Money, Income, Prices, and Causality in Pakistan: A Trivariate Analysis

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I. INTRODUCTION

There has been a long debate in economics regarding the role of money in an economy particularly in the determination of income and prices. The Monetarists claim that money plays an active role and leads to changes in income and prices. In other words, changes in income and prices in an economy are mainly caused by the changes in money stocks. Hence, the direction of causation runs from money to income and prices without any feedback, i.e., unidirectional causation.

The Keynesians, on the other hand, argue that money does not play an active role in changing income and prices. In fact, changes in income cause changes in money stocks via demand for money implying that the direction of causation runs from income to money without any feedback. Similarly, changes in prices are mainly caused by structural factors.

The causal relationships between money and income and between money and prices have been an active area of investigation in economics particularly after the provocative paper by Sims (1972). Based on Granger causality, he developed a test of causality and applied it to the U.S. data to examine the causal relationship between money and income. He found the evidence of unidirectional causality from money to income as claimed by the Monetarists.

However his results were not supported by subsequent studies. Barth and Bennett (1974) replicating Sims test in Canadian economy found a bidirectional causality between income and money, whereas, Williams, Goodhart, and Gowland (1976) applying Sims procedure in the U.K. found the evidence of unidirectional causality from income to money, opposite to Sims' findings. They also found the evidence of unidirectional causality from money to prices.

On the other hand, Brillembourg and Khan (1979) using a longer data set supported Sims' findings and found a unidirectional causality from money to income and prices in the U.S. However, Dyreyes, Starleaf, and Wang (1980), examining the pattern of causality between money and income for six industrialized countries, found different results. For example, they found bidirectional causality in the U.S., contrary to Sims (1972) and Brillembourg and Khan (1979). Similarly, they found unidirectional causality from money to income in Canada, contrary to Barth and Bannett (1974). However, their finding of unidirectional causality from income to money in the U.K. was in line with Williams *et al.* (1976).

In the case of developing countries, Lee and Li (1983) examined causality among money, income, and prices in Singapore and found bidirectional causality between income and money and unidirectional from money to prices. Joshi and

Joshi (1985) found a bidirectional causality between money and income in India. Khan and Siddiqui (1990) found unidirectional causality from income to money and bidirectional between money and prices in Pakistan. Abbas (1991) performed causality test between money and income for Asian countries and found bidirectional causality in Pakistan, Malaysia and Thailand. In an unpublished paper, Bengali, Khan, and Sadaqat found a bidirectional causality between money and income and unidirectional from money to prices in Pakistan.

The above discussion indicates that the empirical evidence regarding causal relations between money and the other two variables, income and prices, remain inconclusive. Moreover, the papers reviewed above investigated causality between two variables, i.e., between money and income and/or between money and prices. However, an economic variable is generally influenced by more than one variables, therefore, models involving more variables may be more useful. Ho (1982) investigated causality among money, domestic prices and import prices in Hong Kong using a trivariate causality approach. He found a unidirectional causality from domestic prices to money as well as significant effects of import prices on domestic prices. However, his results were not different in bivariate and trivariate case.

The purpose of this paper is to re-examine the causal relationship between money and income and between money and prices in Pakistan. We use a longer data set from 1949–50 to 1998–99 covering almost the entire history of the country. Further, we take care of the stochastic properties of the variables used, not done earlier with the exception of Bengali *et al*. (n.d.). In addition, we also investigate the causal relationship through trivariate approach not attempted before.

The rest of the paper is organised as follows. The next section describes the data sources as well as the limitations of the analysis. Section III outlines the methodology to test the stochastic properties of the variables and their interrelationship. Section IV presents and discusses the empirical results. The final section contains the summary and conclusions.

II. DATA SOURCES AND LIMITATIONS

We use annual data from 1949–50 to 1998–99 to investigate the causal relations between money and income and between money and prices in Pakistan. Gross National Product (GNP) at current prices, broad measure of money (M2), and Consumer Price Index (CPI) with base 1980–81, are used as Income, Money and Prices, respectively.

The principal data source is *50 Years of Pakistan in Statistics*, prepared by the Federal Bureau of Statistics.[1] The other data sources include the regular issues of *Economic Survey* by Finance Division and *Monthly Bulletin* by State Bank.

[1]The source adjusts and presents the data which pertain to West Pakistan for the periods prior to the separation of East Pakistan.

The data for GNP at current prices are not available for earlier periods (1949–50 to1958–59). These are generated through GNP at constant prices using CPI as proxy for GDP deflator.

Before proceeding further, we would like to point out that the analysis is based on fifty years of Pakistan during which the country has undergone a series of economic and political changes. In particular, there have been significant improvements in the monetary sector as well as its impact on economy in the 1990's. Examining the causal relationships in this period may provide different conclusions regarding the role of money in Pakistan's economy. Since GNP is not available other than on annual basis and 10 or 11 observations are too short for the kind of analysis carried out in this study we choose to use the present data set. Hence, the conclusions of this study must be taken with care.

III. METHODOLOGY

We start by examining the stochastic properties of the variables used in the analysis before applying formal tests of causation. Hence, the Unit Root Test is performed on the variables to test for the stationarity of variables. In this context, Phillips-Perron (1988) test (PP) is used, which is robust to a wide variety of serial correlation and heteroskedasticity. The test detects the presence of a unit root in a series, say Y_t, by estimating.

$$\Delta Y_t = \alpha + \rho^* Y_{t-1} + e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$\Delta Y_t = \alpha + \beta t + \rho^* Y_{t-1} + e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where the second equation includes a trend variable. The PP test is the *t*-value associated with the estimated coefficient of ρ^*. The series is stationary if ρ^* is negative and significant. The test is performed for all the variables where both the original series and the differences of the series are tested for stationarity.

The co-integration between the two series, X_t and Y_t, is tested by conducting the PP test on residuals obtained from running the OLS regression, called the co-integrating regression:

$$Y_t = \alpha + \beta X_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

The causal relationship between these variables is examined through Granger causality and Error Correction Models (ECM) as,

$$\Delta Y_t = \alpha_1 + \rho_1 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q} \delta_j \Delta X_{t-j} \quad \ldots \quad \ldots \quad (4)$$

$$\Delta X_t = \alpha_2 + \rho_2 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q} \delta_j \Delta X_{t-j} \quad \ldots \quad \ldots \quad (5)$$

where e_{t-1} is an error correction term representing the long run relationship. A negative and significant coefficient indicates the presence of long run causal relationship. If both coefficients are significant, this will suggest the bidirectional causality. If, e.g, only ρ_1 is significant, this will suggest a unidirectional causality from *X* to *Y*, implying that *X* drives *Y* toward long run equilibrium but not the other way around.

On the other hand, the lagged terms of ΔY_t and ΔX_t, appeared as explanatory variables, indicate short run cause and effect relationship between the two series. Thus, if the lagged coefficients of ΔX_t appear to be significant in the regression of ΔY_t, this means that *X* causes *Y*.

If we omit the error correction terms from the equations we will get the conventional Granger causality model, widely used to investigate causal relations.

As pointed out in the literature, Granger model is very sensitive to lag lengths. In this context, the conventional practice is to choose lags on the basis of minimum Final Prediction Error (FPE). We follow the practice and determine the lag, e.g for ΔY_t, as follows,

1. Regress ΔY_t on a constant term and its own past values for p=1 to 5, and choose p which gives the min FPE(p).
2. Given the value of p run the regression again by including past values of ΔX_t, for q=1 to 5, and choose the equation with min FPE(p,q).

Trivariate Causality

One purpose of this paper is to examine the causal relations using trivariate causality approach. In this context, first we examine the long run relations among variables by conducting the PP test on residuals obtained from following co-integrating regression,

$$Y_t = \alpha + \beta X_t + \gamma Z_t + e_t \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (6)$$

The trivariate causality approach involves inclusion of another variable, say ΔZ_t, in Equations (4) and (5), i.e.,

$$\Delta Y_t = \alpha_1 + \rho_1 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q} \delta_j \Delta X_{t-j} + \sum_{k=1}^{r} \gamma_k \Delta Z_{t-r} \quad \ldots \quad (7)$$

$$\Delta X_t = \alpha_2 + \rho_2 e_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q} \delta_j \Delta X_{t-j} + \sum_{k=1}^{r} \gamma_k \Delta Z_{t-r} \qquad \ldots \qquad (8)$$

This model examines the causal relationship between X_t and Y_t conditional on the presence of Z_t. In this case the procedure for the determination of lags is,

1. Regress ΔY_t on a constant term and its own past values for p=1 to 5, and choose the two best equations on the basis of min FPE(p). Similarly,

Regress ΔY_t on a constant term and past values of ΔZ_t for r=1 to 5, and choose the two best equation on the basis of min FPE(r).

2. Regress ΔY_t on a constant term, its own past values and past values of ΔZ_t for four different combinations of best lags chosen in step 1. Now choose the equation with min FPE(p,r).
3. Given the values of p and r run the regression again by including past values of ΔX_t, for q=1 to 5, and choose the equation with min FPE(p,r,q).

The two steps procedure is used to examine bivariate causality between money and income and between money and prices. Whereas, the three steps procedure is used to examine trivariate causality between money and income conditional on the presence of prices and between money and prices conditional on the presence of income.

IV. EMPIRICAL RESULTS

At the first step, the variables used in the analysis are tested for the unit roots suggested by Phillips-Perron. The test is applied to both the original series (in log) and to the first differences. Further, both the models with and without trend are tried. The truncation lag parameters are determined following Schwert's (1987). The results are reported in Table 1 which indicate the presence of unit roots in the original series. The results further suggest that taking first differences remove these roots implying that these variables are first differenced stationary.

Table 1

Unit Root Tests (Phillips–Perron) for the Period 1949–50 to 1998–99

	Series in Levels Truncation Lag Parameters		First Differences Truncation Lag Parameters	
	L 4=3	L 12=10	L 4=3	L 12=10
Without Trend				
Income(Y)	2.084	1.670	−4.487**	−4.615**
Money(M)	2.207	2.606	−4.706**	−4.879**
Prices(P)	2.026	1.750	−4.107**	−4.150**
With Trend				
Income(Y)	−3.104	−3.080	−4.701**	−4.790**
Money(M)	−1.984	−2.104	−5.340**	−5.046**
Prices(P)	−2.093	−2.099	−4.330**	−4.231**

At the second step, co-integrating regressions, to examine long run relations between two variables, are estimated. Then, the series of residuals are obtained from each regression and the PP test is applied to test the presence of unit roots in these residuals. Table 2 shows the results of the PP test on residuals. The table shows the rejection of hypothesis of no co-integration in both cases of two variables indicating the existence of long run relationship between money and the other two variables, that is, income and prices.

Next, the Granger causality and Error Correction Models are employed to explore the direction of bivariate causality. The results are reported in Table 3. The table shows the lags determined as explained above, the F-values for the lags of independent variable, the *t*-values for the error correction term, and the pattern of causation. It can be seen that both the Granger causality and ECM provide similar results regarding the direction of causation. These results show a unidirectional causality running from income to money as argued by the Keynesians. The ECM indicates the same direction of causation in the long run.

Regarding the money-price relationship, the results suggest a bidirectional causality between them. However, the ECM shows a one way causation from money to prices in the long run. This implies that the growth in money stock is affected by inflation in the short run but not in the long run.

Trivariate Causality

Finally, we examined the causal relationship using trivariate causality approach. First, the long run relations among money, income, and prices are examined through co-integration analysis, reported in Table 2. The table shows the existence of long run relations among these variables.

The trivariate causality analysis is shown in Table 4. The table shows the causal relationship between money and income conditional on the presence of prices. Similarly, it shows the causal relationship between money and prices conditional on the presence of income.

Table 2

Results from Co-integration Tests

	Truncation Lag Parameters	
	L 4=3	L 12=10
Two Variables		
M on Y	–2.613**	–2.568**
M on P	–2.498**	–2.494**
Three Variables		
M on Y, P	–2.39**	–2.36**

Table 3

Granger Causality and Error Correction Model: Bivariate Case

	Granger			Error Correction		
Y on X	Lags(y,x)	F-values	Causation	t(err)	F-values	Causation
Y on M	(1,1)	1.593	M $\not\rightarrow$ Y	–0.67	1.52	M $\not\rightarrow$ Y
M on Y	(2,3)	9.384***	Y $\rightarrow$ M	–2.283**	6.25***	Y $\rightarrow$ M
M on P	(2,2)	6.394***	P $\rightarrow$ M	–0.569	5.17***	P $\rightarrow$ M
P on M	(2,1)	11.706***	M $\rightarrow$ P	–2.61**	10.287***	M $\rightarrow$ P

Table 4

Granger Causality and Error Correction Model: Trivariate Case

	Granger			Error Correction		
Y on X/Z	(y,z,x)	F-values	Causation	t(err)	F-values	Causation
Y on M/P	(1,5,1)	1.239	M $\not\rightarrow$ Y	0.466	1.393	M $\not\rightarrow$ Y
M on Y/P	(1,2,3)	5.249***	Y $\rightarrow$ M	–2.866***	6.628***	Y $\rightarrow$ M
M on P/Y	(1,3,1)	3.685*	P $\rightarrow$ M	–2.911***	7.453***	P $\rightarrow$ M
P on M/Y	(2,2,1)	7.236**	M $\rightarrow$ P	–2.243**	8.386***	M $\rightarrow$ P

It can be seen that the results are similar to those found in the bivariate case, i.e., a unidirectional causality from income to money and bidirectional causality between money and prices. However, now the ECM indicates the bidirectional causality between money and prices in the long run.

The findings of this study, a unidirectional causality from income to money and bidirectional causality between money and prices, are in line with those of Khan and Siddiqui (1990) who found similar results using quarterly data from 1972:I to 1981:IV.

V. SUMMARY AND CONCLUSIONS

The objective of the paper is to re-examine the causal relationship between money and the two variables, i.e., income and prices. For this purpose, annual data on money (M2), Income (GNP) and Prices (CPI) from 1949–50 to 1998–99 are used. The Granger causality and Error Correction Models are employed taking care of stochastic properties of the variables.

The analyses indicate the long run relationship between money and other two variables, income and prices. The analyses further suggest a one way causation

from income to money indicating that probably real factors rather than money supply has played a major role in the growth of national income of Pakistan. A closer look at the results reveals that income affects money at third lag, i.e., the significant impact of income on money appears after three years. This result may be useful in estimating demand for money where income acts as an exogenous variable.

Regarding the causal relationship between money and prices, the analyses suggest a both way causation between them. This implies that monetary expansion increases, and is also increased by, inflation in Pakistan. In other words, the increase in money supply raises the general price level which in turn increases the demand for money which results further increase in money supply. A closer look reveals that money affects price after one year but price affects money after two years. Hence it is the money that takes lead in increasing inflation which in turn cause increase in money supply. The increase in money supply resulted from inflation is mainly due to, as discussed in literature, increase in government borrowing to finance its expenditure which in turn results further increase in inflation. This suggests that fiscal policy should also be conducted with care.

REFERENCES

Abbas, Kalbe (1991) Causality Test Between Money and Income: A Case Study of Selected Developing Asian Countries (1960—1988). *The Pakistan Development Review* 30:4 919–929.

Barth, J., and J. Bannett (1974) The Role of Money in the Canadian Economy: An Empirical Test. *Canadian Journal of Economics*, May, 306–311.

Bengali, K., A. Khan, and M. Saddaqat (n.d.) Money, Income, Prices and Causality: The Pakistani Experience. (Unpublished.)

Brillembourg, A., and M. Khan (1979) The Relationship Between Money, Income, and Prices: Has Money Mattered Historically? *Journal of Money, Credit, and Banking*, August, 358–365.

Dereyes, F., D. Starleaf, and G. Wang (1980) Test of Direction of Causation Between Money and Income in Six Countries. *Southern Economic Journal*, October, 477–487.

Ho, Yan-ki (1982) A Trivariate Stochastic Model for Examining the Cause of Inflation in a Small Open Economy: Hong Kong. *The Developing Economies*, September, 301–304.

Joshi, K., and S. Joshi (1985) Money, Income, and Causality: A Case Study for India. *Arthavikas*.

Khan, A., and A. Siddiqui (1990) Money, Prices and Economic Activity in Pakistan: A Test of Causal Relation. *Pakistan Economic and Social Review*, Winter, 121–136.

Lee, S., and W. Li (1983) Money, Income, and Prices and their Lead-lag Relationship in Singapore. *Singapore Economic Review*, April, 73–87.

Pakistan, Government of (1998) *50 Years of Pakistan in Statistics*. Islamabad: Federal Bureau of Statistics.

Pakistan, Government of (Various Issues) *Economic Survey*. Ministry of Finance.

Pakistan, Government of (Various Issues) *Monthly Statistical Bulletin*. State Bank of Pakistan.

Phillips, R., and P. Perron (1988) Testing for a Unit Root in Time Series Regression. *Biometrika*, June, 335–346.

Schwert, W. (1987) Effects of Model Specification on Tests for Unit Roots in Macroeconomic Data. *Journal of Monetary Economics*, July, 73–103.

Sims, C. (1972) Money, Income, and Causality. *American Economic Review*, September, 540–552.

Williams, W., C. Goodhart, and D. Gowland (1976) Money, Income, and Causality: The U.K. Experience. *American Economic Review*, June, 417–423.

ABSTRACT

This paper re-examines the causal relationship between money and income and between money and prices in Pakistan using a longer annual data set from 1949–50 to 1998–99 and employing Granger causality and Error Correction Models. We also investigate the causal relationships through trivariate approach. The analyses indicate the long run relationship among money, income, and prices. The analyses further suggest a one way causation from income to money implying that probably real factors rather than money supply has played a major role in increasing Pakistan's national income. Regarding the causal relationship between money and prices, the analyses suggest a both way causation between them. This implies that monetary expansion increases, and is also increased by, inflation in Pakistan.