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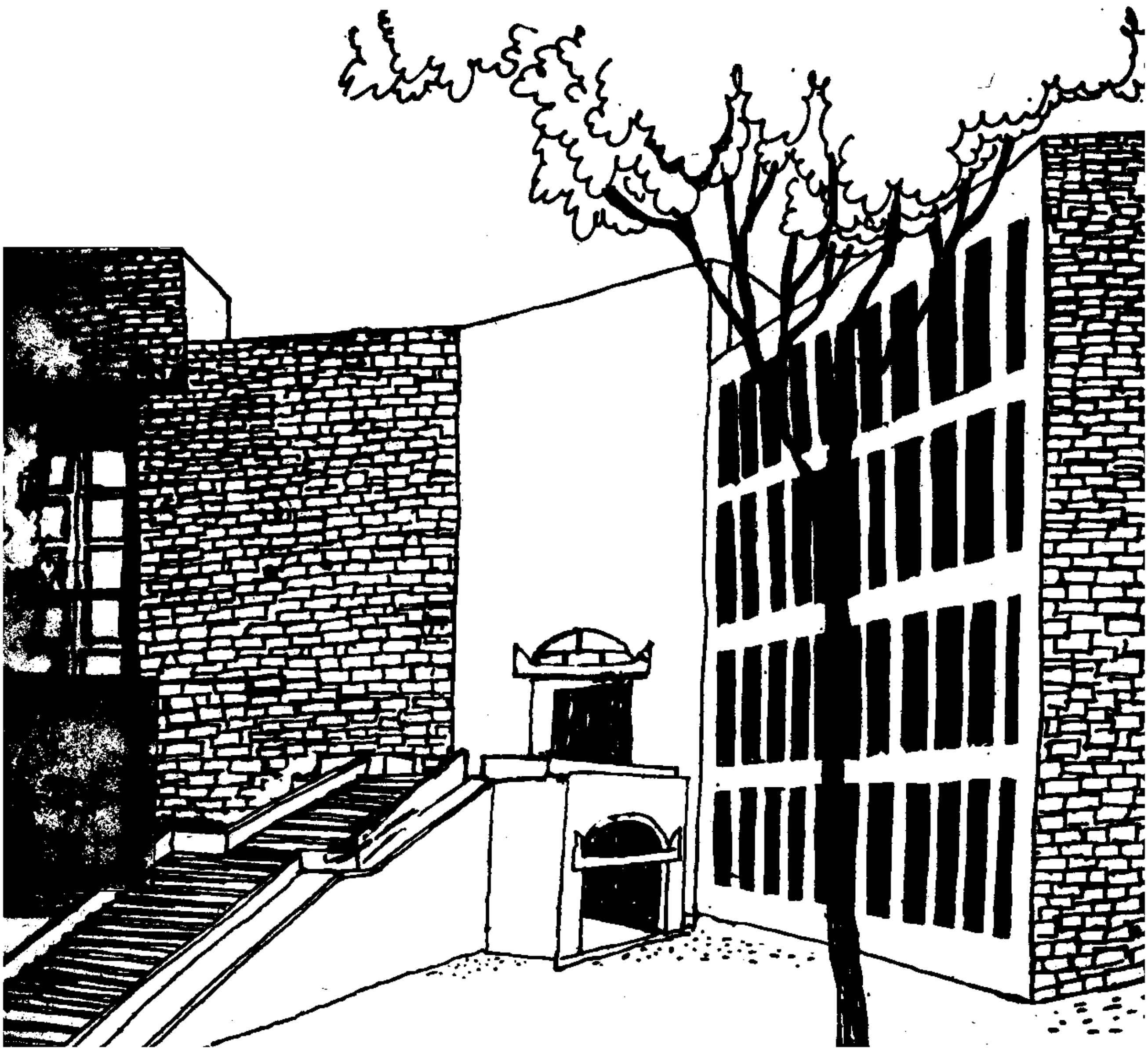

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HOW MUCH DOES MONEY MATTER IN INDIA

By

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HOW MUCH DOES MONEY MATTER IN INDIA*

Ram Lal Sharma[1]

I

Theoretical Background

How much money matters i.e. to what extent changes in the stock of money affect economic activity represented by nominal National income or real national income, has been hotly debated in the literature of monetary economics. The contestants are Keynesians and Monetarists. The former are led, among others by Professor Franco Modigliani and the chief of the latter is professor Milton Friedman.

The Monetarists consider money to be a very important strategic variable determining economic activity and accuse the Keynesians of not recognizing this fact. The Keynesians now are rather on the defence and attempt to show that in their system too, money is important. We have Sir Roy Harrod, Keynes' biographer (1970, P.621) doing this:

"Keynes thought the quantity of the money supply of the greatest importance and the whole Treatise is impregnated

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1. While working on this paper I had many discussions with Professor G.S.Gupta on various issues involved in the paper and I am therefore, grateful to him. However, I am solely responsible for any errors that still remain.

with discussions of its influence...there is nothing in the General theory to suggest that Keynes was repudiating all that finely wrought work of his about money in the Treatise."

But irrespective of what Harrod says there is enough in General theory to show that money is not that important as monetarists think it to be. Now (Keynes in his general theory, 1936: P.105, 149 and P.315) money is considered as one of the variables influencing money income and this variable is not necessarily the major one. Furthermore, it is thought that the market Psychology is always dominated by the concept of normal rate of interest and therefore successive increases in the supply of money would not affect the rate of interest significantly. In the limiting case of liquidity trap, increase in the money supply would not affect the rate of interest at all.

Not only this, it is made specifically clear that the link between rate of interest and the volume of investment is not strong because: (i) "New capital investment can only take place in excess of current capital disinvestment if future expenditure on consumption is expected to increase" (1936: P.105); (ii) "State of confidence" is the significant and a major variable in determining the future expected rate of return on investment (P.149) (iii) Future expectations play a dominant part in influencing the decision to invest and "they (expectations) are subject to sudden and violent changes" (P.315).

Historically speaking, money fell in disrepute during the crash of 1929 and thirties, and this continued right upto 1968 when incometax surcharge was levied in the U.S.A. to curb excess aggregate demand. However, even during this period there existed a group of dedicated economists at Chicago who continued to work on monetary economics and represent the quantity theory of money tradition which of course "differed sharply from the atrophied and rigid caricature that is so frequently described by the proponents of the new income expenditure approach" (Friedman 1956: P.3).

But this group was not taken seriously. As is clear from the following passage, "the view that ... mainly money matters was the province of an obscure sect with headquarters at Chicago for the most part, economists regarded this group - when they regarded it at all - as a mildly amusing not quite respectable collection of eccentrics" (Davis, 1969: P.132).

Teigen has the same story to repeat when he writes "until just a few years ago, the view point which lately has come to be known as monetarist was not taken very seriously by anyone except a few dedicated disciples." (Teigen, R.l. 1972: P.92).

So the Keynesian tradition continued and money continued to be regarded as one of the factors (and in the minds of many, not necessarily the most important) influencing business activity (economic activity). Came 1968 and income tax surcharge was levied to curb excess aggregate demand in the USA.The most of the tools of analysis (forecasting measures) based on Keynesian tradition predicted a slowdown in economic activity but all of them failed in this task as the economic system continued to be buoyant. The people looked for an alternative (methods of analysis) and Monetarism provided the answer All this caused a lot of academic confusion and Keynesian Orthodoxy (to use H.Johnson's words) was badly shaken and mauled. Davis (1969: P.133) writes: "the failure of conventional forecasting technique in the wake of fiscal restraint, would not.... necessarily send one running to the money supply for an explanation were there not a large body of research on the importance of money already waiting in the wings. This research needed only the right historical moment to bring it forth into limelight. The post surcharge experience has provided such a moment."

Thus, it is clear that money is very important to the Monetarists and less so to the Keynesians. But the question is what does important mean in operational terms? We have Professor Friedman (1956: P.3) saying: "Chicago tradition (quantity theory of money tradition as it existed at Chicago) "was a theoretical approach that insisted that money does matter - that any interpretation of short term movements in economic activity is likely to be seriously at fault if it neglects monetary changes and repercussions and if it leaves unexplained why people are willing to hold the particular nominal quantity of money in existence."

While commenting on Tobin, Friedman writes (1970: P.319): "I do believe that changes in the supply of money have accounted for more than half the variance of money income for reasonably long periods and for changes measured over interval, of a year or more. But they certainly have not done so far all periods and all intervals."

The above two paragraphs make the monetarist position on importance of money quite clear. It does not imply that it is only money that matters. This point gets substantiated if we look to the study done by Anderson and Jordon (1968: PP.121-26). The correlations they report between change in stock of money and income are not very high and thus there is enough scope for other variables to affect income.

However, we have not explained the position taken by Brunner and Meltzer. Whatever their differences with Friedmanian system, they do accept the position that change in money stock

Explains a sizeable portion of variation in money income.

What about the Keynesians? As already mentioned at the outset, they are on (because of the changing character of economic problems during seventies and eighties) defensive and most of them now assign a major role to changes in stock of money in explaining changes in output and prices. As Thomas Mayer (1978: PP 81-85) illustrates, the essentially Keynesian MPS econometric model of the united states economy generates long term monetarist results. And then we have professor Modigliani (1977: P.1) declaring: "Milton Friedman was once quoted as saying, 'We are all Keynesians now' and I am quite prepared to reciprocate that 'we are all monetarists' if by monetarism is meant assigning to the stock of money a major role in determining output and prices."

It is true that differences between Keynesians and monetary with regard to the importance of money have narrowed down but have they not vanished. For instance, Friedman and his associates consider demand for money function to be highly stable and the interest elasticity of demand for money to be quite low. Therefore changes in exogenously given stock of money would produce greater changes in money income than it would do in the Keynesian system. Further Keynesians still believe that prediction of determinants of investment in explaining variation in income are crucial but the monetarists do not consider such prediction (as Keynesians like to do) to be of any importance. To use Thomas Mayer's words (1978: PP. 81-90): "All in all although Keynesian and Monetarists still disagree about the relative importance of changes in the quantity of money, the gap between them has shrunk very substantially. Largely as a result of the Keynesians adopting a more monetarist position... (the) Keynesian have moved to occupy the strategic middle ground, having been flexible enough to incorporate a major role for money in the Keynesian scheme, thus leaving to monetarists the role of defending a more extreme position."

Transmission mechanism of money under rival systems

We have explained above at length that changes in money are important in affecting the level of economic activity, but this remains meaningless unless we specify the steps that connect money to economic activity. We outline below this connection following Professor Friedman (1969: PP.229-234).

Let us presume that the supply of money is increased which can be done in a number of ways:

(i) open market purchases by the central bank

(ii) increase in government expenditure financed by Fiat money

(iii) increase in the deposit-currency ratio.

(iv) rise in the deposit-reserve ratio.

In order to make the analysis simple we presume that the supply of money is increased by open market purchases. This would be successful only if the central monetary authority increases the prices of securities (it wants to sell) and lowers the rate of neturn on them. What would happen? the wealth portfolios of individuals and firms that were in equilibrium to begin with, get disturbed because the prices of a kind of securities have risen. In order to benefit from this, firms and individuals sell these securities and get cash in return. This will lower the marginal rate of return on money and the asset holders would attempt to buy first, the type of securities they sold to the central bank: fixed interest coupon, low risk obligations. But as they do this, the prices of these securities rise and rate of return on them falls. Obviously their relative attractiveness compared to other assets reduces. So, the firms and individuals, including those who were not involved in the initial transactions with the central bank, will try to substitute into assets further along the whole range of assets. They will, for instance, look "to other categories of securities higher-risk fixed coupon obligations, equities, real property and so forth" (P.230).

As this process builds up the initial impacts get diffused in several directions of the economic system. The individuals and firms move from financial assets to existing monfinancial assets in order to adjust their actual portfolios to desired portfolios. This raises the prices of non financial assets and thereby non human wealth also increases. Consequently, the ratio of income to wealth declines and direct acquisition of current services becomes cheaper relative to the acquisition of sources of services. Ultimately, the prices for these services also shoot up calling for production of new non financial assets.

Thus the initial impact of increased money supply ends up in the markets for goods and services. Here one thing needs to be noted is that when production of new non financial goods (Producer's durable goods consumer's durable goods, and goods and services in general) increases, prices of factors of production will also go up and this way their money income increase. The increased money incomes will tend to increase the prices of goods and services in general. This is one of the chain of events. It is quite possible that individuals and firms do not take to these steps and instead may spend on goods and services and consumer durable goods directly or they may spend on human capital formation. Thus there may be several routes through which initial impact gets diffused.

So far, we have not introduced banking system based on fractional reserves. Introducing that would mean that the open market purchases will increase the reserves of commercial banks. Some of money in the form of deposits might come from individuals and firms. This will also increase the reserves of commercial banks. The latter, in order to diversify their portfolios would invest in loans and investments and in the process create additional money. The end result will be that the increase in total money stock will be larger than what it would have been without banking.

The most important points to be noticed about the transmission mechanism of monetarists led by Professor Friedman are:

(i) that money as an asset is substitutable for all types of assets;

(ii) that financial markets, assets, investment, ratio of interest must be taken in a broader view:

"....to regard the relevant portfolios as containing a much wider range of assets, including not only government and private fixed-interest and equity securities traded on major financial markets, but also a host of other assets even going so far as to include consumer-durable goods, consumer inventories of clothing and the

the like and, may be also, such human capital as skills acquired though training and the like. Similarly, it is necessary to make rate of interest an equally broad construct, covering explicit or implicit rates on the whole spectrum of assets. (Friedman, 1969: P.231)".

(iii) that money is a stock like the stocks of financial assets or houses or buildings or inventories or skills. It also yields income as other assets do. When the quantity of money is increased, it produces disturbances in the balance sheets of individuals and firms. As a result, adjustments take place between actual and desired stocks which produce changes in flows of expenditure generating cyclical fluctuations. It is this interconnection of stocks and flows that produces a diffusion over different categories and gives rise to cyclical reaction machanisms.

As far as traditional Keynesian transmission mechanism is concerned money is considered as an asset substitutable only for a very limited number of financial assets which are quite close to money in terms of their liquidity. So, if the quantity of money is increased, rate of interest would not fall much before equilibrium in asset holding is reached. As a result of this fall, part of the increased quantity of money will be held for speculative purposes and rest of it will become available for spending. Goodhart (1970, P.165) writes:

"The crucial distinction between the monetarists and the Keynesians resides in their widely differing view of the degree to which certain alternative assets may be close substitutes for money balances: and in particular whether there is a significantly greater degree of substitution between money balances and such financial assets than between money balances and real assets."

But now, most of the Keynesians do not abide by this position while comparing their views with those of monetarists. Therefore, Laidler (1981, p.2) has aptly said that "there is no essential difference between it (the monetarist transmission mechanism) and that analysed for example by James Tobin and his associates."

II

Empirical Results

The purpose of this paper is very much limited in that we want to study whether changes in money narrowly defined

$M_1 = C + DD + OD)$

where C = Currency held by the public

DD = adjusted demand deposits on which no interest is paid and

OD = other deposits.

or broadly defined ($M_3 = M_1$ + Time deposits that yield interest income), affect changes in economic activity represented by national income.

At the outset, we want to make it clear that our approach in this paper belongs to the Chicago tradition. The latter consists of choosing a reduced form of equation (instead of a whole structural model) for estimating a relationship between two variables or more. The reason given is that for every reduced form equation the corresponding structural form of the model exists but that there is no need to estimate the whole model when the purpose is to investigate the relationship between a few variables only.

the reduced form model that we have used is:

$$\Delta GNP = \alpha_0 + \alpha_1 \Delta M_{1t} + \alpha_2 \Delta M_{1t-1} + \dots + \alpha_n \Delta M_{1t-n} + e_{t_1} \quad \dots (1$$

or if there is a reverse relationship then

$$\Delta M_{1t} = \beta_0 + \beta_1 \Delta GNP_t + \beta_2 \Delta GNP_{t-1} + \dots + \beta_n \Delta GNP_{t-n} + e_2 \quad \dots (2$$

where GNP = gross national product in logarithmic first difference form and

M_1 = Money narrowly defined and is first difference form.

In case of reverse relationship (bidirectional causality) we have also used Granger's method to estimate such relationship. Granger's method for estimating bidirectional causality is given as

$$M_{(t)} = \sum_{i=1}^{m} \hat{\alpha}_{(i)} M_{(t-i)} + \hat{\beta} LF + \sum_{i=1}^{n} \hat{\delta}_{i} GNP_{t-i)} \; \ldots\ldots \quad (C)$$

$$GNP_{(t)} = \sum_{i=1}^{m} \hat{b}_{(i)} \; GNP_{(t-i)} + \hat{\beta} LF + \sum_{i=1}^{n} \hat{f}_{(i)} M_{(t-i)} \; \ldots\ldots (D)$$

where $\hat{\alpha}$, $\hat{\beta}$, $\hat{b}$ and $\hat{f}$ are least squares estimates and M is stock of money and GNP is gross national product.

From these equations (from A to D) it appears as if there is a direct relationship between M and GNP. In fact, there are many steps involved before M influences Y or vice versa. We have outlined these steps under rival systems in part I. But, in the words of Professor Friedman, still our knowledge with regard to these steps is too meagre and therefore, it is better not to incorporate them into our model specifications. As a result, (because of this logic) we have specified equations A to D as if there is a direct connection between M and Y.

To begin with, we estimated the equations based on logarithmic first differences (given in table 7) but the results were not significant. Neither the R^2's nor F ratios were high enough to enable us to derive some meaningful conclusions. Even the signs of the estimates did not conform to a priori logic. Therefore, in order to break this deadlock we resorted to the procedure of estimating the partial logarithmic first differences (reported in table 1, annual data). This procedure involved the following steps:

(i) the equations in the first instance were estimated by levels of data; and it was noted that

(ii) the estimated equations this way exhibited autocorrelated residuals;

(iii) so, we estimated the first order autocorrelation coefficient from the residuals;

(iv) In view of the estimated first order autocorrelation coefficient, we transformed the original equations (estimated by levels of data) and obtained the estimated partial logarithmicfirst differences.

Thus, our results in table 1 are based on estimated partial logarithmic first differences. For instance, the variable, ΔM_{1t-3} means $(M_{1t-3} - .9M_{1t-4})$ and so on. Obviously, the results have improved significantly. Eq.(1) shows that changes in the stock of money explain 69.21 percent of variations in nominal income, and there is a four year lag with which changes in the stock of money influence nominal income. But the interesting fact to be noted is that the coefficients do not decay with passage of time, on the contrary they tend to increase.This, result is contrary to the Anderson-Jordan study done for the U.S.A. The reasons for this difference may be that in India, changes in the stock of money in distant past affect economic activity (Price level and real income) more than the corresponding changes in the recent past due to imperfections in money and capital markets. Probably the influence of increased quantity of money takes considerable time in reaching the unorganised sector of the economy. This suggests that the transmission mechanism of money behind equation 1 (table 1) may not be exactly the same as we have outlined in the first part of this paper. It is highly likely that the increased quantity of money in India, affects first the wealth portfolios of individuals and firms (including commercial banks) in the organised sector and the resultant rearrangement of their portfolios in this sector goes to affect the loosely knit portfolios in the unorganised sector of Indian economy.

But these are minor details and do not contradict Professor Friedman's conclusion that more than half the variance in nominal income is explained by changes in the stock of money. However, when we examine eq.(2) (table 1) Friedman's conclusion appears to be a suspect because money turns out to be endogenous to the economic system. Though none of the coefficients are, strictly apeaking statistically significant, the fact remains that the signs on the estimates accord to a priori logic and 't' values in two cases are more than 1.5. R^2 is quite high and F value is significant though D.W. test signifies some positive autocorrelation. On balance, we may say that eq.(2) is not as powerful in contradicting Friedman's conclusion as equation 1 is in supporting his inference. We probably need more statistical evidence to accept the hypothesis that money is endogenous to the system.

In order to see whether changes in the stock of money affect changes in real output (when the economic system is not at full employment as the case is in India), equations 3 and 4 were estimated. Equation (3) shows that change in real output depends heavily on factors other than money (See the 't' value associated with the intercept). However money considered as an input in the process of production (as 'money in growth models' suggests) tends to affect changes in real output as well. Thus changes in the stock of money tend to affect not only nominal income but real income also. A comparison of equations 1 and 2 on the one hand and 3 and 4 on the other shows that lag system involved is similar whether we cast our equations in nominal terms or real terms.

We were unable to infer on the basis of equation (2) that money is endogenous to our economic system but eq.(4) now provides the evidence enabling us to conclude that money does depend on economic activity. In other words there is a bidirectional relationship between money and income and money is not exogenous (in India) as Friedman would have us believe. The difference between eq.(2) and eq.(4) highlights one important fact: changes in the stock of money does not depend on changes in price level, they only respond to changes in real output.

Equations 5 to 8 (table 1) were estimated with money defined broadly. Although they support the conclusions we have reached earlier with money narrowly defined, they provide additional evidence about time deposits. Particularly eq.(6) now shows that changes in money strongly depend on nominal income. In other words changes in money stock now depend not only on changes in real output but also on changes in price level. Since $M_3 = M_1$ + Time deposits, what this equation shows is that time deposits respond to changes in price level but not the other components of money stock. In eqn.(7) changes in money broadly defined fail to explain changes in GDP. It is surprising to see the poor performance of this equation particularly in view of the behavior of equation (3). Eqn.(8) corroborates our earlier inference that money is endogenous in our economic system and therefore is not as unique as some monetarists think it to be. This equation also shows that growth of time deposits is strongly influenced by the growth of real income.

Since money whether narrowly defined or broadly defined is endogenous in our system i.e. it influences income and in turn gets influenced by income, we probably fail to reveal the unique nature of money in monetarists' sense. We therefore attempted to try Reserve Money. Equns. 9 to 12 were estimated for this purpose. It is very clear from this set of equations that the performance of reserve money in explaining the behavior of nominal or real income is not satisfactory but when reserve money is regressed on whether nominal income or real income, the estimates are highly significant. For example, examination of equation 10 and 12 make these facts very clear. They show that reserve money is also endogenous in our system and it is highly probably that currency drains are compensated by the Reserve Bank of India.

We carried our investigation further and examined the behaviour of unborrowed reserves (URM) to find out whether this variable was truly exogenous and corroborated the conclusions of monetarists. Eqn.13 to 16 were estimated for this purpose. But in this case also we find that unborrowed reserve money is not truly exogenous. It affects and gets affected by nominal income and real income. Once again we reach the conclusion that money is not unique in our system and a significant variance in it is explained by economic activity. This is the type of inference the Keynesians may uphold.

At this stage we want to comment on the statistical properties of the equations. Despite our efforts to eliminate autocorrelation (by estimating partial logarithmic first differences we have not succeeded fully in this objective. Most of the equations are still marked by positive or negative autocorrelation and to that extent influence the tests of statistical significance. We are aware that the use of further iteration till autocorrelation was eliminated would have been useful. But we could not do that due to the constraint of limited budget. However, inspite of the presence of autocorrelation, R^2 and F ratios have turned out to be quite significant. The signs of the estimates conform to a priori logic and in many cases 't' values are also quite high. All this enables us to draw broad qualitative inferences and that is what matters, for our purpose Yes, we agree that further research on this topic may throw more light on this aspect of our economy.

If money is not unique (that is, there exists a bi-directional causality between money and income) what is the nature of government expenditure? We estimated equations 17 to 20 to answer this question. As far as changes is nominal income are concerned, 91 percent of them are explained by changes in government expenditure taken by itself (in nominal terms). This estimate of 91 percent has to be taken with caution because positive autocorrelation is indicated by D.W. test. However, this is presumably not less than 69 percent of the variance in nominal income explained by changes in the stock of nominal money. The point we want to emphasize here is that the government expenditure also matters which monetarists tend to ignore. It is true that of the two (government expenditure and nominal stock of money) which possesses more explanatory power, can be answered only if we introduce government expenditure and money in the same equation. Since we are not testing relative importance of fiscal and monetary actions we have not done so. (However, we propose to estimate such equations at the time of publication of this paper).

Eq.(18) (table 1) shows that changes in government expenditure respond to changes in nominal income but not as strongly as do changes in income to changes in government expenditure. The reason may be that during the period of rising prices when nominal income tends to increase, government expenditure tends to be restrictive and vice versa. Eqn.(19) is the best of the whole lot, R^2 is very high, there is no auto-correlation and F test indicates statistical significance which signifies that 91.49 percent of change in growth rate of GDP (real terms) is explained by change in the growth rate of government expenditure. At this stage, if we compare eqn.(3) with eqn.(19), it can be inferred that the growth of real output depends more on government expenditure than on money. And this is quite alright as far as our economy is concerned. We have a framework of planned economy and planned government expenditure influences the rate of growth of real output. Whenever government expenditure has slackened, it has always reflected on the growth of real output. Onething more. Actually the share of government planned expenditure relative to the share of private sector planned expenditure has been increasing and therefore, it is no surprise that the government expenditure influences real output so much.

Does the rate of government expenditure depends on the rate of growth of real output? We have estimated eqn.(20) for this purpose. Yes, the government expenditure does get influenced by the past behavior of real output but this link is not as powerful as the link between government expenditure affecting the behavior of real output. This appears to be quite plausible because the planned government expenditure, though keeping in view the past performance of the economy, is meant to increase the rate of growth of real output in future. A comparison of eqn.(20) with eqn.(4) (both from table 1) shows that whereas money is undoubtedly endogenous to the economic system, the government expenditure is not, although this conclusion needs to be substantiated by further statistical evidence that we have provided in table 4.

In order to provide additional support for the conclusions that we have arrived at above, equations based on quarterly data (1951-52 - 1966-67) were also estimated. Equations 1 and 2 (table 2) very clearly demonstrate that there exists a bidirectional relationship between nominal money and nominal income. The data are in the form of logarithmic first differences. The quarterly data have been estimated by Khetan and Waghmere.

One point that needs to be mentioned here is that in case of annual data, we found that a four period lag was involved that is, money in the fourth preceding year affected the GDP in the current period. In case of quarterly data also, we find that a four period lag is involved. How do we resolve this contradiction? Actually, it seems that the variability of annual and quarterly data appears to be similar because quarterly data estimated by Khetan and Waghmere have been derived from annual data based on the procedure of interpolation that is why we get the same lag while using annual and quarterly data.

Eqn.(3) (table 2), is almost similar to equation 3 of table (1). But eqn.(4) of table (2) does not strongly support the the logic implied by equation (4) of table (1). Eqn.(5) and (6) (table 2), support the inference that we reached above with respect to money narrowly defined. Actually these equations are statistically better than equations 1 and 2 of table (2). Eqn.(7) with money broadly defined explains the growth of real output better than equation (3) of table (2) and equation (3) of table (1). Eqn.(4) and (8) of table (2) do not strongly support the endogeneity aspect of money in our economic system. We need further statistical evidence on this aspect. Eqn.(9) to (12) of table (2) have been estimated to study the behaviour of Reserve money. As far as nominal income is concerned, they show a bidirectional relationship between RM and nominal income. The growth of real output is very well explained by Reserve Money but the endogeneity aspect is not supported by equation 12 of table (2), Although R^2 is very high and F test is also very high but the equation exhibits positively autocorrelated residuals. Therefore, we cannot attach much importance to the high value of R^2.

The unborrowed reserve money equations (eqn.13 to 16 of table 2) support our inferences reached above. But there is subtle difference to be noted. For instance, take eqn.(14) and (16) of table (2). These equations provide a qualitative inference that unborrowed reserve money is exogenous to the system and donot depend on the growth of GDP although they explain the behaviour of GDP in the way suggested by Professor Milton Friedman.

We have quarterly data for the period 1970-1980 for GDP (constant prices). These data were provided to us by Professor V.S.Chitre and are based on the same procedre as the one used by Khetan and Waghmere.

The advantage of estimating equations from quarterly data for various periods is that they provide us statistical evidence for the sub-periods. We are then in a position to see whether the inferences reached for the whole sample period are supported by the sub periods result to or not. As far as sub period 1951-52 - 1966-67 results are concerned they provide support for the results reached on the basis of annual data except the endogeneity aspect of money. Let us see whether 1970-1980 subperiod also provides the same evidence.

We are in for a surprise as far as 1970-1980 subperiod results are concerned. Eqn.1 (table 3) shows that growth of

GDP is not explained by money whether narrowly defined or broadly defined (eq.3 table 3). But the growth rate of money stock whether M_1 and M_3 is being explained by the growth of GDP in a very significant way. The reasons for this type of inference are:

(i) the period 1970-80 was an unusual period in which food and raw materials' prices increased substantially.

(ii) Oil prices increased fourfold

(iii) 5 out of 10 years of this sub period were drought years with 1979 being the worst one.

Thus growth of GDP was affected more by these events than money. Therefore, we should interpret equations 1 and 3 table (3) in the light of these happenings. Since this sub-period was abnormal so the inference that money does not explain GDP should be taken with caution. We tend to think that the other statistical evidence provided so for, proves the hypothesis that the behaviour of GDP is explained by money.

The interesting part of these sub-period results is that they strongly support the endogeneity aspect of money.

As far as results regarding reserve money and unborrowed reserve money are concerned they are marked by very high negative and positive autocorrelation and therefore cannot be taken very seriously.

Thus, so far we have analysed the results for the whole sample period and two sub-periods based on quarterly data. The whole sample period results and (1970-80) sub period results show that there is a bidirectional relationship between money and income but this inference is not supported by the sub-period (1951-52 - 1966-67) results. In case of government expenditure, there exists a bidirectional relationship between government expenditure and nominal income but such relation does not exist between government expenditure and real output.

In order to be certain about these inferences, we have used Granger's test of bidirectional causality*. Equations 1 to 4 (table 4) test the type of causality that exists between government expenditure and income. Equations 1 and 4 (table 4) confirm the earlier inference that there exists a bidirectional causality between nominal income and government expenditure. Eqn.(3) shows that real income (GDP at constant prices) depends significantly on government expenditure. But government expenditure does not depend on real income. This confirms our earlier conclusion that we arrived at on the basis of annual data. Equations 5 to 8 (table 4) have been estimated to test the type of causality that exists between money and income. Eqn.(5) clearly shows that when income is regressed on past 8 values of

*for details see Ramlal Sharma, "Causality between money and price level in India revisited," Working paper No.688, IIM, Ahmedabad.

income, only 65.65 percent of its variance is explained. But with addition of 4 past values of M_1 (money narrowly defined) in the regression equation, the total variance of income explained goes upto 90.82 percent. This means that nominal income depends on nominal money. Eqn.(7) proves the reverse causality. With M_1 regressed on 8 past values of M_1 only 57.63 percent of its variance is explained. But when 4 past values of nominal income are included in the regression equation, then the variance explained goes up to 86.63 percent. Obviously, this explains that growth of nominal money depends on the growth of nominal income. What about the relation between the growth of money and growth of real output? We have equations 6 and 8 (table 4) estimated for this purpose. It is very clear that the growth of real output (real income) depends on the growth of money. We have already given an explanation why it happend so while explaining the equations based on annual data.

Eqn.(8) shows that rate of growth of money depends on real income also. This appears to be a demand for money equation although our purpose here is somewhat different.

In order to see whether the conclusions arrived at for M_1 on the basis of causality tests also hold good for M_3, we estimated equations 9 to 12 (table 4). It is obvious from equations 10 and 11 that there exists a bidirectional causality between

M_3 and nominal income, although this result is not as significant as it was in case of M_1 and nominal income. Eqn.(9) and (12) very clearly show that even in case of real output and M_3, there exists a bidirectional causality. Obviously these inferences conform to the ones that we have reached for M_1.

The results of table (5) relate to the subperiod 1951-52 - 1966-67 and are based on quarterly data, if we simply go by the criterian of the magnitude R^2 (with no autocorrelation as shown by the results and f ratio highly significant), then they uphold the inferences we reached above. But one disturbing aspect of these results needs to be noted. For instance we take eqn.(1) when Y (real output) is regressed on past 8 values of Y, R^2 is .9983 and when 4 past values of M_1 are added, R^2 goes upto .9985. Now this is only amarginal improvement. We can say that both values of R^2 are almost similar. In fact, this pattern is repeated in rest of the equations as well, which means that equations of table 5 are auto regressive. Actually it can be proved that if*

$$M_k = \alpha_1 M_{k-1} + \ldots\ldots\ldots + \alpha_8 M_{k-8} \qquad \ldots \quad (1)$$

and

$$Y_k = \beta_1 Y_{k-1} + \ldots\ldots\ldots + \beta_8 Y_{k-8} \qquad \ldots \quad (2)$$

Now if quantity theory is valid and the rate of inflation is constant then

$$(1) \Leftrightarrow (2)$$

---

*this proof has been suggested by Professor S.D.Lahiri, IIM, Ahmedabad. The detailed proof is with the author and can be obtained on request.

So, the equations of table 5 also uphold the conclusions reached earlier.

We estimated causality results for the sub-period (1970-1980) also which are based on quarterly data. They do not follow the pattern of results derived from quarterly data for 1951-52 - 1966-67 sub-period (table 5). These results (table 6) exactly follow the conclusions based on regression results contained in (table 3). Eqn. (1) (table 6) clearly shows that during this period, growth of real output was not influenced by the growth of nominal money. The same thing is being revealed by eqn. (3). In other words money neither narrowly defined nor broadly defined affected real output during this sub period. However, the growth of money stock either M_1 or M_3 was significantly affected by the growth of real output, as shown by equation 2 and 4 table (6). We have already mentioned above that sub-period (1970-1980) was abnormal in many ways and therefore, we got such results.

<u>Conclusion</u>:

Money is not unique in India as is claimed by the monetarists in the context of the U.S.A. Because:

(i) Bi-directional relationship was found between nominal money and nominal income;

(ii) the same type of relationship was found between money and real income;

(iii) Money, Reserve money and unborrowed reserve money were found to be endogenous to the economic system;

(iv) Bi-directional relationship was detected between nominal government expenditure and nominal income;

(v) Money did not influence the course of behaviour of real income in the subperiod (1970-1980);

(vi) Government expenditure affected the behaviour of real output in a significant way but was not much affected by the growth of real output;

(vii) Government expenditure was found to be more effective in affecting the growth of real income than the stock of money.

Table 1 (1951-52 - 1984-85) Annual data

Results based on estimated partial log. first differences

eq.No.(1)

$$\Delta GDP = .3493 + .2953\,\Delta M_{1t} + .3888\,\Delta M_{1t-1} - .264\,\Delta M_{1t-2}$$

t values (3.1264) (1.1991) (1.915) (1.301)

$$+ .4151\,\Delta M_{1t-3}$$

(2.4361)

Current prices

$\rho = .9$

$R^2 = .6921$ $\bar{R}^2 = .6428$

D.W. = 2.0589

$F(4,25) = 14.047$

---

eq.No.(2)

$$\Delta M_1 = -.2201 + .247\,\Delta GDP_t + .2922\,\Delta GDP_{t-1}$$

t values (1.4019) (1.2451) (1.818)

$$+ .2423\,\Delta GDP_{t-2} + .2798\,\Delta GDP_{t-3}$$

(1.5294) (1.285)

Current prices

$\rho = .9$

$R^2 = .702$ $\bar{R}^2 = .6543$

D.W. = 1.6597

$F(4,25) = 14.722$

---

eq.No.3

$$\Delta GDP = 1.1976 + .1436\,\Delta M_{1t} + .0915\,\Delta M_{1t-1}$$

t values (20.1245) (1.6385) (.8814)

$$-.112\,\Delta M_{1t-2} + .1692\,\Delta M_{1t-3}$$

(1.078) (1.9476)

Constant prices

$\rho = .85$

$R^2 = .66$ $\bar{R}^2 = .612$

D.W. = 2.68 $F(4,25) = 12.47$

eq.No.(4) $\Delta M_1 = -3.9252 + .6442\,\Delta GDP_t + 1.1404\,\Delta GDP_{t-1}$

t values (9.0503) (1.842) (3.7952)

$+ 1.117\,\Delta GDP_{t-2} + .4429\,\Delta GDP_{t-3}$

(3.5772) (1.2341)

$\rho = .85$

constant prices $R^2 = .8603$ $\bar{R}^2 = .837$

D.W. = 1.77

$F(4,25) = 38.4845$

---

eq.No.(5) $\Delta GDP = 0.3605 - 0.3234\,\Delta M_{3t} + 0.8275\,\Delta M_{3t-1}$

t values (3.3563) (0.805) (2.0255)

$+ 0.1206\,\Delta M_{3t-2} + 0.1410\,\Delta M_{3t-3}$

(0.3147) (0.4335)

current prices $\rho = .9$

$R^2 = .69$ $\bar{R}^2 = .6405$

D.W. = 2.2419

$F(4,25) = 13.916$

---

eq.No.(6) $\Delta M_3 = -0.347 + 0.1772\,\Delta GDP_t + 0.3752\,\Delta GDP_{t-1}$

tvalues (3.27) (1.3207) (3.4504)

$+ 0.3666\,GDP_{t-2} + 0.3305\,\Delta GDP_{t-3}$

(3.1441) (2.2431)

$\rho = .9$

Current prices $R^2 = 0.8773$ $\bar{R}^2 = 0.8366$

D.W. = 0.9614

$F(4,25) = 44.6695$

---

eq.No.(7) $\Delta GDP = 0.8263 + 0.0725\,\Delta M_{3t} + 0.1107\,\Delta M_{3t-1}$

t values (14.915) (0.3504) (0.5256)

$+ 0.09072\,\Delta M_{3t-2} - 0.03206\,\Delta M_{3t-3}$

(0.4593) (0.1912)

constant prices

$\rho = 0.9$

$R^2 = 0.4573$, $\bar{R}^2 = 0.3705$

D.W. = 2.5807, $F(4,25) = 5.27$

---

eq.No.(8) $\Delta M_3 = -3.1599 + 0.6742\,\Delta GDP_t + 1.1397\,\Delta GDP_{t-1}$

t values (9.5625) (2.4865) (4.8343)

$+ 1.1713\,\Delta GDP_{t-2} + 0.9368\,\Delta GDP_{t-3}$

(4.1765) (3.3283)

$\rho = .9$

$R^2 = .87$ $\bar{R}^2 = 0.846$

D.W. = 1.297

$F(4,25) = 40.83$

---

eq.No.(9) $\Delta GDP = 1.0354 + 0.3912\,\Delta RM_t + 0.3741\,\Delta RM_{t-1}$

t values (16.3979) (1.4558) (1.3348)

$+ 0.1498\,\Delta RM_{t-2} + 0.01799\,\Delta RM_{t-3}$

(0.5156) (0.0641)

current prices

$\rho = .85$

$R^2 = .8076$ $\bar{R}^2 = 0.7768$

D.W. = 2.2508

$F(4,25) = 26.2364$

---

eq.No.(10) $\Delta RM = -1.0104 + 0.2596\,\Delta GDP_t + 0.06616\,\Delta GDP_{t-1}$

t values (8.1412) (1.7302) (0.5472)

$+ 0.3963\,\Delta GDP_{t-2} + 0.3192\,\Delta GDP_{t-3}$

(3.3346) (1.9551)

current prices

$\rho = 0.85$

$R^2 = 0.8849$ $\bar{R}^2 = 0.8665$

D.W. = 1.3462

$F(4,25) = 48.0651$

---

eq.No. (11)

$$\Delta GDP = 1.3969 + 0.01925\,\Delta RM_t + 0.112\,\Delta RM_{t-1} + 0.2006\,\Delta RM_{t-2} - 0.02526\,\Delta RM_{t-3}$$

t values (43.8024) (0.1418) (0.7916) (1.3677) (0.1781)

constant prices

$\rho = 0.85$

$R^2 = 0.642$ $\bar{R}^2 = 0.585$

D.W. = 2.395

$F(4,25) = 11.223$

---

eq.No. (12)

$$\Delta RM = -4.3631 + 0.3274\,\Delta GDP_t + 0.9814\,\Delta GDP_{t-1} + 1.0695\,\Delta GDP_{t-2} + 0.7967\,\Delta GDP_{t-3}$$

t values (13.446) (1.2534) (4.4221) (4.623) (2.956)

constant prices

$\rho = 0.85$

$R^2 = .875$ $\bar{R}^2 = .801$

D.W. = 2.1535

$F(4,25) = 28.53$

---

eq.No. (13)

$$\Delta GDP = 1.9179 + 0.3673\,\Delta URM_t + 0.2053\,\Delta URM_{t-1} + 0.2533\,\Delta URM_{t-2} + 0.1402\,\Delta URM_{t-3}$$

t values (24.373) (1.449) (0.6621) ([illegible].7714) (0.5064)

current prices

$\rho = 0.7195$

$R^2 = 0.896$ $\bar{R}^2 = 0.878$

D.W. = 1.769 $F(4,25) = 49.89$

---

eq.No. (14)

$$\Delta URM = -0.666 + 0.2364\,\Delta GDP_t + 0.04944\,\Delta GDP_{t-1} + 0.3558\,\Delta GDP_{t-2} + 0.3874\,\Delta GDP_{t-3}$$

t values (3.954) (1.1871) (0.2576) (1.6616) (1.554)

current prices

$\rho = 0.7$

$R^2 = 0.6894$ $\bar{R}^2 = 0.6353$

D.W. = 1.3006

$F(4,25) = 12.76$

---

eq.No.(15) $\Delta GDP = 4.1255 + 0.0788\,\Delta URM_t + 0.1069\,\Delta URM_{t-1}$

t values (95.2908) (0.5692) (0.6069

$+ 0.05272\,\Delta URM_{t-2} + 0.08787\,\Delta URM_{t-3}$

(0.4461) (0.5714)

constant prices

$\rho = 0.5476$

$R^2 = 0.9044$ $\bar{R}^2 = .8679$

D.W. = 1.5934

$F(4, 25) = 54.45$

---

eq.No.(16) $\Delta URM = -3.385 + 0.2171\,\Delta GDP_t + 1.1037\,\Delta GDP_{t-1}$

t values (8.3404) (0.743) (4.2328)

$+ 1.3554\,\Delta GDP_{t-2} + 1.0861\,\Delta GDP_{t-3}$

(5.0267) (3.5408)

constant prices

$\rho = .9046$

$R^2 = 0.7996$ $\bar{R}^2 = .7648$

D.W. = 1.642

$F(4, 25) = 22.94$

---

eq.No.(17) $\Delta GDP = 2.2509 + 0.1656\,\Delta G_t + 0.2554\,\Delta G_{t-1}$

t values (23.89) (2.3236) (3.9985)

$+ 0.1940\,\Delta G_{t-2} + 0.08685\,\Delta G_{t-3}$

(3.1482) (1.2462)

current prices

$\rho = 0.65$

$R^2 = 0.91$ $\bar{R}^2 = 0.9$

D.W. = 1.3027

$F(4, 25) = 66.2614$

---

eq.No.(18) $\Delta G_t = -3.338 - 0.3608\,\Delta GDP_t + 0.06816\,\Delta GDP_{t-1}$

t values (6.1046) (.5594) (0.129)

$+ 1.2532\,\Delta GDP_{t-2} + 0.5598\,\Delta GDP_{t-3}$

(2.403) (0.8257)

current prices

$\rho = 0.65$

$R^2 = .82$ $\bar{R}^2 = 0.79$

D.W. = 2.1679

$F(4, 25) = 27.59$

---

eq.No.(19)

$$\Delta GDP = 3.1566 + 0.05234\,\Delta G_t + 0.09596\,\Delta G_{t-1}$$

t values (95.1318) (2.085) (4.2653)

$$+ 0.09119\,\Delta G_{t-2} + 0.00778\,\Delta G_{t-3}$$

(4.2009) (0.3169)

constant prices

$\rho = .65$

$R^2 = .9149$

$\bar{R}^2 = .9013$

D.W. = 2.0204

$F(4, 25) = 67.204$

---

eq.No.(20)

$$\Delta G_t = -13.0532 + 0.5832\,\Delta GDP_t + 1.2535\,\Delta GDP_{t-1}$$

t values (8.2115) (0.435) (1.096)

$$+ 2.1958\,\Delta GDP_{t-2} + 0.1285\,\Delta GDP_{t-3}$$

(1.8787) (0.0939)

constant prices

$\rho = .65$

$R^2 = 0.7892$ $\bar{R}^2 = 0.7554$

D.W. = 2.106

$F(4, 25) = 23.40$

Table 2 (1951-52 - 1966-67) Quarterly Data (Desea)

Results based on logarithmic first differences, (GDP data provided by Khetan and Waghmere)

---

eq. No. (1)

$$\Delta GDP = 0.009032 + 2.4288\,\Delta M_{1t} + 0.3462\,\Delta M_{1t-1}$$

t values (0.1995) (3.371) (0.5182)

$$-7.6092\,\Delta M_{1t-2} + 4.7734\,\Delta M_{1t-3} + 0.2256\,\Delta M_{1t-4}$$

(11.25) (7.0158) (0.7884)

current prices

$R^2 = 0.9392$ $\bar{R}^2 = 0.9335$

D.W. = 2.7689

$F(5, 53) = 163.79$

---

eq. No. (2)

$$\Delta M_1 = 0.01208 - 0.00188\,\Delta GDP_t + 0.04402\,\Delta GDP_{t-1}$$

t values (3.3307) (.0514) (0.9597)

$$+ 0.03844\,\Delta GDP_{t-2} + 0.1047\,\Delta GDP_{t-3} + 0.164\,\Delta GDP_{t-4}$$

(0.8103) (2.2038) (2.001)

current prices

$R^2 = .9257$ $\bar{R}^2 = 0.917$

D.W. = 1.9367

$F(5, 53) = 106$

---

eq. No. (3)

$\Delta GDP_t = 0.01067 + 0.9533\,\Delta M_{1t}$ + 0.3[illegible]12 ΔM_{1t-1}

t values (0.2452) (0.8[illegible]48) (0.4703)

$$-7.66\,\Delta M_{1t-2} + 4.9826\,\Delta M_{1t-3} + 1.2361\,\Delta M_{1t-4}$$

(11.8026) (7.6645) (1.2259)

constant prices

$R^2 = .9413$ $\bar{R}^2 = 0.9358$

D.W. = 2.7645

$F(5, 53) = 170.004$

eq.No.(4) $\Delta M_1 = 0.01688 + 0.01357 \Delta GDP_t + 0.03029 \Delta GDP_{t-1}$
t values (5.6355) (0.4228) (0.662)

$-0.06239 \Delta GDP_{t-2} - 0.00025 \Delta GDP_{t-3} + 0.0026 \Delta GDP_{t-4}$
(1.0746) (0.0043) (0.0516)

constant prices

$R^2 = 0.9223$ $\bar{R}^2 = 0.915$
D.W. = 2.0034
$F(5,53) = 125.86$

---

eq.No.(5) $\Delta GDP = 0.1140 + 1.7918 \Delta M_{3t} + 6.351 \Delta M_{3t-1} + 6.067 \Delta M_{3t-2}$
t values (1.6495) (1.2865) (4.6785) (6.5724)

$+ 2.8734 \Delta M_{3t-3} - 0.3047 \Delta M_{3t-4} - 5.147 \Delta M_{3t-5}$
(3.076) (0.2396) (3.9706)

current prices

$R^2 = 0.8941$ $\bar{R}^2 = 0.8817$
D.W. = 2.1015
$F(6,51) = 71.7891$

---

eq.No.(6) $\Delta M_{3t} = 0.0587 + 0.08257 \Delta GDP_t + 0.2969 \Delta GDP_{t-1}$
t values (3.6239) (0.5051) (1.4487)

$+0.4702 \Delta GDP_{t-2} - 0.4091 \Delta GDP_{t-3} - 0.5083 \Delta GDP_{t-4}$
(2.2184) (1.9276) (2.4206)

$-0.06757 \Delta GDP_{t-5}$
(0.4036)

current prices

$R^2 = 0.3841$ $\bar{R}^2 = .3116$
D.W. = 2.609
$F(6,51) = 5.29$

---

eq.No.(7) $\Delta GDP_t = .1046 + 1.3936 \Delta M_{3t} + 6.2918 \Delta M_{3-1} + 6.3259 \Delta M_{3t-2}$
t values (1.5983) (1.054) (4.8955) (7.22)

$+2.2564 \Delta M_{3t-3} - 0.535 \Delta M_{3t-4} - 5.1056 \Delta M_{3t-5}$
(2.5458) (.4434) (4.1514)

constant prices

$R^2 = 0.9004$ $\bar{R}^2 = 0.88$
D.W. = 2.1366
$F(5,51) = 768.7$

---

eq. No. (8) $\Delta M_{3t} = 0.02315 + 0.02038 \Delta GDP_t + 0.0216 \Delta GDP_{t-1}$

t values (6.90) (.5672) (.3340)

$-0.05212 \Delta GDP_{t-2} - 0.0773 \Delta GDP_{t-3} - 0.0234 \Delta GDP_{t-4}$

(.8016) (.1202) (.4096)

constant prices

$R^2 = 0.8133$ $\bar{R}^2 = 0.7957$

D.W. = 1.8088

$F(5,53) = 46.19$

---

eq. No. (9) $\Delta GDP = 0.0262 + 1.8807 \Delta RM_t + 0.2947 \Delta RM_{t-1}$

t value (0.768) (1.7769) (.2823)

$-7.6265 \Delta RM_{t-2} + 3.9477 \Delta RM_{t-3} + .665 \Delta RM_{t-4}$

(14.998) (7.7577) (0.6636)

constant prices

$R^2 = .9741$ $\bar{R}^2 = 0.9711$

D.W. = 2.5077

$F(5,53) = 320.14$

---

eq. No. (10) $\Delta RM = 0.01766 - 0.0175 \Delta GDP_t + 0.0045 \Delta GDP_{t-1}$

t values (7.825) (0.4806) (0.8479)

$-0.10698 \Delta GDP_{t-2} - 0.027 \Delta GDP_{t-3} - .0049 \Delta GDP_{t-4}$

(2.0116) (.5146) (.1354)

constant prices

$R^2 = 0.964$ $\bar{R}^2 = 96.04$

D. = 1.547

$F(5,53) = 2$[illegible]4.7

---

eq. No. (11) $\Delta GDP = 0.01972 + 2.6791 \Delta RM_t + 0.1276 \Delta RM_{t-1}$

t values (0.5798) (2.5306) (0.1222)

$-7.4793 \Delta RM_{t-2} + 3.9129 \Delta RM_{t-3} + 0.5421 \Delta RM_{t-4}$

(14.711) (7.6965) (.5573)

$+ 0.1511 \Delta RM_{t-5}$

(0.1682)

current prices

$R^2 = 0.9753$ $\bar{R}^2 = 0.9723$

D.W. = 2.5117

$F(6,51) = 334.93$

---

eq.No.(12) $\Delta RM = 0.0161 + 0.03159\,\Delta GDP_{t} + 0.0489\,\Delta GDP_{t-1}$

t values (6.4763) (1.2212) (1.5822)

$-0.0632\,\Delta GDP_{t-2} + 0.02097\,\Delta GDP_{t-3} + 0.01210\,\Delta GDP_{t-4}$

(2.0397) (0.6796) (.4588)

current prices

$R^2 = .9632$ $\bar{R}^2 = .9597$

D.W. = 1.6425

$F(5,53) = 277.514$

---

eq.No.(13) $\Delta GDP = -0.00193 + 1.4236\,\Delta URM_{t} + 0.1713\,\Delta URM_{t-1}$

t values (.04749) (1.2779) (0.1593)

$-6.634\,\Delta URM_{t-2} + 5.9987\,\Delta URM_{t-3} + 1.86\,\Delta URM_{t-4}$

(10.524) (9.1636) (1.77)

$-2.4949\,\Delta URM_{t-5}$

(2.4645)

$R^2 = .9577$ $\bar{R}^2 = .9527$

D.W. = 2.4807

$F(6,52) = 192.47$

---

eq.No.(14) $\Delta URM = 0.0168 - 0.0406\,\Delta GDP_{t} + 0.0072\,\Delta GDP_{t-1}$

t values (5.897) (.867) (.1076)

$-0.1136\,\Delta GDP_{t-2} - 0.0402\,\Delta GDP_{t-3} - 0.0143\,\Delta GDP_{t-4}$

(1.6939) (0.6018) (.3129)

constant prices

$R^2 = .9368$ $\bar{R}^2 = .9308$

D.W. = 1.747

$F(5,53) = 157.087$

---

eq.No.(15) $\Delta GDP = -0.00935 + 2.1752\,\Delta URM_t + 0.1052\,\Delta URM_{t-1}$

t values (.2399) (2.0358) (0.102)

$-6.5836\,\Delta URM_{t-2} + 6.1336\,\Delta URM_{t-3} + 1.8864\,\Delta URM_{t-4}$

(10.889) (9.7686) (1.8764)

$-2.257\,\Delta URM_{t-5}$

(2.3433)

current prices

$R^2 = 0.9627$ $\bar{R}^2 = 0.9584$

D.W. = 2.5396

$F(6, 52) = 219.703$

---

eq.No.(16) $\Delta URM = 0.0173 - 0.0049\,\Delta GDP_t + 0.0248\,\Delta GDP_{t-1}$

t values (5.4557) (.1496) (0.6315)

$-0.0985\,\Delta GDP_{t-2} - 0.01923\,\Delta GDP_{t-3} - 0.0354\,\Delta GDP_{t-4}$

(2.5034) (0.4902) (1.0509

current prices

$R^2 = 0.9343$ $\bar{R}^2 = 0.9281$

D.W. = 1.8535

$F(5, 53) = 150.73$

Table 3: (1970-1980) Quarterly Data (log first differences)
GDP (Constant Prices) Data Provided by Prof.V.S.Chitre

---

eq.No.(1) $\Delta GDP = 0.01953 + 0.09133 \Delta M_{1t} - 0.7228 \Delta M_{1t-1}$

t values (1.2077) (.3542) (0.471)

$- 0.0957 \Delta M_{1t-2} - 0.03467 \Delta M_{1t-3} - 0.06193 \Delta M_{1t-4}$

(0.355) (.1294) (.2468)

constant prices

$R^2 = 0.464$ $\bar{R}^2 = .3829$

DW = 1.9122

$F(5,33) = 5.7148$

---

eq.No.(2) $\Delta M_1 = -.05854 + 2.2113 \Delta GDP_t + 0.7308 \Delta GDP_{t-1}$

t values (.9234) (3.5463) (1.1788)

$+ 1.0426 \Delta GDP_{t-2} - 1.9802 \Delta GDP_{t-3} + 2.60 \Delta GDP_{t-4}$

(1.7176) (2.8299) (3.7001)

constant prices

$R^2 = .7318$ $\bar{R}^2 = 0.6912$

DW = 2.8546

$F(5,33) = 18.008$

---

eq.No.(3) $\Delta GDP = 0.04113 + 0.04681 \Delta M_{3t} + 0.002901 \Delta M_{3t-1}$

t values (8.3725) (0.5693) (0.0335)

$+ 0.008061 \Delta M_{3t-2} + 0.02982 \Delta M_{3t-3} + 0.025 \Delta M_{3t-4}$

(0.09372) (0.3409) (.3177)

constant prices

$R^2 = 0.6561$ $\bar{R}^2 = 0.6039$

DW = 2.2886

$F(5,33) = 12.59$

---

eq.No.(4) $\Delta M_3 = -0.1484 + 4.8059 \Delta GDP_t + 2.0607 \Delta GDP_{t-1}$

t values (.784) (2.7948) (1.4184)

$+ 0.5099 \Delta GDP_{t-2} - 4.9678 \Delta GDP_{t-3} + 5.2917 \Delta GDP_{t-4}$

(0.3534) (3.4866) (3.2059)

$R^2 = 0.8307$ $\bar{R}^2 = 0.8051$

DW = 2.1465

$F(5,33) = 32.36$

---

eq.No.(5)

$$\Delta GDP = -0.02481 + 1.537\,\Delta RM_t - 1.1299\,\Delta RM_{t-1} + 1.6657\,\Delta RM_{t-2}$$

t values (.5318) (2.0503) (1.6849) (5.2635)

$$- 4.741\,\Delta RM_{t-3} + 3.60\,\Delta RM_{t-4} - 0.1822\,\Delta RM_{t-5}$$

(12.82) (5.26) (.2430)

constant prices

$R^2 = 0.9718$ $\bar{R}^2 = .9664$

$DW = 3.3299$

$F(6, 31) = 178.316$

---

eq.No.(6)

$$\Delta RM = 0.0329 + 0.02058\,\Delta GDP_t - 0.00758\,\Delta GDP_{t-1}$$

t values (6.905) (.2574) (0.0899)

$$+ 0.0373\,\Delta GDP_{t-2} + 0.1375\,\Delta GDP_{t-3} + 0.1498\,\Delta GDP_{t-4}$$

(.4461) (1.655) (1.9251)

constant prices

$R^2 = 0.9049$ $\bar{R}^2 = 0.8906$

$DW = 0.9829$

$F(5, 33) = 62.85$

---

eq.No.(7)

$$\Delta GDP = -0.0225 + 2.033\,\Delta URM_t - 1.7551\,\Delta URM_{t-1}$$

t values (.6496) (4.0719) (6.636)

$$+ 0.5851\,\Delta URM_{t-2} - 2.8829\,\Delta URM_{t-3} + 2.617\,\Delta URM_{t-4}$$

(2.2451) (11.054) (5.7009)

constant prices

$R^2 = .9745$ $\bar{R}^2 = 0.9707$

$DW = 3.1176$

$F(5, 33) = 252.61$

---

eq.No.(8)

$$\Delta URM = 0.0345 + 0.0745\,\Delta GDP_t + 0.0244\,\Delta GDP_{t-1}$$

t values (5.5211) (.7112) (0.2206)

$$+ 0.00234\,\Delta GDP_{t-2} + 0.0839\,\Delta GDP_{t-3} + 0.1299\,\Delta GDP_{t-4}$$

(0.0213) (.7717) (1.2743)

constant prices

$R^2 = .875$ $\bar{R}^2 = .8561$

$DW = 1.1325$

$F(5, 33) = 46.20$

Table 4 :: (1951-52 - 1984-85) Annual Data Results based on Granger's Test (log second differences estimating bi-directional causality

---

eq.No.(1) $E = f$ (8 past E_i and 4 Past Y_t) where E_t = Government Expenditure

(current prices) Y = Gross National Product

with 8 past E	with 4 past Y included
R^2 = .6911 $\bar{R}^2$ = .5263	R^2 = .9352 $\bar{R}^2$ = .8645
DW = 1.9270	DW = 1.87
F(8,15) = 4.1952	F(12,11) = 13,2313

---

eq.No.(2) $E = f$(8 past E_i and 4 Past Y_i)

constant prices

with 8 past E_i	with 4 past Y_i included
R^2 = .6743 $\bar{R}^2$ = .5005	R^2 = .6918 $\bar{R}^2$ = .3556
DW = 2.1351	DW = 2.37409
F(8,15) = 3.86094	F(12,11) = 2.0575

---

eq.No.(3) $Y = Y$(8 past Y_i and 4 past E_i)

constant prices

with 8 past Y_i	with 4 past E_i included
R^2 = .7533; $\bar{R}^2$ = .6297	R^2 = .8653; $\bar{R}^2$ = .7183
DW = 2.1079	DW = 1.9914
F(8,15) = 5.8599	F(12,11) = 5.8887

---

eq.No.(4) $Y = Y$(8 past Y_i and 4 past E_i)

current prices

with 8 past Y_i	with 4 past E_i included
R^2 = .6564 $\bar{R}^2$ = .4732	R^2 = .7594 $\bar{R}^2$ = .497
D.W. = 2.1167	D.W. = 2.0504
F(8,15) = 3.5828	F(12,11) = 2.8936

Note: lag profiles of these equations are not being reported. However, they are available with the author and can be obtained on request

---

eq.No.(5) $Y = Y$(8 past y_i and 4 past M_{1i})

current prices

<u>with 8 past Y_i</u>	<u>with 4 past M_{1i} included</u>
$R^2 = .6565$ $\bar{R}^2 = .4732$	$R^2 = .9082$ $\bar{R}^2 = .8051$
D.W. = 2.116	D.W. = 1.706
$F(8,15) = 3.583$	$F(12,11) = 9.072$

---

eq.No.(6) $Y = Y$(8 past Y_i and 4 past M_{1i})

constant prices

<u>with 8 past Y_i</u>	<u>with 4 past M_{1i} included</u>
$R^2 = .7585$ $\bar{R}^2 = .6297$	$R^2 = .8404$ $\bar{R}^2 = .67$
D.W = 2.1079	D.W = 2.1297
$F(8,15) = 5.89$	$F(12,11) = 4.829$

---

eq.No.(7) $M_1 = M_1$(8 past M_{1i} and 4 past Y_i)

current prices

<u>with 8 past M_1</u>	<u>with 4 past Y_i included</u>
$R^2 = .5763$ $\bar{R}^2 = .4067$	$R^2 = .8663$ $\bar{R}^2 = .7204$
D.W.= 1.9584	D.W. = 1.4822
$F(8,15) = 3.3998$	$F(12,11) = 5.9392$

---

eq.No.(8) $M_1 = M_1$ (8 past M_{1i} and 4 past Y_i)

constant prices

<u>with 8 past M_{1i}</u>	<u>with 4 past Y_i included</u>
$R^2 = .5763$ $\bar{R}^2 = .4067$	$R^2 = .80014$ $\bar{R}^2 = .5221$
D.W. = 1.9584	D.W. = 1.125
$F(8,15) = 3.3998$	$F(12,11) = 3.6698$

Eq.No.(9) $Y = Y$(8 past Y_i and 4 past M_{3i})

constant prices

with 8 past Y_i	with 4 past M_{3i} included
$R^2 = .7811$; $\bar{R}^2 = .6644$	$R^2 = .87$ $\bar{R}^2 = .7283$
DW = 1.9918	DW = 1.9628
$F(8,15) = 6,6919$	$F(12,11) = 6.137$

Eq.No.(10) $Y = Y$ (8 past y_i and 4 past M_{3i})

at current prices

with 8 past Y_i	with 4 past M_{3i} included
$R^2 = .6573$ $\bar{R}^2 = .4746$	$R^2 = .812$; $\bar{R}^2 = .6058$
DW = 2.1155	DW = 2.1627
$F(8,15) = 3.5974$	$F(12,11) = 3.945$

Eq.No.(11) $M_3 = M_3$(8 past M_{3i} and 4 past Y_i)

at current prices

with 8 past M_{3i}	with 4 past Y_i included
$R^2 = .4479$ $\bar{R}^2 = .1535$	$R^2 = .6205$ $\bar{R}^2 = .6065$
DW = 2.002	DW = 2.24
$F(8,15) = 1.5214$	$F(12,11) = 1.4989$

Eq.No.(12) $M_3 = M_3$(8 past M_{3i} and 4 past Y_i)

at constant prices

with 8 past M_{3i}	with 4 past Y_i included
$R^2 = .4479$ $\bar{R}^2 = .1535$	$R^2 = .6942$; $\bar{R}^2 = .3605$
DW = 2.002	DW = 2.1675
$F(8,15) = 1.5214$	$F(12,11) = 2.081$

Table 5 (1951-52 – 1966-67) Quarterly data results based on Granger's test (logarithm second differences) estimating bi-directional causality:

---

eq.No.(1) $Y = Y(8 \text{ past } Y_i \text{ and } 4 \text{ past } M_{1i})$

constant prices

with 8 past Y_i		with 4 past M_{1i} included	
$R^2 = .9983$	$\bar{R}^2 = .9980$	$R^2 = .9985$	$\bar{R}^2 = .9980$
D.W. = 2.0369		D.W. = 1.9639	
F(8,45) = 3438.26		F(12,41) = 2227.5	

---

eq.No.(2) $Y = Y(8 \text{ past } Y_i \text{ and } 4 \text{ past } M_{3i})$

constant prices

with 8 past Y_i		with 4 past M_{3i} included	
$R^2 = .9985$	$\bar{R}^2 = .9982$	$R^2 = .9986$	$\bar{R}^2 = .9982$
D.W. = 1.9586		D.W. = 1.9681	
F(8,45) = 3832.23		F(12,41) = 2474.35	

---

eq.No.(3) $Y = Y(8 \text{ past } Y_i \text{ and } 4 \text{ past } M_{3i})$

current prices

with 8 past Y_i		with 4 past M_{3i} included	
$R^2 = .9972$	$\bar{R}^2 = .9967$	$R^2 = .9975$	$\bar{R}^2 = .9968$
D.W. = 2.1178		D.W. = 2.13011	
F(8,45) = 2033.36		F(12,41) = 1385.61	

---

eq.No.(4) $M_3 = M_3$(8 past M_{3i} and 4 past Y_i)

current prices

with 8 past M_{3i}		with 4 past Y_i included	
R^2 = .8792	$\bar{R}^2$ = .8577	R^2 = .9062	$\bar{R}^2$ = .8788
DW = 1.9845		DW = 1.873	
$F(8,45)$ = 40.92		$F(12,41)$ = 33.022	

---

eq.No.(5) Y = Y (8 past Y_i and 4 past M_{1i})

current prices

with 8 past Y_i		with 4 past M_{1i} included	
R^2 = .9969	$\bar{R}^2$ = .9963	R^2 = .9976	$\bar{R}^2$ = .9969
DW = 1.8616		DW = 1.726	
$F(8,45)$ = 1824.36		$F(12,41)$ = 1433.57	

---

eq.No.(6) $M_1 = M_1$(8 past M_{1i} and 4 past Y_i)

current prices

with 8 past M_{1i}		with 4 past Y_i included	
R^2 = .9623	$\bar{R}^2$ = .9556	R^2 = .9686	$\bar{R}^2$ = .9597
DW = 2.1107		DW = 1.9159	
$F(8,45)$ = 143.59		$F(12,41)$ = 106.25	

---

eq.No.(7) $M_1 = M_1$(8 past M_{1i} and 4 past Y)

constant prices

with 8 past M_{1i}		with 4 past Y_i included	
R^2 = .9623	$\bar{R}^2$ = .9556	R^2 = .9716	$\bar{R}^2$ = .9633
DW = 2.1107		DW = 1.9275	
$F(8,45)$ = 143.59		$F(12,41)$ = 117.17	

Table 6 : (1970-71 - 1980-81) Quarterly data
GNP data in real terms provided by Prof.V.S.Chitre

eq. No.			
eq.No.(1)	$Y = f$(8 past Y_i and 4 past M_{3i}) constant prices		
	with 8 past Y_i		with 4 past M_{3i} included
	R^2 = .9987	$\bar{R}^2$ = .9983	R^2 = .9991 $\bar{R}^2$ = .9985
	DW = 1.9536		DW = 1.7525
	$F(8,25)$ = 2413.76		$F(12,21)$ = 1896.72
eq.No.(2)	$M_3 = f$(8 past M_{3i} and 4 past Y_i) constant prices		
	with 8 past M_{3i}		with 4 past Y_i included
	R^2 = .5937	$\bar{R}^2$ = .4637	R^2 = .7050 $\bar{R}^2$ = .5363
	DW = 1.5484		DW = 2.05
	$F(8,25)$ = 4.5672		$F(12,21)$ = 1403.58
eq.No.(3)	$Y = Y$(8 past Y_i and 4 past M_{1i}) constant prices		
	with 8 past Y		with 4 past Y_i included
	R^2 = .9987	$\bar{R}^2$ = .998	R^2 = .9987 $\bar{R}^2$ = .998
	DW = 1.9536		DW = 1.9458
	$F(8,25)$ = 2473.76		$F(12,21)$ = 1403.58
eq.No.(4)	$M_1 = M_1$ (8 past M_{1i} and 4 past Y_i) constant prices		
	with 8 past M_{1i}		with 4 past Y_i included
	R^2 = .6508	$\bar{R}^2$ = .5392	R^2 = .7908 $\bar{R}^2$ = .6713
	DW = 1.9931		DW = 2.0186
	$F(8,25)$ = 5.826		$F(12,21)$ = 6.6171

Table 7 : (1951-52 - 1984-85) Annual data*
logarithmic first differences

---

eq.No.(1)

$$\Delta GDP = 0.0964 + 0.1087\,\Delta M_{1t} + 0.2386\,\Delta M_{1t-1}$$

t values (2.4856) (.5399) (1.5444)

$$- 0.3689\,\Delta M_{1t-2} + 0.2669\,\Delta M_{1t-3} - .2015\,\Delta M_{1t-4}$$

(1.857) (1.2892) (1.0784)

current prices

$R^2 = 0.2192$; $\bar{R}^2 = .0494$

$DW = 2.1932$

$F(5,23) = 1.2913$

---

eq.No.(2)

$$\Delta M_1 = 0.03281 + 0.1212\,\Delta GDP_t - 0.0622\,\Delta GDP_{t-1}$$

t values (0.7331) (0.6673) (.3237)

$$- 0.076\,\Delta GDP_{t-2} + 0.1246\,\Delta GDP_{t-3} + 0.7323\,\Delta GDP_{t-4}$$

(.4313) (.6078) (3.3805)

current prices

$R^2 = 0.3551$ $\bar{R}^2 = .2149$

$DW = 1.9338$

$F(5,23) = 2.53$

---

eq.No.(3)

$$\Delta GDP = 0.0357 - 0.0127\,\Delta M_{1t} + 0.0797\,\Delta M_{1t-1}$$

t values (1.7947) (0.1229) (0.7534)

$$- 0.1662\,\Delta M_{1t-2} - 0.0068\,\Delta M_{1t-3} + 0.1321\,\Delta M_{1t-4}$$

(1.6327) (0.0643) (1.3808)

constant prices

$R^2 = 0.1661$ $\bar{R}^2 = -0.0152$

$DW = 2.7828$

$F(5,23) = .9161$

---

*only preferred results have been reported.

eq. No. (4) $\Delta M_1 = -0.0401 + 0.6552\, \Delta GDP_t + 0.8852\, \Delta GDP_{t-1}$

t values (0.6242) (1.4583) (1.8318)

$+ 1.040\, \Delta GDP_{t-2} + 0.5575\, \Delta GDP_{t-3} + 0.848\, \Delta GDP_{t-4}$

(1.9781) (1.1313) (1.8421)

constant prices

$R^2 = 0.2176$ $\bar{R}^2 = .0457$

$DW = 1.3919$

$F(5,23) = 1.2794$

---

eq. No. (5) $\Delta GDP = 0.04309 - 0.003\, \Delta M_{1t} - 0.0211\, \Delta M_{1t-1} - 0.0183\, \Delta G_t$

t values (3.0584) (0.0395) (0.2312) (.7443)

constant prices

$R^2 = 0.0201$ $\bar{R}^2 = -0.0849$

$DW = 2.7269$

$F(3,28) = .1911$

---

eq. No. (6) $\Delta GDP = 0.0906 - 0.0195\, \Delta M_{1t} + 0.2492\, \Delta M_{1t-1} - 0.0642\, G_t$

t values (2.6573) (0.0841) (1.1306) (1.0781)

current prices

$R^2 = 0.097$ $\bar{R}^2 = -.00013$

$DW = 2.5368$

$F(3,28) = .9987$

---

eq. No. (7) $\Delta GDP = 0.0438 - 0.1557\, \Delta M_{3t} + 0.0421\, \Delta M_{3t-1}$

t values (1.6274) (0.7318) (0.1806)

$+ 0.2770\, \Delta M_{3t-2} - 0.5847\, \Delta M_{3t-3} + 0.4189\, \Delta M_{3t-4}$

(1.2953) (2.797) (2.3644)

constant prices

$R^2 = .2918$ $\bar{R}^2 = 0.1378$

$DW = 2.1488$

$F(5,23) = 1.8952$

---

eq. No. (8) $\Delta GDP = 0.0677 - 0.5503\,\Delta M_{3t} + 0.924\,\Delta M_{3t-1}$

t values (1.3378) (1.3259) (2.046)

$- 0.3208\,\Delta M_{3t-2} - 0.01959\,\Delta M_{3t-3} + 0.2284\,\Delta M_{3t-4}$

(0.7739) (0.04832) (0.665)

current prices

$R^2 = 0.1856$ $\bar{R}^2 = 0.0086$

DW = 2.3269

$F(5, 23) = 1.0436$

---

eq. No. (9) $\Delta M_3 = 0.0655 + 0.16716\,\Delta GDP_t + 0.2243\,\Delta GDP_{t-1}$

t values (1.6141) (0.5893) (0.7352)

$+ 0.3434\,\Delta GDP_{t-2} + 0.4784\,\Delta GDP_{t-3} + 0.49\,\Delta GDP_{t-4}$

(1.0318) (1.5377) (1.6846)

constant prices

$R^2 = 0.2342$ $\bar{R}^2 = 0.0576$

DW = .6669

$F(5, 23) = .7163$

---

eq. No. (10) $\Delta M_3 = 0.06712 + 0.01427\,\Delta GDP_t + 0.1006\,\Delta GDP_{t-1}$

t values (2.4331) (0.1274) (0.8887)

$+ 0.0746\,\Delta GDP_{t-2} + 0.1549\,\Delta GDP_{t-3} + 0.3367\,\Delta GDP_{t-4}$

(0.6865) (1.2256)

current prices

$R^2 = .3201$ $\bar{R}^2 = 0.1723$

DW = 0.9582

$F(5, 23) = 2.1661$

---

eq. No. (11) $\Delta GDP = 0.0796 + 0.0702\,\Delta RM_t - 0.0961\,\Delta RM_{t-1}$

t values (1.6167) (0.2125) (.2979)

$- 0.0754\,\Delta RM_{t-2} - 0.5011\,\Delta RM_{t-3} + 0.735\,\Delta RM_{t-4}$

(.2246) (1.4682) (2.3158)

constant prices

$R^2 = 0.2210$ $\bar{R}^2 = 0.0527$

DW = 2.6058

$F(5, 23) = 1.3113$

---

eq.No.(12) $\Delta GDP = 0.0829 + 0.0746\,\Delta RM_t - 0.1129\,\Delta RM_{t-1}$

t values (1.6148) (.2211) (.3386)

$-0.0896\,\Delta RM_{t-2} - 0.4649\,\Delta RM_{t-3} + 0.7295\,\Delta RM_{t-4} - 0.0211\,\Delta G$

(0.2592) (1.2665) (2.2495) (0.3119)

current prices

$R^2 = 0.2253$

$\bar{R}^2 = 0.014$

$DW = 2.583$

$F(6, 22) = 1.0661$

---

eq.No.(13) $\Delta GDP = 0.04118 - 0.1239\Delta URM_t + 0.0045\Delta URM_{t-1}$

t values (1.9308) (.8654) (.0677)

$+ 0.0717\Delta URM_{t-2} - 0.1949\Delta URM_{t-3} + 0.2052\Delta URM_{t-4}$

(0.4932) (1.3184) (1.4918)

constant prices

$R^2 = 0.1495$

$\bar{R}^2 = -0.0398$

$DW = 2.8998$

$F(5, 23) = 0.7858$

---

eq.No.(14) $\Delta GDP = 0.04197 - 0.1229\Delta URM_t + 0.0055\Delta URM_{t-1}$

t values (1.8831) (0.8391) (0.0382)

$+ 0.0684\Delta URM_{t-2} - 0.1565\Delta URM_{t-3} + 0.2039\Delta URM_{t-4}$

(0.4563) (1.1707) (1.4487)

$- 0.00496\,\Delta G_t$

(0.1684)

constant prices

$R^2 = 0.147$

$\bar{R}^2 = -0.0856$

$DW = 2.8972$

$F(6, 22) = .6319$

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