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## The Role of Monetary Policy in Transmission of Asset Prices into Goods Prices

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### ABSTRACT

*Monetary policy in the contemporary world reacts, through short term interest rate, to deviations of inflation rate and output from their respective targets, while asset prices are responded to the extent they contribute to these deviations. This practice significantly affects transmission of asset prices into goods prices, which has serious implications for income distribution. This paper sets the objectives of estimating transmission of asset prices into goods prices and the role of monetary policy in influencing this transmission. In this regard, the paper hypothesizes that inflation rate positively responds to asset prices and this response weakens if interest rate leans against the winds of inflation, output and asset prices. To test these hypotheses, we have estimated different specifications of vector autoregressive (VAR) model and impulse response functions have been found after identifying structural shocks. Data of Pakistan's economy on inflation rate, large scale manufacturing index, interest rate and asset price index – comprising house prices, stock prices and exchange rate – are used for the time period 2000m01 to 2019m06. We find evidence in support of both hypotheses; asset price inflation positively transmits into goods price inflation and this transmission intensifies if interest rate does not respond to other variables in the model. Moreover, transmission of asset prices into inflation rate, as compared to output, is influenced more by monetary policy. Finally, we find that the transmission of exchange rate and house prices to inflation rate are very much affected by monetary policy while in case of stock prices the influence of policy is moderate.*

### Keywords

Asset Prices,  
Inflation rate,  
Structural Vector  
Autoregressive  
(SVAR) Model

### JEL

**Classification**  
E31, E44

## 1. Introduction

The quantitative strength of asset price channel in the transmission of monetary policy depends on how much policy affects asset prices and the contribution these prices make in shaping the target variables – inflation rate and output. Three of the asset prices – stock prices, real estate prices and exchange rate – are most affected by changes in monetary

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policy instrument and in turn these prices influence the paths of inflation rate and output. Asset prices affect target variables via their interim effect on a number of variables such as, Tobin's  $q$ , cost of credit, net worth of firms and banks, probability of households being financially distressed, household wealth, and competitive position of a country in international trade (Modigliani, 1971; Bosworth, 1975, Hayashi, 1982, Bernanke and Gertler, 1995; Steindel, Lettau and Ludvigson, 2001; Mishkin, 2001).

The debate on whether or not central banks should take asset prices as part of their policy reaction function, when loss function is defined over deviation of inflation rate from its target and that of output from its potential level with the knowledge that asset prices affect these deviations, occupies significant place in the literature. For example, Cecchetti, et al. (2000) warned against asset price bubbles, which when collapse are damaging to real economic activity, and argue for active role of monetary policy to contain bubbles from building. However, this is possible only if central bankers have informational advantage, asset prices are predominantly driven by monetary policy and central banks have mandate to do that (Mishkin, 2001). Most of the studies like Goodhart and Hofmann (1998), Bernanke and Gertler (1999), Filardo (2001), Issing (2003), and Svensson (2011) argue for indirect response of monetary policy to asset prices; central banks react to changes in asset prices when these are reflected in goods price inflation (or inflation forecast), which is a target variable in policy reaction function. This recommendation is practiced by most of the central banks.

Existing literature considers asset prices as mediating variable in the transmission of monetary policy to target variables. However, variation in asset prices can be driven by many factors and monetary policy instrument is one of them. For instance, stock prices fluctuate in response to drivers of economic growth, all sort of shocks that change the investors' willingness to take risk, and shocks that change income distribution between workers and shareholders (Greenwald, Lettau, and Ludvigson, 2014). Hence, it is needed to estimate the responses of goods prices and economic activity to shocks in asset prices, no matter what are the sources of asset price fluctuations. This is important because changes in monetary policy instrument interact with other sources of asset price fluctuations while affecting asset prices and in turn inflation and output. Moreover, if there is change in asset prices, which may be because of a factor independent of monetary policy, then economic activity and inflation tend to change. This calls for a change in monetary policy instrument but recommendation of such intervention crucially depends on the knowledge of whether or not systematic monetary policy remains successful in weakening the effect of asset prices on inflation and output; this necessitates estimation of the moderating role of monetary

policy in the transmission of asset prices to goods prices and economic activity<sup>2</sup>. Furthermore, knowledge of moderating role of monetary policy is essential for future work in the area of monetary policy and income distribution. Goods prices are reward to producers in the production process while the same are deflator of assets or wealth and wages of workers; thus increase in goods prices may increase producers' profits but deflate assets, especially the ones that are unrelated to producers' profits.

In this paper, we state that changes in asset prices are transmitted into goods prices and monetary policy, the way it is practiced, can affect this transmission. When there is increase in asset prices then goods prices tend to increase via wealth channel, Tobin's  $q$ , or balance-sheet channel. Monetary policy then controls inflation through discouraging aggregate demand, damaging some economic activity. Therefore, when increase in asset prices trigger aggregate demand through Tobin's  $q$  or wealth and balance sheet channels, central banks create a parallel opposing force through increasing interest rate. This opposing force makes transmission of asset prices to goods prices slow and incomplete. Therefore, in a model, which allows reaction of monetary policy instrument to target variables, response of goods prices to asset prices is found weaker compared to the case when policy variable is super exogenous<sup>3</sup>.

The objectives of this paper are twofold. Firstly, the paper estimates transmission of asset prices into goods prices for Pakistan's economy. The existing literature of Pakistan economy mostly focuses on finding whether or not stock prices provide hedge against goods price inflation<sup>4</sup> or estimating the pass-through effect of exchange rate into goods prices<sup>5</sup>; the real estate sector is largely ignored<sup>6</sup> and there is dearth of research on transmission of stock and house prices into goods prices. The second objective is to estimate the extent to which monetary policy remains successful in diluting this transmission. The existing literature of Pakistan economy estimates the mediating role of asset prices in the transmission of monetary policy into target variables<sup>7</sup> but does not consider the moderating role of policy in transmission of asset prices into goods prices. For these two objectives we use Structural

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<sup>2</sup> Shiratsuka (1999) states that Japanese economy experienced large fluctuations in asset prices and economic activity, but inflation remained stable. This points to moderating role of monetary policy, though the study does not estimate such role.

<sup>3</sup> Super exogeneity entails absence of reaction of policy instrument to target variables at all lags, including zero.

<sup>4</sup> (See, Tiwari, et al. 2015; Shahbaz, Islam and Rehman, 2016 and Ali and Wahid, 2019)

<sup>5</sup> (See, Choudhri, et al. 2005; Hyder and Shah, 2005; Jaffri, 2010; Younus and Yucel, 2020)

<sup>6</sup> Shafiq and Malik (2018) is the only exception.

<sup>7</sup> See for instance, Agha et al. (2005)

Vector Autoregressive (SVAR)<sup>8</sup> model for Pakistan's economy and estimate impulse response functions.

We claim two contributions of our paper in the existing literature with regards to Pakistan's economy. First, we estimate the role of monetary policy in weakening the transmission of asset prices into goods prices. For this, two VAR models have been estimated; one in which monetary policy instrument does not respond to other variables in the model while in the second it does. We find significant role of monetary policy in fading the transmission. Second, we take prices of three assets, namely stocks, housing, and foreign exchange<sup>9</sup>. We estimate the responses of inflation rate and economic activity to changes in these three asset prices, while previous literature focuses only on pass-through effect of exchange rate into inflation.

It is noteworthy that scope of this paper is delimited to estimation of the transmission of asset prices to goods prices and economic activity and the moderating role of monetary policy in this transmission. The paper is not focused on identifying any specific channel through which this transmission occurs. In the same way, the paper does not estimate the effects of monetary policy on income distribution that occur due to moderating role of policy, though the paper offers an opportunity for future research to look into this issue.

Rest of the paper proceeds as follows: section 2 discusses some theoretical linkages from existing literature that support our empirical estimation; section 3 elaborates methodological issues, construction of variables and data sources; section 4 explains empirical findings; and section 5 concludes the paper.

## **2. Theoretical Framework**

Theoretically, there are some channels through which changes in asset prices are transmitted into goods prices or the latter responds to changes in the former. In this regard, transmission channels of equity prices and house prices are different to those of exchange rate. Equity and house prices affect goods prices in three important ways. First, equity and housing occupy significant share of consumers' wealth. Therefore, an increase in prices of these assets translates into higher wealth, which encourages aggregate demand to rise thereby causing an increase in goods prices. The quantitative strength of this wealth channel hinges on proportion of equity and housing in total wealth and consumers' propensity to consume out of these two assets (see for instance, Friedman, 1953; Ando and Modigliani, 1963; Bover and Muellbauer, 1989; Girouard and Blondal, 2001). Second, increase in value of equity or housing that markets attach to these assets may cause this value to be higher

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<sup>8</sup>It must be mentioned at the outset that after estimating reduced form VAR we have used Choleski Decomposition to identify structural shocks and estimate impulse response functions

<sup>9</sup>We follow Shafiq and Malik (2018) for constructing series on house price index and asset price index

than replacement cost of capital or construction cost of housing. This makes attractive for firms to raise capital from market and invest in these assets. This Tobin's q channel is related to investment (Tobin, 1969) as opposed to wealth channel that works through consumers' expenditure. Third, changes in asset prices may transmit into goods prices through credit channel. Asymmetric information between borrowers and lenders lead to adverse selection and moral hazard problems and limit the credit expansion. Increase in asset prices improves balance sheet of households/firms causing credit expansion through increase in the value of collateral. Extended credit fuels into higher aggregate demand and in turn into higher goods prices (Bernanke and Gertler, 1995).

Exchange rate also affects goods prices in four different ways. First, higher exchange rate leads to lesser value of domestic currency as compared to foreign currency and therefore makes locally manufactured finished goods more attractive for both domestic consumers and foreigners while discourages imports. Higher net exports then expand aggregate demand for locally manufactured finished goods and therefore result in higher domestic prices of goods and services (See for instance, Dornbusch, 1976). Second, higher exchange rate increases prices of imported raw material or intermediate products, which result in higher cost of production leading to lesser supply of locally manufactured finished goods if demand is elastic or in higher prices of finished goods if demand is inelastic. Third, if imports and exports are less elastic, especially in the short run, then higher exchange rate results in higher value of imported goods thereby causing an increase in the cost of consumers' basket. This induces labor to demand higher wages, which, if actually increase, results in higher cost of production (Obstfeld and Rogoff, 2001; Engel, 2002). Fourth, *balance sheet channel*, which is especially relevant for emerging economies, states that higher exchange rate leads to higher liabilities, denominated in foreign currency, of domestic firms and therefore decreases the *net worth* if assets are denominated in domestic currency. This limits borrowing capacity of domestic firms and discourages economic activity thereby putting lesser pressure on goods prices to increase.

The transmission of changes in asset prices into goods prices can be significantly influenced by monetary policy. Most of the literature in this field focuses only on whether or not monetary policy should target asset prices. For example, Cecchetti, et al. (2000) suggest active role of monetary policy in containing asset prices as asset price bubbles, when bursts, may cause subsequent disruption in real economic activity<sup>10</sup>. This suggestion hinges on informational advantage of central banks, their mandate to contain asset prices, and significance of the role that monetary policy can play in determining asset prices (Mishkin,

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<sup>10</sup> Asset price bubbles, if they are left unattended, cause slowdown in economic activity when burst. This hypothesis gained much importance after Global Financial Crisis, when Minsky's (1986) theory was revitalized.

2001). Kontonikas and Ioannidis (2005) conduct stochastic simulations using inflation forecast targeting and standard Taylor rule; they find that macroeconomic performance can be improved by making interest rate responsive to asset prices. Goodhart and Hofmann (1998), Bernanke and Gertler (1999), Filardo (2001), Issing (2003), and Svensson (2011), on the other hand, advocate indirect response of monetary policy to asset prices; central banks react to changes in asset prices only when these are reflected in goods price inflation

– a target variable in the policy reaction function. Similarly, Reinhart (1998) states that targeting asset prices by making it part of reaction function is not desirable as relationship between asset prices and inflation rate may not remain stable if monetary policy tries to exploit it. Papademos and Stark (2010) raise some practical concerns regarding leaning against the wind of asset price surges. It is difficult to differentiate between surges of asset prices that are driven by fundamentals and those that are speculative. However, monetary aggregates and credit expansion can be used as early warning alarms for asset price bubbles as historical data show significant correlation among money, credit and asset prices.

In this paper, we focus on the moderating role of monetary policy on the transmission of asset prices into goods prices and economic activity. When central banks target asset prices then they can keep bubbles from building thereby saving economic activity to be hurt by bursting of asset price bubbles<sup>11</sup>. For instance, Kent and Lowe (1998) conclude that monetary policy should take contractionary measures in response to an emerging asset price bubble. This policy action aims at bursting the bubble before it becomes large and cause disturbance in the economic activity. They call this action an optimal response to asset price bubble even if it causes inflationary expectations to be lower than the target. On the other hand, when asset prices do not directly appear in the policy reaction function and central banks respond only to deviations of goods price inflation and economic activity from their respective targets then policy response to asset price bubble is delayed until it is reflected in inflation or at least in its forecast. This policy makes asset prices and economic activity much more volatile as compared to goods price inflation<sup>12</sup>. Hence, monetary policy allows asset prices to increase in response to positive shock in asset market but does not allow inflation rate to gain momentum, thereby weakening the transmission of asset prices into goods prices. In this case, in a model with systematic response of monetary policy instrument to target variables, the effects of asset prices on goods prices are found weak. This provides rationale for estimating response of goods prices and economic activity to asset prices in a model in which policy instrument does not systematically respond to any

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<sup>11</sup> However, targeting asset prices may itself render economic activity unstable (Bernanke, Laubach, Mishkin and Posen, 1999).

<sup>12</sup> Shiratsuka (1999) mentions this regarding Japanese economy in 1980s.

of the target variables. Theoretically, such response would be higher in magnitude as compared to the case in which monetary policy is actively used as state contingent rule.

### **3. Econometric Methodology**

In line with the objectives set in this paper, we need to identify structural shocks in asset prices that are orthogonal to other variables in the model. There are two methods to identify these shocks; finding residuals from single equation in which concerned variable is regressed on relevant variables along with their lags or finding structural errors from SVAR model using certain identifying restrictions. First approach requires valid instruments for endogenous variables to find consistent estimates of parameters, while the second approach needs identifying restrictions to be placed on structural parameters. While both methods make some arbitrary assumptions regarding valid instruments and sequencing of variables in a dynamic setup, the second method is mostly used in the literature due to its appealing features. VAR models treat all variables as endogenous and then sequencing of variables in dynamic setup can be imposed to identify structural shocks.

There are other considerations that need to be discussed for the choice of appropriate model. For instance, a priori knowledge about exogeneity of the regressor of interest is helpful in identifying the response of dependent variable to that regressor in an Autoregressive Distributed Lag (ARDL) framework. However, if exogeneity is not known or the concerned regressor is contemporaneously responsive to other variables in the model, then SVAR model is the suitable option. Another issue is regarding the order of integration. If scope of the study is to find level relationship in the long run and order of integration of variables is not known with certainty then ARDL model provides suitable way to find cointegration among variables and estimate legitimate long run relationship. However, if interest is not in estimating values of parameters and there is uncertainty regarding exogeneity of variable of interest then SVAR is more relevant model to use.

In this paper, the objective is to find structural shocks in asset prices and then estimate the dynamic response of inflation and output to these shocks. Consistent with the literature, we assume asset prices to respond contemporaneously to other variables (interest rate and output) and therefore do not treat asset price index as weakly exogenous. Moreover, we have three variables measured as percentage growth rates, which are less likely to be integrated of order greater than zero. Therefore, we use SVAR model to satisfy objectives set in the paper.

To estimate the effects of asset prices on inflation rate (and output), we have used structural VAR model containing four variables:

$$Bx_t = B_0 + \sum C_i x_{t-i} + \varepsilon_t \text{-----} \quad (1)$$

Here,  $B$  is a matrix of contemporaneous response coefficients,  $x_t$  is a vector of endogenous variables, (inflation rate, output, asset prices and interest rate),  $C$  is a matrix of coefficients attached to lagged endogenous variables, and  $\varepsilon_t$  contains zero mean, constant variance and serially and contemporaneously uncorrelated structural shocks.

The above system of equations can be converted into reduced form VAR as:

$$x_t = A_0 + \sum A_i x_{t-i} + e_t \text{ ----- (2)}$$

Here,  $e_t$  consists of one step ahead forecast errors with zero mean and constant variance. These errors are serially uncorrelated but may be contemporaneously correlated.

Our objective in this paper is to estimate the effects of shocks in asset prices on inflation rate (and output). For that we estimate the model in equation (2) and then use estimated parameters of these equations to identify structural parameters and recover structural shocks from the system of equations (1) by imposing appropriate restrictions on structural parameters.

The moving average representation of VAR in equation (2) is given as:

$$x_t = B(L)e_t \text{ ----- (3)}$$

$B(L)$  denotes the matrix of coefficients polynomial in the lag operator  $L$ , defined as  $B(L) = \sum_{i=0}^{\infty} b_i L^i$ .  $e_t$  can be written as linear combination of structural shocks as:

So VMA can be written in terms of structural shocks as:

$$x_t = B(L)S\varepsilon_t \text{ ----- (4)}$$

$$x_t = \Phi(L)\varepsilon_t \text{ ----- (5)}$$

Here,  $\Phi(L)$  represents impulse response functions.

### 3.1 Identifying Restrictions

Though the forecast errors,  $e_t$ , are estimated, the structural shocks,  $\varepsilon_t$ , need to be recovered. For that,  $n(n-1)/2$  restrictions are needed on  $S$  matrix to identify the system, where  $n$  is the number of variables in the VAR model. In our case, we need minimum six restrictions on structural parameters to identify VAR model. We allow sluggish response of monetary policy to all variables, which restricts three parameters to be zero. More specifically, interest rate is allowed to respond to all other variables in the VAR model only after lags and not contemporaneously. Monetary policy is either forward-looking or backward-looking. In the case of former, monetary policy responds to expected changes in



inflation rate and output. Future forecasts of these variables depend on their own current and lagged values and on current and lagged values of other variables. In this case, interest rate contemporaneously respond to other variables in the model. However, in developing economies prompt response of monetary policy to future forecasts is lacking due to time lags involved in data availability, less than complete operational autonomy of the central banks and economies being hit by frequent shocks. This inertia in policy decisions prevails even if considerable weight is given to inflation forecast in monetary policy committee's meetings. Sluggish response of monetary policy to target variables is consistent with Iacoviello (2005) and Sims and Zha (2006).

Inflation rate, on the other hand, responds contemporaneously to all other variables. This is somewhat unusual assumption if goods prices are sluggish to adjust. However, the way we constructed inflation rate (explained below), and the empirical finding that goods prices in Pakistan are not so rigid (see, Malik, Satti and Saghir, 2008; Chaudhary et al, 2016, Iqbal and Amin, 2019) justify this identifying restriction. In between these two extremes are placed output and asset prices with the assumptions that output contemporaneously responds only to interest rate<sup>13</sup> while asset prices contemporaneously respond to interest rate and output but not to inflation rate<sup>14</sup>. Though, asset prices can hedge savers against positive inflation in which case inflation rate should appear before asset prices but this channel has been found weak in Pakistan (see, Khan, 2004; Nishat and Shahieen, 2004, Sohail and Hussain, 2009, Zafar and Rafique, 2013, Hussain, Zaman and Ahmad, 2015; Qamri, Haq and Akram, 2015; Saleem, et al., 2015; and Muzammil et al. 2019). Placing output before asset prices and inflation reflects inertia in economic activity and is consistent with the empirical literature (see for instance, Christiano, Eichenbaum and Evans, 1999). Economic shocks hitting the economy are first absorbed by asset prices and inflationary expectations and then decisions about investment and consumption follow. Finally, placing asset prices after policy instrument is consistent with Choudhri, Jan and Malik (2015). That study however places goods market variables before interest rate; therefore, for sensitivity analysis, we change identifying restrictions and place output before interest rate – results largely remain same.

Based on these assumptions, we can write the system of equations (4) with zero restrictions on coefficients as:

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<sup>13</sup>This restricts two structural parameters to be zero.

<sup>14</sup>This restricts one structural parameter to be zero.

$$\begin{bmatrix} i_t \\ y_t \\ API_t \\ \pi_t \end{bmatrix} =_{\text{nd}} \begin{bmatrix} S_{11} & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} \end{bmatrix} \begin{bmatrix} \varepsilon^i_t \\ \varepsilon^y_t \\ \varepsilon^{API}_t \\ \varepsilon^\pi_t \end{bmatrix} \quad (6)$$

To estimate the effect of monetary policy on transmission of asset prices into goods prices, we modify the above baseline VAR model. Interest rate – monetary policy instrument – is taken as exogenous variable in the VAR model by disallowing it to respond to any other variable, contemporaneously as well as with lags. However, interest rate appears in equations of all other variables. In this specification, interest rate does not react to any of the target variables and policy is passive. The gap between impulse response functions of this counterfactual model and that of baseline VAR model is a measure of the role monetary policy plays in diluting the transmission of asset prices into goods prices.

A point of caution in the use of the term SVAR is in order here. As explained above, after estimating reduced form VAR we have used Choleski Decomposition to identify structural shocks and estimate impulse response functions and variance decomposition. Some researchers use the term SVAR only if structural shocks are identified through Sims-Bernanke or Blanchard-Quah methodologies. However, SVAR refers to a model in which dynamics of all variables are determined by their own lags and current and lagged values of other variables. Moreover, error terms in all equations are structural shocks that are not correlated across equations. Therefore, the term SVAR can be used if structural parameters and structural shocks are recovered from reduced form VAR using any of Sims-Bernanke, Blanchard-Quah or Choleski identifying restrictions.

### 3.2 Data and Construction of Variables

We measure output by Large Scale Manufacturing Index (LSM), which is available at monthly frequency and portrays fluctuations in aggregate economic activity. In the empirical model, annualized growth rate of this variable is used. Karachi Interbank Offered Rate (KIBOR) is used for short term interest rate. In Pakistan, money market rate is targeted by State Bank of Pakistan (SBP) through interest rate corridor system. This follows most of the studies in the literature, which use money market rate as proxy of policy variable (see Taylor, 1993; Thorbecke, 1997; Svensson, 1999; Bernanke and Mihov, 1998; Gali and Gertler, 1999, among others). Some studies (notably, Romer and Romer, 2004) use discount rate as policy variable but this proxy is not appropriate. In contemporary world, monetary policy committee sets an operating target for money market rate, which is contained by repo rate and reverse repo rate (discount rate). Central banks use different policy tools to keep money market rate close to the operating target. Discount rate signals stance of monetary policy and is upper bound for money market rate but central banks also use other tools, like

open market operation, to keep money market rate on target. In this case, discount rate does not portray complete picture of monetary policy actions. Moreover, in case of Pakistan, monetary policy committee meets after every two months and most of the times discount rate is not changed<sup>15</sup>. This makes discount rate inappropriate measure of monetary policy at monthly frequency. For instance, in our sample period, discount rate remained constant for many long episodes – July 2005 to June 2006, July 2006 to January 2008, November 2011 to August 2012, and June 2016 to December 2017.

We define inflation rate as year-on-year percentage change in non-house-rent consumer price index (CPI)<sup>16</sup>. We then adjust this inflation rate by a common factor measured as *factor score* using eight macroeconomic variables<sup>17</sup>. The inflation rate, which we use for our analysis, is the residual estimated from a regression of inflation rate, measured from non-house-rent CPI basket, on this *factor score*. This residual series carries all information regarding variation in goods price but the effect of large shocks that change the paths of macroeconomic variables, especially inflation rate. We follow Shafiq and Malik (2018) for construction of asset price index from equity/stock prices, house prices and exchange rate, and simulating house price index using house rent index. Data on house price index are available from January 2011 onwards on [www.zameen.com](http://www.zameen.com) website. Following Shafiq and Malik (2018) we estimate two variables VAR model comprising house price index and house rent index for the period 2011m01 to 2019m06 and then data on house price index for the period 2000m01 to 2010m12 are backcasted. Asset price index and individual asset prices are also used in terms of annualized percentage growth rates in empirical model.

We have used monthly data on output, inflation rate, asset prices and interest rate for the period 2000M01 to 2019M06. The data on exchange rate and stock prices are taken from International Financial Statistics (IFS). The data on CPI, LSM, and KIBOR are taken from monthly Bulletin of Statistics published by SBP. The data on House rent index is taken from Monthly Price Indices published by Pakistan Bureau of Statistic (PBS), which is then used to construct house price index.

#### **4. Empirical Results**

The main objective of this paper is to estimate the response of goods prices to changes in asset prices. For that we construct four variables VAR model and select lags using Likelihood ratio statistics. We check the presence of autocorrelation in the errors of each

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<sup>15</sup>Monetary policy committee sets operating target for money market rate. Whenever, this target is changed, discount rate is also set accordingly.

<sup>16</sup>House rent is excluded from CPI basket because our model contains house price index, which is constructed using house rent.

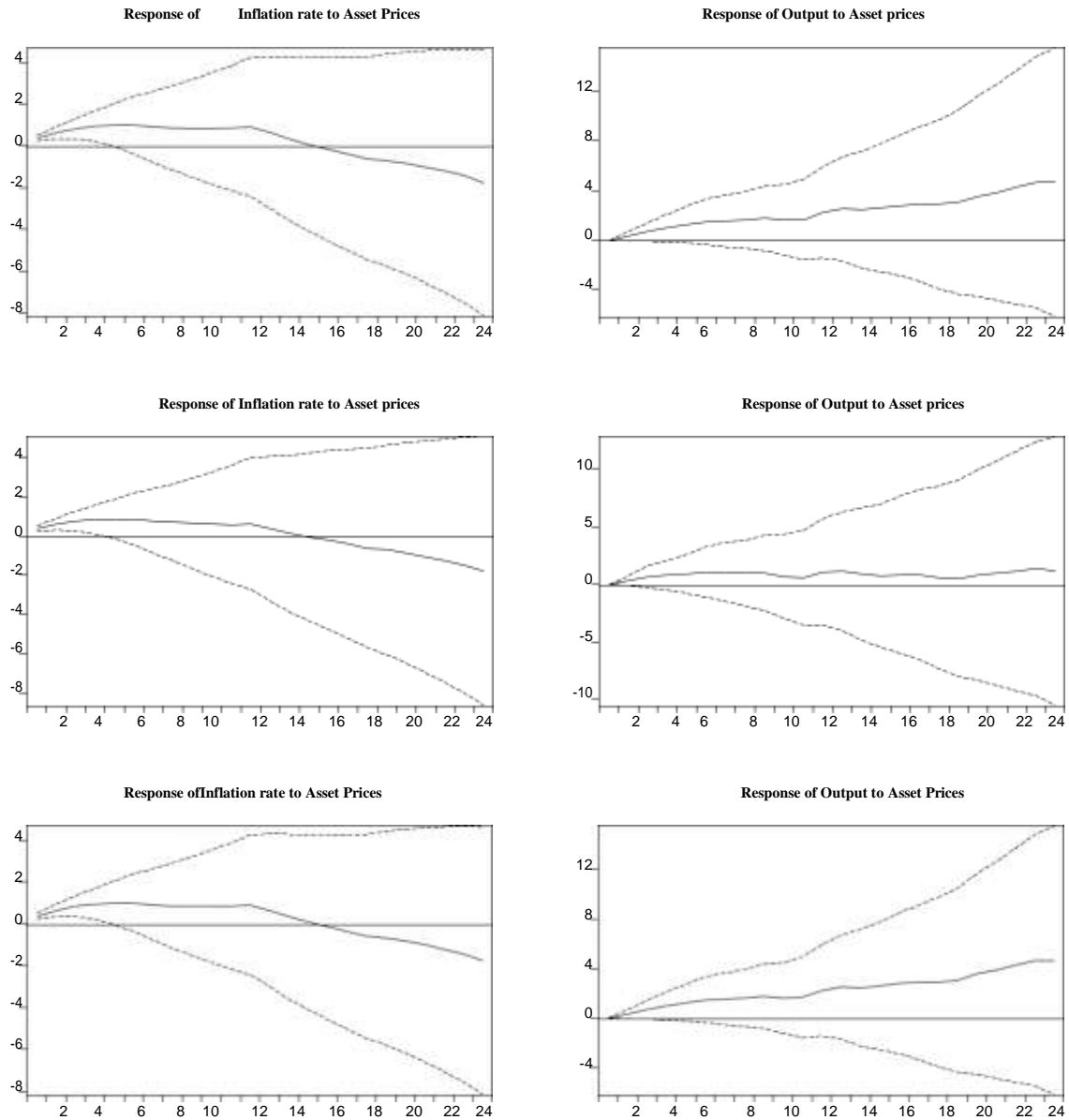
<sup>17</sup>These variables include large scale manufacturing index, interest rate, house price index, stock prices, exchange rate, money supply, trade deficit, and budget deficit.

model and proceed further only if errors are found serially uncorrelated. Results in Table A1 (in Appendix) show that errors in all of our estimated models are free from autocorrelation. As all variables, except interest rate, are measured as annualized growth rate so we use them in level form<sup>18</sup>. Interest rate is non-stationary at level<sup>19</sup> so there is a choice between using this variable in level form or in first differenced form. Sims (1980) and Sims, Stock, and Watson (1990) warn against differencing in VAR model if variables are non-stationary. Therefore, we use interest rate in level form. However, to check robustness of results we also estimate VAR model with first differenced interest rate and give results of both specifications for comparison. Moreover, for robustness, identifying restrictions are changed by placing output before interest rate. Our results are robust to three specifications as in all cases we find same responses of inflation rate and output to asset prices (Figure 1).

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<sup>18</sup>Growth rate of a variable is stationary if the variable is non-stationary.

<sup>19</sup>ADF test Statistic for null of unit root at level is -2.94 with probability 0.16 and -17.64 with probability < 0.01 for the null that first differenced interest rate is unit root process.



**Figure 1: Accumulated Impulse Response Functions ( $\pm 2$  S.E)**

(Source: Authors' Estimations)

*Note:* Dotted lines represent  $\pm 2$  standard errors band. Results in upper and lower horizontal panels are from a VAR model with interest rate at level while the middle horizontal panel shows result of VAR model with interest rate in first differenced form.

**Choleski Ordering:** Interest rate, Output, Asset Prices and Inflation rate in upper and middle panels, while Output, Interest rate, Asset Prices and Inflation rate in lower panel.

The response of inflation rate to asset prices is found positive and significant. This positive response coexists with the positive effect of asset prices on output. This finding makes it clear that higher asset prices expand business activity via wealth channel, Tobin's q channel or balance sheet channel which in turn puts upward pressure on goods prices because of excess demand. Our results are in conformity with all theoretical channels explained in section 2, which predict positive response of inflation to asset prices, except the balance sheet channel of exchange rate. According to that channel exchange rate depreciation worsens balance sheet of non-financial firms of emerging economies as their assets are denominated in domestic currency but liabilities are denominated in foreign currency. This limits their capacity to borrow and credit constrained firms are unable to expand business activity, which results in low inflation. All other channels predict expansion in economic activity led by increased asset prices which in turn results in high inflation. Our results are such as if the balance sheet channel of exchange rate is dominated by other channels in Pakistan; this is likely because Pakistani firms rely more on domestic credit market and their exposure to exchange rate fluctuations is low (Ihsan, Rashid and Naz, 2018)<sup>20</sup>. We also find that interest rate does not respond to asset prices (Figure A1 in Appendix). This result is not surprising as most of the central banks do not directly respond to asset prices. Monetary policy statements of Pakistan also show that policy decisions are predominantly driven by state of economic activity, inflation and external account position. Asset prices are responded only to the extent they influence paths of inflation and economic activity.

Though the responses of inflation and output to changes in asset prices are in conformity with the economic theory, the confidence intervals of impulse responses are wide. This is a problem researchers more often face while estimating impulse response functions. The dilemma lies in the fact that lesser lags make errors of the VAR model auto-correlated while long lags make VAR model over-parameterized and estimation errors attached with more parameters result in wide confidence intervals of impulse response functions. Our results in Figure 1 show that response of inflation to asset price shock is statistically significant only for four months and then it becomes insignificant. This may be of concern if policy implications are to be drawn from this empirical finding. However, two points make our result relevant for policy even with statistical significance for short period of time. First, inflation rate has strong inertia in it and most of the variation in this variable is explained by its own lags (variance decomposition shows that about 70 percent of the variation in inflation rate at 24 months horizon is explained by its own lags)<sup>21</sup>. In this case, actual effect of asset prices on inflation rate is long lasting despite an apparent short lived direct effect.

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<sup>20</sup>In that paper authors show that domestic firms have less exchange rate exposure as compared to multinational firms.

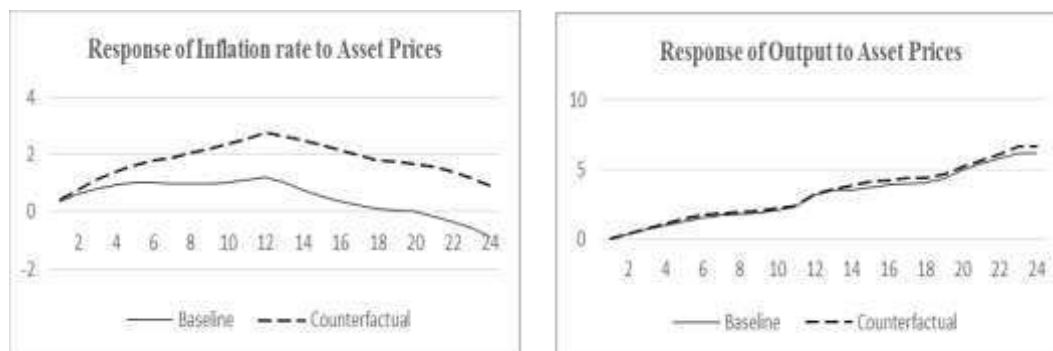
<sup>21</sup>Results can be shared on request from the authors

Second, the short lived effect of asset prices on inflation is found in baseline VAR model in which monetary policy moderates this effect. As shown below, the time period of significant effect increases when interest rate is not allowed to respond to other variables in the model (Figure A2 in Appendix).

Monetary policy has a role in determining inflation rate and asset prices. For instance, central banks can directly put asset prices in their reaction function and react to any undesirable movement in this variable. This action of central banks keep asset prices in check and associated inflation rate is also controlled. However, asset prices are more often treated as intermediate targets in which case they cannot be made part of policy reaction function. But there is ample evidence in the literature to augment policy reaction function by other variables like exchange rate and lagged interest rate (Clardia, Gali and Gertler, 1998; Amato and Laubach, 1999; Taylor, 2001; Reudefbusch, 2002; Saghir and Malik, 2017). Asset prices too have justification to be treated as ultimate target and not only as intermediate target. For instance, biasedness in inflation rate as a measure of change in overall cost of living (Alchian and Klein, 1973) makes asset prices suitable target of monetary policy. These arguments notwithstanding, most of the central banks target only inflation rate and do not intervene in the asset market. In this case, central banks respond to asset prices only indirectly; monetary policy instrument is changed whenever asset prices make inflation forecast deviate from the target. We hypothesize in this paper that if central banks directly respond only to inflation rate (along with output) and not to asset prices then transmission of asset prices to inflation rate is diluted. In the absence of active monetary policy, response of inflation to asset prices is higher compared to the case when central banks target variables like inflation, output or asset prices.

We test this hypothesis by assuming a counterfactual scenario in which interest rate does not change in response to any of the other three variables in the VAR model. More specifically, interest rate is taken as exogenous variable in which case it cannot change in response to any other variable in the VAR model at any lag. However, interest rate appears in equations of other three variables. In this setting policy is not state contingent but it has the power to change the economic state. We find support for our hypothesis as response of inflation rate to asset prices significantly changes in this counterfactual scenario (Figure 2). In the absence of active monetary policy, transmission of asset prices to goods prices is higher compared to what is found in case when policy does respond to other variables in the VAR model. In quantitative terms, accumulated response of inflation to asset prices in baseline scenario is 83% of that in counterfactual scenario after one lag. The difference increases with higher lags as response in baseline scenario is 58% of that in counterfactual scenario after 6 lags; 44% after 12 lags; and just 5% after 18 lags. Same result is found for the case of output but the difference between two impulse response functions is smaller

compared to what has been found for inflation; response of output in baseline VAR model is approximately 90% (at all lags) of that in counterfactual model.



**Figure 2: Moderating Role of Monetary Policy (The Case of Asset Price Index)**

(Source: Authors' Estimations)

We also estimate the effect of monetary policy on transmission of asset prices into inflation rate for individual assets. This analysis makes sense as different assets may have different transmission channels. We have used same methodology for individual asset prices as that in the case of asset price index. More specifically, we have estimated three VAR models with asset price index replaced by one of the asset prices<sup>22</sup>. Lag length for each VAR model is selected using Likelihood ratio statistics which is allowed to be different in different models and dummy variables are included in the model to capture structural breaks. We find some interesting results. First, for all of the asset prices the transmission to inflation rate is higher in counterfactual scenario compared to that in the baseline scenario. This shows robustness of result found in case of asset price index that monetary policy lowers the transmission of asset prices into goods prices. Moreover, statistical significance of impulse response functions is also improved. For instance, in the baseline model, response of inflation rate to asset prices is statistically significant only for four months but in the counterfactual model the response becomes insignificant only after 10 months (see Figure A2 in Appendix).

Second, the highest gap between responses in the baseline and counterfactual scenarios is found for exchange rate followed by house prices while in case of stock prices<sup>23</sup> the

<sup>22</sup>Exchange rate depreciated sharply after a period of overvaluation twice in our sample; in 2008-09 and 2018-19. We adjusted exchange rate for these abnormal fluctuations using dummy variables. Similarly, asset prices sharply declined in the year 2009 and remained volatile till the end of year 2010. Dummy variable for this period is also used for this period in VAR model with stock prices. We test for structural breaks in the paths of structural shocks identified from SVAR model. We find no evidence of such breaks as shown in Table A2 in the Appendix, which implies that the effects of asset price shocks on output and inflation are not biased subject to structural breaks in the data.

<sup>23</sup>We find positive response of inflation to shocks in asset prices, while Mukhtar and Younas (2019) find negative response. The reason behind this difference of results is the way we measure inflation rate in our



difference is found low. In quantitative terms, after 12 lags, accumulated response of inflation to asset prices in baseline scenario is 10% of that in counterfactual scenario for exchange rate, 13% for house prices and 67% for stock prices. In Pakistan, exchange rate plays major role in monetary policy decisions. Interest rate is kept high whenever there is upward pressure on exchange rate. This is evident from recent contractionary stance of monetary policy in the middle of economic crisis<sup>24</sup>. In this case, higher exchange rate does not fully transmit into goods prices because of strict reaction of monetary policy to exchange rate depreciation and associated expected hike in inflation rate. In case of stock and housing markets SBP does not directly respond to asset price hike<sup>25</sup>. But there are certain reasons behind why gap is more prominent in house prices<sup>26</sup>. Housing market has close linkages with other economic activities. Therefore, expansion in housing market activities can potentially expand aggregate demand thereby putting upward pressure on goods prices. Moreover, house prices are closely linked with house rent, which carries significant weight in CPI; increase in house prices are quickly reflected in CPI. Finally, housing market activities are broad based and high in market value. All these characteristics make central banks respond more quickly to rising house prices compared to stock prices. This response may not be direct however, as most of the times central banks respond to asset prices indirectly through their response to inflation rate and economic activity.

Third, response of inflation rate to exchange rate is negative in baseline model but positive in counterfactual model. The result in baseline model looks counterintuitive as historically inflation rate in Pakistan always soared after massive currency depreciation. However, there are certain reasons that justify such a result. We adjusted inflation rate for the effects of big shocks measured by *factor score* using macroeconomic variables. Therefore, our inflation rate does not carry the effects of big shocks. Three such shocks in our sample are massive capital inflow after 9/11, oil price hike in 2008, and foreign exchange crisis starting in fiscal year 2019. In all of these three episodes inflation rate gained momentum but our inflation series does not contain the unusual change of path of inflation rate. Moreover, we adjusted exchange rate for massive depreciation during these time periods, so our results are not applicable for abnormal times. Finally, above two issues coupled with the strict response of monetary policy to exchange rate depreciation make response of inflation rate to exchange rate negative in baseline model. Chaudhry et al (2011)

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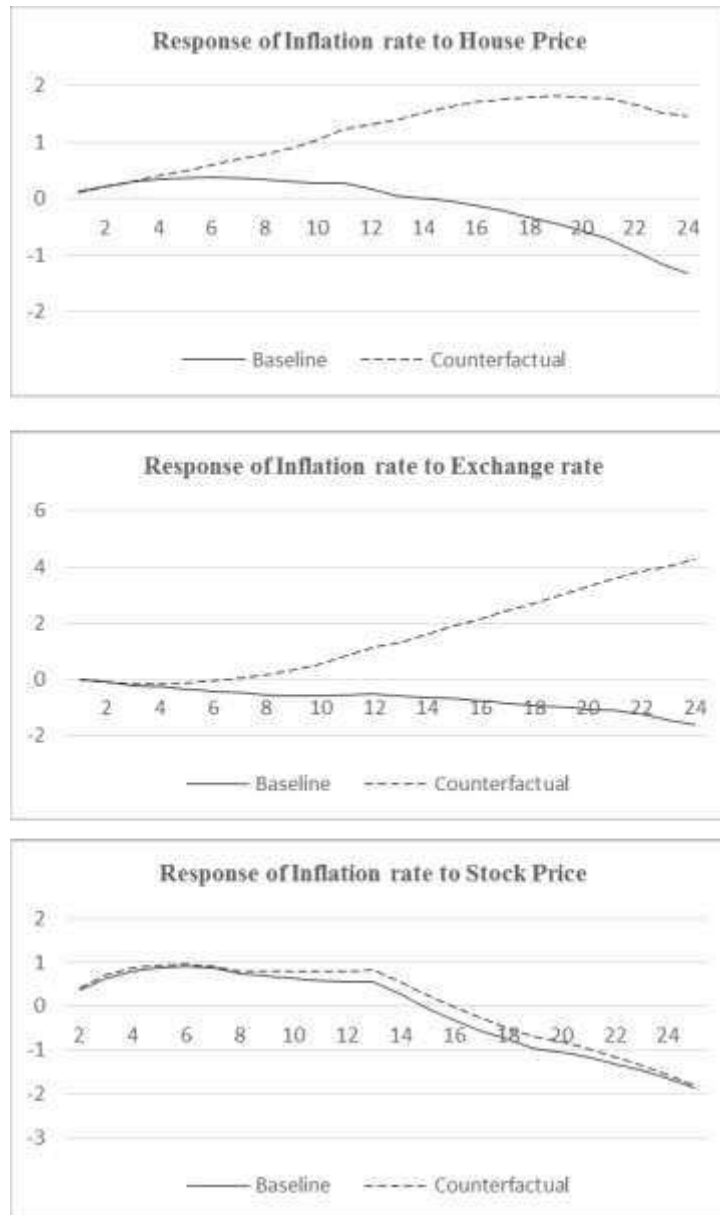
study. If inflation rate is not adjusted for common component of macroeconomic variables then it is negatively correlated with stock prices.

<sup>24</sup> At the start of fiscal year 2018-19 economic activity was slowing down and exchange rate started depreciating after a long period of overvaluation. Inflation rate was not that high but it was expected to gain momentum because of further currency depreciation. In this scenario SBP took tight stance of monetary policy despite criticism from academia, businesses and general public. This shows SBP's preference to stabilize exchange rate.

<sup>25</sup> This is evident from Monetary Policy Statements.

<sup>26</sup> Umer et al (2019) find positive effect of inflation on house prices. Though our objective is to estimate the effect of house prices on inflation, our results are consistent with Umer et al (2019) in correlational context.

also find negative relationship between exchange rate and inflation, while Shaheen (2013) finds positive association.



**Figure 3: Moderating Role of Monetary Policy (The Case of Individual Asset Prices)** (Source: Authors' Estimations)

## 5. Conclusion

This paper estimates the transmission of asset prices into inflation rate and the role of monetary policy in weakening this transmission. The paper hypothesizes that inflation rate positively responds to asset prices and this response is influenced by the way monetary policy is conducted in contemporary world. To test these hypotheses different specifications of four variables VAR model have been estimated and impulse response functions are found. Data of Pakistan's economy on non-house-rent CPI, large scale manufacturing index, asset prices and KIBOR are used for the time period 2000m01 to 2019m06. Asset price index includes stocks prices, house price index and exchange rate. VAR models have been estimated for asset price index as well as for individual asset prices. We find evidence in support of both hypotheses in that asset price inflation positively transmits into goods price inflation and this transmission intensifies if interest rate does not respond to other variables in the model. Moreover, transmission of asset prices to inflation rate is influenced more, as compared to output, by monetary policy. Finally, we find that the transmission of exchange rate and house prices to inflation rate is affected significantly by monetary policy while in case of stock prices the influence of policy has been found moderate.

According to these results, the way monetary policy is currently practiced has important implications for income distribution. If monetary policy does not respond to asset prices but remains strict on deviations of inflation and output from their respective targets then growth rates of assets' value and nominal GDP will be different. More specifically, central banks respond to inflation and output if they are not on target; hence, asset prices are responded to the extent they affect output or inflation rate. It means asset prices are responded when they are already changed and are reflected in inflation forecast. In this process economic activity in real sector is affected through changing interest rate. Hence, real sector bears the cost of contractionary monetary policy, in case of high inflation, that has been necessitated by activities in the asset markets. If this process continues then growth rate of GDP will be lesser than that of assets' value and income distribution will be skewed towards asset markets. This discussion entails monetary policy to differentiate between inflation caused by asset market activities and the one caused by goods market activities. Goods market activities should not be discouraged when inflation is induced by speculative activities in the asset markets.

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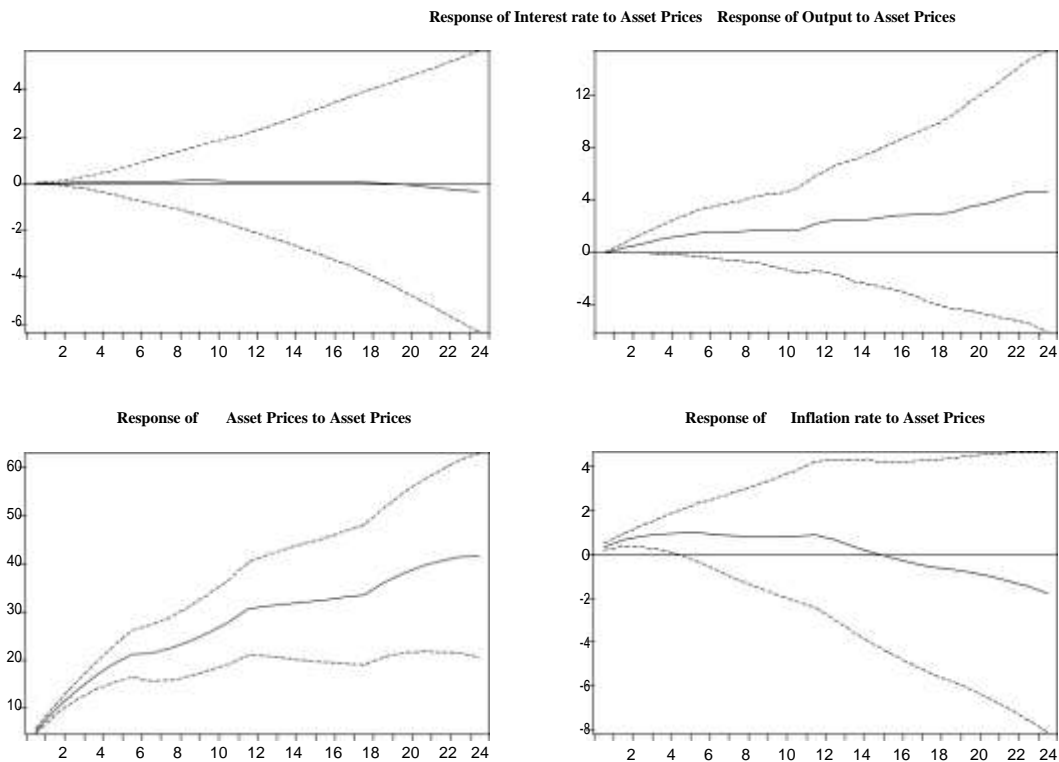
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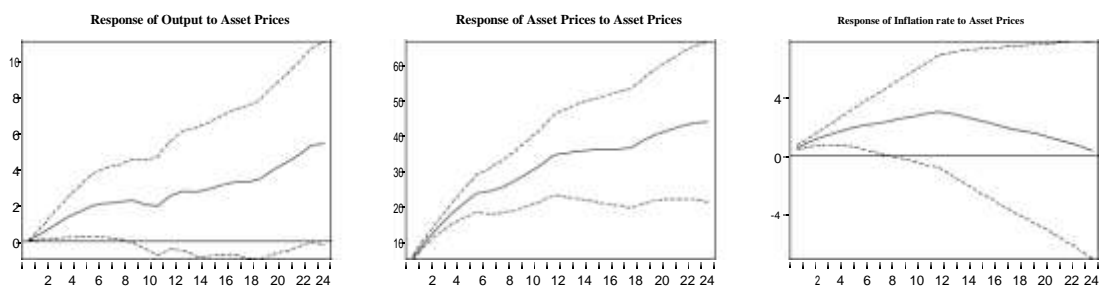
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**Appendix**



**Figure A1: Accumulated Impulse Response Functions ( $\pm 2$  S.E): Baseline Model**  
(Source: Authors' Estimations)



**Figure A2: Accumulated Impulse Response Functions ( $\pm 2$  S.E): Counterfactual Model**  
(Source: Authors' Estimations)



**Table A1: Autocorrelation Test in VAR Models**

	Max Lags	LRE stats	Probability
Model 1	14	18.02	0.32
Model 2	14	10.47	0.84
Model 3	14	18.02	0.32
Model 4	14	12.53	0.19
Model 5	14	28.77	0.05
Model 6	14	11.85	0.22
Model 7	14	20.82	0.19
Model 8	14	15.44	0.08
Model 9	14	22.02	0.14
Model 10	14	16.35	0.06

Source: Authors' Estimations

*Note: Model 1 corresponds to impulse response functions (IRF) in upper panel of Figure 1, model 2 to middle panel and model 3 to lower panel. Model 4 corresponds to counterfactual IRF in Figure 2. Model 5 (6) corresponds to baseline (counterfactual) IRF in upper panel, model 7 (8) in middle panel and model 9 (10) in lower panel of Figure 3.*

**Table A2: Testing Structural Breaks in Structural Shocks**

Variable	Break Test	F-Statistic	Scaled F-Statistic	Critical Value
KIBOR	0 vs. 1	5.88	5.88	8.58
LSM	0 vs. 1	1.94	1.94	8.58
AP	0 vs. 1	1.80	1.80	8.58
Inflation	0 vs. 1	3.27	3.27	8.58

Source: Authors' Estimations