

**THE RELATIONSHIP
BETWEEN MONEY AND
REAL VARIABLES:
PAKISTAN'S EXPERIENCE
(1972-2008)***

Muhammad Aijaz Rasheed
Department of Economics
College of Business Management, Karachi

Abstract

Considerable research has been done to explore the causal relationships between money and 'real' economic variables. Some economists hold that money 'causes' real economic variables such as prices, output etc. while others argue that real output, prices etc. 'cause' money supply. Uptil now there is no consensus on this. Empirical research also does not confirm unidirectional causation. The aim of this paper is to provide findings about the relationship between money supply and real variables by testing these propositions across several key economic variables over a long period, taking into account different prevalent monetary policy regimes in Pakistan. The empirical tests conducted begin with unit root and Johansen cointegration tests to test for stationarity of the variables and to determine whether the variables are cointegrated. Standard Granger causality tests are used to test whether there is one-way or bidirectional causality in the long run and in the short run. Multivariate VAR tests developed by Toda and Yamamoto are also used to test causality.

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The results provide several important new and useful insights. In the credit planning regime most post Keynesian claims are accepted i.e. private credit causes M0 (reserve money); income causes money supply (M2); inflation causes money supply (M0 and M2) and interest rate causes income. In the market-oriented monetary policy regime period starting from early 1991 in which various financial sector reforms; deregulation, liberalization and privatization in the financial sector were undertaken traditional neoclassical views are supported by our findings. Reserve money causes changes in price level; reserve money causes private credit; reserve money causes interest rate and reserve money causes broad money (M2). When both regimes are combined; we obtained mixed results.

Keywords: Causality, Endogenous money, Post-Keynesian, monetary policy

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I Introduction

Monetary theoreticians and empirical analysts have long been concerned with the nature of the causation between money stock and real economic variables. If money stock was solely determined by real economic activities, then monetary policy makers would be powerless. If, however, changes in the money stock had a significant causal effect on changes in real economic activity, then monetary policy actions would be very powerful. If a two-way causal relationship between money and real economic activity characterized the economic system, this would lead to ambiguous results. Such a relationship would mean that monetary policy would need to be formulated with special consideration of the feedback effects of these real economic activities on money.

Time-series analysis is employed as a means of testing cause-effect relationships between money and real economic activity. In the last three decades various econometric techniques have been developed to test these cause-effect relationships. Very little effort has been devoted to this issue in Pakistan in the past.

Earlier attempts have produced questionable results because of problems associated with:

- a. The time-period considered
- b. Frequency of time-series data employed
- c. Statistical techniques used
- d. And the number of economic variables incorporated in the model.

The results obtained are sensitive to these factors. We have tried to overcome these problems in the following way:

1.1 The time-period considered

Our analysis is based on a long period from May 1972 to June 2008, further we divide this period into two sub-periods. The first sub-period runs from May 1972 to March 1991 and the second sub-period runs from March 1991 to June 2008. We also combined these sub-periods for a full period analysis. In the first period the monetary policy was mainly conducted by fiat through the National Credit Consultative Council (NCCC) and Annual Credit Plan. In the second period starting from 1991, financial sector reforms were introduced and short term (6-month) Market Treasury Bills (MTBs) were first auctioned. Moreover the multiple exchange rate system was abolished and a unified exchange rate system was introduced thus integrating the exchange rate with monetary policy.

1.2. Frequency of time-series data employed

Data frequency is monthly in our study. The motivation for using high frequency data is that the data includes high powered money, broad money, consumer price index, private credit, interest rate etc.. These variables possess dynamic properties that can be best captured with high frequency data. For compatibility purposes we have also used quarterly data in our analysis.

1.3 Statistical techniques employed

This paper has employed Granger Causality test. The Granger criterion may be used to test the causal relationship between two variables in a distributed-lag model framework. However, an economic variable is generally influenced by more than one variable; therefore, models involving more variables may be more useful. Ho (1982) investigated causality using a tri-variate causality approach. In this study beside Granger causality tests, we also conducted the exercise using three-variable and four-variable models using co-integration and multivariate Granger causality tests developed by Toda and Yamamoto (1995).

The paper is organized as follows:

Section 2 provides a brief review of the theoretical and empirical literature.

Section 3 describes different econometric techniques used to examine the relationship between monetary variables and real economic activities and test related hypotheses. A description of the data used in this paper is also provided in this section.

Section 4 is devoted to the discussion of the results of the empirical tests. It presents summary results obtained from simple bivariate Granger tests and Vector Auto-regression models to determine the relationship between monetary variables and real economic activities.

Section 5 concludes the paper by summarizing the main findings. Some policy recommendations are made. The section also identifies the limitations of this research and the scope and avenues for future research.

II. Review of Literature

2.1 Theory

The issue of causality of money supply is one that is very important in formulating monetary policy. The relationship of money with real variables is one of the oldest doctrines in monetary economics literature and is known as the *Quantity Theory of Money*. This is an identity and written as $MV = PY$; M = quantity of money in circulation may be represented by any monetary aggregate such as M0, M1 or M2; V = velocity that a unit of money is transacted; P = price level usually measured by GDP deflator or CPI (consumer price index); Y = real value of aggregate output (GDP).

This identity usually known as the equation of exchange has generated several debates among economists. Firstly, it has been debated whether the causation in the equation runs from left to right *MV causes PY* or from right to left *PY causes MV*. Secondly, whether velocity (V) and output (Y) are fixed (constant) or not. Thirdly, whether money supply (M) is fixed by the central bank or not. In the classical model output is taken as determined by availability of capital and labor. Velocity is assumed fixed therefore any exogenous change in money supply leads to change in price level. Money in this case does not have any impact on the real variables and is said to be a 'veil over the real workings of the economy'. Irving Fisher (1911) considered this equation to be a behavioral equation for the demand for money. In his version money is demanded only for its medium of exchange role. Alfred Marshall and A.C. Pigou (1923) assume that people demanded money for both its *medium of exchange role* and *store of value role*. Thus, Fisher's theory rejects the dependence of the demand for money on interest rates while Marshall accepts the role of interest rate in determining the demand for money. Marshall's money demand function shifted focus from money's annual rate of turnover i.e. velocity to the proportion of income that people hold in the form of money. Keynes considers money's purchasing power role, he develops a real money demand function and postulates three motives; transactions demand, precautionary demand and speculative demand for holding real money.

Friedman (1956), assumes that people hold money with the intention of using it for upcoming purchases of goods and services. Thus, he integrates asset theory and transactions theory of demand for money within the context of neoclassical microeconomic theory. He also assumed that money competes with other assets (for example, stocks, bonds and physical goods) and the marginal utility of money declines as the quantity of money held increases. His money demand function is:

$$\frac{M^d}{P} = f \left(Y_p, r_b - r_m, r_e - r_m, \pi^e - r_m \right) \quad (1)$$

Y_p : Friedman's measure of wealth, permanent income

r_m : expected return on money

r_b : expected return on bonds

r_e : expected return on equity

δ^e : expected inflation (the expected return on goods)

Money demand depends positively on permanent income (average long-run income). Permanent income is assumed to be stable, and hence the demand for money is expected not to fluctuate much with business cycle movements. Friedman's money demand includes alternative assets to money; money and goods are substitutes; expected return on money is not taken as a constant; however, $r_b - r_m$ does stay constant as interest rates rise. Interest rates have little effect on the demand for money. Velocity is not constant but predictable. Freeman and Kydland (2000), Hodrick, Kocherlakota, and Lucas (1991), Cooley and Hansen (1995) endogenize money velocity in models with shocks to goods sector productivity and the money supply¹. Theoretical monetarism contains a coherent theoretical criticism of orthodox-Keynesian economics as represented by the IS/LM model. Empirical monetarism argues that money supply fluctuations induced by the monetary authority were the principal cause of movements in the U.S business cycle.

Empirical monetarism argues that money supply fluctuations induced by the monetary authority were the principal cause of the U.S. business cycle, Palley(1993).

According to early post-Keynesian scholars such as Joan Robinson (1956), Kaldor (1970), Moore (1979a, 1979b, 1983, 1988) and Davidson (1972), money appears in the economy along with production when banks agree to honour debt contracts with firms. As the economy grows, banks increase their loans to meet the growing needs of the system, either to pay wages or to remunerate other factors of production. The creation of money is thus parallel to, but must not be confused with, the creation of income. As is argued by Joan Robinson (1956) and by post-Keynesians in general, the supply of money expands and contracts with the needs of production, in response to expectations of aggregate demand, through the banking system (see Arestis and Eichner, 1988).² There are three distinct theories of money supply endogeneity: those presented by Accommodationists', Structuralists' and the Liquidity Preference School. Kaldor (1970), Weintraub and Moore among others present money endogeneity as accommodative.

This approach is also known as "horizontalism". In this view the central bank as the lender of last resort must meet commercial banks' needs for the supplementation of reserves. Kaldor's critiques of monetarism are two: the non existence of exogenous money supply and the absence of stable demand for money. Kaldor describes the money supply function as endogenous determined by the requirements of firms. The causal relationship runs from the money stock to the monetary base. Friedman reacted to Kaldor's critique and admitted the possibility of reverse causation. Basil Moore (1988) presented this approach as the money supply (central bank money) function drawn as a horizontal line with the interest rate on the vertical axis. Given the rate of interest, the money supply is determined by the demand for loans and central banks cannot control the demand for loans. Structuralists argue that there is no necessity for full accommodation, and that interest rates may increase endogenously. Palley (1996) focuses on the interaction between the monetary authority's policy reaction function and the asset

and liability management activity of banks. He argues that an increase in lending can cause congestion. This congestion is mitigated by banks asset and liability management policy, but it requires an increase in bank loan and deposit rates. Structuralists consider the money supply function to be upward sloping, they emphasize that the banking system can effectively circumvent reserve constraints placed by the central bank in the long run through innovation of banking services and financial instruments by providing more liquid financial assets. Liquidity preference theorists state that, it is the relative interest rates that reconcile the decision to borrow with the decisions to hold increased deposits. Arestis and Howells (1996) conclude that it is the changes in relative interest rate which reconcile the demand for additional loans with the demand for additional deposits.

Chick (1986) representing the Evolutionary view distinguishes monetary causality through stages of financial development. In the first stage, money is entirely exogenous; saving determines the volume of investment. The causality runs from bank deposits to reserves, and finally to loans – money is exogenous. In the next stage, the “‘bank deposit multiplier’ provides the relevant theory: the banking system can now lend a multiple of its reserves. At this stage banks are able to expand lending beyond their reserve capacity. Therefore, now the central bank may play an accommodative role through the removal of reserve constraints. Endogenous money is thus viewed as the result of institutional changes, defined as the ability of the banking system to expand the supply of loans with no prior expansion of bank reserves. Louis-Philippe Rochon (2004), Lavoie (1992) and Lavoie (1996) argue that money has always been endogenous, irrespective of the historical period.

Money is endogenous irrespective of the character of the central bank, the specific stage of development of the banking sector, financial innovations, or other recent institutional changes. Hicks (1967), Graziani (2003), Rochon (2004) argue that money creation is a result of the evolving debt relationship between borrowers and lenders. In

bookkeeping terms, the creation of money is the means by which the banking system provides the economy with money units that are debited and credited to the payer and to the payee, who use them to exchange objects. Money creation is always an endogenous phenomenon, because it stems from the agents' demand for a (final) means of payment – be it in the form of gold coins, paper money, or purely book-entries. It follows that money is always and everywhere endogenous – even if a central bank is non-existent or non-accommodating with respect to the banks' demand for reserves. Palley (2002) argues that the post-Keynesian innovation is not the distinction between exogenous and endogenous money, but rather the construction of endogenous money in terms of bank lending. He described the wide range of approaches to endogenous money. This included evolutionary endogeneity, central bank endogeneity, fiscal endogeneity, money multiplier portfolio endogeneity, credit money endogeneity, financial intermediary supply-side endogeneity, monetary circuit endogeneity and open economy endogeneity.

2.2 Approach of Empirical Studies in Pakistan.

Table 1 present some studies, which empirically investigate the endogenous money hypothesis in Pakistan.

Table 1 : Studies that test the endogeneity of money supply hypothesis in Pakistan				
Study	Sample	Variables	Methodology	Findings
Siddiqui, Anjum (1989)	Monthly Data 1972-81	1. Narrow money (M1) 2. Broad money (M2) 3. Consumer price index (CPI) 4. Whole sale price index (WPI)	1. ARIMA filter applied for the dependent variable 2. Ordinary least square OLS Method	WPI causes M1 and M2 respectively
Chaudhary and Ahmad (1995)	Annual data 1973-92	1. International reserves 2. Domestic financing of budget deficit including banking and nonbanking systems. 3. Commercial banks credit to the private sector 4. income 5. Expected prices 6. Government exp. 7. real price of foreign exchange and 8. exports	Simultaneous equation model estimate by OLS method	Money supply is not exogenous; rather it depends on the position of international reserves and fiscal deficit, and it is an endogenous variable.
Husain and Abbas (2002)	Annual 1949-50 to 1998-99	1. Gross National Product (GNP) at current prices 2. broad measure of money (M2) 3. Consumer Price Index (CPI) 1980-81, 2. Broad money (M2) 3. Consumer price index (CPI)	1. Phillips-Perron Unit root test 2. Granger causality and Error Correction Models	1. Unidirectional causality from income to money 2. Bidirectional causality between money and prices
Kul Luintel (2002)	Annual 1959 to 1996 in four South Asian economies India, Nepal, Pakistan and Sri Lanka	Real Gross Domestic Product Narrow money (M1) Broad Money (M2) Consumer Price Index (CPI)	Tri-variate VAR	Money stocks, price level and real output are cointegrated and M1 and M2 are endogenous for all countries. Consumer price level appears to be weakly exogenous with respect to M1 and M2 in Pakistan
Ahmad and Ahmed (2006)	Monthly data 1980-2003	1. total bank advances 2. monetary base 3. Broad money M2 4. Broad money multiplier 5. Quantum Index Number of Manufacturing	1. Augmented Dickey-Fuller test (ADF) 2. Standard Granger Causality	1. Two-way causality between broad money and income in the short run. 2. Absence of causality between broad money and the income in the long run.

a) Siddiqui (1989) has studied the question “Is there unidirectional causality from money to inflation? He used monthly data for Pakistan’s money supply (M1, M2) and price indices (CPI, WPI), from 1971 to 1982. He has estimated ARIMA filter for the dependent variable and then applied ordinary least square OLS. The results show that in most equations money and inflation are independent except in equation WPI on M1 and WPI on M2 which show that WPI causes M1 and M2 respectively. The study shows that inferences on causality are sensitive to the type of causality tests, pre-whitening filters, and measures of money and inflation. He said robust conclusions cannot be reached by applying a particular causality test and advocated the use of more than one procedure.

Iqbal and Nadeem (2006)	Annual Data 1971-72 to 2003-04	1. Social development 2. Real economic development 3. Monetary and financial growth 4. Infrastructure development.	1. Granger Causality test in a Vector Error Correction model	No causal relationship can be reached by applying a particular causality test and advocated the use of more than one procedure.
Omer and Saqib (2008)	Annual data 1975-2006	1. Broad money 2. Real GDP 3. CPI inflation	1. Augmented Dickey-Fuller test (ADF) 2. Auto Regressive Distributed Lag Model (ARDL)	QTM does not hold, @ some velocity of money is unstable, and the money endogeneity hypothesis.

By Ahmad (1995) have studied the endogeneity hypothesis in Pakistan. This study was intended to identify the causes of inflation; they also studied the nature of money supply i.e. whether it is endogenous or exogenous. They used annual data for the period 1973–92. All variables were converted to log form and then employed in a simultaneous equation framework. The econometric technique employed for estimating parameters is ordinary least square (OLS). They found that while the execution of monetary policy is undertaken by the central bank, the overall formulation of policy is heavily dependent on the fiscal decisions made by the government. In order to control inflationary

pressure, the government needs to cut the size of the budget deficit. They also found that money supply is not exogenous; rather it depends on the position of international reserves and fiscal deficit, and according to them money supply emerged as an endogenous variable.

- c) Fazal Husain & Kalbe Abbas (2002), examine the causal relationship between money and income and between money and prices in Pakistan. They used annual data from 1949–50 to 1998–99, and investigated the causal relationship through the tri-variate causality approach. Unit Root Test developed by Phillips & Perron (1988) was used to examine whether the time-series data is stationary. In this study a two-step procedure is used to examine bi-variate causality between money and income and between money and prices. A three-step procedure is used to examine tri-variate causality between money and income conditional on the presence of prices and between money and prices conditional on the presence of income. In the first step Unit Root Test is performed on the variables. In the second step, co-integration between the two series, X_t and Y_t , was tested, and in the third step Granger causality test was used. Their results show the existence of a long run relationship among these variables. The findings of this study were that unidirectional causality runs from income to money and that bidirectional causality exists between money and prices.
- d) Kul Luintel (2002) investigated the exogeneity status of money stocks (M1 and M2) vis-a-vis price level and real GDP through tests of various concepts of exogeneity (weak-exogeneity, strong- and super-exogeneity¹) in four South Asian economies India, Nepal, Pakistan and Sri Lanka. He used annual data and the sample period was 1959–1996 for India, 1966–1997 for Nepal, 1961–1997 for Pakistan and 1957–1996 for Sri Lanka. Data was obtained from IMF CD-ROM, 1998. He used the tri-variate VAR framework. The

variables in the VAR were alternative measures of money stock (M1 and M2), consumer price index (CPI) and real GDP. The overall finding was that money stock, price level and real output are cointegrated and M1 and M2 are endogenous for all countries. Moreover, the consumer price level appears to be weakly exogenous with respect to M1 and M2 in Pakistan.

- e) Ahmad and Ahmed (2006) empirically investigated the endogenous money hypothesis for Pakistan. They used Granger causality tests on monthly data for the period of 1980 to 2003. Their sources of data were the Statistical Bulletin of the State Bank of Pakistan (SBP) and IMF's International Financial Statistics (IFS). Using de-trended series of narrow money (M1), broad money (M2), broad money multiplier, total bank advances, and quantum index for manufacturing as proxy variables for GDP, they ran the standard Granger causality test to examine different testable hypotheses of Post-Keynesian theory on money supply endogeneity. The results supported the existence of two-way causality between broad money (BROAD) and income (M_INDEX) in the short run (period of 18 months). However, for durations greater than eighteen months, their results exhibit no causality between money income and broad monetary aggregates. The absence of causality between the broad aggregate measure of money supply and the income variable implies that money does not determine economic activity in the long run. Their empirical results support the neutrality of money hypothesis in the long run.
- f) Javed Iqbal and Khurram Nadeem (2006) examine the causal relationship among composite indicators for real, monetary / financial, social and infrastructure development in Pakistan. This study addresses the following issues:
- i) Monetary and real sector causality

ii) Social development and economic development causality

The factor analysis technique using principal component analysis is employed to construct the composite indicators of development in four major sectors of the economy: social development, real economic development, monetary and financial growth and infrastructure development. The data were collected from 1971-72 to 2003-04 on an annual basis. They applied Granger causality test in a Vector Error Correction Model (VECM) and concluded that social development is caused by real economic development but not vice versa, which is indicative of the relative effectiveness of 'trickle-down' development policies. They also conclude that no causal relationship exists between real economic development and monetary growth; meaning that monetary development has no impact on the economic growth of the country.

g) Omer and Saqib (2008) evaluated monetary targeting strategy in Pakistan by testing three hypothesis

- i) Quantity Theory of Money (QTM)
- ii) the income velocity of money
- iii) the endogenous money hypothesis

The Quantity Theory of Money(QTM) equation estimations involve the testing of one-on-one money-inflation relationship in the long run. The second test focuses on the 'constant' assumption of the income velocity of money. The third, as postulated by the Post Keynesians, relates to the identification of the endogenous money hypothesis.

The endogenous money hypothesis was tested by using the Auto Regressive Distributed Lag (ARDL) procedure popularized by Pesaran and Pesaran (1997) and Pesaran and Shin (1999). They analyzed the data for the period covering about thirty years from 1975 to

2006 and taking annualized observation. The variables used in this study are broad money (M2), real GDP, and CPI inflation. To test this assumption of velocity stability standard Augmented Dickey-Fuller (ADF) test was applied. They found that all three velocities are integrated processes of order one, I(1); The income velocities of money in Pakistan are non-stationary and money supply is endogenous.

To estimate the validity of the Endogenous Money Hypothesis, the logarithm of consumer price index (LCPI)* and logarithm of base money (LM0[@]) and logarithm of broad money (LM2[#]) over the period 1973-2006 were used and causality between LCPS and LM0 and LM2 were tested. They took account of changes in the policy regime and distinguished between two periods: 1973-1991 and 1992-2006. The test confirmed the presence of a co-integrating relationship and established the direction of causality, further the results were strengthened by calculating the long run coefficients and estimating the significance of the error term in the ECM specification. This study concluded that the QTM does not hold, income velocity of money is unstable, and that money supply is endogenous.

*LCPI = National Logarithm of Consumer Price Index

@ LM0 = Reserve Money

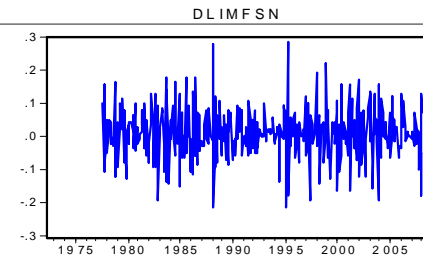
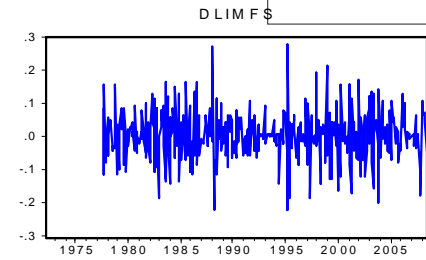
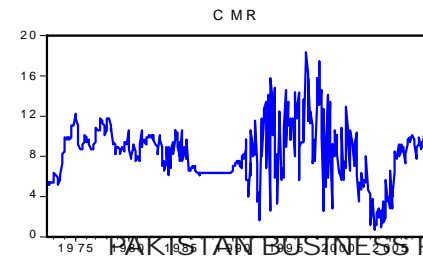
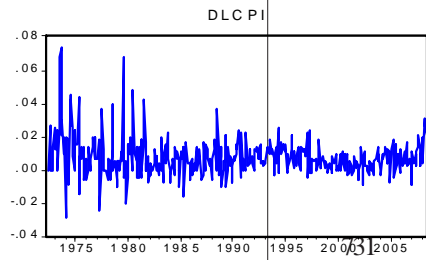
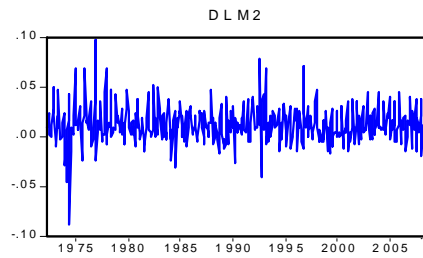
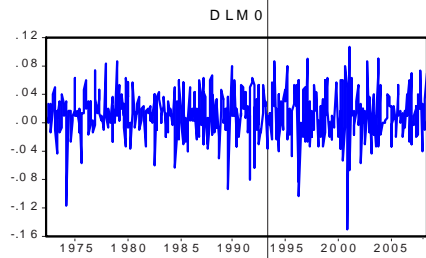
LM2 = Broad Money

III. Methodology & Data

There are different econometric techniques available for examining the endogeneity of money hypothesis. In this research we apply causality analysis i.e the simple bi-variate Granger causality test. The Vector Auto Regression (VAR) model, VAR Error Correction Model (ECM) and the Toda Yamamoto modified version of the Granger causality test has the advantage of being able to handle non-stationary variables.

The frequency of time-series data used in this paper is monthly and quarterly. The examined period is between May 1972 and Jun-2008. We divided the data into two sub-periods and one full period. The first sub-period runs from May 1972 to Feb 1991¹, the second for March 1991 to June 2008², and the full-period data is for May 1972 to June 2008. The variables to be studied are; Real and Nominal GDP (for monthly data we used Industrial Production Index (IPI) as a proxy for GDP, Reserve Money (M0), Broad Money (M2), Call money rate (Interest Rate), GDP Deflator (for quarterly and monthly data), Consumer Price Index (CPI) is used, private credit from IFS-database (IFS line 32d-Claims on private sector) and net foreign assets from IFS-database (net foreign assets are the sum of foreign assets held by monetary authorities and deposit money banks, less their foreign liabilities). Monthly fluctuation in these variables are shown in Figure 1

Figure 1 Fluctuation in Variables (Monthly Data 1972-2008)



IV. Empirical Results:

Since most of the time series were trended; therefore, we have used growth specifications for our analysis. The difference of natural logarithm is used to calculate the growth rate in the selected variables. Figure-1 exhibits the behavior of time series variables.

The only variable that shows a significant seasonal factor is the first difference of industrial production index (DLIMFS, DLIMFSN)*. Therefore, we used seasonally adjusted Industrial production index.

Table 2 and Table 3 present Augmented Dickey-Fuller (ADF) test statistics for all the variables on a monthly as well as a quarterly data basis.

• DLMIFS = First Difference of Log Industrial Production Index

Table 2
Results of Unit Root Tests (Monthly Data)
Augmented Dicky-Fuller Test

Variables	Variables in Level								
	Full Sample			1972:5 -1991:2			1991:3 - 2008:6		
	Lag length	ADF statistic	P-value	Lag length	ADF statistic	P-value	Lag length	ADF statistic	P-value
dln0	13	-4.34	0.00	12	-3.07	0.03	13	-3.52	0.01
dln2	16	-4.51	0.00	11	-2.84	0.05	13	-2.06	0.26
dlimfs	11	-8.16	0.00	11	-5.86	0.00	9	-8.66	0.00
dlim2	16	-4.17	0.00	14	-2.31	0.17	12	-2.40	0.14
dlnpi	13	-3.15	0.02	13	-2.57	0.10	2	-4.85	0.00
dlnsv	0	-20.91	0.00	11	-4.45	0.00	0	-14.74	0.00
cnr	10	-2.36	0.15	14	-2.63	0.09	10	-1.47	0.55
discrete	1	-2.11	0.24	14	-5.92	0.00	0	-1.36	0.60
dlnincome	11	-8.24	0.00	11	-5.73	0.00	9	-8.79	0.00
dlnpvt	13	-3.82	0.00	11	-3.40	0.01	11	-3.01	0.04
Variables in First Difference									
dln0	12	-15.78	0.00	12	-10.11	0.00	14	-9.08	0.00
dln2	14	-7.96	0.00	14	-4.98	0.00	12	-9.19	0.00
dlimfs	16	-10.73	0.00	13	-8.04	0.00	13	-9.40	0.00
dlim2	17	-5.59	0.00	14	-4.83	0.00	11	-9.92	0.00
dlnpi	10	-15.10	0.00	12	-6.49	0.00	6	-8.97	0.00
dlnsv	11	-11.67	0.00	10	-10.29	0.00	11	-7.57	0.00
cnr	9	-11.18	0.00	4	-8.64	0.00	9	-8.21	0.00
discrete	0	-22.89	0.00	14	-2.24	0.19	0	-15.91	0.00
dlnincome	16	-10.75	0.00	13	-8.38	0.00	13	-9.28	0.00
dlnpvt	12	-14.00	0.00	12	-9.89	0.00	11	-11.17	0.00

The unit-root test results are given for level and first differences (changes) of the time series, the optimal lag length for the full sample period (1972:5 – 2008:6) and the two sub periods (1972:5 – 1991:2 and 1991:3 – 2008:6) are estimated.

Table 3
Results of Unit Root Tests (Quarterly data)
Augmented Dicky-Fuller Test

Variables	Full Sample			1972:2 - 1991:1			1991:2 - 2008:4		
	Lag length	ADF statistic	P-Value	Lag length	ADF statistic	P-Value	Lag length	ADF statistic	P-Value
d1m0	9	-4.06	0.0015	5	-3.64	0.7%	9	-2.20	0.2100
d1m2	12	-3.29	0.0171	8	-3.02	3.9%	5	-2.91	0.0489
d1gdp	4	-5.12	0.0000	11	-1.74	40.8%	4	-3.01	0.0390
d1cpi	7	-2.82	0.0587	4	-2.54	11.0%	2	-1.72	0.4180
cmr	4	-2.48	0.1233	0	-2.56	10.7%	4	-1.41	0.5733
d1c1pvt	8	-4.11	0.0013	5	-3.59	0.8%	8	-3.06	0.0345
dgnfa	0	-11.96	0.0000	0	-9.15	0.0%	0	-8.28	0.0000
Variables in First Difference									
d1m0	6	-8.65	0.0000	6	-5.78	0.0%	6	-6.24	0.0000
d1m2	11	-4.56	0.0003	11	-3.25	2.2%	6	-4.51	0.0005
d1gdp	12	-5.65	0.0000	10	-4.84	0.0%	4	-8.11	0.0000
d1cpi	6	-6.78	0.0000	2	-11.01	0.0%	1	-9.64	0.0000
cmr	3	-6.56	0.0000	11	-3.79	0.5%	2	-8.19	0.0000
d1c1pvt	10	-6.77	0.0000	10	-4.79	0.0%	9	-4.44	0.0006
dgnfa	6	-7.50	0.0000	2	-9.02	0.0%	4	-6.20	0.0000

The variables have been found to be non stationary at level. They are further tested by taking first order differences of the time-series. The result shows that they have unit root at first difference level. These time-series are integrated of order 1 - I(1).

At the second stage we have tested causal relationships among the variables. For the two-variables causality tests applied were bi-variate standard Granger causality tests on different pairs of variables.

The omission of an important causative variable from the bi-variate system may significantly affect inference on causality between the variables in the bi-variate system. We, therefore, considered two models one three-variate VAR and another four- variate VAR. However, the simple VAR procedure is not applicable when the variables are cointegrated. Our analysis on stationarity shows that variables are co-integrated at 1-1(1) order (Table 2 and Table 3). Therefore, we applied Toda and Yamamoto level VAR for this analysis.

Table 4 presents the results based on monthly data. In this table we compare the various causality hypotheses using the two-variable model, three-variable model and four-variable model.

**Results of Unit Root Tests (Quarterly data)
Augmented Dicky-Fuller Test**

Variables	Variables in Level								
	Full Sample			1972:2 - 1991:1			1991:2 - 2008:4		
	Lag length	ADF statistic	P-Value	Lag length	ADF statistic	P-Value	Lag length	ADF statistic	P-Value
d1m0	9	-4.06	0.0015	5	-3.64	0.7%	9	-2.20	0.2100
d1m2	12	-3.29	0.0171	8	-3.02	3.9%	5	-2.91	0.0489
dlgdp	4	-5.12	0.0000	11	-1.74	40.8%	4	-3.01	0.0390
dlcpi	7	-2.82	0.0587	4	-2.54	11.0%	2	-1.72	0.4180
cmr	4	-2.48	0.1233	0	-2.56	10.7%	4	-1.41	0.5733
dlclpvt	8	-4.11	0.0013	5	-3.59	0.8%	8	-3.06	0.0345
dgnfa	0	-11.96	0.0000	0	-9.15	0.0%	0	-8.28	0.0000
Variables in First Difference									
d1m0	6	-8.65	0.0000	6	-5.78	0.0%	6	-6.34	0.0000
d1m2	11	-4.56	0.0003	11	-3.25	2.2%	6	-4.51	0.0005
dlgdp	12	-5.65	0.0000	10	-4.84	0.0%	4	-8.11	0.0000
dlcpi	6	-6.78	0.0000	2	-11.01	0.0%	1	-9.64	0.0000
cmr	3	-6.56	0.0000	11	-3.79	0.5%	2	-8.19	0.0000
dlclpvt	10	-6.77	0.0000	10	-4.79	0.0%	9	-4.44	0.0006
dgnfa	6	-7.50	0.0000	2	-9.02	0.0%	4	-6.20	0.0000

<i>Int.Rate</i> ⇒ <i>M0</i>	V,L	S	V,L					Prices, Income	--	--	--	--			Prices, Income	--
<i>M2</i> ⇒ <i>PvtCredit</i>	V,S,L	V,S,L	V					M0,NFA	Cause	Cause	--					
<i>NFA</i> ⇒ <i>PvtCredit</i>	S,L	S,L	--					M0, M2	Cause	Cause	--					
<i>PvtCredit</i> ⇒ <i>M2</i>	V,S,L	V,S	--					M0,NFA	--	Cause	Cause					
<i>NFA</i> ⇒ <i>M2</i>	--	--	V					M0, Pvt.Credit	--	--	Cause					
<i>M2</i> ⇒ <i>NFA</i>	--	--	--													
<i>M0</i> ⇒ <i>M2</i>								Pvt.Credit, NFA	--	--	Cause					
<i>M2</i> ⇒ <i>M0</i>								Pvt.Credit, NFA	Cause	--	--					
<i>M0</i> ⇒ <i>CPI</i>								M2, Income	Cause							
<i>CPI</i> ⇒ <i>M0</i>								M2, Income	--	Cause	--					
<i>M0</i> ⇒ <i>Income</i>				M2	Cause	--	Cause	M2, Prices	Cause	Cause	Cause					
<i>Income</i> ⇒ <i>CPI</i>								M2, M0	--	--	--					
<i>Income</i> ⇒ <i>M0</i>				M2	--	Cause	--									
<i>Income</i> ⇒ <i>M2</i>				M0	--	Cause	--									
<i>M2</i> ⇒ <i>Income</i>				M0	--	--	Cause									

In the two-variables model the causality is presented in three ways;

1. 'V' represents very-short-run causality, defined as the causality between the two variables in a period of up to six-months.
2. 'S' represents short-run causality, defined as causality between the two variables over a period of six to eighteen months.
3. Long-run causality 'L' is defined as the causality between the two variables over a period exceeding eighteen months.

Three-variable causality is tested using the vector auto regression (VAR) technique. The VAR models are estimated using symmetric lags, i.e. the same lag length is used for all variables in all equations of the model. The number of lags is based on optimal lag length criteria based on different information criteria.

Four-variable causality is also tested using the same methodology as described for the three-variable case.

We also did the same exercise for quarterly data. Table 5 presents the results of our findings based on quarterly data. Our main findings are:

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Table - 5

Variables	Quarterly Data										
	2-Variable ¹			3-Variable				4-Variable			
	Full-Period	S ₁	S ₂	Other Variable	Full-Period	S ₁	S ₂	Other Var	Full-Period	S ₁	S ₂
$M0 \Rightarrow M2$	V,S	V	V,S,L	Prices	--	--	Cause	Pvt.Credit, NFA	--	--	Cause
$M2 \Rightarrow M0$	V,S,L	V,S,L	--	Prices	Cause	Cause	--	Pvt.Credit, NFA	Cause	Cause	--
$M0 \Rightarrow CPI$	V,S	V,S	V,S	M2	--	--	Cause	Income, Int. Rate	--	--	Cause
$CPI \Rightarrow M0$	S,L	S,L	--	M2	Cause	Cause	--	Income, Int. Rate	--	Cause	--
$M0 \Rightarrow Income$	V	V	V	Prices	--	--	--	Prices, Int. Rate	--	--	--
$Income \Rightarrow M0$	V,S	V,S	S	Prices	Cause	Cause	Cause	Prices, Int. Rate	Cause	Cause	Cause
$M2 \Rightarrow Income$	V	V	V	Prices	--	--	--				
$Income \Rightarrow M2$	V,S,L	V,S,L	S	Prices	Cause	Cause	Cause				
$M2 \Rightarrow CPI$	V,S,L	--	--	M0	Cause	--	--				
$CPI \Rightarrow M2$	S,L	S,L	--	M0	Cause	Cause	--				
$Income \Rightarrow CPI$	S,L	S,L	V,S,L	M0	Cause	Cause	Cause	M0, Int.rate	Cause	Cause	Cause
$CPI \Rightarrow Income$	V	V	--	M0	--	--	--	M0, Int.rate	--	Cause	--
$Income \Rightarrow Int.Rate$	--	V,S,L	--					Prices	--	Cause	Cause
$Int.Rate \Rightarrow Income$	--	--	--					M0, Prices	--	--	--
$M0 \Rightarrow Pvt.Credit$	V,S	--	V,S,L					M2, NFA	Cause	--	Cause
$Pvt.Credit \Rightarrow M0$	V,S,L	V,S	--					M2, NFA	Cause	Cause	--
$M0 \Rightarrow NFA$	--	--	--					M2, Pvt. Credit	--	--	--

¹ V: Very Short run - two quarters or less, S: Short run - three to six quarters and L: long run - more than six quarters

M0 – M2 causality

The hypothesis that causality is running from broad money to base money i.e. $M0 \Rightarrow M2$ for the full-period and sub-period-1 is accepted. The Post-Keynesian view is that loans made by banks cause deposits, and that deposits in banks, induce accommodative action by the SBP leading to changes in $M0$. Both monthly time-series data and quarterly time-series data support money supply endogeneity hypothesis for the full-period and sub-period-1.

In sub-period-2 the hypothesis that causality is running from *base money* to *broad money* ($M0 \Rightarrow M2$) is accepted. The neo-classical argument that the monetary authority does control the overall monetary/liquidity situation in the economy so long as reserve money is kept at a level consistent with desired broad money expansion is, therefore, validated by our results for the sub-period-2. This means that financial liberalization has enhanced the ability of the State Bank to influence the monetary sector.

M0 – CPI causality

The full-period time-series data analysis shows no relationship between the growth of base money and growth in prices. But for sub-period-1, we found that CPI causes $M0$ and this provides some support for the hypothesis of endogeneity of money. The increase in price level causes increase in base money in sub-period 1.

In sub-period-2, we found that increases in money supply cause inflation in the long run. This supports the neo-classical view that inflation is a monetary phenomenon.

M2 – CPI causality

Both the monthly time-series data and the quarterly time-series data show causality running from growth in broad money to growth in CPI for the full-period dataset. The monthly time-series data shows also that growth in CPI causes growth in broad money for the full-period.

Both the monthly time-series data and quarterly time-series data shows causality running from growth in CPI to growth in broad money for sub-period-1. This result supports the view of Siddiqui (1989).

Only monthly time-series data validates the neo-classical prediction that growth in broad money causes growth in CPI for sub-period-1 as reported by Khan, Moshin, and Axel Schimmelpfenning (2006) and Abdul Qayyum (2006).

Both monthly and quarterly time-series data show the independent behavior of broad money and growth in consumer price index for sub-period-2. Hence, the relationship between M0 and CPI is seen to be bidirectional and controlling monetary asset growth has not been found to be an effective means for controlling inflation even in the liberalization period.

M0 – Income causality

Monthly time-series data shows bi-directional causality between base money and nominal income for the full-period. Both monthly and quarterly time-series data show that the growth in nominal income causes growth in base money for sub-period-1.

Monthly time-series data also show bi-directional causality between base money and nominal income for sub-period-2.

M2 – Income causality

The neo-classical expectation that growth in broad money causes growth in money income is rejected in both monthly and quarterly time-series data for the full-period and for both sub-periods.

The Post Keynesian view that growth in income causes growth in broad money is accepted in quarterly time-series data for the full-period, sub-period-1 and sub-period-2. Ahmad and Ahmed (2006) found bidirectional causality in the short run, in the long run broad money and income are found to be independent.

CPI – Nominal Income causality

The quarterly time-series data shows that the growth in nominal income causes growth in CPI for the full-period.

Both monthly and quarterly time-series data shows that growth in nominal income causes growth in CPI for sub-period-1.

The quarterly time-series data shows growth in nominal income causes growth in CPI for sub-period-2.

The quarterly time-series data shows that growth in CPI causes growth in nominal income for sub-period-1. The results provide some justification for the view that inflation may be viewed as a structuralist phenomenon in Pakistan at least during the first sub period.

M0 – Interest rate causality

Both monthly and quarterly data show that growth in base money causes changes in interest rate for the full-period and for sub-period-2.

Changes in interest rate do not cause growth in base money for the full-period and either sub periods.

Nominal Income – Interest rate causality

Both monthly and quarterly time-series data show that the growth in nominal income causes changes in the interest rate for sub-period-1. However, for the full-period and sub-period-2, money income and changes in interest rate are independent.

In no period changes in interest rate cause change in nominal income.

\Net foreign assets – M0/M2

The quarterly data shows that growth in net foreign assets causes growth in base money (M0) for the full-period and for sub-period-2.

Both monthly and quarterly time-series data shows that growth in net foreign assets causes growth in broad money for sub-period-2. However, only monthly data shows that the growth in net foreign assets causes growth in broad money for the full-period. Autonomous growth in NFA has become an increasingly important determinant of reserve money growth and monetary assets growth in the liberalization period.

Private Credit – M0

Quarterly data show that the growth in base money (M0) causes growth in private credit for the full-period and for sub-period-2.

Both quarterly and monthly time-series data show that the growth in private credit causes growth in base money (M0) for the full-period and for sub-period-1. The State Bank thus seems to play an accommodative role as predicted by the Post Keynesians.

Monthly time-series data shows that growth in private credit causes growth in base money (M0) for sub-period-2. This finding also strengthens the view that base money responds to credit growth and the State Bank is playing an accommodative role. Ahmad and Ahmed (2006) found bidirectional causality between private credit and broad money.

Private Credit – net foreign asset

Monthly data shows that growth in net foreign assets causes growth in private credit for full-period, and sub-period-1 but not for sub period-2 (the policy liberalization period). This shows that the SBP is relatively sterilizing NFA inflows into private credit during the liberalization period. Results are summarized in Table 6.

Table 6

Toda and Yamamoto Level VAR test (money, income, price and interest rate)						
Variables	Full Period		1972:5 - 1991:2		1991:2 - 2008:6	
	Direction	p-value	Direction	p-value	Direction	p-value
M0 - Income	$M0 \Rightarrow Income$	0.0036	$M0 \Rightarrow Income$	0.1908	$M0 \Rightarrow Income$	0.0000
	$M0 \Leftarrow Income$	0.2700	$M0 \Leftarrow Income$	0.0007	$M0 \Leftarrow Income$	0.3270
M0 - prices	$M0 \Rightarrow Pr ices$	0.0508	$M0 \Rightarrow Pr ices$	0.0006	$M0 \Rightarrow Pr ices$	0.0245
	$M0 \Leftarrow Pr ices$	0.3282	$M0 \Leftarrow Pr ices$	0.0984	$M0 \Leftarrow Pr ices$	0.0146
M0 - Interest rate	$M0 \Rightarrow Interest rate$	0.0020	$M0 \Rightarrow Interest rate$	0.0852	$M0 \Rightarrow Interest rate$	0.0027
	$M0 \Leftarrow Interest rate$	0.5892	$M0 \Leftarrow Interest rate$	0.1050	$M0 \Leftarrow Interest rate$	0.7270
Income - prices	$Income \Rightarrow Pr ices$	0.1143	$Income \Rightarrow Pr ices$	0.0237	$Income \Rightarrow Pr ices$	0.0524
	$Income \Leftarrow Pr ices$	0.8876	$Income \Leftarrow Pr ices$	0.1412	$Income \Leftarrow Pr ices$	0.4949
Income - Interest rate	$Income \Rightarrow Interest rate$	0.7379	$Income \Rightarrow Interest rate$	0.0343	$Income \Rightarrow Interest rate$	0.6280
	$Income \Leftarrow Interest rate$	0.0272	$Income \Leftarrow Interest rate$	0.6437	$Income \Leftarrow Interest rate$	0.0014
Price - Interest rate	$Pr ices \Rightarrow Interest rate$	0.5018	$Pr ices \Rightarrow Interest rate$	0.0003	$Pr ices \Rightarrow Interest rate$	0.1591
	$Pr ices \Leftarrow Interest rate$	0.6021	$Pr ices \Leftarrow Interest rate$	0.7662	$Pr ices \Leftarrow Interest rate$	0.6870

Conclusions

The results reported in the last section indicate that the findings are mixed. It is evident that money is endogenous in sub-period-1 and exogenous in sub-period-2. What is contrasting in these periods is that:

- a) In sub-period-1, the State Bank is working under the control of the federal government.
- b) The revealed endogeneity of money in Pakistan in this period could possibly be due to effects of monetization of large budget deficits and relatively large trade deficits.
- c) A fixed-exchange rate regime existed till 1982 and then a managed (dirty) floating-exchange rate was adopted. Thus NFA growth was controlled.
- d) The regime was characterized as one of interest rate 'repression', segmented financial markets and financial disintermediation.

In sub-period-2, various financial sector reforms; deregulation, liberalization and privatization in the financial sector were undertaken. For this sub-period-our findings are as follows:

- a) Our results broadly support Khan and Schimmelpfenning(2006) findings namely, that the money supply (M0) is exogenous as theorized by Neo-classical economists.
- b) The State Bank can more effectively control the monetary base and can, therefore, influence money asset growth (M2). Pakistan has been practicing market-based monetary policy in this period. The State Bank believes that stabilizing money supply at a particular level will generate a target level of income and price. The assumed superiority of money supply targeting policy depends on the assumption of 1) less developed (and therefore more controllable) financial system; 2)

Demand for money is interest inelastic and not subject to large shifts and 3) investment is interest elastic (Meenai and Ansari 2010). The discovery of a causal relationship between (a) reserve money M0 and broad money; (b) reserve money M0 and Income; (c) reserve money M0 and prices; (d) reserve money M0 and interest rate, implies that reserve money is exogenous and, therefore, influences macroeconomic aggregates.

- c) In this sub-period, we find that net foreign assets Granger cause both reserve money and broad money. The effectiveness of monetary policy based on control of money supply is thus seriously limited by autonomous movements in net foreign assets.
- d) The results are sensitive to the frequency of data i.e. monthly time-series data or quarterly time-series data. If we interpret our findings using only monthly time-series data the results shows bi-directional causality between reserve money M0 and Income; reserve money M0 and Price index; reserve money M0 and Private credit in the second period. This illustrates that the effectiveness of monetary policy is relatively seriously constrained even in the liberalization period. This is particularly the case of the short period. It is only after the lapse of more than six months that variations in base money start to have effects on prices, income and private sector credit even in the liberalization period.

Notes

¹ See also Szilárd Benk & Max Gillman & Michal Kejak, 2008. "Money Velocity in an Endogenous Growth Business Cycle with Credit Shocks," *Journal of Money, Credit and Banking*, Blackwell Publishing, vol. 40(6), pages 1281-1293.

² Leading proponents of this view include Minsky (1982, 1986); Rousseas (1985, 1989) Earley (1983), Earley and Evans (1982).

³ The concepts of and test procedures for weak, strong, and super-exogeneity as well as their implications for model

estimation, forecasting and policy analysis are thoroughly discussed in Engle et al. (1983) and Engle and Hendry (1993).

⁴ In May 1972 the first significant banking reforms were carried out after the fall of East Pakistan. The National Credit Consultative Council (NCCC) set up under the SBP.

⁵ In 1990-91 the SBP begins marketization of the monetary management system.

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