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# THE PREDICTIVE POWER OF MONEY FOR INFLATION AND ECONOMIC ACTIVITY: THE MODERATING ROLE OF ASSET PRICES

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**Abstract**. In the past three decades the focus of researchers and policy makers shifted from money to interest rate as monetary policy instrument owing to low predictive and explanatory power of the former for the target variables – real economic activity and the inflation rate. In this study, we hypothesize that the apparent weak relationship between money and the target variables, found in empirical literature, is predominantly due to the absence of asset prices in the empirical models (see for instance, Bernanke and Blinder, 1992). We test our hypothesis using data of the Pakistan economy over the period 1981 Q1 to 2018 Q2. We compare the forecasting power of interest rate with that of money stock for goods prices and real economic activity in the presence of asset prices. This has been done using Granger causality test and by decomposing variances of the GDP deflator rate and output. In both cases, the predictive power of money, for the prices and output, significantly increases when asset prices are considered in the model. Moreover, as a second objective, we also find out the moderating role that asset prices play in strengthening or weakening the relationship between money and the target variables. This has been done using two different methods; the two steps regression based method and by incorporating an interaction term of asset prices and money in the regressions of the target variables. In both cases, we find evidence of asset prices affecting the relationship between money and the target variables. More specifically, the asset prices proved to weaken the relationship between money and price level and strengthen the relationship between money and the economic activity.

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The study is important in two respects; the role of asset prices in prediction of money for the prices and output has been contributed to the empirical literature of Pakistan and the results have strong policy relevance

**Keywords**: Asset Prices, Money, Predictive Power, Moderating Role

**JEL Classification:** E41, E52

## I. INTRODUCTION

Macroeconomic literature, in the last three decades, has downgraded money as monetary policy instrument owing to its low predictive and explanatory power for the target variables – real economic activity and inflation rate. Consequently, the focus of researchers and policy makers shifted to the use of interest rate as monetary policy instrument in macroeconomic models with the complete disregard of using money[1]. The empirical research has highlighted this failure of money due to the unstable relationship between money growth and nominal income – declining velocity overtime and also a weak relationship between money and the inflation rate.

In this study, we hypothesize that the weak relationship between money and the target variables is due to the absence of asset prices in macroeconomic models[2]. Money flows into asset market as well as into goods market; therefore, these flows in a particular market are overstated when the other market is overlooked in the model. In this case, the effects of money on the variables of that particular market are underestimated. Hence, when asset prices are absent from the model but total stock of money is considered, irrespective of where it is being used, then the effects of money on goods prices and economic activity are seemingly weak. Once asset prices are incorporated in the models, the explanatory power of money can improve.

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[1] For instance, Woodford (2003) put forward that equilibrium paths of inflation rate and economic activity are generated solely on the basis of interest rate rule and independent of money supply or money demand.

[2] Shafiq and Malik (2019) show that the velocity decline phenomenon can be explained by asset prices

Furthermore, interest rate also affects the asset prices, which means that monetary transmission mechanism works from interest rate to target variables through asset prices as is the case for money. Therefore, asset prices must be included while comparing predictive power of money and interest rate. Some studies in the literature compare the predictive power of money and interest rate, for example, Bernanke and Blinder (1992), but these studies do not include asset prices in the analysis. The absence of asset prices from the analysis makes this sort of comparison biased in favor of interest rate if money, as compared to interest rate, is more closely related to asset prices. If asset prices moderate the effect of money on income or inflation rate, then in the models without asset prices, money would have weak explanatory power for variations in both the target variables.

Moreover, in the current practice, the way inflation rate and economic activity are measured is biased as the former excludes asset prices while the latter excludes asset transactions. However, inclusion of asset prices, as a separate variable, in the models with money can potentially remove this bias. Asset prices affect the strength and/or direction of the relationship between money and inflation rate and money and economic activity in the economy. In this sense, asset prices moderate the relationship between money and the two target variables. We, therefore, hypothesize that the asset prices can remove the noise due to velocity shocks that would no longer obscure the signals from the monetary aggregates which can predict output and inflation rate.

We test our hypothesis using data of Pakistan economy. Prior to 2009, State Bank of Pakistan used to target inflation rate and output growth using monetary aggregates targeting and keeping M0 as its operational target. However, it switched to interest rate targeting from 2009 onwards, keeping overnight money market repo rate as its operational target. Despite adoption of interest rate as monetary policy instrument, the fact remains that for cash based economy like Pakistan, the role of money in explaining prices and real economic activity cannot be understated[3]. In the context of the hypothesis set in this paper, the

[3] Monetary aggregates could play three important roles: as an information variable for the efficient conduct of monetary policy; as a signal of policy actions by the central banks for

question now arises that should State Bank of Pakistan give due weight to monetary aggregates while taking monetary policy decisions. To answer the question of desirability of money stock as an indicator of monetary policy, the forecasting power of interest rate and money stock for the target variables – goods prices and real GDP – should be compared because it is imperative for an instrument of monetary policy to have strong relationship with and predictive power for the target variables. In the existing literature of Pakistan, Malik (2010) tests whether monetary policy actions are responsible for the episodes of high inflation in Pakistan. That study also used Granger Causality to test the direction of bivariate causality between inflation rate and reserve money and real GDP gap and reserve money. Nevertheless, the study does not incorporate the moderating role of asset prices in determining the direction of causality among these variables. Similarly, Qayyum (2006), Kemal (2006), Ghumro and Memon (2015) and Chaudhry et.al (2015) while discussing the effect of money growth on inflation rate, do not consider the moderating role that asset prices play in affecting the relationship.

To test our hypothesis, we compare the forecasting power of interest rate with that of money stock for prices and real economic activity in the presence of asset prices. This has been done using Granger causality and by decomposing variances of price level and output. In both cases, the predictive power of money, for the price level and output, significantly increases when asset prices are considered in the model. Moreover, we also find out the moderating role that asset prices play in strengthening or weakening the relationship between money and the target variables – output and the inflation rate. This has been done using two different methods. In the two step method, the slope coefficient is recursively estimated in the regression of target variables on money and then recursive estimates of coefficients are regressed on asset prices. The second method tests the moderating role by incorporating an interaction term of asset prices and money in the regression of the target variables on

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implementing suitable policies that enhance its credibility in pursuing its goals and fulfilling public's expectations; an instrument in policy rule for which aggregates must have the ability to have stable causal relationships with the ultimate goals of the policy of the central bank (Estrella and Mishkin, 1990).

money. In both cases, we find evidence of asset prices affecting the relationship between money and the target variables.

Rest of the study is organized as follows. Section II discusses the conceptual and theoretical framework, while econometric methodology is discussed in section III. The results of the study are analyzed in section IV and section V concludes the study.

## II. CONCEPTUAL AND THEORETICAL FRAMEWORK

This section elaborates theoretical framework of the empirical model used in the study. This section is further divided into three subsections. Firstly, theoretical justification is given of how money has predictive power for economic activity and goods prices. Secondly, the section explains theoretical relationship of asset prices with economic activity and goods prices. Thirdly, the section explains moderating role, the asset prices have in the relationship of money with economic activity and goods prices.

### Predictive Power of Money for Economic Activity and Goods Prices in the Presence of Asset Prices

An increase in money supply increases goods prices in the economy through raising aggregate demand for the goods, which having inelastic supply in the short run experience a rise in their prices. This remained a well-established standard economic theory until late 1980s after which questions were raised on the predictive content of money for the goods prices. However, this effect of money on goods prices fails to include the variable of asset prices for the explanation of above mentioned relationship. Once the asset prices are considered in the model, a part of the increase in money supply is also used for the purchase of assets thereby leading to an increase in their prices. The wealth effect of the increase in asset prices further increases the aggregate demand and goods prices. This indirect effect of increase in asset prices on goods prices weakens the relationship between money, goods prices and economic activity due to three reasons. First, indirect effect of asset prices on goods prices delays the ultimate effect of money on goods prices. Second, since asset holders are mostly the people belonging to upper income group of the society, their marginal propensity to consume (MPC) is less than the

average MPC of the society. Therefore, they spend relatively lesser amount of the increase in their wealth on spending, thereby, reducing overall impact of the increase in asset prices on GDP and goods prices. Third, increase in asset prices signifies an increase in wealth and not income of the individuals, therefore, people tend to have a lower MPC out of wealth as compared to income. This further shrinks the effect of increase in asset prices.

Due to these reasons, the effect of increase in money is not completely transmitted in the economic activity and goods prices. It is noteworthy that apparently wealth channel reinforces the effect of money on goods transactions and prices. However, the weakness of the relationship between money and goods prices and economic activity, due to asset market transactions, can be better understood by comparing this case with that when there is no asset market. In this case, all of the money directly flows into goods market and the relationship between money and goods prices is strong. Therefore, we hypothesize in our study that the seemingly weak relationship between money and the target variables can be attributed to asset market transactions and once the effect of money on asset prices is controlled, the relationship between money and goods prices would become strong.

**Predictive Power of Asset Prices for Economic Activity and Goods Prices**

The stock prices are generally found to have a substantial predictive power for output growth in different countries whereas property prices have significant indicative power for the output gap. However, differing views have been presented on this complex and difficult to predict relationship between asset prices and economic activity. The traditional view suggests that the relationship between these two variables is positive through wealth effects and variations in the cost of capital (Altissimo et al, 2005). Another view holds that there does not exist any causal relationship between asset prices and economic activity; however, the asset prices may be leading indicator of future output growth. Therefore, according to this view, the stock markets are called as being a side show in the current and future output growth (Morck et al, 1990). Furthermore, asset prices may affect economic activity negatively. This negative effect might be due to the fact that in order to invest in assets,

resources are diverted towards the financial sector and also the borrowed credit is invested in assets and people reduce investment in real sector of the economy which depresses the economic activity. Furthermore, with increase in asset prices, central bank tends to increase interest rate, which increases the cost of credit. People in real sector who are earning profits on the margin are then affected badly so they further reduce investment, which results in lower output.

Stock and Watson (1989; 1999a) showed a broader channel through which house prices can help to forecast real economic activity, inflation rate or both. Stock and Watson (2003) suggest that predictive power of asset prices for output is stronger than that for inflation rate.

**Moderating Role of Asset Prices**

The apparent unstable relationship between money stock and price level and also between money and output might be due to a third variable – asset prices. Asset prices can affect the strength of the relationship between money stock and price level and output through their direct effects on the latter two variables. The macroeconomic models that are still used for policy analysis do not include this moderating variable of asset prices and fail to understand that why the relationship between money and goods prices is getting weaker. Once the asset price variable is included in the macroeconomic models, the channel completes and we can ascertain that still the effect of money, compared to interest rate, will be stronger on goods prices and real economic activity.

The traditional economic theory states that an increase in money supply increases the aggregate demand in the economy, which in turn increases the price level at given level of output. However, the effect of increase in money supply will not be reflected in goods prices if instead of spending on goods and services in the real sector, increased money supply goes into the purchase of assets which increases asset prices. Therefore, asset prices weaken the effect of money on goods prices when expanded money supply is spent on the purchases of assets. On the other hand, the purchase of assets can also strengthen or reinforce the relationship between money and the price level if the net worth of individuals increases due to increased prices of the purchased assets. People will increase aggregate demand for goods and services which then

increases the price level. But, the effect of money on output and prices through asset prices only delay the direct effect of the former on the latter two variables. Similarly, through traditional channel the increase in money supply decreases interest rate, increases the consumption, investment and lending and borrowing in the economy which is ultimately reflected in increased gross domestic product. Nonetheless, if we consider the moderating role of asset prices then reduction in the interest rate due to increase in money supply not only increases real investment but also financial investment. If we only consider the substitution effect of the increase in money supply where people invest all the money in purchase of assets instead of purchasing goods, then this would weaken the relationship between money supply and real output. However, the increase in asset prices may also increase the demand for goods and services in the economy through wealth channel and also through Tobin's Q channel whereby increase in the value of assets increases the investment and hence real GDP in the economy. Hence, we can say that asset prices can delay the effect of money on inflation and business activity.

## III. ECONOMETRIC METHODOLOGY

We have used three approaches in this study to satisfy the objectives this study deals with. In order to check the predictive power of interest rate and money for economic activity and goods prices we have used Granger Causality test and Variance Decomposition. Granger causality is a test of predictive power; if one variable Granger causes the other, then the former has predictive content for the latter. Moreover, forecast error variance is also an important tool to predict the contribution of different variables into the variance of the target variables. In this study, we are focusing on the moderating role that asset prices play in affecting the relationship between money and goods prices, hence, we have also tested this role. The following sections explain the details of these issues.

### Predictive Power of Money and Interest Rate

To measure the predictive power of interest rate and money for economic activity and goods prices we use two methodologies.

**Granger Causality:**

According to Enders (2010) Granger causality test detects whether or not the lags of one variable can be excluded from the equation of another variable.

$$x_t = A_{10} + A_{11}(L)x_{t-1} + A_{12}(L)y_{t-1} + e_{xt}$$
$$y_t = A_{20} + A_{21}(L)y_{t-1} + A_{22}(L)y_{t-1} + e_{yt} \quad (1)$$

If the coefficients of $A_{21}(L)$ are equal to zero, $\{x_t\}$ does not Granger cause $\{y_t\}$ in a two equations model. Hence $\{x_t\}$ does not Granger cause $\{y_t\}$ if former does not improve the forecasting of the latter. Given that all the VAR variables are stationary (at level or otherwise the VAR is first differenced) we use a standard F- stats to test the Granger causality.

$$A_{21}(L) = 0 \quad (2)$$

Granger Causality simply refers to the predictive power of past values of, for example, $\{x_t\}$ on the current value of $\{y_t\}$.

**Variance Decomposition of Economic Activity and Goods Prices**

Bernanke and Blinder (1992) point out one serious drawback of using Granger Causality to assess the predictive power because of the non-orthogonality of the right hand side variables. If, for example, broad money supply, which moved the treasury bill rate, were a truly exogenous policy variable, and T-bill rate in turn moved the real economy, then this might mean that in a regression involving T-bill rate, broad money is an unimportant variable even though broad money is the real driving force. This means that if the variables are correlated then it becomes difficult to assess their separate effects. Therefore, Sims (1980) and Litterman and Weiss (1985) suggested to use another approach, constructed from VAR with orthogonolized residuals, to measure predictive power: "The percentage of the variance of the forecasted variable attributable to alternative right-hand-side variables at different horizons" (Bernanke & Blinder, 1992).

Therefore, the proportion of the movement in a sequence due to its own shocks versus shocks to other variables is called forecast error variance decomposition. To elaborate the concept, consider the following structural VAR model.

$$Bx_t = \Gamma_0 + \Gamma_1 x_{t-i} + \varepsilon_t \qquad (3)$$

where, B is a matrix of contemporaneous coefficients, x is a vector of endogenous variables, and ε represents vector of structural shocks.

One of the variables in x is said to be exogenous if forecast error variance of this variable at all forecast horizons is not explained by the shocks in other variables. On the other hand, the variable is said to be entirely endogenous if all of the forecast error variance at all forecast horizons is explained by the shocks in other variables. It is imperative to restrict B matrix in order for structural shocks to be identified and for this we have used Cholesky decomposition such that some of the contemporaneous effects are assumed zero (for details about Choleski Decomposition, see Enders, 2010). Real GDP is assumed not to respond while asset prices do respond contemporaneously to other variables. Interest rate also responds contemporaneously to other variables except asset prices. GDP Deflator responds only to real GDP but not to other variables. Money supply contemporaneously responds to GDP and GDP Deflator.

The nth step ahead forecast error variance of the ith variable, i.e. σi(n)2 can be decomposed into the proportions due to shocks in the ith variable and in other variables as given below:

$$1 = \frac{\sigma_i^2[\phi_{jk}(0)^2 + \phi_{jk}(1)^2 + .....\phi_{jk}(n-1)^2]}{\sigma_i(n)^2} + \frac{\sum \sigma_m^2[\phi_{jk}(0)^2 + \phi_{jk}(1)^2 + .....\phi_{jk}(n-1)^2]}{\sigma_i(n)^2} \qquad (4)$$

We have selected the lags of 12 quarters to see the variance decomposition because of the quarterly frequency of our data and we will be reporting the 12th lag's value.

In our study, we construct VAR containing GDP deflator, real GDP, asset prices, interest rate and money supply and would like to see how innovations in these variables account for percentage variation in Real GDP and GDP deflator.

## Moderating Role of Asset Prices for the Effects of Money on Prices and Real GDP[4]

We have checked the moderating role of asset prices for the effects of money on prices and real GDP with two different methods.

### Two Step Regression Method

In the first step we run a simple logarithmic regression of GDP deflator on money supply and find recursive estimates of the slope coefficient.

$$\log(GDPD_t) = \alpha + \beta \log(M2) + \varepsilon_t \qquad (5)$$

We then explain the graph of the coefficient of M2 and asset price index (API) and compare that how API is explaining the movements in the recursive coefficient of M2. Having explained the graph, we then regress the coefficient of M2, found in in step one, on the asset price index. The coefficient of asset price index in this case explains how the asset prices affect the relationship between money supply and goods prices; whether it positively affects the relationship or negatively and with what magnitude.

$$Coeff\_M2 = \gamma + \delta \log(API) + \varepsilon_t \qquad (6)$$

If coefficient of API is significantly different from zero in this second stage regression, then asset prices significantly moderate the relationship between money and goods prices.

We also repeat this procedure for GDP in place of GDP deflator.

### Barron and Kenny (1986) Procedure

We check the moderating effect of asset price index on the relationship between GDP Deflator and money supply by incorporating asset price index and the interaction term of asset price index and money supply. The coefficient of the interaction term explains if asset price index strengthens or weakens the relationship between the two variables.

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[4] We have done the analysis for M2 and Private Sector Credit (PSC). Results of M2 are presented in the main text where as that of PSC are given in the appendix.

Finally, same steps have been repeated to check the moderating role of asset prices on the effect of money on real GDP.

**Data and Construction of Variables**

The data on nominal and real GDP are taken from Hanif et al, (2013) and Arby (2008). Arby (2008) quarterized the production side of annual GDP in Pakistan for the time period 1972-2005 and Hanif et al, (2013) provided quarterly estimates of the production side of annual GDP in Pakistan for the time period 1999-2000 to 2009-2010 based on constant prices of 1999-2000 and also for current prices. For the computation of data for the time period 2011-2018, we calculated quarterly shares of annual GDP from previous data and observed their variations. Based on the small variations in quarterly weights, we assume that the quarterly weights that we are taking for the data of next 6 years are stable. Therefore, we took the average of the quarterly weights of the last ten years with the assumption that this average is stable for the next 6 years. By multiplying these quarterly weights with the annual GDP of the next 6 years we obtain the quarterly GDP for the time period 2011-2018. GDP Deflator is constructed as the ratio of nominal GDP to real GDP and multiplying the result by 100. Call Money Rate is the proxy of monetary policy instrument; the interest rate at which short term loans are lent and borrowed in the money market. Weighted average deposit rates with maturity 5 years and above are used as proxy for long term interest rates. Weighted average deposit rates with the maturity 6 months and below are used as proxy for the short term interest rate. Data on House Price Index (HPI) are not available. Therefore, we have constructed HPI using data on House Rent Index (HRI). For details see Shafiq and Malik (2018). We have constructed Asset Price Index using House Price Index, stock prices and exchange rate by using four methods of assigning weights to the three assets. For details see Shafiq and Malik (2018).

Data spans over the period 1981 Q1 to 2018 Q2 at quarterly frequency.

# IV. RESULTS AND DISCUSSIONS

## Predictive Power of Money and Interest Rate

### Granger Causality

In order to assess the predictive power of money and interest rate for price level and real economic activity we now apply Granger Causality test in the models with and without asset prices. Summary of the results for Granger causality test is given in Table 1.

TABLE 1

Predictive Power of Different Variables for Economic Activity and Goods Prices

| | Without Assets Prices | | With Assets Prices | |
|---|---|---|---|---|
| | RGDP | GDP Deflator | RGDP | GDP Deflator |
| GDP Deflator | 2.72<br>(0.61) | ---- | 3.85<br>(0.43) | ---- |
| RGDP | ---- | 9.06<br>(0.06) | ---- | 10.99<br>(0.03) |
| Money Supply | 8.23<br>(0.08) | 7.89<br>(0.10) | 27.34<br>(0.00) | 14.22<br>(0.01) |
| Interest Rate | 1.93<br>(0.75) | 18.34<br>(0.00) | 2.23<br>(0.69) | 21.39<br>(0.00) |
| Asset Prices | ----- | ----- | 7.90<br>(0.10) | 5.78<br>(0.22) |
| All Variables | 11.17<br>(0.51) | 39.06<br>(0.00) | 44.18<br>(0.00) | 62.65<br>(0.00) |

Note: F-values for the hypothesis that the variable has no predictive power for concerned variable are given in the table. Probability values for accepting null hypothesis are given in parentheses. Last row tests the hypothesis that all variables have no joint predictive power for the concerned variable in the column. All variables are seasonally adjusted and are in differenced logarithmic form except interest rate, which is in differenced form

In the model without asset prices the interest rate has no predictive power for real GDP whereas money supply does but the statistical significance can be established only at 10 percent. On the other hand, interest rate is better predictor of prices as it Granger causes GDP deflator at 1 percent level of significance but money stock does so only at

10 percent. So money supply is weak predictor in the sense that money Granger causes real GDP and GDP deflator in case of 10 percent level of significance but not at 1 or 5 percent. The reason is that we have hypothesized that asset prices do matter in explaining the economic activity and price level and they are not included in this model. Asset prices have strong positive association with money; once, asset price index is part of the model, this positive association is captured and in this case net effect of money on GDP and goods prices can be traced out. Therefore, asset prices can potentially increase the predictive power of money. And this happens in our case as once we incorporate the asset prices in the model our results change drastically in the sense that money now helps predict both real GDP and GDP deflator at 1% significance level but interest rate remains unhelpful for predicting real GDP. This result indicates that in case of Pakistan money supply plays an important role in explaining the economic activity and goods prices, i.e. with the inclusion of asset prices, money does Granger cause GDP and GDP deflator. Anna and Friedman (1963) were the first to empirically observe that money had real effects and changes in the real economy occurred due to changes in monetary aggregates. Sims (1972) also finds that in a bivariate system, money Granger causes nominal GNP. Moreover, Lawrence et al, (1988) observe for industrial production that if money is partly exogenous, then changes in nominal money can have real effects.

The predictive power of asset prices for real GDP is also significant at 10% level of significance; however, this power for GDP deflator is insignificant. This result suggests that asset prices have more predictive content for real economic activity in Pakistan than for prices.

We can conclude that according to Granger Causality criterion, in Pakistan, only money supply is significant predictor of real GDP and both the rate of interest and money supply are predictor of GDP deflator.

Bernanke and Blinder (1992) highlight one serious drawback of using Granger causality to assess the predictive power because of the non-orthogonality of the right hand side variables. If variables are correlated then it becomes difficult to assess their separate effects. As in our case asset prices and money might be correlated and Granger causality might have provided spurious results. Therefore, to measure

predictive power, we use Variance Decomposition method as was suggested by Sims (1980) and Litterman and Weiss (1985) which is constructed from VAR with orthogonolized residuals.

**Variance Decomposition of Economic Activity and Goods Prices**

We now move to the results of Variance Decomposition to assess the comparative predictive power of money supply and interest rate for economic activity and goods prices. The values in Table 2 are percentages of variance of the column variables attributable to each of the row variables taken at a 12 quarters horizon. The order of the row variables in the table is same as that used in the VAR model estimation.

TABLE 2

Variance Decomposition of Economic Activity and Goods Prices

| | Without Assets Prices | | With Assets Prices | |
|---|---|---|---|---|
| | RGDP | GDP Deflator | RGDP | GDP Deflator |
| RGDP | 93.04 | 9.47 | 85.93 | 10.17 |
| GDP Deflator | 2.16 | 76.53 | 3.07 | 71.49 |
| Money Supply | 3.67 | 8.11 | 7.31 | 10.68 |
| Interest Rate | 1.13 | 5.90 | 2.20 | 6.18 |
| Asset Prices | ---- | ---- | 1.48 | 1.47 |
| All Variables | 100.00 | 100.00 | 100.00 | 100.00 |

Note: percentage of variance of concerned variables, explained by different variables, (at three-year horizon, 12 quarters) are given in the table. Appropriate lag length for VAR model is selected on the basis of minimum AIC. All variables are seasonally adjusted and are in differenced logarithmic form except interest rate which is in differenced form.

The results of the previous section on Granger Causality are proved robust and consistent with Variance Decomposition approach and strongly support our hypothesis that money is a better predictor of economic activity and goods prices than the interest rate. Even without asset prices in the model, money explains variation in GDP and GDP deflator more than interest rate does. When asset prices are included in the model then the explanatory power of both money supply and interest rate increases but change is more pronounced in case of money supply. Inclusion of asset prices increased explanatory power of money for GDP

by 3 and half percentage points while for GDP deflator by 2 and a half percentage points. These figures for interest rate are, 1 percentage point and quarter of a percentage point. This conforms to the result of the previous section that once asset prices are included in the model money is not weak predictor of economic activity and prices in Pakistan. Moreover, results of this section confirm that money, compared to interest rate, contains more information for GDP.

Results of Granger causality and Variance Decomposition can be justified on the basis of following discussion. Pakistan economy has faced severe recession in the period 1999-2002. In 1998, when initially the economy was performing well, Nuclear blast by Pakistan resulted in economic sanctions from international community. This put pressure on external account and money contracted due to decrease in net foreign assets of the country. This process set a well operating economy into deep recession. The 9/11 incident increased foreign exchange inflows which expanded money supply as SBP increased its foreign exchange reserves; hence, the policy became expansionary. After this, Pakistan economy experienced the highest GDP growth rate in 2006-07 as the economy recovered from recession, which started in 1998 and ended in 2002. This historical evidence suggests that high money growth leads to economic expansion while money contraction leads to slowdown of economic activity in Pakistan. Due to this reason, we found significant predictive power of money for GDP.

**Moderating Role of Asset Prices for the Effect of Money Supply on Prices and Economic Activity**

The results of the Granger causality and Variance Decomposition suggest that the inclusion of asset prices improves the predictive power of money for real GDP and GDP deflator. This indicates that asset prices may moderate the relationship or predictive power of money for GDP deflator and real GDP. Therefore, we now formally check this moderating role of asset prices for the effect of money supply on price level and real GDP.

We have mentioned in the methodology the procedure to analyze moderating role of asset prices for the effect of money supply on prices

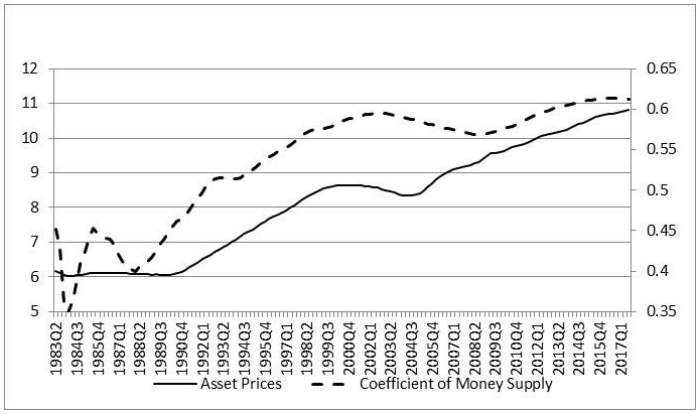
and real GDP. In the first step we run the simple regression of GDP deflator on money supply and find the series of recursive slope coefficients which is then plotted with the asset price index.

## Moderating Role of Asset Prices for the Effect of Money on Prices

We plot, in Figure 1, the asset price index along with the recursive coefficients estimated from the regression of GDP deflator on money supply.

FIGURE 1

Asset Prices and the Recursive Coefficient of M2 in the Regression of GDP Deflator




The figure suggests a clear positive relationship between asset prices and recursive coefficient. Initially, when the asset prices are constant, the coefficient of money supply also fluctuates around a constant mean. When the asset prices start to increase the coefficient of money supply is also increasing till 1997. After this, asset prices become constant till 2002 and coefficient of money is increasing at a lesser rate which seems constant. After 2002, again, both are increasing. The result indicates that effect of money on aggregate price level is not stable and it changes with the change in asset prices. Hence, asset prices moderate the effect of money on prices.

In the next step, we regress the recursive coefficient of money supply on asset price index (results are given in Table 3). The regression of second step gives us the coefficient of asset prices which explains the direction (sign of the coefficient) and magnitude of the effect it has on the relationship between money and aggregate price level. The magnitude of this coefficient is 0.04 and it is statistically significant at less than 1% level of significance. This implies that asset prices are positively associated with the coefficient of money estimated in a regression of GDP deflator on money supply.

TABLE 3

Moderating Role of Asset Prices for the Effect of Money Supply on Goods Prices

| | GDP Deflator | Coeff_GDPD_M2 | GDP Deflator | GDP Deflator |
|---|---|---|---|---|
| Constant | -0.23<br>(0.00) | 0.21<br>(0.00) | 0.02<br>(0.41) | -0.58<br>(0.00) |
| Asset Prices | ----- | 0.04<br>(0.00) | 0.02<br>(0.19) | 0.11<br>(0.00) |
| Asset Prices x Money supply | ----- | ----- | ----- | -0.01<br>(0.00) |
| Money Supply | 0.61<br>(0.00) | ----- | 0.12<br>(0.00) | 0.25<br>(0.00) |
| Adjusted-$R^2$ | 0.99 | 0.81 | 0.99 | 0.99 |
| F-Stats | 18285.76<br>(0.00) | 564.67<br>(0.00) | 12955.66<br>(0.00) | 12971.23<br>(0.00) |
| DW-stats | 0.19 | 0.03 | 1.94 | 1.98 |

Note: Probability values for accepting null hypothesis (that the respective coefficient is zero) are given in parentheses. All variables are seasonally adjusted and are in logarithmic form.

In the last step, we have also used Barron and Kenny (1986) procedure to test the moderating role of asset prices for the effect of money supply on aggregate price level. In this regard we regress GDP deflator on asset prices, money and their interaction term. The coefficients of asset prices and money are positive and statistically significant. The coefficient of the interaction term of asset prices and money supply which explains whether the asset prices strengthen or weaken the relationship is -0.01 with the statistical significance of less than 1%. To find more robust results we have also used Private Sector Credit (PSC) as the measure of money and run another regression with

the interaction term including the PSC and asset prices. The coefficients of PSC and asset prices are positive and are statistically significant as well. The results are almost same for the interaction term with the coefficient of -0.01 which is significant at less than 1% level of significance (Detailed results of PSC are given in the Appendix). These results imply that the changes in asset prices weaken the relationship between private sector credit/money and aggregate prices in Pakistan. Higher the value of asset prices the lower would be the effect of private sector credit/money supply on the goods prices. This result signifies the importance of incorporating asset prices in the estimation of money and price relationships because the apparent failure of money to be used in the macroeconomic models and the switch to Taylor type interest rate rules was due to the weakness of money supply in explaining goods prices. These results support our hypothesis that the inclusion of asset prices help to explain that the relationship between money and price level has not weakened rather it is the changes in asset prices that affect the relationship between these two variables and money still can explain the price level.

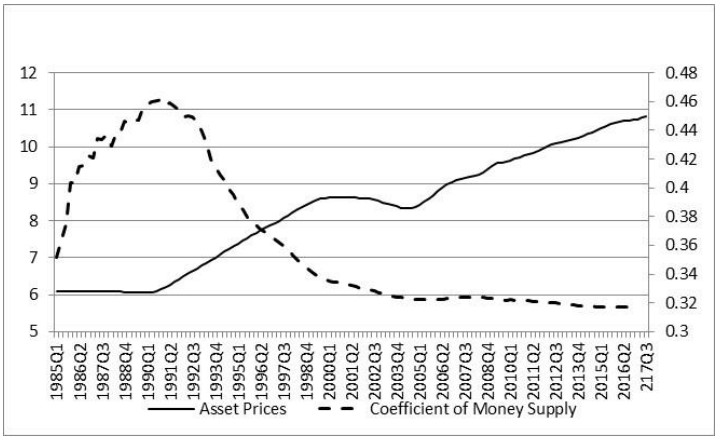
## Moderating Role of Asset Prices for the Effect of Money on Real GDP

The relationship between the recursive coefficient of money, generated from the regression of real GDP on money, and the asset prices is shown in Figure 2.

For the first 20 quarters, asset prices and the coefficient of money seem unrelated as former is almost constant while the latter is increasing during this time period. However, for rest of the sample period the asset prices are negatively associated with the coefficient of money. As the sample period for which the association is negative is larger than the first one, in which asset prices and coefficient of money are unrelated, the overall relationship seems negative. This can be confirmed later when we formally analyze their relationship.

FIGURE 2

Asset Prices and the Recursive Coefficient of M2 in the Regression of GDP




In the next step, we regress the coefficient of money on asset price index; the results are given in Table 4. The regression of second step gives us the coefficient of asset prices which explain the direction (sign of the coefficient) and magnitude of the effect of asset prices on the relationship between real GDP and money supply. The coefficient is negative and statistically significant at 1% level of significance (column 3 of Table 4). This implies that asset prices moderate the relationship between real GDP and money supply.

TABLE 4

Moderating Role of Asset Prices for the Effect of Money on RGDP

| | Log(RGDPSA) | Coeff_RGDP_M2 | Log(RGDPSA) | Log(RGDPSA) |
|---|---|---|---|---|
| Constant | 5.00<br>(0.00) | 0.53<br>(0.00) | 1.28<br>(0.00) | 0.24<br>(0.00) |
| Asset Prices | ----- | -0.02<br>(0.00) | -0.03<br>(0.00) | -0.07<br>(0.00) |
| Asset Prices x Money supply | ----- | ----- | ----- | 0.01<br>(0.00) |
| Money Supply | 0.32<br>(0.00) | ----- | 0.11<br>(0.00) | 0.04<br>(0.16) |
| Adjusted R2 | 0.99 | 0.10 | 0.99 | 0.99 |

| | Log(RGDPSA) | Coeff_RGDP_M2 | Log(RGDPSA) | Log(RGDPSA) |
|---|---|---|---|---|
| F-Stats | 17813.43<br>(0.00) | 16.06<br>(0.00) | 12063.10<br>(0.00) | 12164.61<br>(0.00) |
| DW-stats | 0.66 | 1.19 | 1.70 | 1.83 |

Note: Probability values for accepting null hypothesis (that respective coefficient is zero) are given in parentheses. All variables are seasonally adjusted and are in logarithmic form.

The last step is the regression assessing the moderating role of asset prices for the effect of money on real GDP using Barron and Kenny procedure. The coefficients of asset prices and money are statistically significant but coefficient of asset prices is negative while that of money supply is positive. The coefficient of interaction term of asset prices and money supply which explains whether the asset prices strengthen or weaken the relationship is 0.01 with the statistical significance of less than 1%. We have also used private sector credit (PSC) as the measure of money and run another regression with the interaction term including the PSC and asset prices. In this case results are almost same for the interaction term with coefficient of 0.01 which is statistically significant. These results imply that the changes in asset prices strengthen the relationship between private sector credit/money supply and real GDP in Pakistan. This result signifies that the money supply affects real GDP under the influence of asset prices; therefore, it is important to consider asset prices in the estimation. Higher the value of asset prices the higher would be the effect of private sector credit/money supply on real GDP. These results also support our hypothesis that the inclusion of asset prices help to explain that the relationship between money/credit and real economic activity is strengthened and the changes in the money can boost or weaken the economic activity through asset prices.

## Implications of Findings for Pakistan Economy

Pakistan is an emerging economy that undertook financial sector reforms starting at the end of 1980s. Owing to these reforms financial sector was liberalized that made the sector efficient and vibrant. This development of financial sector notwithstanding, there is a large population that is still financially excluded. That is why a significant portion of total transactions in the economy is still cash based. This highlights the importance of monetary aggregates in the design of

monetary policy. Though the State Bank of Pakistan started using short term interest rate as its operating target, a decade ago but monetary aggregates cannot be overlooked.

## V. CONCLUSION

The evidence of the analysis in this study proves that there exists a moderating role of asset prices for the effect of money supply on aggregate prices and real economic activity in Pakistan. In the model without asset prices, the predictive power of money is lesser for economic activity but significantly improves after incorporating asset prices. Money, compared to interest rate, has better explanatory power for forecast error variance of output and prices. And this explanatory power improves with inclusion of asset prices. Though the explanatory power of interest rate also improves but the improvement is more pronounced in case of money supply. Moreover, the asset prices proved to weaken the relationship between money and price level and strengthen the relationship between money and the economic activity. The higher the value of asset prices, the higher will be the effect of money on real GDP and lower will be the effect on the goods prices.

We can conclude that economists and policy makers shifted their focus from money supply to interest rate due to the apparent failure of money supply to explain variations in economic activity and goods prices. However, our results challenge this shift because when we incorporate asset prices in forecasting models, money supply not only better explains goods prices and economic activity than interest rate but also moderates the effect of money on the target variables. Therefore, previous studies focusing on the relationship between money supply and aggregate prices and output do not provide meaningful results if they fail to incorporate asset prices in their models.

Moreover, we suggest the State Bank of Pakistan to give due weight to monetary aggregates in the design of monetary policy. Though interest rate is an easy to control and identifiable operating target, still monetary aggregates have predictive content for the target variables of monetary policy. We also recommend to put more weight on asset prices in the macroeconomic model of the State Bank of Pakistan so that unbiased effects of changes in monetary policy instruments on the target variables

can be estimated. This will help increase appropriateness of the stance of monetary policy that will in turn help control inflation rate and keep goods prices more stable. Putting more weight on asset prices in monetary policy decisions will also make income more equitably distributed.

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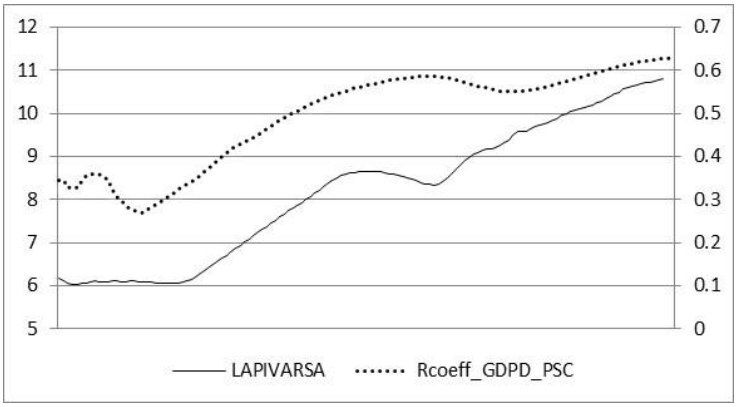
# APPENIX

## FIGURE A-1

Asset Prices and the Recursive Coefficients of Credit in the Regression of GDP Deflator




## TABLE A-1

Moderating Role of Asset Prices for the Effect of Credit on Prices

| | GDP Deflator | Coeff_GDPD_PSC | GDP Deflator | GDP Deflator |
|---|---|---|---|---|
| Constant | -4.28<br>(0.00) | -0.01<br>(0.71) | -1.50<br>(0.00) | -0.58<br>(0.00) |
| Private Sector Credit | 0.63<br>(0.00) | ----- | 0.16<br>(0.00) | |
| Asset Prices | ----- | 0.06<br>(0.00) | 0.17<br>(0.00) | 0.11<br>(0.00) |
| Asset Prices x Private sector Credit | ----- | ----- | -0.01<br>(0.00) | ----- |
| Adjusted-$R^2$ | 0.97 | 0.80 | 0.99 | 0.99 |
| F-Stats | 5089.33<br>(0.00) | 580.07<br>(0.00) | 12313.17<br>(0.00) | 12971.23<br>(0.00) |
| DW-stats | 0.06 | 0.07 | 1.94 | 1.98 |

Note: Probability values for accepting null hypothesis (that respective coefficient is zero) are given in parentheses. All variables are seasonally adjusted and are in logarithmic form.

FIGURE A-2

Asset Prices and Recursive Coefficient of Credit in the Regression of Real GDP

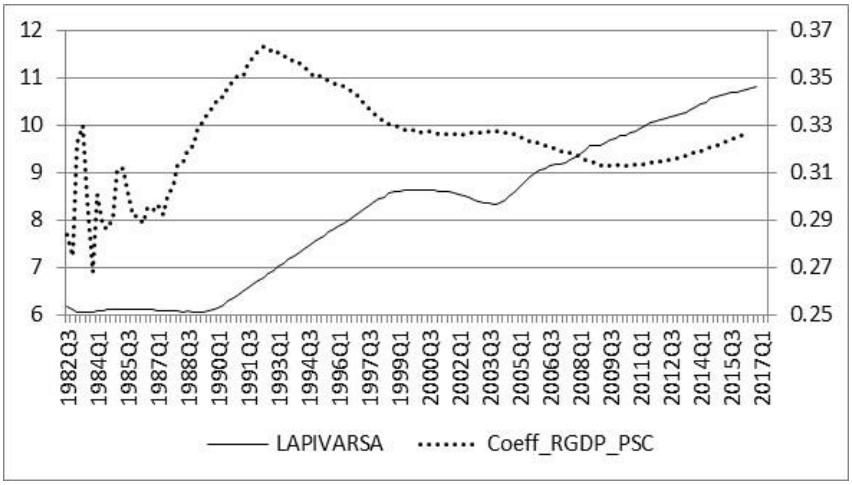



TABLE A-2

Moderating Role of Asset Prices for the Effect of Credit on Real GDP

| | Log(RGDPSA) | Coeff_RGDP_PSC | Log(RGDPSA) | Log(RGDPSA) |
|---|---|---|---|---|
| Constant | 2.90<br>(0.00) | .026<br>(0.00) | 0.87<br>(0.00) | 0.24<br>(0.00) |
| Private Sector Credit | 0.36<br>(0.00) | ----- | -0.06<br>(0.00) | ---- |
| Asset Prices | ----- | 0.01<br>(0.01) | -0.13<br>(0.00) | -0.07<br>(0.00) |
| Asset Prices x Private Sector Credit | ----- | ----- | 0.01<br>(0.00) | ----- |
| Adjusted R2 | 0.99 | 0.04 | 0.99 | 0.99 |
| F-Stats | 14173.15<br>(0.00) | 6.38<br>(0.01) | 11182.80<br>(0.00) | 12164.61<br>(0.00) |
| DW-stats | 0.57 | 0.53 | 1.79 | 1.83 |

Note: Probability values for accepting null hypothesis (that respective coefficient is zero) are given in parentheses. All variables are seasonally adjusted and are in logarithmic form.