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Asset Prices and Velocity Decline: An Empirical Investigation

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Abstract

The quantity theory of money lost much of its significance in 1980s due to the phenomenon of velocity decline and consequent instability of the money demand function; missing financial transactions and asset prices were believed to be responsible (Borio, Kennedy and Prowse, 1994; and Werner, 2012). This study, therefore, uses asset prices for Pakistan to explain the velocity decline phenomenon in a regression model as well as in Vector Error Correction Model (VECM) using quarterly data for the time period 1981Q1-2018Q2. The study finds significant role of asset price index in explaining income velocity of money with a negative effect. Moreover, the sub-sample regressions show that asset prices are helpful in explaining velocity decline phenomenon for the time period 1981-1998 and 2008-2018 but not for 1998-2008. Moreover, there are brief periods in the sample when velocity actually increased despite an overall declining trend. To explain those short term reversals in velocity trend, the study uses indicator function. Results show that the increase in velocity for brief periods is also explained by asset prices.

Keywords

Velocity
Decline, Asset
Prices, Money
Demand
Function,
Monetary
Policy

JEL

Classification

E41, E52

1. Introduction

The quantity theory of money lost much of its significance in 1980s due to the phenomenon of velocity decline and at that time money demand function was also found unstable (see, for instance, Hendry, 1985; Belongia and Chalfant, 1990; Boughton,

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1991). Notwithstanding the assumption of equation of exchange, velocity of money was believed to be declining over time and the money demand was found to be an unstable function of its determinants. Various sources of instability were offered that were linked to decline in the velocity of money. For instance, arguments of money demand function, like interest rate and income, had an effect on velocity, which then became unstable because of variability in the arguments; financial innovations and deregulations that changed the interest elasticity of demand for monetary aggregates ultimately led to unanticipated changes in the velocity of money; the function may also be unstable if there was continuous gap between money supplied in the system and what economic agents wanted to hold (Anderson, 1985). The empirical research in the field stressed that money was highly unpredictable and the literature was unable to explain the phenomenon that when the money supply was increasing the velocity of money kept on declining. Therefore, the need was felt to replace money with the interest rate as monetary policy instrument.

Historically, the monetary policy of the State Bank of Pakistan majorly focused on price stability and output growth using monetary aggregates targeting and keeping base money as its operational target. However, from 2009 onwards, it switched to having overnight money market repo rate – the short term interest rate – its operating target. The available literature in Pakistan mainly deals with substantiating, or otherwise, the quantity theory of money and estimating money demand function. Limited literature that is available on velocity of money concludes that the relationship between income velocity of money (derived from any of the monetary aggregates) and its determinants is stable (Omer, 2010), while on the other hand, some studies show that the relationship between income velocity of money and real per capita income seems to have changed and is unstable due to financial and economic developments in post 1971 war period (Omer and Saqib, 2009; Bilqees and Rauf, 1994). The income velocity of money carries important information for the design of monetary policy in Pakistan and evidence on its stability will be helpful for the debate on the adoption of monetary aggregates or inflation targeting regimes. Moreover, the importance of money and hence velocity of money is still relevant for a cash based economy of Pakistan where money plays important role in determining inflation rate (Qayyum, 2006; Khan and Schimmelpfening, 2006; Kemal, 2006; Chaudhry et al., 2015). However, the existing research does not relate income velocity of money with asset prices; the relationship needs to be explored.

This study adds to the existing empirical literature with regards to Pakistan economy by explaining the velocity decline phenomenon using asset price index. Therefore, the objective of this paper is to explain the issue of the velocity decline phenomenon for the Pakistan economy and this has been done with the help of asset price indices constructed by the authors. By distinguishing between transactions that are part of GDP and those transactions that are excluded from GDP and then taking both

of these transactions in the quantity theory equation solves the mystery of missing money due to velocity decline (Werner, 2012; Borio, Kennedy and Prowse, 1994). Moreover, the study also contributes by analyzing the velocity of money in three different sub-samples divided on the basis of breaking trend and then investigating how asset prices can explain the movements in the velocity of money in different regimes. The study also attempts to explain increases in the velocity of money observed over brief periods of time using indicator function.

Our methodology, to accomplish these objectives, is however different from that of Richard Werner. Instead of taking data on all real and financial transactions and then disaggregating equation of exchange for these two sectors, we have found income velocity of money based on transactions that are included in GDP and ignored assets or financial transactions. This velocity is then regressed on the asset price index to find whether or not the former can be explained by the latter. For this, regression model and VECM have been estimated using the time series data that span 1981-Q1 to 2018-Q2. For the sub-sample estimations, we have divided the whole sample into three sub-samples; 1981Q1 to 1998Q2, 1998Q1 to 2008Q2, and 2008Q3 to 2018Q2. Finally, for investigation of whether asset prices explain both the velocity increase and decline phenomena we have used the indicator function.

As hypothesized, we find the evidence that the asset prices are significant determinant of the income velocity of money; the effect of former on the latter is negative. Same result is found in first and third sub-samples while second sub-sample shows contrary evidence. Furthermore, results of the indicator function conform to our hypothesis that the asset prices not only explain velocity decline but also the increase in velocity of money.

Remainder of the study proceeds as follows: section 2 reviews the existing literature related to the issue; section 3 sheds light on the empirical methodology; results are discussed in detail in section 4; and section 5 gives concluding remarks..

2. Review of Literature

The quantity theory of money remained a dominant theme in the macroeconomic models and analysis and an important instrument in the conduct of monetary policy in the late 1970s. Nonetheless, from 1980s onwards the theory faced severe criticism due to the failure of some of its basic premises which led to its apparent failure in that era. The world witnessed various phenomena overtime, which the empirical literature observes as the decline in the income velocity of money, the case of the missing money, unstable money demand function, and inability to define money that were thought to be the weaknesses of the quantity theory of money (see, for instance, Goldfeld, 1976; Goodhart, 1989; Hendry, 1985; Kaldor, 1985; Belongia and Chalfant, 1990; Boughton, 1991; Pollin, 1991; Cottrell, 1992). The researchers and policy makers sidelined money by formulating moneyless models and focusing on interest rate to understand the workings of the economy in the form of real business cycle (RBC) models, which

evolved to DSGE models, later on. Money was considered a weak instrument and was replaced by the interest rate as an instrument of monetary policy by almost all the central banks around the world on the assumption that the interest rate is more predictable than money. However, the relationship between interest rate and the nominal GDP growth was never well established and the correlation between the two was never more likely to be negative rather it was found positive. Especially for the developing economies with low financial access indicators where most of the transactions are cash based, the monetary models, mostly perform well with money growth rules instead of Taylor type interest rate rules (Ahmed, Pasha & Rehman, 2016) . Also mostly the causation runs from the economic growth to the interest rate. Moreover, the failure of the decrease in interest rate to revive the Japanese economy from deflation in 1990s, after the price bubble in both real estate and equity, also raised questions about the validity of the interest rate instrument and the models using it, in explaining asset prices, bank lending or international capital flows. Due to this failure, the bank of Japan returned back to targeting bank reserves using open market operations in March 2001 later naming it as quantitative easing, as role of money becomes the only remaining influence of monetary policy when the interest rate hits the zero nominal bound (Werner, 2012; Meyer, 2001). Similarly, the bank of England also introduced quantitative easing after the global financial crisis in 2009 and researchers and central banks are now focusing on the quantity of money than on the price of money (Werner, 2012).

Consequently, the economists instead of finding answers to questions posed by issues of velocity decline, inability to define money and unstable money demand function, deemed all these phenomena a failure of the quantity theory of money and found an escape route in building moneyless models and focusing on the short term nominal interest rate and supply side economics. Considering the recurrent financial crisis over different time periods, failure of the interest rates in explaining relationship between financial markets and the economy and stimulating a stagnant economy, the failure of the researcher to model banks in macroeconomic theories, and inability of the supply side economics to explain real world phenomena, it is now important to analyze the factors that were responsible for the breakdown of the quantity theory of money and to find answers to questions posed by the events that followed.

In order to accurately estimate the equation of exchange and reviving its place in economics, it is imperative to identify the factors that led to severe criticism and relinquishment of the quantity theory of money. As also pointed out by Werner (2012), two major flaws in the equation of exchange led to its downfall. First, the original equation of exchange given by Irving Fisher (1911) is:

$$MV = PT \quad (1)$$

Which implies that the total volume of transactions equals the amount of money paid for these transactions in a typical time period. However, due to unavailability of data on total transactions, the Cambridge economist replaced ‘PT’ with ‘PY’ in the

equation of exchange which is the total purchases of the final goods and services only i.e. GDP of an economy, on the assumption that $PT=PY$. The GDP statistics do not include real estate transactions and financial transactions which are a crucial element in the original equation of exchange. Therefore, a distinction should be made between transactions that are included in GDP and those that are excluded because GDP is only a subset of the total transactions and it does not represent all the transactions in the economy (Werner, 2012; Howells & Biefang-Frisancho Mariscal, 1992).). If the value of transactions, not included in GDP, rises then the equation of exchange shows a fall in the velocity, which explains all the phenomena which are considered responsible for the breakdown of the quantity theory of money. Moreover, economic activity in an economy cannot be defined by goods transactions only rather the asset transactions¹ are also an important component of the economic activity. And the narrow focus of the monetary policy on goods transactions has serious implications for asset price bubbles and hence for financial crisis. Consequently, it is imperative to consider the effects of monetary policy changes on the asset transactions because it may so happen that the asset transactions are leading monetary policy and goods transactions as well and may very well be an important source of the financial crisis. This issue was first taken up by Richard Werner in his papers (1992; 1997; 2012) and both sides of equation (1) were decomposed into two components – one that is related to transactions that are part of GDP and the other related to financial transactions (excluded from GDP).

$$MV = M_R V_R + M_F V_F \quad (2)$$

$$PT = P_R T_R + P_F T_F \quad (3)$$

$M_R V_R$ and $P_R T_R$ are the GDP based transactions and the value of these transactions respectively and $M_F V_F$ and $P_F T_F$ are non GDP or financial transactions and their value respectively.

Therefore, the following equations should hold as well:

$$M_R V_R = P_R T_R \quad (4)$$

$$M_F V_F = P_F T_F \quad (5)$$

Since $P_R T_R$ represents the value of GDP transactions, it should be equal to nominal GDP i.e $P_R Y$.

$$M_R V_R = P_R Y \quad (6)$$

Where $V_R = (P_R Y)/M_R = \text{Constant}$

Eq (6) implies that with stable velocity the amount of money used for GDP transactions must be equal to nominal GDP over any time period and Eq (5) implies that the quantity of money used in financial transactions must be equal to their value.

For the economic growth of an economy the value of economic transactions during one time period should be greater than the previous time period. Therefore, considering the net changes in the variables over time we obtain:

¹ Asset transactions include all those transactions that are excluded from GDP such as financial assets and second hand sale of real estate.

$$\Delta(M_R V_R) = \Delta(P_R Y) \quad (7)$$

$$\Delta(M_F V_F) = \Delta(P_F T_F) \quad (8)$$

The increase in the amount of money used for GDP transactions also increases the nominal GDP and vice versa. Similarly, an increase/decrease in the amount of money used for non-GDP/financial transactions increases/decreases the value of non-GDP transactions which implies that if more money is created and directed towards fulfilling the demands for financial transactions, it may lead to the creation of asset price bubbles.

Second, the complexities in defining money, perhaps due to financial innovations, cast doubt on the validity of the quantity theory of money. Many economists defined money as the deposit aggregates such as M0, M1, M2, M3, M4 to be used in equation of exchange but these deposit aggregates represent money that is out of circulation, whereas the M in the equation of exchange is defined as the purchasing power of money in transactions i.e. money in circulation (Werner, 2012). Hence, a proper definition of money used for total transactions which represents the purchasing power of money and implies money in circulation is imperative to accurately estimate the equation of exchange. The history of money suggests that the quantity theory of money had persisted through major changes in the currency systems overtime and therefore has the ability to cope with current innovations to prove its validity with empirical evidence (Graff, 2008). Therefore, a more proper definition of money needs to be established for which different measures of money can be constructed. One of such measures could be defining M as total credit in the economy and disaggregating it as credit for GDP/real transactions and credit for financial transactions as is suggested by Werner (1997 and 2012). We did not use the credit variable in this analysis because most of the transactions in Pakistan are cash based especially in asset purchases.

The monetary policy of the State Bank of Pakistan mainly focused on maintaining price stability and output growth with initially using monetary aggregates targeting and keeping M0 as its operational target. Nevertheless, from 2009 onwards the operational target was replaced by the overnight money market repo rate owing to weakening relationship between monetary aggregates and inflation rate, which can be attributed to the structural changes in the economy, in general, and the financial sector, in particular (Hanif, 2014).

The existing literature on the quantity theory of money in case of Pakistan has mainly focused on verifying the positive relationship between growth of money stock and the inflation and to testify the monetarist stance that inflation is always and everywhere a monetary phenomenon. Such as Farooq, Hassan and Shahid (2015), Qayyum (2006), and Kemal (2006) showed a positive relationship between money supply and inflation in Pakistan. However, Omer & Saqib (2008) shows that the quantity theory of money does not hold, in its original form, in case of Pakistan, owing to the absence of proportional relationship between money supply and prices, instability of the

income velocity of money, and the endogeneity of money stock in the economy; therefore, Pakistan should rethink about monetary targeting strategy.

Other than above mentioned two directions, Ahmed, Pasha and Rehman (2016) evaluates the role of money in creating business cycles in closed economy DSGE model and concludes that Pakistan being the country with lowest financial access indicators has a high level of currency and the most of the transactions are cash based. Money has significant role in the models of the Pakistan economy because monetary aggregates are not only strongly procyclical but may also be considered as leading indicators of business activity. Moreover, performance of money growth rule in the form of matching to actual data is superior to the Taylor type interest rate rule. Moreover, Hanif and Hayat (2016) emphasize that the inflation in Pakistan is significantly being explained by the broad money throughout all regimes including monetary targeting regime, transition phase and interest rate targeting regime. This means that the control of the money supply still has the potential to curb inflation rate but more focus on interest rate has undermined the importance of monetary targeting. These two studies highlight the importance of money in explaining the economic activities in Pakistan.

Moreover, the literature related specifically to velocity of money in Pakistan is also limited. Omer (2010) shows that the velocity of base money and that of broad monetary aggregate do not dependent on the changes in interest rate but the relationship between income velocity of monetary aggregate and its determinants is stable. Therefore, the study suggests to use monetary aggregates as the nominal anchor in Pakistan. Bilqees and Rauf (1994) conclude that the relationship between income velocity of money and real per capita income has changed overtime due to the financial and economic developments in post 1971 war period.

However, asset prices and asset transactions and their effect on the economic activity and velocity decline have always been ignored as an area of research in the field of monetary policy in Pakistan.

3. Econometric Methodology

3.1 Asset Prices and the Velocity of Money

From theoretical discussion on the topic, given in literature review, we hypothesize that the decline in velocity of money is associated with rising asset prices over time. Therefore, velocity of money is negatively associated with asset prices. To test this hypothesis, we have estimated different models with different indices of asset prices.

In the first step of the analysis we run a simple bivariate regression of income velocity of money on real aggregate asset price index. We, then estimate the multivariate models through two different approaches: regression based approach which is in conformity with Engle-Granger method and VECM using Johansen's approach.

Bivariate regression model is given as:

$$\log\left(\frac{PY}{M}\right)_t = \alpha + \beta \log\left(\frac{AP}{P}\right)_t + \sum \delta_i \log\left(\frac{PY}{M}\right)_{t-i} + \varepsilon_t \quad (9)$$

Where PY/M is the velocity of money and AP/P is the asset price index deflated by GDP deflator that has been constructed using three types of assets, namely the house prices, equity prices and the exchange rate using four different measures based on weights assigned to each asset. We run the bivariate regression using four different measures of real asset price indices constructed with each of the procedure of assigning weights along with the three more specifications that include individual asset prices namely the house price index, equity prices and the exchange rate. The coefficient on real asset prices (β) will indicate the direction and magnitude of the effect of asset prices in explaining income velocity of money.

Below we discuss some important steps that we follow while estimating all the specifications of bivariate regressions:

1. We have checked the stationarity of variables. If the variables are non-stationary then we may have spurious results. In that case, we have tested the presence of unit root in the residual series, which is actually the second step in Engle-Granger cointegration test. If residual series is found to be stationary then it signifies a long run equilibrium relationship between asset prices and the income velocity of money.
2. There are structural breaks in our data which signify important changes in the economy over time such as financial sector reforms, shift towards the floating exchange rate system, 9/11 incident, world oil price hike of 2008 and the global financial crisis. Events like these change the structure of an economy and hence the behavior of the parameters. We, therefore, have used dummy variables in our analysis to incorporate those structural breaks in the data.
3. The errors are mostly autocorrelated in time series data; therefore, we have included lagged dependent variable accordingly to remove autocorrelation of errors. For selection of the number of lags (from a maximum of 12 lags in quarterly data), Akaike Information Criterion (AIC) has been used.
4. Because of the inclusion of lags the model becomes a short run model. We, therefore, have adjusted short run estimates to compute long run coefficients.

The bivariate analysis is subjected to the risk of specification bias and the coefficient of real asset prices may be biased due to omitted variables. Moreover, it is suspected that the relationship between asset prices and velocity of money is caused by a third variable which is missing in the analysis. To prove that the above found relationship is robust we postulate a function that relates velocity of money to the asset prices and a vector of control variables including real permanent income, transitory income, and short run and long run interest rates [for detail on determinants of velocity of money in Pakistan see Omer (2010)].

$$\log\left(\frac{PY}{M}\right)_t = \alpha + \beta \log\left(\frac{AP}{P}\right)_t + \gamma \log X_{it} + \sum \delta_i \log\left(\frac{PY}{M}\right)_{t-i} + \varepsilon_t \quad (10)$$

Where PY/M is the velocity of money, log AP/P is log value of the ratio of asset price index to GDP deflator and Xi contains other control variables such as RS (short term interest rates), RL (Long term interest rates), Yp (Permanent income) and Yt (transitory income). All these variables have some theoretical relationship with to the income velocity of money; thus, the multivariate analysis has theoretical justification.

The velocity is expected to positively relate to permanent income in the economy as an increase in the latter will expand aggregate demand thereby increasing transactions which, in turn, will increase the income velocity of money. A coefficient of transitory income is expected to be positive and less than 1 which indicates that the velocity will move pro-cyclically as is consistent with the Friedman's Permanent income hypothesis. Over the business cycle, an increase in transitory income would increase the demand for money balances which serve as a buffer stock, thereby leading to increase in velocity.

Short term and long term interest rates are hypothesized to positively affect velocity as an increase in the interest rate reduces the demand for money, thereby leading to an increase in the velocity at a given level of income. Asset price index is expected to have a negative sign as an increase in the prices of assets will lead to an increase in the amount of money that goes into the financial transactions whereas the GDP based transactions remain the same. This leads to a decline in the income velocity of money.

As we are performing multivariate analysis, therefore, we also estimate it as a system in the form of vector error correction model that includes lagged error correction term and lags of first differenced variables. Akaike information criterion has been used to select lag length. Cointegration among variables has been tested using trace statistics and maximum Eigen value statistics. The VECM can be written as:

$$\Delta \log\left(\frac{PY}{M}\right)_t = \alpha + \sum \beta_{ji} \Delta \log\left(\frac{AP}{P}\right)_{j-i} + \sum \delta_{ji} \Delta X_{j-i} + \sum \chi_j Y_{j-i} + \sum \gamma_i \Delta \log\left(\frac{PY}{M}\right)_{t-i} \dots (11)$$

Where i= 1, ..., p denotes lag length while j represents variable. PY/M is the income velocity of money, AP/P is the real asset prices, Y is a vector containing dependent and independent variables, and X vector contains control variables.

It becomes evident from the estimations of section 4.2 that the asset prices are significant determinant of velocity decline, however, if we look at the figure 1 of velocity of money and asset prices (see section 4.1) we observe that there are certain time periods in which this relationship is reversed or asset price do not seem to explain the velocity phenomenon. Therefore, we divide our whole sample into three sub-

samples to analyze that how asset prices explain the movements in the velocity of money in different time periods. The sub-samples are 1981Q1 to 1998Q2, 1998Q3 to 2008Q2, and 2008Q3 to 2018Q2. We use the same regression equation 4.9 for all the sub-samples.

If we look at the figure of velocity of money and asset prices (See section 4.1) it can be seen that on average velocity is declining with the increase in asset prices. However, if we observe minutely, we can see that velocity is also rising in few time periods. So we have made an indicator function for both rising and declining velocity. We then estimate the regression with this indicator function to check if the inclusion of asset prices gives only one way explanation of velocity decline or asset prices are capable for a two way explanation for both rising and declining velocity. The regression equation takes the following form:

$$\log\left(\frac{PY}{M}\right)_t = \alpha_0 I + \alpha_1 (1-I)_t + \beta_1 I * \log\left(\frac{AP}{P}\right)_t + \beta_2 (1-I) * \log\left(\frac{AP}{P}\right)_t + \sum \delta_i \log\left(\frac{PY}{M}\right)_{t-i} + \varepsilon_t \dots\dots\dots (12)$$

Where I, is the indicator function which takes on a value of 1 if $(PY/M)_t > (PY/M)_{t-1}$ and 0 otherwise. If asset prices explain the movements (rise and fall) in velocity then both the coefficients should have same value. Therefore, in order to check the symmetry of coefficients of β_1 and β_2 , we use Wald statistics to test the hypothesis that $\beta_1 = \beta_2$.

3.2 Construction of Variables

We use Hanif et al, (2013) and Arby (2008) as data source for nominal and real GDP. Arby (2008) quarterized 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. We extend data for the time period 2011-2018 using quarterly shares found from quarterly data taken from above two sources. We find small variations in quarterly shares over time. We therefore assume that the quarterly shares, calculated as average, remain constant for the next six years for which data are to constructed. We construct quarterly data of GDP for the time period 2011-18 by multiplying the average quarterly shares with the annual GDP. Broad Money comprises currency in circulation, other deposits with the State Bank of Pakistan (SBP) excluding IMF A/c Nos. 1 & 2 SAF loan accounts, counterpart funds, deposits of foreign central banks, foreign governments, international organizations and deposit money banks. Moreover, scheduled banks' demand deposits excluding inter-bank deposits, deposits of central and provincial governments and foreign constituents are also included. Finally, scheduled banks' time deposits are part of broad money. GDP Deflator is constructed from the ratio of nominal GDP to Real GDP and multiplying the result by 100. Call Money Rate is the interest rate at which short term loans are lent and borrowed in the money market. It is the monthly average of daily minimum and maximum call money rate. Long term Interest rate is 5 years and above weighted average deposit rates,

which is used as a proxy for long term interest rates. Short term interest rate is 6 months and below weighted average deposit rates, which proxies short term interest rate. According to IFS, beginning in September 1997 the share price index for Pakistan refers to the mid-day quotes for the last day of the month for 100 common shares on the Karachi Stock Exchange with November 1991 as base period. Exchange Rate is taken as price of US dollar in terms of Pakistani Rupees. Private Sector Credit includes credit provided to the private sector of Pakistan from conventional bank branches, Islamic banks, and Islamic banking branches of conventional banks. Quarterly data on private sector credit was available only from 1998 Q3. Therefore, we have constructed quarterly data of private sector credit from 1981 Q1 to 1998Q2 on the assumption of fixed quarterly weights calculated from available quarterly data and the given data on stock of annual private sector credit. Housing Services consists of three sub-sectors, namely ownership of dwellings, real estate and cooperative housing societies. This variable is used as percent of nominal GDP to assess the size of housing services relative to the overall size of the economy. Size of stock market is measured by market capitalization, which is computed as the number of outstanding shares traded on the Karachi Stock Exchange of the listed domestic companies times the price of these shares. We have used this variable as percent of nominal GDP to calculate the size of the stock market relative to the size of the economy. Foreign Exchange Reserves consists of reserve assets held by the State Bank of Pakistan and scheduled banks in foreign currency which includes foreign currencies, gold, and special drawing rights of the IMF. This variable is also expressed as percent of nominal GDP to evaluate the size of foreign exchange market relative to the size of the economy. House Rent Index is extracted from the monthly CPI series published by Pakistan Bureau of Statistics. we have calculated year on year inflation rate as the fourth difference of log GDP deflator multiplied by 100, which is the percentage growth rate of a particular quarter over the same quarter of previous year.

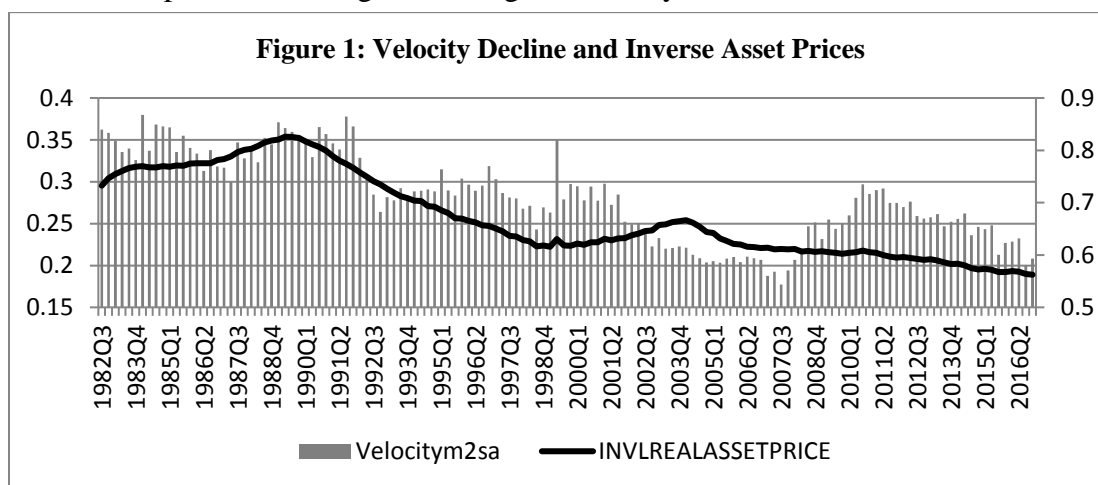
3.3 Data Sources

Quarterly data of the above mentioned variables have been used for a period spanning 1981 Q1 to 2018 Q2. The data source for call money rate, exchange rate and share prices is the International Financial Statistics (IFS). Data on M₂, 5 years and above deposit rates, 6 months and below deposit rates, 6 and 3 months T-bill rate, private sector credit, house rent index and market capitalization are extracted from the Handbook of Statistics by the State Bank of Pakistan. Finally, Economic Survey of Pakistan has been used as data source for housing services and foreign exchange reserves.

4. Empirical Findings

4.1 Velocity Decline and Asset Prices: A Visual Inspection

For preliminary analysis we plot asset price index along with income velocity of money. The objective is to establish long run average relationship between these two variables. At the same time, the figure 1 is useful for identifying sub-samples, which are to be used in regression analysis. Finally, the figure is helpful in constructing indicator function for positive and negative change in velocity.



We are using inverse of the asset prices for this figure which means that a downward portion of the curve of the asset prices indicates a rise in the asset prices and vice versa. As can be seen from the figure, asset prices are explaining the phenomenon of velocity decline in Pakistan; on average, with an increase in the asset prices, the income velocity of money is declining.

For the first decade in the sample, i.e. from 1982Q1 to 1991Q3 the velocity of money is more or less constant and during that period asset prices have U-shape. However, from 1991Q3 to 1998-Q3 the asset prices are increasing and the velocity is declining.

A jump in velocity can be observed from the figure in the year 1999 due to the events that took place in 1998. During 1998 Pakistan conducted nuclear bomb tests which led to certain economic sanctions on the economy. This action reduced the net foreign assets of the country and the foreign exchange reserves fell to an extremely low levels of 1.5 billion dollars, thereby leading to a fall in the money supply in the economy. Given the level of income, this fall in the money supply produced a jump in the velocity.

From 1999 Q1 to 2003 Q4 asset prices are falling and so is the velocity of money. This time period shows that asset prices are not helpful in explaining the velocity decline. However, asset prices started to increase from 2004 Q1, but the velocity of money continued to fall till 2007 Q3. After 2007 Q3 even with the increase in asset prices till 2009Q1, the velocity of money is also increasing during this time period and even after that till 2011 Q1. This disturbance in the relationship can be explained by variables other than asset prices. Asset transaction during this period can explain the

increase in the velocity of money. During this time period oil prices soared to their record high levels and also the exchange rate and the consumer prices jumped up at the same time. Due to increased oil prices, our foreign exchange reserves decreased to a large extent which led to decrease in the net foreign assets of the economy. Therefore, money supply in the economy decreased, thereby leading to a rise in velocity of money at a given income level.

Moreover, it can be inferred from the figure that the relationship between the velocity of money and asset prices was disturbed over the period 2007Q3 to 2011Q1. Asset prices do not seem to explain the velocity decline phenomenon during this time period. However, prior to 2007 and from 2011 to 2016 the increasing asset prices explain decline in velocity of money.

4.2 Testing Stationarity of the Variables

Testing unit root in the variables is necessary first step in the time series analysis. Analysis very much depends on the order of integration of the variables included in the model. We, therefore test unit root in each of the variable. As power of unit root tests is quite weak so results from only one test cannot be relied. Therefore, two unit root tests – Augmented Dickey-Fuller test and Phillips-Perron test – have been used. In unit root test specifications variables are taken in logarithmic form, except interest rate that is taken in level form. All variables are assumed to have deterministic trend in log-level form but only intercept in first differenced form. Akaike information criterion has been used to select lag length in unit root test equation. Results in table 1 show that all variables are non-stationary at level but stationary at first difference. In this case, regression results are spurious unless the variables in the regression are cointegrated.

Table 1: Results of Unit Root Test

	ADF Stat		PP Stat	
	Level	FD	Level	FD
Money supply	-1.82	-10.14***	-2.02	-10.31***
GDP Deflator	-2.12	-18.02***	-2.41	-17.27***
Real GDP	-2.29	-6.59***	-1.04	-33.26***
Asset Price	-2.46	-3.18***	-1.87	-3.59**
Index				
Short term	-2.33	-3.75***	-2.35	-7.99***
Interest Rate				
Long term	-1.83	-3.73***	-0.96	-7.97***
Interest Rate				

Note: all variables except interest rates are in logarithmic form. **(***) show statistical significance at 5% (1%) significance level. ADF refers to Augmented Dickey-Fuller, and PP refers to Phillips-Perron. FD stands for first difference.

4.3 Asset Prices and the Velocity of Money: Bivariate Analysis

In the first step we start our formal analysis by using bi-variate regression model. The results of this simple model of velocity and asset price indices are given in the following table (2).

Table 2: Effect of Asset Prices on Velocity of Money: Bivariate Analysis

	Velocity	Velocity	Velocity	Velocity
Constant	0.04 (0.07)	-0.02 (0.02)	0.64 (0.00)	0.23 (0.00)
Asset Price (SR)	-0.02 (0.01)	-0.05 (0.00)	-0.24 (0.00)	-0.12 (0.00)
Asset Price (LR)	-0.21	-0.39	-0.69	-0.97
Adjusted R-square	0.91	0.91	0.93	0.91
Q-Stat at lag 1	0.05 (0.82)	0.32 (0.57)	1.60 (0.21)	0.63 (0.43)
Q-Stat at lag 4	3.00 (0.56)	4.35 (0.36)	6.04 (0.196)	4.52 (0.30)
EG Tau stats	-3.09 (0.1)	-2.16 (0.15)	-3.95 (0.03)	-2.63 (0.23)

Note: Parentheses contain probability values for accepting null hypothesis (that the coefficient is zero). Akaike Information criterion is used for lag length selection. All variables are taken after seasonal adjustment. All variables except interest rate are taken in log form. EG refers to Engle and Granger (test of cointegration).

We have performed this regression with four different measures of asset price index constructed with each of the procedure of assigning weights. In all specifications, the short run coefficient of asset price index is negative and statistically significant at less than 1% level of significance except for specification one (which is significant at 1% level of significance). The coefficient of asset price index ranges from -0.02 to -0.24. This signifies that asset prices have an inverse relationship with the income velocity of money in Pakistan; thereby an increase in asset prices makes the velocity decline. Our findings are in conformity with Borio, Kennedy and Prowse (1994). Also the long run coefficient of asset price in all regressions is negative and ranges between -0.21 to -0.97; long run coefficient shows that the relationship is quite strong in magnitude. All of these results show that the apparent decline in the income velocity of money over time is associated with asset prices. Money is used in transactions of goods as well as asset. But in calculating income velocity of money, only goods market transactions are included, while asset market transactions are ignored. This ignorance makes income velocity of money decline over time as asset prices gain momentum. This has been captured by the negative coefficient of asset prices in the regression of income velocity of money.

We have used 2 lags for model 1, 2 and 4 whereas model 3 uses 5 lags of the dependent variable. It can be seen from results that inclusion of asset prices in the

regression increases explanatory power as shown by increase in adjusted R-square. Ljung Box Q stats for lag 1 and 4 have been reported due to quarterly frequency of our data. The results show that there is no autocorrelation in our errors. EG (Engle-Granger) Tau stats shows that the variables are cointegrated in models 1 and 3 at 10% and 5% level of significance respectively.

It is noteworthy that asset price indices are dominated by one type of asset price i.e. house prices, therefore, we have also used individual asset prices in place of asset price index in the same regression to analyze their effects on the velocity of money. The results are shown in Table 3.

We still have consistent results with different types of asset prices. The coefficients of house prices, exchange rate and the share prices have the negative sign and all are statistically significant at less than 1% level of significance. These results indicate that an increase in all types of asset prices leads to a fall in the velocity of money in Pakistan. The long run coefficients are high in magnitude and indicates a long run negative relationship between asset prices and the income velocity of money. As all of the asset prices have increased in the past and all are ignored while calculating income velocity of money, therefore, each asset price is negatively associated with the velocity. This also shows that the velocity decline phenomenon cannot be associated with just one asset; rather, it can be generalized with respect to all asset prices. Money used in each asset's transactions is responsible for velocity decline, if that is not considered in finding the income velocity of money.

Table 3: Effect of Asset Prices on Velocity of Money

	Short run coefficient	P-value	Long run coefficient
Intercept	0.75	(0.00)	2.44
House Price Index	-0.08	(0.00)	-0.25
Exchange Rate	-0.21	(0.00)	-0.69
Share Price Index	-0.06	(0.00)	-0.20
Adjusted R²	0.92		
Q-Stat at lag 1	0.96	(0.33)	
Q-Stat at lag 4	5.04	(0.28)	
EG Tau stats	-4.88	(0.01)	

Note: Parentheses contain probability values for accepting null hypothesis (that the coefficient is zero). Akaike Information criterion is used for lag length selection. All variables are taken after seasonal adjustment. All variables except interest rate are taken in log form. EG refers to Engle and Granger (test of cointegration).

We have used 3 lags for this specification. The adjusted R square is high, the Q-stat is showing no autocorrelation of errors and the variables are found cointegrated.

These results are in conformity with our hypothesis that asset prices play a vital role in explaining the velocity decline phenomenon in Pakistan. As mentioned in section 2, two types of transactions take place in an economy, one is GDP transactions and the

other is non-GDP transactions. If the value of non-GDP transaction rises, then even with constant GDP transactions, the equation of exchange shows a fall in the velocity, which explains all the phenomena which are considered as the breakdown of the quantity theory of money. Therefore, it is important to include asset prices in the estimation of the quantity theory of money because movements in asset prices can explain the phenomenon of velocity decline and missing money appropriately.

4.4 Asset Prices and the Velocity of Money: Multivariate Analysis

For the sake of conformity of the previous section's results we add control variables, one by one, to our bivariate regression analysis and perform multivariate regression and VECM as well. The results are summarized in table 4².

Table 4: Effect of Asset Prices on Velocity of Money: Multivariate Analysis

	Regression Analysis				VECM
	Specification 1	Specification 2	Specification 3	Specification 4	
Constant	0.019 (0.24)	0.02 (0.27)	0.03 (0.24)	-0.11 (0.00)	0.04 [0.49]
Asset Prices	-0.14 (0.01)	-0.18 (0.05)	-0.20 (0.05)	-0.10 (0.00)	-0.20 [-12.17]
Permanent Income	----	0.00 (0.52)	0.00 (0.45)	0.00 (0.16)	0.00 [4.27]
Transitory Income	----	----	0.00 (0.00)	0.00 (0.00)	0.00 [15.63]
RS	----	----	----	0.04 (0.00)	0.02 [3.52]
RL	----	----	----	0.00 (0.42)	0.01 [3.94]
Adjusted R²	0.91	0.91	0.91	0.92	0.19
Q-Stat at lag 1	0.36 (0.55)	0.37 (0.54)	0.93 (0.34)	1.36 (0.22)	----
Q-Stat at lag 4	5.25 (0.26)	4.07 (0.40)	3.92 (0.42)	3.59 (0.47)	----
LM Stat (1)	----	----	----	----	431.59 (0.00)
LM Stat (4)	----	----	----	----	266.53 (0.00)
Trace Stat	----	----	----	----	330.91 (0.00)
Max Eigen Stat	----	----	----	----	209.15 (0.00)

Note: Parentheses contain probability values for accepting null hypothesis (that the coefficient is zero) while brackets contain t-values. Akaike Information criterion is used for lag length selection.

² Results of CUSUMS test for the first equation of VECM are given in the appendix, which show that coefficients are stable.

For lag selection in VECM, different test statistics, LR, FPE, AIC, SIC, and HQ are used. All variables are taken after seasonal adjustment. All variables except interest rate are taken in log form. EG refers to Engle and Granger (test of cointegration).

It is found that the asset prices are significant determinant of velocity of money and the relationship is found negative in all specifications based on different weights criteria used in the construction of asset price indices. This implies that our bivariate regression results are reliable and consistent. The coefficient of permanent income is insignificant for all specifications in the regression but significant in VECM having negligible value in magnitude. However, the coefficient of transitory income is positive, trivial in magnitude but statistically significant and less than unity which means that the velocity of money is pro-cyclical. Transitory income is a measure of business cycle and a positive coefficient implies that during booms velocity increases while it decreases during recessions. The regression and VECM analyses show that coefficients of short run and long run rate of interest are significant and positive. This result implies that an increase in the interest rate reduces the demand for money balances thereby leading to a rise in velocity with a given level of income.

4.5 Velocity Decline and Asset Prices: Sub-samples

It is evident from the results of the previous section that asset prices have an important role in explaining the velocity decline phenomenon. However, if we consider the figure 1 in section 4.1, we have seen that there are certain time periods in which asset prices do not seem to explain movements in the velocity of money. Therefore, we perform regression of the previous section with three sub-samples divided according to the time periods in which the relationship between velocity of money and asset prices seemed to be strong and weak. The summary of results is given in Table 5.

Table: 5 Effect of Asset Prices on Velocity of Money: Sub-samples

	1981-1998	1998-2008	2008-2016
Constant	0.03 (0.18)	-0.15 (0.32)	0.40 (0.01)
Asset Price (SR)	-0.03 (0.00)	0.03 (0.46)	-0.11 (0.00)
Asset Price (LR)	-0.11	0.35	-0.36
Adjusted R²	0.80	0.81	0.78
Q-Stat at lag 1	0.09 (0.77)	0.05 (0.83)	0.01 (0.93)
Q-Stat al lag 4	0.82 (0.94)	1.91 (0.75)	0.75 (0.945)

Note: Parentheses contain probability values for accepting null hypothesis (that the coefficient is zero). Akaike Information criterion is used for lag length selection. All variables are taken after seasonal adjustment. All variables except interest rate are taken in log form. EG refers to Engle and Granger (test of cointegration).

We have used 5 lags for the first and third sub-samples, whereas the second sub-sample uses 2 lags. The adjusted R-square is high in all the three samples and the Q-stat is showing that there is no autocorrelation at 1st and 4th lag.

The results of first and the third sub-samples are showing that asset prices explain the velocity decline phenomenon for the time period 1981-1998 and from 2008-2016. These are the two periods when continuous increase in asset prices was matched with continuous decline in velocity. However, as was observed in the figure 1, asset prices do not seem to explain the movements in velocity of money for the time period between 1998 and 2008. The coefficient of asset prices for this time period has positive sign and is also statistically insignificant which implies that no clear relationship can be explained between asset prices and the velocity of money during this time period. Over this sample period, velocity was continuously declining while asset prices show a U-shaped pattern initially decreasing and then increasing. That's why we find a statistically insignificant relationship between velocity and asset prices in the sample. We can find a significant coefficient if we divide this subsample into two further subsamples based on the two sides of U (of asset prices) but instead of doing that we have done the analysis using indicator function as discussed below.

4.6 Velocity Decline and Asset Prices: Indicator Function

In order to analyze whether the results of section 4.2 hold on average only or the asset prices explain both the phenomena of velocity rise and decline, we run the regression of asset prices and velocity of money using indicator function based on rising and declining velocity. As mentioned in section 3.1 the indicator function (I) takes the value 1 for positive change in velocity and zero otherwise. The results are given in table 6.

Table 6: Role of Asset Prices in Explaining Fluctuations in Velocity

		Velocity of Money	Velocity of Money	Velocity of Money	Velocity of Money
Short run Coefficients	I	0.08 (0.00)	0.04 (0.00)	0.02 (0.21)	0.20 (0.00)
	1-I	0.00 (0.93)	-0.03 (0.00)	-0.04 (0.00)	0.11 (0.03)
	I*Asset prices	-0.02 (0.00)	-0.03 (0.00)	0.02 (0.00)	-0.08 (0.00)
	(1-I)*Asset prices	-0.01 (0.06)	-0.02 (0.03)	0.01 (0.35)	-0.06 (0.01)
Long run Coefficients	I	2.56	1.13	0.79	4.71
	1-I	0.04	-0.82	-1.83	2.52
	I*Asset prices	-0.49	-0.85	0.77	-1.86
	(1-I)*Asset prices	-0.32	-0.58	0.25	-1.51

Adj R ²	0.95	0.95	0.95	0.96
Q-Stat at lag 1	0.06 (0.82)	0.04 (0.84)	0.14 (0.70)	0.00 (0.98)
Q-Stat at lag 4	4.10 (0.39)	3.88 (0.42)	5.20 (0.27)	3.78 (0.44)
Wald Test	0.87 (0.35)	0.84 (0.36)	3.47 (0.06)	0.34 (0.56)

Note: Parentheses contain probability values for accepting null hypothesis (that the coefficient is zero). Akaike Information criterion is used for lag length selection. All variables are taken after seasonal adjustment. All variables except interest rate are taken in log form. EG refers to Engle and Granger (test of cointegration)

The coefficients of both $I \cdot \text{asset prices}$ and $(1-I) \cdot \text{asset prices}$ are negative and statistically significant in three out of four specifications which means that our results of section 4.3 are robust. This means that asset prices not only explain velocity decline but also the increase in velocity. Furthermore, we have also checked the symmetry of these coefficients by Wald test which accepts the null hypothesis that coefficients in both states, velocity decline and rise, are equal. The explanatory power of the models is very high and there is no autocorrelation of errors.

4 Conclusion

The objective of the study is to explain the increase in velocity and velocity decline phenomenon in a model that includes asset prices. We use asset prices as the candidate variable to explain the velocity decline phenomenon in Pakistan for a time period spanning 1981-Q1 to 2018-Q2. The empirical analysis shows a significant role of asset prices in explaining the velocity decline phenomenon. The asset price index has negative coefficient and ranges from -0.02 to -0.24. This indicates an inverse relationship between asset prices and the velocity whereby, an increase in the asset prices are associated with a decline in the income velocity of money. Our findings are in conformity with the Borio, Kennedy and Prowse (1994). Moreover, the sub-sample regression for the weak and strong relationship between asset prices and velocity of money shows that in the first and the third sub sample asset prices were explaining the velocity decline phenomenon for the time period 1981-1998 and from 2008-2018. However, asset prices do not seem to explain the movements in velocity of money for the time period between 1998 and 2008. The results of the indicator function show that the asset prices not only explain velocity decline but also the increase in income velocity of money.

The results of the study are consistent with our hypotheses and indicate that asset prices significantly explain both the velocity decline and increase phenomena in different time periods in Pakistan. It is important to distinguish between transactions

that are part of GDP and those excluded from GDP because GDP is only a subset of the total transactions and it does not represent all the transactions in the economy. The equation of exchange shows a decline in the income velocity of money when the value of financial or asset transactions rises, and that explains all the phenomena which are considered as the breakdown of the quantity theory of money. Therefore, the research in the field of velocity and quantity theory of money in Pakistan should focus and incorporate asset prices for an accurate estimation and explanation of these phenomena. This inclusion of asset price indices or asset prices provides useful insights into the movements of income velocity of money even if GDP based transactions remain constant.

Results of this paper implicate changes in policy. First, on the basis of volatility of velocity of money and therefore unstable money demand function, monetary aggregates cannot be ignored as indicators of monetary policy. Velocity of money is not constant only if it is constructed using wrong proxy of economic activity or economic transactions. Once, all types of economic transactions are included, velocity becomes constant and monetary aggregates become important for monetary policy. Second, asset price index, being an important indicator of monetary policy, deserves appropriate weight in monetary policy decisions. The weakening of relationship between inflation and monetary aggregates, over time, is a result of specification bias through ignoring asset prices. Appropriate specifications of models that include asset prices find significant relationship between asset prices and inflation.

Finally, more research is needed to investigate the suitability of quantity of money or its price as monetary policy instrument, especially for the case of Pakistan. Our study can be further extended to incorporate the effects of modern technologies in payments on velocity of money. For instance, Chaudhari et al. (2020) finds statistically significant long run effect of broader measure of technology on velocity and concludes that advances in payment technologies have significant negative effect on money demand. Franco (2015) finds that more use of bitcoins can lead to increase in velocity of money. Durgun and Timur (2015) put forward that only exceptional groups use electronic payments system, therefore the developments in payment technologies have little effect on monetary policy. Holly (1999) finds insignificant effect of advances in payment technology on the co-movement of money supply, velocity, interest rate and income. In case of Pakistan, Mumtaz and Smith (2020) finds that there is no change in velocity of money and money multiplier in pre-fintech periods as compared to those in post-fintech periods. We suggest combining the role of asset prices with advances in payment technology to see their joint effect on velocity of money.

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Appendix

Figure 2: CUSUMS Test for First Equation of VECM

