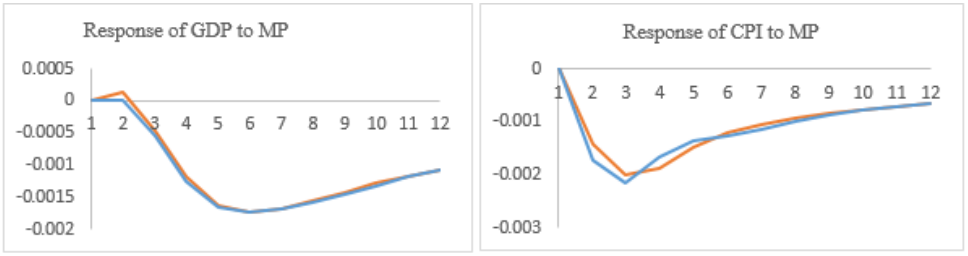
The comparison of these two responses of GDP to MP shocks provides the rough picture of the strength of credit channel in MPTM. The response of GDP to MP shocks with and without exogenous of credit is quite different in the 1st quarter of Fig. 3 (a), suggesting that the credit channel starts to work from the 1st quarter after the MP tightening in Pakistan. The GDP response to contractionary MP shock starts to dissipate from the 1st quarter to 3rd quarter. After the 3rd quarter, this response is almost similar in both models. The total response of GDP to MP shock accounts for 18% in the 1st year, 4% in the 2nd year and 3% in the 3rd year. Similarly, the left panel of Fig. 3(b) illustrates the impulse response of GDP to contractionary MP shock in Indian context. The response of GDP to contractionary MP shocks with and without exogenous of *credit* is quite similar for 1st two quarters, suggesting that the credit channel starts to work from the 3rd quarter after the MP tightening in India. After that, the response of GDP to MP shock is different in both models, suggesting the importance of credit channel in India. The response GDP to contractionary MP shock accounts for 13% in 1st year, 15% in the 2nd year and 11% in the 3rd year. By the same token, the left panel of Fig. 3(c) illustrates the impulse response function in the context of Bangladesh with and without the exogenous of *credit.* In the first 2 quarters, the response of GDP to MP shocks in both models is quite similar, suggesting that the credit channel starts to work from the 3rd quarter after the MP tightening in Bangladesh. The fluctuation in GDP after the MP shock is around 21% in 1st year, 46% in the 2nd year and 61% in the 3rd year. The left panel of Fig. 3(d) shows the impulse response of GDP to MP shock in the context of Sri Lanka. The extended SVAR model shows that the response of GDP to contractionary MP shock is quite similar to our benchmark model in the 1st quarter, suggesting that credit channel starts to work from the 2nd quarter in case of Sri Lanka. The impulse response function shows that total fluctuation in GDP after the MP shock is 20% in the 1st year, 63% in the 2nd year and 17% in the 3rd year. Further, the results show that the magnitude of credit channel in case of Bangladesh and Sri Lanka is stronger as compared to Pakistan and India. The right panel of Fig 3 (a-d) depicts that CPI reaction to MP shocks is similar for the given panel except Bangladesh holding *credit* as endogenous in the benchmark model. In case of Bangladesh, CPI reacts to MP

shocks in the same pattern for 1st two quarters but thereafter continuously fall for the whole period. Thus, the evidence of price puzzle is still not obvious in SAARC economies. Moreover, there is still no improvement in price puzzle for the first two quarters in case of India.

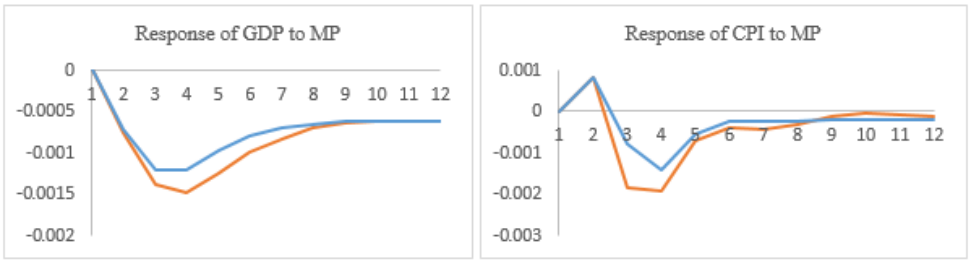
4.3 Exchange Rate Channel

Exchange rate has important role in MPTM, and it links domestic economy with international economies. This channel is well explained by the Mundell-Fleming model. The model outlined the positive relationship between interest rate parity and exchange rate. The transmission mechanism of MP through exchange rate has following channel: firstly, increase in interest rate makes local currency stronger, it results in increasing the demand of local currency as compared to foreign currency. The appreciation in domestic currency makes domestic goods more expensive which leads to the decline in net export and total output. The left panel of Fig.4 depicts the estimated response of GDP to contractionary MP shock when exchange rate is treated as endogenous (orange line) in the extended SVAR and as exogenous (blue line) in the basic SVAR model over the period 2005Q1-2020Q4. The latter effectively blocks off the MP effect through exchange rate channel. The response of GDP to contractionary MP shocks in both models provides the rough picture of the strength of exchange rate channel of MPTM in SAARC countries. The response of GDP to contractionary MP shocks (with and without exogenizing the exchange rate) is quite different in the 1st quarter of the left panel of Fig. 4 (a), suggesting that the exchange rate channel starts to work from the 1st quarter after the MP tightening in Pakistan. Thus, the GDP response to exchange rate starts to dissipate from the very 1st quarter without taking *er* as an exogenous factor. It suggests the importance of exchange rate channel in Pakistan.

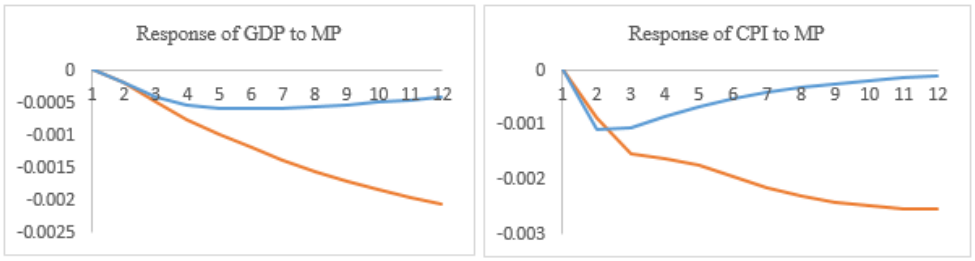
Fig.3:Pakistan (a)



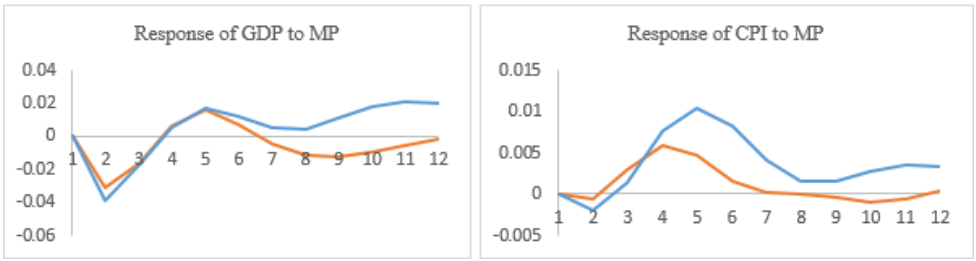
India (b)



Bangladesh (c)

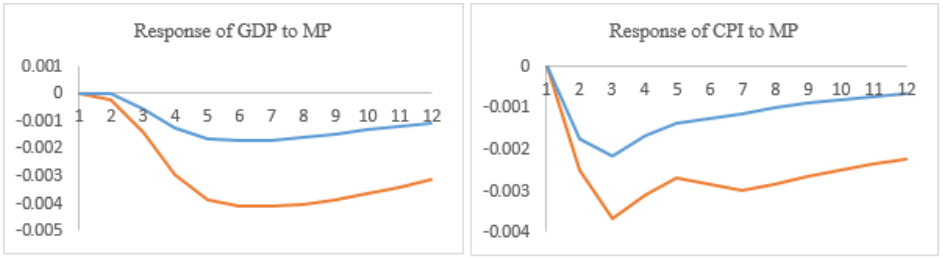


Sri Lanka (d)

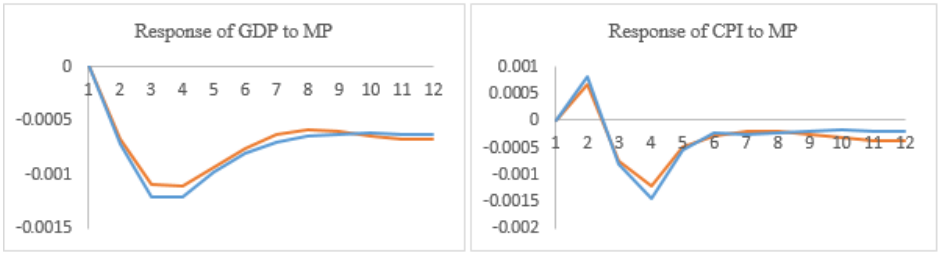


In the 1st two quarters, the response of GDP to contractionary MP shocks (with and without exogenizing *er*) is quite similar, suggesting that the exchange rate channel starts to work from the 3rd quarter after the MP tightening in India. After that, the GDP response to MP shock is little different in both models. The response of GDP to this MP shock accounts for 9% in 1st year, 8% in the 2nd year and 4% in the 3rd year. Similarly, the left panel of Fig. 4(c) illustrates the impulse response function in the context of Bangladesh (with and without exogenizing the *er).* In the 1st quarter, the response of GDP to MP shocks in both models is quite similar, suggesting that the exchange rate channel starts to work from the 2nd quarter after the MP tightening in Bangladesh. The fluctuation in GDP after the contractionary MP shock is around 29% in 1st year, 11% in the 2nd year and only 1% in the 3rd year. The left panel of Fig. 4(d) shows the impulse response of GDP to MP shock in the context of Sri Lanka. The extended SVAR model shows that this response is quite different from benchmark SVAR from the 1st quarter, suggesting that the exchange rate channel starts to work from the very 1st quarter in case of Sri Lanka. The impulse response functions depicts that the total fluctuation in GDP after the contractionary MP shock is around 13% in the 1st year, 70% in the 2nd year and 67% in the 3rd year. Further, the results show the stronger magnitude of exchange rate channel in case of Pakistan and Sri Lanka as compared to Bangladesh and India and the result is in line with the studies of (Hussain *et al.*, 2009; Zahid *et al.*, 2021). Similarly, the importance of exchange rate channel in Pakistan and Sri Lanka is also in line with the study of Khan & Ahmed (2016). By the same token Perera (2013) also found the importance of exchange rate channel along with interest rate and credit channel in Sri Lanka. The right panel of Fig 4 (a-d) in the extended SVAR model depicts the reaction of CPI to the MP shock in the same pattern for all SAARC countries except Bangladesh. In case of Bangladesh, the response of CPI to MP shocks is in the U-shaped before moving towards the baseline level. Similarly, the evidence of price puzzle is still not obvious in SAARC economies. Moreover, it can also be examined that in case of India, after endogenizing *er,* there is still no improvement in price puzzle for the first two quarters.

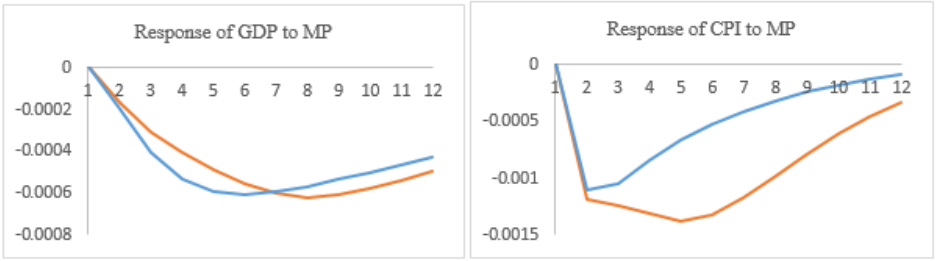
Fig.4: Pakistan (a)



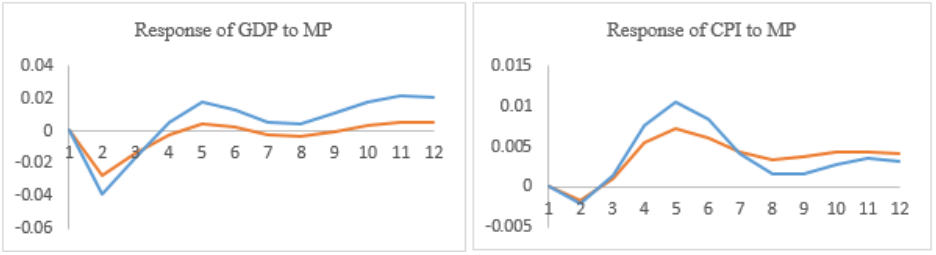
India (b)



Bangladesh (c)



Sri Lanka (d)

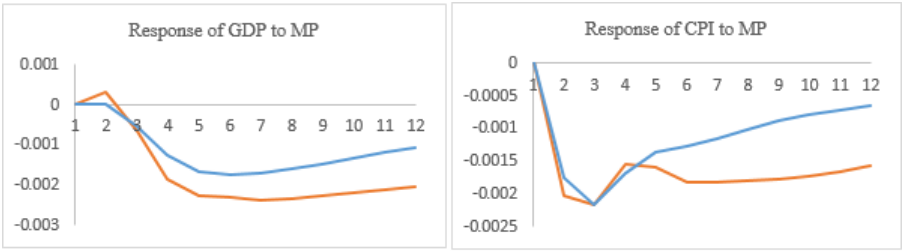


4.4 Asset Price Channel

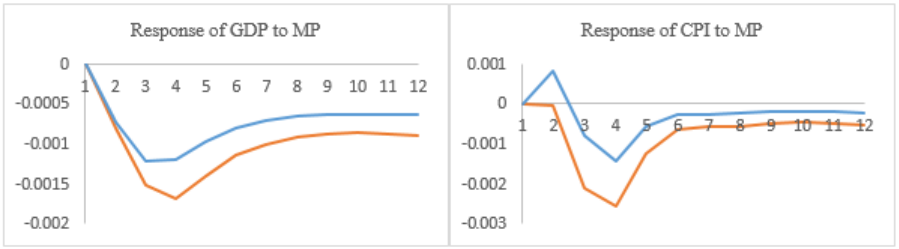
The asset price channel affects the aggregate demand through further two channels: the Tobin's q theory of investment and the wealth effect on consumption (Yemba *et al*, 2020). It also explores the impact of innovation in MP on households' wealth and spending. These two practices bring changes in aggregate demand by affecting output and prices and it is referred as Tobin's q theory. The asset price channel works through real and financial price of assets. For instance, a contractionary MP triggers the interest rate to rise resulting an increase in return on bank deposits as compared to return on any other assets i.e., real estate, bonds, and stocks. The low return on these assets causes a reduction in demand of these assets which eventually decreases the price as well as the wealth of these assets' holder as compared to deposits. This complete phenomenon decreases the demand of goods and services in the economy. The left panel of Fig.5 shows the estimated response of asset price channel in MPTM over the period 2005Q1-2020Q4. The results depict the estimated response of GDP to contractionary MP shock when *st.index* is treated as endogenous (orange line) in the extended SVAR model and as exogenous (blue line) in the basic SVAR model. The latter effectively blocks off the MP effect through asset price channel. The response of GDP to contractionary MP shocks in both models provides the rough picture of the strength of asset price channel of MPTM in SAARC countries. The response of GDP to MP shocks (with and without exogenous of st.indexs) is quite different in the 1st quarter of the left panel of Fig. 5(a), suggesting that the asset price channel starts to work from the 1st quarter after the MP tightening in Pakistan. The response of GDP to this MP shock starts to dissipate from the 1st quarter (without taking *st.index* as exogenous), suggesting that the importance of asset price channel in Pakistan. The total response of GDP to contractionary MP shock accounts for 18% in the 1st year, 26% in the 2nd year and 32% in the 3rd year. Similarly, the left panel of Fig. 5(b) illustrates the impulse response of GDP to contractionary MP shock in Indian context. In the 1st two quarters, the response of GDP to contractionary MP shocks (with and without exogenous of *st.index)* is quite similar, suggesting that the asset price channel starts to work from the 3rd quarter after the MP tightening in India. After that, the response of GDP to contractionary MP shock is different in both models, suggesting the importance of asset price channel in India. The response

of GDP to contractionary MP shock accounts for 21% in 1st year, 25% in the 2nd year and 26% in the 3rd year. Similarly, Fig. 5(c) illustrates the impulse response function in the context of Bangladesh (with and without exogenous of *st.index*). In the 1st quarter, the response of GDP to contractionary MP shock in both models (with and without exogenizing of *st.index*) is quite similar, suggesting that the exchange rate channel starts to work from the 2nd quarter after the MP tightening in Bangladesh. The fluctuation in GDP after the contractionary MP shock is around 12% in 1st year, 3% in the 2nd year and 6% in the 3rd year. Fig. 5(d) shows the impulse responses of GDP to MP shock in the context of Sri Lanka. The extended SVAR model shows that the response of GDP to contractionary MP shock is almost similar to benchmark SVAR in the first 3 quarters, suggesting that asset price channel starts to work from the 4th quarter in case of Sri Lanka. The impulse response function also shows that the total fluctuation in GDP after the contractionary MP shock is 37% in the 1st year, 36% in the 2nd year and only 4% in the 3rd year. Further, the results show that the magnitude of asset price channel in Pakistan, India and Sri Lanka is stronger than that in Bangladesh. Overall, the results show that the asset price channel is not the dominant channel in SAARC countries and the result is in line with the previous studies of (Agha *et al.,* 2005; Aleem, 2010). The right panel of Fig 5 (a-d) depicts that CPI response to the contractionary MP shock looks similar for all SAARC countries except for Pakistan. In our benchmark model, holding *st.index* as an endogenous variable, instead of V-shaped response as in our benchmark model, it becomes almost flat after the 4th quarter and moves slowly towards the baseline level. Similarly, the evidence of price puzzle is still not obvious in SAARC economies. Moreover, it can also be examined that in case of India, after endogenizing *st.index*, we find the improvement in price puzzle and there is no more empirical evidence of price puzzle.

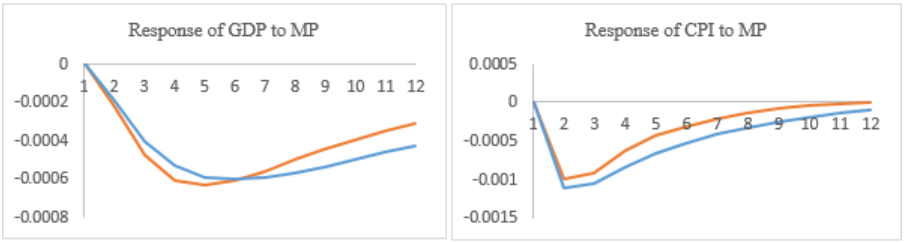
Fig.5: Pakistan (a)



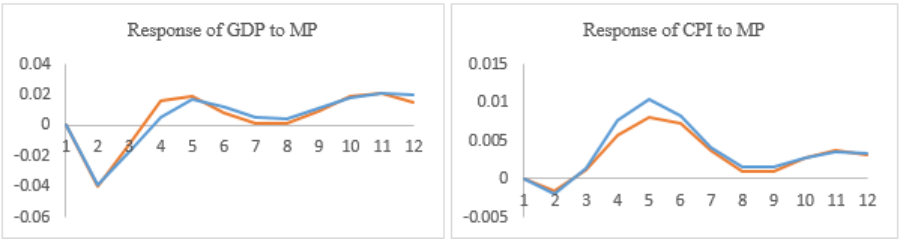
India (b)



Bangladesh (c)



Sri Lanka (d)



4.5 Variance Decomposition Analysis

The results of variance decomposition of MPTM channels over the period of 12-time horizon are shown in table 2 and 3. Since this study has analyzed the individual impact of each channel on GDP and CPI, therefore discussion is restricted to the variance decomposition analysis of each channel in the context of Pakistan, India, Bangladesh, and Sri Lanka.

The results in table 4 show that exchange rate channel of MPTM bring more variation in GDP over the period of 12-time horizons in Pakistan. Similarly, credit channel plays an important role to explain the variation in CPI. In India, variation in real GDP and CPI is mainly explained by the credit and exchange rate channels, respectively during the given time. However, real GDP variation in Bangladesh and Sri Lanka is mainly contributed by credit channel during the whole period whilst asset price channel is also an important channel in Sri Lanka to explain the total variation in real GDP. On the other hand, variation in inflation in case of Bangladesh and Sri Lanka are mainly explained by exchange rate and credit channels, respectively. Generally, the study finds a stream of mixed findings as the MP shocks are transmitted to the real economy through variety of different transmission mechanisms. Our results indicate that the credit channel is the stronger channel in the selected SAARC countries except Pakistan and India. The possible explanation about the importance of credit channel is to gain external financing through bank credits. The dependence of external financing on bank credits is mainly due to the underdevelopment of the capital market. The credit channel of Bangladesh and Sri Lanka shows a good financial system in these countries and the result is in line with the study of (Afrin, 2017). In case of Pakistan, the pulses of MP are transmitted through exchange rate channel. This outcome has the justification that there may be incompetency in exports as any inflationary supply shock has negative impact on exchange rate that causes the export demand to decrease and results in decline of total output. It can be concluded that exchange rate fluctuations have caused severe challenges in Pakistan (Zahid *et al.,* 2021).

5. Conclusions and Recommendations

The transmission mechanism of MP has recently gained considerable attention from researchers and policymakers of different economies. A vast body of literature has analyzed the role of MPTM in different economies but so far, there is lack of empirical evidence exists to analyze the individual impact of each channel of MPTM in SAARC countries. The study fills the gap in the existing literature by providing the empirical evidence of the relationship between aggregate output (GDP and CPI) and the channels of MPTM in SAARC countries. To analyze the results, the study has compared the outcomes of basic SVAR model with the extended SVAR model. The findings show that the exchange rate channel is relatively the most important channel of MPTM in Pakistan and Sri Lanka. The importance of exchange rate channel in Pakistan and Sri Lanka is mainly due to their more reliance on imports as compared to exports. So, any change in MP has immediate impact on GDP and prices through the fluctuation in exchange rate. Whilst interest rate channel and the credit channel are the dominant source of fluctuation in India and Bangladesh, respectively. The results of the study suggest that the asset price channel is the least important channel of MPTM in SAARC countries. Similarly, the results also show that there is no evidence of price puzzle in SAARC economies for short term. The findings of our study offer important implications for researchers and policy makers to design and implement effective MP framework for SAARC economies. It also provides some important policy implications for the role of banks in MPTM in India and Bangladesh where credit channel is the most dominant channel.. The dominance of credit channel in these countries suggests that central bank should enhance credit market functioning, strengthen bank resilience during shocks and support financing facilities. Similarly, the study also provides the important policy implications for the role of exchange rate in Pakistan and Sri Lanka where exchange rate channel is the most dominant channel. The importance of exchange rate channel in Pakistan and Sri Lanka suggests that the central bank of these countries may target exchange rate to stabilize output and inflation. Similarly, due to the effectiveness of exchange rate channel in Pakistan and Sri Lanka, central banks of these particular countries should allow the exchange rate to act as a shock absorber which significantly strengthens

the overall monetary policy effectiveness. The identification of transmission channels of MP is very important to set an effective MP with an efficient set of policy instruments by the central banks in SAARC countries. The study also indicates that like European Union, SAARC economic union can be created by SAARC countries to provide benefits inside and outside of ASIA. Similarly, the study suggests that SAARC monetary union can significantly enhance MPTM in South ASIA by eliminating the exchange rate risk and uncertainty, integrating financial markets, enhancing credibility and policy coordination across region and the stronger interest rate pass through in SAARC countries. It also lays foundation for other regional and international organizations (OIC, European Union) to adopt same monetary environment for monetary policy effectiveness and coordination among countries.

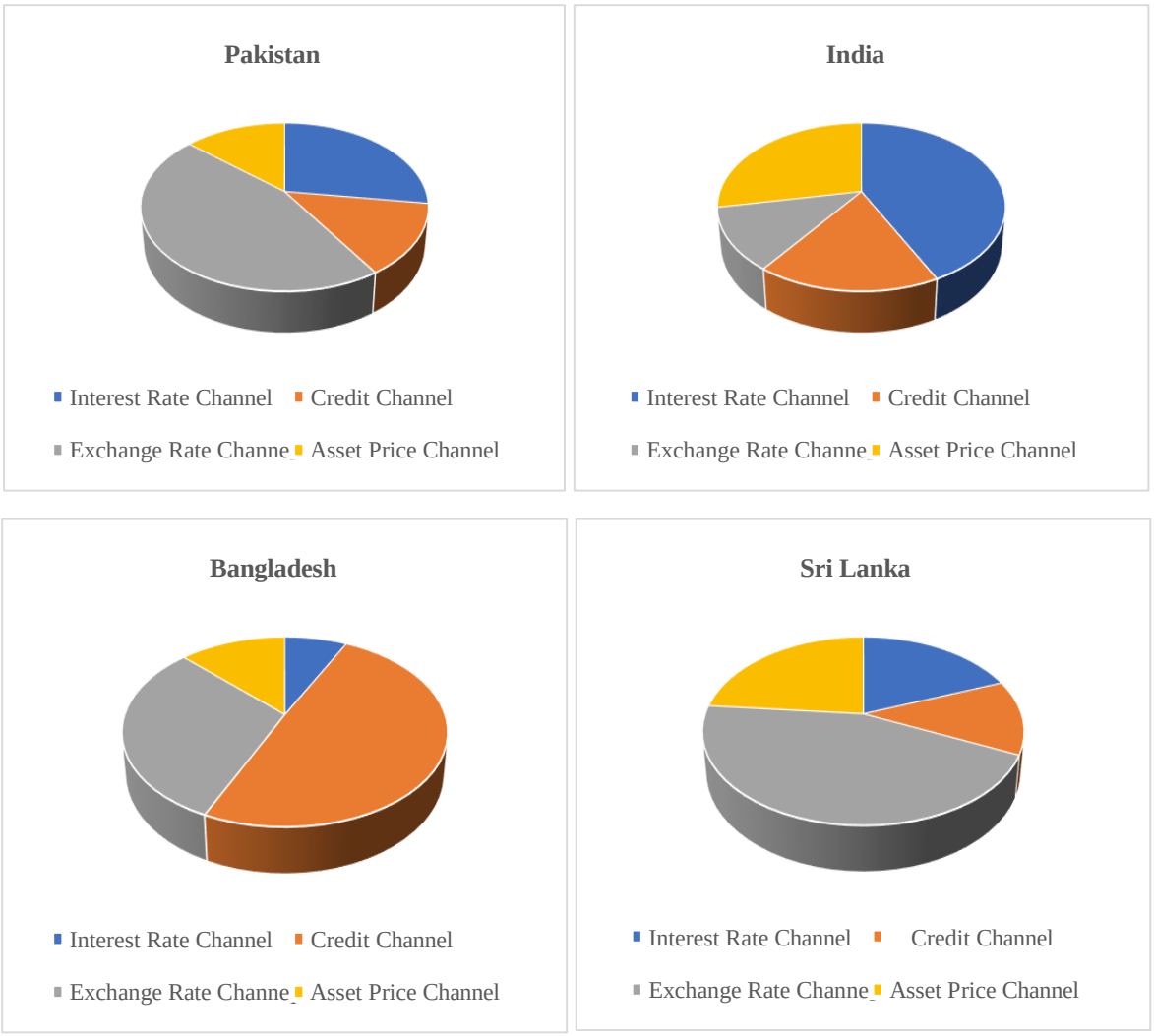
Table.3: Variance decomposition of GDP

Country	Quarters	Interest Rate Channel	Credit Channel	Exchange Rate Channel	Asset Price Channel
Pakistan	1	0	0	0	0
	4	1.009517	0.595263	1.159837	0.130877
	8	2.027658	1.851098	5.674316	0.390086
	12	1.725041	2.17957	6.68712	0.61685
India	1	0	0	0	0
	4	6.239689	2.18E-09	0.109836	0.355032
	8	3.441987	2.93E-09	0.528192	0.530011
	12	2.450492	2.78E-09	0.889119	1.098198
Bangladesh	1	0	0	0	0
	4	0.44136	1.80239	0.546561	1.556973
	8	0.749694	7.21741	3.977511	3.54758
	12	0.854103	10.11016	4.754355	4.411401
Sri Lanka	1	0	0	0	0
	4	2.590567	3.77823	0.648443	4.549343
	8	2.795236	5.813486	1.029805	5.083532
	12	4.094407	6.893101	1.659229	5.739276

Table.4: Variance decomposition of Inflation

Country	Quarters	Interest Rate Channel	Credit Channel	Exchange Rate Channel	Asset Price Channel
Pakistan	1	0	0	0	0
	4	3.533274	2.192716	0.067111	2.010724
	8	3.83257	5.467328	1.091043	3.151747
	12	3.464015	6.370134	2.220007	2.883021
India	1	0	0	0	0
	4	7.678692	6.55E-10	7.677627	0.286407
	8	6.471172	7.47E-10	12.65051	0.695731
	12	6.39002	7.53E-10	12.8447	0.738461
Bangladesh	1	0	0	0	0
	4	0.594926	3.695332	18.83887	0.293849
	8	5.362024	12.81738	33.07962	0.290441
	12	8.181945	16.20978	33.91753	0.284217
Sri Lanka	1	0	0	0	0
	4	0.189127	6.757511	0.413862	4.613808
	8	1.356348	13.02896	2.163691	8.359594
	12	3.01704	14.04538	3.976358	8.856534

Figure 6: Summary of Results



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Appendix 1 Unit Root test

	ADF			PP	
Countries	**Variables**	**Level**	**1st Difference**	**Level**	**1st Difference**
Pakistan	*lngdp*	-1.2859	-1.4077*	-2.3882	-2.6971*
	lncpi	-1.387	-3.964***	-1.687	-3.951***
	lnms	-2.188	-8.242***	-2.326	-8.251***
	ir	-2.317	-5.388***	-2.693*	-5.311***
	er	0.289	-3.805***	0.045	-7.223***
	ffr	-1.112	-6.349***	1.506	-6.537***
	lnwop	-2.436	-8.067***	-2.436	-8.400***
	lncredit	-1.227	-4.786***	-1.504	-4.751***
	lnst.index	-1.002	-7.236***	-1.023	-7.236***
	dr	-3.0396**	4.3856***	-3.5772***	-3.4599**
India	*lngdp*	-2.0044	-1.846	-5.0271***	-1.9163
	lncpi	-3.7574***	-4.4720***	-2.9765*	-4.5039***
	lnms	-5.7817***	-2.1466	-7.0705***	-7.1718***
	ir	-2.3040	-6.9804***	-2.1066	-9.0495***
	er	0.1874	-5.6599***	0.1913	-5.4518***
	ffr	-1.9404	-6.1182***	-1.8325	-6.3037***
	lnwop	-2.2811	-7.6803***	-2.3282	-8.0516***
	lncredit	-6.4562***	-2.4344	-5.4124***	-4.9220***
	lnst.index	-1.7846	-7.2695***	-1.7871	-2.2664***
	dr	-1.6864	-7.8497***	-1.6532	-8.1248***

Figures in parenthesis represent: p- statistics *** Significant at 10%; ** significant at 5%, * significant at 1%; Source: Authors 'estimates

Appendix 1 **Unit Root test**

	ADF			PP	
Countries	**Variables**	**Level**	**1st Difference**	**Level**	**1st Difference**
Bangladesh	*Lngdp*	-0.2294	-2.2756*	0.3394	-2.7913*
	lncpi	-2.2153	-5.9551***	-2,1159	-5.8991***
	lnms	-3.4340**	-7.0811***	-3.4695**	-7.3968***
	ir	-1.8861	-7.2733***	-1.9832	-7.2716***
	er	-1.6551	-7.3617***	-1.6541	-7.4262***
	ffr	-1.1121	-6.3493***	1.506	-6.537***
	lnwop	-2.436	-8.067***	-2.436	-8.400***
	lncredit	-2.7534*	-2.7442*	-2.9367**	-4.6523***
	lnst.index	-4.8250***	-14.3761***	-4.9391***	-15.2828***
	dr	-1.6857	-5.5459***	-1.5486	-5.4919***
Sri Lanka	*Lngdp*	-0.8369	-10.4415***	-0.9280	-10.4415***
	lncpi	-3.7332***	-4.3324***	-3.2869**	-4.3324***
	lnms	-0.9875	-6.7528***	-0.9244	-6.8242***
	ir	-2.1761	-3.7941***	-2.1066	-3.6284***
	er	0.3867	-5.4971***	0.4985	-5.2791***
	ffr	-1.9890	-5.9694***	-2.1704	-6.1510***
	lnwop	-2.2363	-7.5084***	-2.2363	-7.7887***
	lncredit	-1.3584	-5.1298***	-1.5700	-5.1240***
	lnst.index	-2.5460	-7.7036***	-2.3685	-9.0754***
	dr	-4.8939***	-3.3516**	-2.3008	-2.5216

Figures in parenthesis represent: p- statistics *** Significant at 10%; ** significant at 5%, * significant at 1%; Source: Authors 'estimates

Appendix 2. Description of variables

Variables		Description	Sources
Foreign Variables	World oil price	Control variables for international economic events	International financial statistics
	Federal fund rate		US Energy Information Agency (EIA)
Policy Variable	Interest Rate	Interbank offered interest rate as an instrument of monetary policy	International financial statistics
Channels of monetary policy transmission variables	Stock Exchange Index	Proxy variable of asset price channel	Stock exchange/ https://www.investing.com/
	Deposit Rate	Proxy variable of interest rate channel	International financial statistics
	Exchange Rate	Proxy variable of exchange rate channel	International financial statistics
	Credit	Total private credit (loans) Proxy variable of credit channel	International financial statistics
	GDP		International financial statistics
Macroeconomic Variables		$\frac{Y_t - Y_{t-1}}{Yt-1} \times 100$	
	Inflation (CPI)	As reported by central bank	International financial statistics
	Money Supply	Broad money	International financial statistics