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Money, Income, and Causality: Some Evidence from Pakistan

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INTRODUCTION

The role of money in determining the level of economic activity has long been debated among economists. The classical economists were of the view that the changes in the money supply can only affect the monetary variables like the price level and nominal wage rates but cannot influence real output. J. M. Keynes and his followers asserted that changes in money supply do influence the level of real output through their effect on the rate of interest and thereby changing investment expenditure. However, by introducing the idea of a liquidity trap and by making investment as highly interest inelastic, Keynes did not assign any active role to money.

Milton Friedman and his followers, known as the Monetarists, raised the slogan that "money does matter" and thus tried to assign a dominant role to money supply in determining the level of economic activity. They assert that changes in money supply have a dominant influence on changes in nominal income. They are of the view that in the short run money does influence real output and employment and thus money is the dominant factor causing cyclical movements in output and employment. However, they believe like the classical economists, that in the long run the changes in money primarily influence the price level and other nominal magnitudes.

[Friedman and Schwartz (1963), p. 676)] in their monumental work, A Monetary History of the United States, conclude for the United States that during the 1867–1960 period, "the changes in the behaviour of money stock have been closely associated with changes in economic activity, money income and prices". And that "monetary changes have often had an independent origin; they have not been simply a reflection of changes in economic activity".

The Neoclassical economists, who are also known as the 'monetarists of the second kind', using the rational expectations hypothesis, assert that un-

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anticipated changes in money supply do affect income and employment but anticipated ones do not.

Some economists, having a monetarist inclination [Park (1970) and Polak (1957)], have expressed the view that because of the availability of a limited volume of financial assets in developing countries, the impact of increases in money supply is not diffused among the various money substitutes but is transmitted directly to the real assets market. Consequently, the increases in money supply directly impinge on expenditures and income in these countries.

The objective of this study is to empirically test for a developing economy like that of Pakistan, whether changes in money supply cause changes in nominal GNP and that there is no feedback between both the variables as is claimed by the Monetarists.

Although many tests have been developed for detecting causal relationships between money and nominal income and between a number of other variables, this study mainly uses the test procedure as developed by Sims (1972).

THE TEST PROCEDURE FOR DETECTION OF CAUSALITY

Sims (1972) developed a test procedure, which is based on the one originally suggested by Granger (1969) to detect causality between two variables, say X and Y. Following the suggestions given by Granger, Sims points out that in the presence of jointly co-variance-stationary pair of stochastic processes X and Y, if X causes Y, then a regression of Y on past and future values of X, after taking account of the serial correlation either by generalized least squares or by prefiltering it, will give significant coefficients for past values of X but insignificant coefficients for future values of X. Again if X causes Y, a regression of X on past and future values of Y will give significant coefficients for future values of Y and it may or may not give significant coefficients for past values of Y. While using Sims's test procedure, some writers Williams *et al.* (1976); Brillembourg and Khan (1979) have mentioned the current values along with the past values of the independent variables in the above regressions. The current values of the independent variables must also exhibit the same behaviour in the test as is mentioned above in connection with the past values of the independent variables.

The test procedure for detecting the direction of causality between money and nominal income, as laid down by Sims, involves first prefiltering of time-series data by using an appropriate filter so that they become stationary series. The filter used for this purpose is explained later on. After prefiltering data, a regression of nominal GNP on money's past and future values and a regression of

money on past and future values of nominal GNP need to be run. In this way, if the regression of nominal GNP on money gives significant coefficients for past values of money and gives insignificant coefficients for future values of money and the regression of money on nominal GNP results in significant coefficients for the future values of nominal GNP, and may or may not give significant coefficients for past values of GNP, then a unidirectional causality running from money to nominal GNP is detected. On the other hand, if the regression of money on GNP results in significant coefficients for the past values of nominal GNP and insignificant ones for the future values of GNP and the regression of GNP on money gives insignificant coefficients for the future values of money and may or may not give significant coefficients for the past values of money, then a unidirectional causality running from nominal GNP to money is detected. In this procedure the statistical significance of the variables is judged by their *F*-values. Sims has also stated that while making these kind of decisions "one should bear in mind that the absolute size of the coefficient is important regardless of the *F*-value" and relatively large coefficients "should not be casually set to zero no matter how statistically insignificant they are".

According to Sims's test procedure, if in these regressions, the future values of the independent variables either exhibit significant coefficients or give as large or larger coefficients than the estimated coefficients for the past values of these variables, then bi-directional causality or feedback in practice is possible.

With a view to detecting the direction of causality, Sims's test procedure was applied first using nominal GNP and Monetary Base (the commercial banks' deposits with the State Bank of Pakistan plus currency in the tills of the commercial banks plus the currency in circulation among the non-bank public) data from Pakistan for the period 1971-72 to 1988-89. The Monetarists like Andersen and Jordan (1968) believe that the monetary base is a strategic monetary variable as it is under the direct control of the monetary authorities.

Then nominal GNP and broadly defined money supply (currency in circulation plus demand deposits plus time deposits of the commercial banks), M_2, data from present Pakistan for the period from 1959-60 to 1988-89 were used. It may be pointed out that Friedman and Meiselman (1963) have expressed the view that M_2 rather than M_1 is the true representative of the quantity of money. As chequing facilities are available on the time deposits in Pakistan, the present writer is of the view that M_2 is a better representative of the quantity of money and M_2 in case of Pakistan is practically analogous to M_1 of the countries, where chequing facilities are not available on time deposits.

The nominal GNP and narrowly defined money supply (currency in circulation plus demand deposits of the commercial banks), M_1, data from the present Pakistan for the period from 1959-60 to 1988-89 were also used.

Following the test procedure as adopted by Sims, all variables used in the regressions were measured as natural logarithms and they were prefiltered using the filter $1–1.5\ B + 0.5625B^2$ i.e. each naturally logged variable X_t was replaced by $X_t - 1.5_{t-1} + 0.5625\,X_{t-2}$. Sims has stated that "this filter approximately flattens the spectral density of most economic time series", and hopefully it may make the regression residuals nearly white noise.

To detect the direction of causality the following regressions were run:

$$Y_t = a_0 + a_1 B_{t-1} + a_2 B_{t+1} + e_t \quad \ldots \quad (1)$$

$$Y_t = a_0 + a_1 B_t + a_2 B_{t-1} + a_3 B_{t+1} + e_t \quad \ldots \quad (2)$$

$$B_t = a_0 + a_1 Y_{t-1} + a_2 Y_{t+1} + e_t \quad \ldots \quad (1')$$

$$B_t = a_0 + a_1 Y_t + a_2 Y_{t-1} + a_3 Y_{t+1} + e_t \quad \ldots \quad (2')$$

$$Y_t = a_0 + a_1 M_{2t-1} + a_2 M_{2t+1} + e_t \quad \ldots \quad (3)$$

$$Y_t = a_0 + a_1 M_{2t} + a_2 M_{2t-1} + a_3 M_{2t+1} + e_t \quad \ldots \quad (4)$$

$$M_{2t} = a_0 + a_1 Y_{t-1} + a_2 Y_{t+1} + e_t \quad \ldots \quad (3')$$

$$M_{2t} = a_0 + a_1 Y_t + a_2 Y_{t-1} + a_3 Y_{t+1} + e_t \quad \ldots \quad (4')$$

$$Y_t = a_0 + a_1 M_{1t-1} + a_2 M_{1t+1} + e_t \quad \ldots \quad (5)$$

$$Y_t = a_0 + a_1 M_{1t} + a_2 M_{1t-1} + a_3 M_{1t+1} + e_t \quad \ldots \quad (6)$$

$$M_{1t} = a_0 + a_1 Y_{t-1} + a_2 Y_{t+1} + e_t \quad \ldots \quad (5')$$

$$M_{1t} = a_0 + a_1 Y_t + a_2 Y_{t-1} + a_2 Y_{t+1} + e_t \quad \ldots \quad (6')$$

Where Y, B, M_2 and M_1 are nominal GNP, monetary base, broadly defined money supply and narrowly defined money supply respectively. The regression coefficients are represented by a's and e_t is the error term. The t indicates

current year's value, t–1, past year's value and t +1 future year's value of the variable concerned.

As stated earlier, the monetary base, broadly defined money supply, M_2, and narrowly defined money supply, M_1, were used as measures of money supply and the results of the regressions from 1 to 6' are reported in Tables 1, 2 and 3 respectively.

It is pointed out that one year's lag for past values and future values of the independent variables was used in the study, because lagging by more than one year resulted in insignificant coefficients for the second year's lagged values of the variable when different monetary measures were used as independent variable. One year's lag was also considered to be appropriate because Monetarists like [Andersen and Jordan (1968), p. 22] feel that four quarters constitute an appropriate response period for monetary actions. One year's lag was also in line with the view expressed by Hamburger (1974) that most of the effect of monetary action occurs within four to five quarters.

It may also be pointed out that in all of the above regressions, time or trend variable was also tried as an additional variable. But it was dropped, because it proved to be statistically insignificant in most of the cases.

Table 1

SIMS'S METHOD

Natural Logged and Prefiltered Annual Data Belonging to Present Pakistan, 1971-72 to 1988-89

Regression of GNP on Monetary Base			Regression of Monetary Base on GNP		
Equation	(1)	(2)	Equation	(1')	(2')
Regressors	Coefficients (F-values)	Coefficients (F-values)	Regressors	Coefficients (F-values)	Coefficients (F-values)
Constant	0.233* (89.9)	0.162* (34.4)	Constant	– 0.119 (0.73)	–0.124 (0.79)
B_t	–	0.0335* (11.2)	Y_t	–	0.715 (1.05)
B_{t+1}	0.419* (10.5)	0.433* (22.5)	Y_{t-1}	–0.473 (0.54)	–0.737 (1.14)
B_{t+1}	–0.095 (0.54)	0.075 (0.51)	Y_{t+1}	1.279** (3.54)	0.860 (1.18)
R^2	0.517	0.785	R^2	0.279	0.347
D. W.	2.149	2.714	*D.W.*	2.664	2.490
n	13	13	n	14	14

EMPIRICAL RESULTS AND CONCLUSIONS

The results of the regression of nominal GNP on the monetary base and the regression of the monetary base on the nominal GNP are reported in Table 1.

In Sims's test procedure Equations (1) and (1') are crucial in determining the direction of causality. In Equation (1) the coefficient of past value of the monetary base, B_{t-1}, is statistically significant at the 5 percent level of significance when the standard F-test is applied to it, while the coefficient of the future value of the monetary base, B_{t+1} is statistically insignificant at the 5 percent level of significance. The estimates reported for Equation (1') show that the coefficient of Y_{t-1} is not only statistically insignificant but also has a negative value, but the coefficient of Y_{t+1} is statistically significant at the 10 percent level of significance. These results indicate that causality is unidirectional from monetary base to nominal GNP in Pakistan.

Estimates reported for Equations (2) and (2') also establish the same conclusion. In Equation (2), B_t and B_{t-1} have statistically significant coefficients, while the coefficient for the future value of the monetary base, B_{t+1}, is not only smaller in value that the coefficients of B_t and B_{t-1}, but also is statistically insignificant when judged by its F -value. On the other hand, in Equation (2') although the coefficient of Y_{t+1} is statistically insignificant at the 5 percent level of significance, yet its size is larger than the coefficients of other variables in the regression. Hence it should not be casually set to zero.

Estimates of the regression for the detection of causality between broadly defined money supply, M_2, and the nominal GNP are reported in Table 2.

Estimates reported for Equations (3) and (3'), show that the coefficient of M_{2t-1} is statistically significant at the 5 percent level of significance, while that of M_{2t+1} is not only statistically insignificant but also is relatively small in size. On the other hand, the coefficient of Y_{t+1} is statistically significant and that of Y_{t-1} is statistically insignificant. These results also establish that causality is unidirectional from M_2 to nominal GNP in Pakistan. Estimates of Equations (4) and (4') also help us in arriving at the same conclusion.

The inferences made from the results reported in Tables 1 and 2 are in line with Sims's (1972) findings that there is unidirectional causality running from money to nominal GNP. It may be pointed out that he represented the money supply with monetary base and narrowly defined money supply, M_1. The finding of the present study is in agreement with his finding as far as the unidirectional causality running from the monetary base to the nominal income is concerned.

These results are also in line with the findings of Brillembourg and Khan (1979), who using annual U. S. data for the period 1870–1975, and applying Sims's test, found the evidence that tends to support monetarists proposition contained in Friedman and Schwartz (1963). They concluded that broadly defined money "caused" both nominal income and prices. Similarly, applying a sequential approach based on Granger's concept of causality and Akaike's final prediction error criterion and using U. S. post-war money and income data, Hsiao (1981) found that a one-way causal model from M_2 to GNP performs better. Thornton and Batten (1985) also found unidirectional causality running from the monetary base to the nominal income in case of the United States. However, their results suggest a bi-directional causality between M_2 and nominal income as well as between M_1 and nominal income. The results of the present study also differ from the findings of Williams *et al.* (1976) for the U. K. They used Sims's test and found that the direction of causality between money and income in the U. K. is less clear cut than which was found by Sims for the U. S. Their findings suggest that perhaps there is "a more complicated causal relationship between money and incomes in which both are determined simultaneously". Joshi and Joshi (1985) also found bi-directional causality between money and income in the case of India.

The estimates of regressions for the detection of causality between narrowly defined money, M_1, and the nominal GNP are reported in Table 3. Here the whole scenario is reversed. The estimates reported in Equations (5) and (5') show that coefficient of M_{1t-1} is statistically insignificant and that of M_{1t+1} is significant at the 5 percent level of significance, while that of Y_{t+1} is insignificant at the 5 percent level of significance. These results show that there is unidirectional causality running from nominal GNP to M_1 in Pakistan. The same conclusion can be arrived at from the estimates reported for Equations (6) and (6'). In these equations coefficients of M_{1t-1} and M_{1t+1} are significant at 5 percent level of significance, while those of Y_{t+1} and Y_t are statistically insignificant.

This finding is not in line with what was found by Sims (1972). He found unidirectional causality running from M_1 to nominal income in case of the United States. However, our finding is in agreement with the finding of Williams *et al.* (1976), who found for the U. K. some evidence of unidirectional causality running from nominal income to narrowly defined money supply. Hsiao (1981), using post-war U. S. data, found that between M_1 and GNP a bivariate feedback model fits the data best. He found unidirectional causality between M_2 and nominal GNP but a feedback between M_1 and nominal GNP. He has also expressed the

view that if the issue of definition of money is to decide on grounds of usefulness in organizing our knowledge of economic relationships then his findings confirm that a more appropriate definition of money is M_2.

It is already pointed out in this paper that because of the availability of chequing facilities on time deposits in Pakistan, M_2 (and not M_1) is analogous to M_1 of other countries, where chequing facilities are not available on time deposits. Consequently M_1 was not the true indicator of narrowly defined money in Pakistan and that could be the reason that results in line with our earlier results could not be found in case of M_1 and nominal GNP.

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Comments on "Money, Income, and Causality: Some Evidence from Pakistan"

Professor Hussain has presented a paper based on Sims's Test of 1972. The paper is interesting but is fraught with grave errors and involves improper tests.

The paper is based on Sims's Test of causality between money and income but ignores other relevant literature in this field. A detailed list of the relevant literature is given for the attention of the author at the end of my comments as a source of reference. These studies show how the application of Sims's Test would lead to different conclusions over time for the same countries. In fact Sims himself has commented on page 542-3, that the results are peculiar to his sample. Therefore, I would suggest that this paper require a mention of the possible caveats of Sims's model and other tests of causality besides Sims's test. Then the author could put forward and justify his preference for the use of Sims's test for Pakistan.

The author by referring to Sims uses the filter but fails in establishing that it is judicious to use. He even misquotes Sims. The equations to detect the direction of causality do not include the time trend variable which is the standard procedure in such estimations for detrending the series. Moreover, the author has used only one lag for past and future values. However it is not clear how he determines the lag structure. In fact he does not mention the lag structure selection at all in his paper. The author is strongly recommended to see Thornton and Batten (1985). They have used Final Prediction Error (FPE), Bayesian Estimation Criterion (BEC), Pagano and Hartley (P-H) techniques along with arbitrarily chosen lag lengths. The author seems to be completely oblivious of the importance of the lag structure also emphasized in Sims's paper which he has adopted so religiously.

The results of the study are described very briefly. The first test between monetary base and GNP is reported in Table 1. The author selects Equations (3) and (3') in explaining the direction of causality. However it is obvious from Equations (1') and (3') that the exclusion of Y_t leads to an improvement in the coefficient of Y_{t+1} in Equation (3'). The right equations in explaining the direction of causality are (2) and (2'), and (1) and (1'). This is so because they satisfy the

then add the future values. Therefore, we should actually be looking at Equations (1) and (1') in Table 1. However when we select Equations (1) and (1') the results differ from those reported by Professor Hussain. There is no unidirectional causation between monetary base and GNP.

Similarly, Professor Hussain has repeated the same mistake in Tables (2) and 3. The relevant Equations in Table (2) are (4) and (4'), and in Table (3) Equations (7) and (7').

Surprisingly the author does not use the *F*-test which is a standard technique to determine the direction of causality. The author has confused the test of a variable (*t*-test) and the test of the model (*F*-test). The *F*-test which is essential for testing the direction of causality is missing in all the tables. Therefore the paper fails to establish the direction of causality between money and income in Pakistan.

Professor Hussain on his paper says, "the inference made from the results reported in Tables 1 and 2 are in line with Sims's findings but they differ from the U. K. study by William *et al.*" I have two points to make here. First, what if the results from Pakistani data conform to the U. S. results? Professor Hussain does not say anything, but his statement appears to imply that it has some significance for Pakistan. Secondly, if we read the U. K. study carefully William *et al.* make it very clear on the first page (pp. 417) that the study is being undertaken to show that the underlying differences between the U. S. and the U. K. economy would give different results for Sims's model when applied to the U. K. Therefore, again the comparison of the U. K. and Pakistani results, without any explanation is irrelevant here.

There are no conclusion or recommendations of the paper but that is not very surprising.

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