*Jour.Soc.Sci. & Humn. 1996-2000*
*pp.1-10*

# COINTEGRATION & CAUSALITY BETWEEN MONEY SUPPLY AND INFLATION THE CASE OF PAKISTAN

Abdul Waheed
Mohammad Sabir

*ABSTRACT*

*This paper is an attempt at re-examining the question of co integration and causality between money supply and inflation. As a first step we have used the statistical theory of integrated regresses to establish the time series properties of M1, M2, CPI and WPI economic series for Pakistan and then tested causality between money supply and inflation using Granger causality test. The result indicates that $M_1$, $M_2$, CPI and WPI are integrated of order one. Both M1and $M_2$ are co integrated with CPI and WPI. The result also indicates that money supply ($M_1$or $M_2$) cause inflation irrespective of whether it is represented by the CPI or WPI. It is also observed that inflation (CPI or WPI) cause changes in money supply, irrespective of whether it is measured as $M_1$ or $M_2$.*

## INTRODUCTION

There is a great debate in macroeconomics for the last quarter century between structuralist and monetarist over the believe that inflation is brought about by increases in aggregate demand unaccompanied by increases in real output. This increase in aggregate demand is caused, according to them, by excessive expansion in money supply. Hence, according to them, money supply is the cause, and inflation is the effect. So the direction of causality runs from money to inflation without any feedback and inflation is purely a monetary phenomenon.

The structuralist, on the other hand, views excessive money supply as permissive rather than causal in explaining inflation. the root causes of inflation, according to them, are the structural bottlenecks in the development process.[1]

Several attempts have been made both in developed and developing countries to test empirically the direction of causality between inflation and money supply in order to resolve the above theoretical controversy. However, the results of the previous studies are mixed. Fr example, study by Jones and Uri (1987) for the United States and Beltas and Jones (1993) for Algeria indicated that money supply Granger cause inflation. Where as the study by Turnovsky and Wohar (1984) found that there was no causal relationship between money supply and inflation. In relation to the developing countries, Aghevli and Khan (1978), found bi-directional causality for four developing countries but Darat (1986) evidenced unidirectional causality from money to inflation in the cause of three North Africa developing countries. Similarly in case of India, Sharma (1984) finds evidence of

unidirectional causality from $M_1$ to WPI. When $M_1$ is replaced by $M_2$, bi-directional causality is detected between $M_2$ and WPI. However, saini (1983) finds that monetary growth is not at all significant in explaining inflation.

In case of Pakistan, the result of the previous studies on causal relationship between supply and inflation are also mixed one. The pioneer studies by porter (19610 and Islam (1963) highlighted the importance of monetary expansion, increase in import price and the agricultural sector bottlenecks as the cause of inflation in Pakistan. Azhar (1973) suggested that the growth rate of money supply and the level of real GDP played a major role in the inflationary process, Bilquees (1981) found that both the structural and monetarist models are capable of explaining inflation in Pakistan during 1960-70 but not satisfactory. In a recent study Nasim (1995) and Hossain (1990) find money supply as the principal factor underlying the rising inflation rate in Pakistan. In fact, Naqvi (1994), Hasan (1994), Hasan (1995) and Bilquees (1988) accord relatively less importance to money supply as a factor influencing the rate of inflation but in no way recommend a relatively easy monetary policy.

Most of the studies mentioned above did not considered the integration properties of the economic variables while conducting causality test. It has been widely or rather universally accepted that most time series data used in economic analysis are non-stationary in nature (i.e., they have a persistent tendency to increase over time). A regression of one non-stationary series on another can give rise to the so-called spurious regression problem and lead to incorrect statistical inferences.

Thus, prior to estimating any functional relationship it is essential to determine the nature of the long run movements in the variable being studied. A functional relationship can then be estimated directly with the help of conventional econometric technique. It may be noted that the classical statistical inference is only valid in models in which all variables are stationary.

**OBJECTIVES OF THE STUDY**

The purpose of this paper is two folds. We will first investigate the order of the integration and co integrability of the four series- $M_1$, $M_2$, CPI, and WPI and then reconsider the causality between them using the statistical theory on integrated repressor. A priori, we may expect the direction of causality running from money to inflation or a feedback relationship. The findings of this paper will go a long way in determining the role of money in the economic activity of Pakistan and will provide insight into the efficacy of the monetary policy in Pakistan.

This paper is organised in five sections. Following section, I, section II provide the date source and specification of the variables. Section III discusses the integration properties of variables and results of the stationary, co integration test. Section IV explains the methodology of Granger causality test and its empirical results. Section V provides conclusion and policy implication.

## DATA SOURCE & SPECIFICATION OF VARIABLES

The data used in the present analysis are the annual observations of the variables for the period from 1972-73 to 1995-96. We have selected this period because of the quite stability of the economy during this period. The data was obtained from various issues of the economic survey [2]. For the measurement of the money supply we have used both $M_1$ and $M_2$ definition of money supply. $M_1$ comprises Private Sector Deposits at the State Bank of Pakistan, Demand Deposit of the Commercial Banks and Co-operative Banks and Currency in circulation. Where as $M_2$ is $M_1$ plus Time Deposit at the Commercial Banks and Co-operative Banks and Saving Deposits at the Post Office Saving Banks[3].

There are three measures of general price level that are widely used in economic literature i.e. the Wholesale Price Index (WPI), the Consumer Price Index (CPI) and the implicit GNP price defoliator is a ratio of real GNP to nominal GNP.

The implicit GNP price deflator is not a suitable measure of the cost of buying a fixed basket of goods and services in an economy. The reason is that, it includes the prices of exports, which are not consumed domestically, and excludes the prices of imports, which are consumed domestically. Thus we will consider only CPI and WPI as a measure of inflation. The Consumer Price Index Wholesale Price Index is expressed with base 1990-91[4].

## INTEGRATION PROPERTIES

Prior to the development of co integration theory and recent work on integration properties of variables, econometric models have been based on the assumption that the underlying data processes are stationary. Empirically it has been shown that most of the macro variables are non-stationary in nature. Hence analysis of non-stationary series with conventional techniques gives rise to a fair possibility of spurious[5] co-movement between variables.

Thus, it is important to find out whether the variables under investigation are stationary, then functional relationship can be estimated directly with the help of conventional econometric technique. Recent advances in econometric theory and practice have developed a new dynamic modelling approach, which is presented in the co integration and error correction models. The basic idea of co integration is that if two or more variables are co integrarted then it confirms the existence of long-run relationship between these variables. If, on the other hand, they are not co integrated, the variables under investigation have no long-run relationship among themselves.

Since a key concept underlying this paper is the idea of stationary, non-stationary and co integrability of economic time series, so it is appropriate to describe briefly the exact implications of that concept before we go on.

## TEST FOR STATIONARITY

A time series is defined as stationary if its mean and variance do not systematically over time. A non-stationary series on the other hand will exhibit a

mean and variance process that changes over time. Consider a single time series AR (1) process:

$$Y_t = \alpha + \rho Y_{t-1} + \lambda_t$$

Where $\alpha$ and $\rho$ are parameters and $\lambda$ is the stochastic error term that follows the classical assumptions namely zero mean, constant various $\delta^2$ and non-auto correlation. Such an error term is known as which noise error term. If $\rho = 1$, then we say that Y has a unit root. In time series econometrics, a time series that has a unit root is known as random walk and for testing non-stationarity is that the absolute value of $\rho$ should be equal to one i.e. H-; $\rho = 1$. The test of this hypothesis is a unit root test. The simplest way to test the null hypothesis is to re-specify the AR (1) equation as:

$$\Delta Y = \alpha + \beta Y_{t-1} + \lambda$$

Where, $\beta = \rho - 1$. Thus the null the null hypothesis is now H-; $\rho = 0$. In each case the test for a unit root is a test on the coefficient of $Y_{t-1}$in the regression. If the coefficient is significantly different from zero then the hypothesis that Y contains a unit root is rejected and the hypothesis is accepted that Y is stationary [6].

## STATIONARY TEST RESULTS

Our first step is to determine the order of integration and co integration of $M_1$, $M_2$, CPI, and WPI. All variables are expressed in logarithmic form. The results of unit root tests for the level series and the first difference series are reported in Table-1. The conventional Dickey-Fuller and Augmented Dickey-Fuller test (where necessary) were applied. The first column presents the DF adjusted t-statistics for a unit root in the level series against the alternative that the series is stationary around a linear trend. All the t-statistics are below the critical value. So the null hypothesis of a unit root or non-stationarity of any of the four time series, $M_1$, $M_2$, CPI, and WPI cannot be rejected.

Next, we defined the first differences of each of the four series and tested the log-difference series for unit roots. The results are presented in column 2 of Table-1. In contrast tot he test statistics in column-1 for the levels series, all the computed test statistics in this column are significant indicating that when the data are difference non-stationarity of first differences is rejected for all the four series. Therefore, first difference of $M_1$, $M_2$, CPI, and WPI series gives stationary series.

**Table-1: Test for Stationarity for $M_1$, $M_2$, CPI, and WPI**

| Series | Levels | First Diffs. |
|---|---|---|
| $M_1$ | -0.977326 | -4.843258** |
| $M_2$ | -0.043066 | -3.935314* |
| CPI | -1.745968 | -3.903699* |
| WPI | -0.996332 | -4.531272* |

- Significant and at 5% level & ** significant at 1% level.

## TEST FOR CO INTEGRATION

The co integration technique tries to establish the linear long-run equilibrium relationship between two or more variables. Behind this technique lies the idea that some non-stationary variables may drift apart in the short-run, but they converge toward an equilibrium in the long run. In order to test such a proposition, we first need to determine whether a variable is stationary or not. As described by Engle and Granger (1987), a non-stationary time series $X_t$, is said to be integrated of order d if it achieves stationarity after being difference d times. This is usually denoted $X_t \sim I(d)$. Furthermore, two I (d) variables are said to be co integrated if a linear combination of them is integrated of any order less that d. Thus, to test for co integration between two variable X, and Y, (both integrated of the same order) we need to obtain an estimate of a linear combination between X, and Y, say $Z_t = Y_t - \beta X_t$ where Z, may be interpreted as a dis-equilibrium error or short-run deviations from the long-run equilibrium relationship and $\beta$ is the co integration vector. If $X_t \sim I(1)$ and $Y_t \sim I(1)$ in order for X, and Y, to be co integrated the residuals or dis-equilibrium error term $Z_t \sim I(0)$. What this simply means that there exists a long run equilibrium relationship between the two series. If $Z_t$ is not 1(0) then the two series may diverge from each other indefinitely. Therefore, the basic idea behind co integration of series is that the presence of co integration ensures that the series will move closely together in the long run since the difference between them is stationary with well-defined mean and variance.

Thus a test for the null hypothesis of independence between the two series must precede a formal test of causality. In other words, independence eliminates the possibility of feedback and unidirectional causality in either direction. If two variables are found to be co integrated, the possibility of no-causation between them is ruled out and there must be at least one way of causation either unidirectional or bi-directional.

## CO INTEGRATION TEST RESULTS

Having established that the four series $M_1$, $M_2$, CPI and WPI are integrated of order one, 1(1), that is to say they are non-stationary in their levels but stationary when defined in terms of their first differences, we now examine their co integration properties. That is, we examine whether $M_1$is co intergated with each of the two price series, CPI and WPI and also whether M2 is co integrated either or both of the two price variables. According to the Granger Representation Theorem (Engle and Granger [1987]) if two series are co integrated then the residuals from the co integration regression will be stationary. Therefore, the co integrating regression was first estimated using indifference data and then residuals from these regressions were tested for non-stationarity. These results are reported in Table-2. The first column gives the simple Dickey-fuller test statistic and the second column gives the Augmented Dickey-fuller test statistics. Almost all the test statistics are significant indicating that the residuals are stationary and the money supply series are co integrated with the price series. Thus both $M_1$ and $M_2$ are co integrated with CPI and WPI based on the DF and the ADF test statistics.

**Table-2: Test for Co integration between the money & price variables**

| Co integration Regression | Dicky-Fuller | Augmented D.F. |
|---|---|---|
| $M_1$ and CPI | -2.756137** | - |
| 3.839246* | | |
| $M_1$ and WPI | -3.009880** | - |
| 3.081791** | | |
| $M_2$ and CPI | -3.038802** | - |
| 4.926444* | | |
| $M_2$ and WPI | -3.473500** | - |
| 4.447205** | | |

- * significant at 5% & ** significant at 1% level.

## II. GRANGER CAUSALITY TEST

There are several methodologies available for causality test. One of the widely used methods is the Granger Causality Test. According to Granger test, variable X is said to cause variable Y if variable X is able to improve the prediction of variable Y. in general Granger test consists of estimating the following equations:

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + e_t \quad (1)$$

$$Y_t = \sum_{j=1}^{m} C_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + n_t \quad (2)$$

Where $X_t$ and $Y_t$ are two stationary time series; $e_t$ and $n_t$ are tow serially independent error terms with zero mean and finite covariance, m is equal to infinity but in practice, of course, due to the finite length of the available data, m is assumed finite and shorter than the given time series.

One the basis of estimation of equation (1) and (2), unidirectional causality from the variable X to Y is implied if the estimated coefficients on the lagged X variable in equation (2) are statistically different from zero as a group and the set of estimated coefficient on the lagged Y is equation (1) is not statistically different from zero. Conversely, unidirectional causation from Y to X exists if the coefficients on lagged Y in equation (1) are statistically non-zero as a group and the set of the lagged X's coefficient is zero in equation (2). Feedback (bi-directional causation) from Y to X exists when the set of the coefficients on the lagged Y variable in equation (1) and on lagged X variable in equation (2) are statistically different from zero.

CAUSALITY TEST RESULTS

The test results indicate $M_1$ and $M_2$ (individually) Granger cause inflation irrespective of whether inflation is represented by the Consumer Price Index or the Wholesale Price Index as evidenced by the significance of the F-statistics. The F-statistics, which test reverse causality between the variables, indicate that inflation (CPI or WPI) granger cause changes in money supply, irrespective of whether it is measured as $M_1$ and $M_2$.

**Table-3: Causality Test between and Inflation (CPI and WPI) Money ($M_1$ & $M_2$)**

| Null Hypothesis | F-Statistics | Probability |
|---|---|---|
| $M_1$ does not Granger Cause CPI | 8.30890 | 0.00304 |
| CPI does not Granger Cause $M_1$ | 8.40495 | 0.00290 |
| $M_2$ does not Granger Cause CPI | 8.83265 | 0.00234 |
| CPI does not Granger Cause $M_2$ | 4.87792 | 0.02117 |
| $M_1$ does not Granger Cause WPI | 5.89605 | 0.01135 |
| WPI does not Granger Cause $M_1$ | 5.25179 | 0.01675 |
| $M_1$ does not Granger Cause WPI | 6.52174 | 0.00791 |
| WPI does not Granger Cause $M_2$ | 3.97287 | 0.03840 |

In all cases the lag length is two.

## III. CONCLUSIONS AND POLICY IMPLICATIONS

As a first step we have used the statistical theory of integrated regressors to establish the time series properties of $M_1$, $M_2$, CPI and WPI economic series for Pakistan and used these empirical properties of the data to specify and test Granger causality between money supply and inflation. The results indicate that the four economic series are non-stationary at levels but stationary when defined in terms of their first differences. The results also indicate that $M_1$ and $M_2$ are co integrated with CPI and WPI based on Dickey Fuller and Augmented Dickey Fuller test statistics. This shows that there exists long-run relationship between these series. The results of the causality test indicate that there exists bi-directional causality between money supply ($M_1$ or $M_2$) and inflation (CPI and WPI).

Their reverse causality between inflation money supply indicates that monetary policy in Pakistan is to some extent accommodative so that when there is inflation in the economy the State Bank of Pakistan increases money supply. This is a very likely scenario because unlike developed countries where the Central Bank is generally independent of government, the State Bank of Pakistan is directly controlled by the government. Very often, the Government of Pakistan run into a higher than expected budget deficit mid-way through the fiscal year because of a rising price level. Since it cannot change budgetary outlays, it asks the State Bank to issue it credit. This explains the reverse causality from CPI and WPI to $M_1$ and $M_2$ that we see in our empirical results.

The results of this study have important implications at a macroeconomics level and revenue collection system. When building a macroeconomics model for the Pakistan economy, money supply could be used as an explanatory variable for inflation. From the results we can conclude that an active fiscal policy is favourable during the time of inflation. Deliberated actions by budgetary authorities are required in order too eliminate inflation-induced budgetary deficits or even to achieve surpluses. Priority should be given too improve the revenue system so as to mitigate all kinds of lags in revenue collection.

## REFERENCES


Abdullah, A.Z. "Money Inflation and Causality: The Case of Malaysia Yousuf,Z. (1970-1992)", *The Asian Economic Review*, 44-51,1996.

Aghevli B. & Khan,M. "Government deficits and the inflationary process in developing countries", *IMF Staff papers*, 25, 383-416, 1978.

Ahmed, E. & Ram, H. "Foreign Price Shocks and Inflation in Pakistan: A monetarist Approach", *Pakistan Economic & Social Review*, Vol. XXXIX, No. 1,1-20, 1991.

Azhar, B.A. "An Econometric Analysis of the price Behaviour in Pakistan", *Pakistan Development Review*, Vol. 12, No. 4,1973.

Beltas, A. & Jones, T. "Money Inflation and Causality in a Financially Repressed Economy: Algeria 1970-1988", *Applied Economic*, 25,473-480, 1993.

Bilquees, F. "Inflation in Pakistan- An Empirical Analysis". *Research Report Series* No. 119, Pakistan Institute of Development Economic, Islamabad, 1981.

Bilquees, F. "Inflation in Pakistan: Empirical Evidence on the Monetarist and structuralist Hypothesis". *The Pakistan Development Review*, Vol. XXXVII, 1988.

Biswas. B. & Saunders, P.J. "Money and price Level in India', *Indian Economic Journal*, 1990, 38: 103-114.

Butt, M.S. & Jamal, H. "A Monetarist Approach to Inflation for Pakistan", Pakistan Economic &social Review, Vol. XXXVI, No.2, 69-87, 1988.

Engle, R. & Granger, C.W. J. "Co integration and Error Correction, Representation. Estimation and Testing". *Econometric*, 55,251-276, 1987.

Granger C. W.J. "Investigating Causal Relationship by Economic Model and Cross Spectral Methods", *Econometric*, 37,424-438, 1969.

Hasan, A. M, Khan,A.H, Pasha, H.A. & Rasheed, A. "What Explain the Current High Rate of Inflation in Pakistan". Paper presented in the Eleventh Annul General Meeting of the Pakistan Society of Development Economic, April 18-21, Islamabad, 1995.

Hossian, A. "The Monetarist Versus he Neo-Keynesian views on the Acceleration of Inflation: Some Evidence from South Asian countries", *The Pakistan Development Review*, Vol. 29, No. 1, Spring, 1969.

Jones ,J. D. & Uri, N. D. "Money, Inflation and Causality" : *Another Look at the Evidence for the USA*. 1953-84", Applied Economics, 19, 1969-1980.

Masih, A.M.M. & Masih, R. "Temporal Causality between Money and price in LDCs and the Error-correction Approach: New Evidence from India", *Indian Economic Review*. Vol. XXXIX, No.1, 33-35, 1994.

Naqvi, S.N.H., Khan, A.H., Ahmed. A.M., & Siddiqui, R. "Inflation in Pakistan: Cause and Remedies", Islamabad: *Pakistan Development Economics*, November, 1994.

Nasim, A. "Determinants of Inflation in Pakistan ", Karachi: *State Bank of Pakistan*, December, 1995.

Porter, R.C. "Income Velocity and Pakistan's Second Fine Year Plan," *Pakistan Development Review*, Vol.1, No.1.1961.

Saini, K. "Can Monetary Growth Explain Inflation in India?", *Indian Economic Journal*, 1984, 32:1,61-71.

Thacker, N. "Is Inflation a Monetarist Phenomenon?: The Case for India", *The Indian Economic Journal*, No.1, 145-152, 1992.

Tumovsky, S. & Wohar, M. "Monetarism and the Aggregate Economy: some Long run evidence", *Review of Economics and Statistics*, 66,619-29, 1984.

Verma, S. & Kumar, S. "Causality Between Money supply and Price in India", *Indian Economic Journal*, Vol.42, No.1, 57-62, 1994.

---

**END NOTES**

[1] For further details on structuralist and monetarist controversy see, *Macroeconomics*, Rudiger Dornbusch & Stanley Fischer, Sixth Ed.

[2] The data on all variables can be obtained from the authors on request.

[3] See Annual Reports, State Bank of Pakistan.

[4] For Further details on CPI and WPI see footnote on Page No. 1, *Inflation in Pakistan Revisited* by Ashfaque H. Khan & Mohammad Ali Qasim PIDE, Twelfth Annual General Meeting 14-16th Dec. 1996.

[5] $R^2 > d$ (Durbin Watson) is a good rule of thumb to suspect that the estimated regression suffered spurious regression.

[6] For further detail on unit root test see Domodar N. Gujarati, *Basic Econometrics*. Third Edition.