Nexus of Money and Prices: Distributed Lag Approach

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ABSTRACT

This paper discusses the phenomenon of lag in monetary policy action and effect on macroeconomic aggregates. The focus lies on distributed lag analysis of money supply (M1) on prices (WPI) in India since1970 with the help of annual data. It is known theoretically that change in money supply has an impact on prices and this change keeps on affecting over a long period of time. We have hypothesized the same for India also and found it to be true. The relation is very strong and is distributed over many years although the best lag comes out to be lag 4.We have also calculated speed of adjustment and mean, median lag for the two variables. Firstly we have tried to take stock of general information and then after reviewing, specified the methodology .Finally after analyzing the relationship we have concluded the discussion with policy implications for monetary as well fiscal policy.

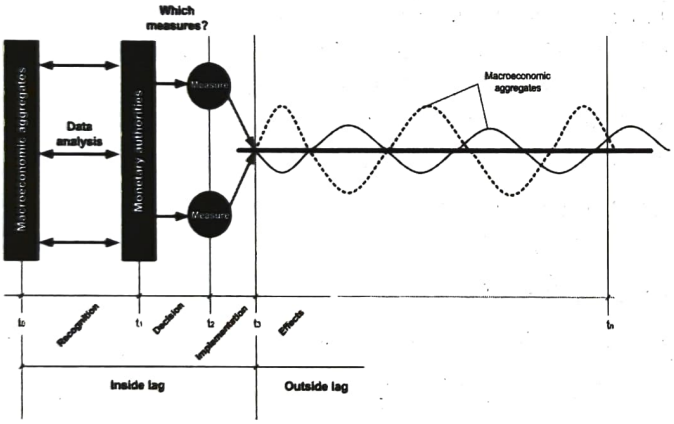
Key Words: *distributed lag, money supply, monetary policy, fiscal policy*

I. INTRODUCTION

Monetary policy is the part of stabilization policy, the goals of which are to smooth out fluctuations in output and employment and to keep prices as stable as possible. Time lags are delays in the economy 's response to stabilization policies There are different types of lags in the monetary policy making and implementation e.g. the recognition lag refers to the time it takes for policy makers to recognize the existence of a boom or a slump ,the implementation lag is the time it takes to put the desired policy into effect once economists and policy makers recognize that the economy is in a boom or a slump and it is smaller in case of monetary policy than fiscal policy, the response lag is the time it takes for the economy to adjust to the new conditions after a new policy is implemented, the lag that occurs because of the operation of the economy itself .One of the controversial but important questions of monetary policy is finding the nature and the length of these lags. It helps in suggesting many possible reasons for the lags but does not give any concrete answer to lag length. Knowledge in this regard occupies very important place as attempts to stabilize the economy can prove destabilizing because of time lags. Milton Friedman likened these attempts to a "fool in the shower" which means policy is constantly stimulating or contracting the economy at the wrong time leading to even more fluctuations. Few like Friedman and Schwartz (1963) relate cycles in monetary growth to cyclical peaks and troughs in business activity, suggests lag length

from two to six or even more quarters while many others claim it to be shorter, moreover inferring lags from timing of turning points of cycle alone is not sufficient. Svensson (2009) says that there is a considerable time lag before monetary policy measures have an impact on inflation, and the duration of this time lag also varies depending on the circumstances. The impact is normally gradual and becomes apparent over the course of a few years. Time lags are crucial in shaping stabilization strategies, and their importance should not be lost sight of so easily (Gramlich, 1969) and he further adds if the lags are long, the multi-period horizon decision-maker will use his instrument primarily to stabilize next period and, apart from forecasting problems, will be able to do just as well as he could if the lags were short. Correct knowledge of lags is needed and if lags were variable and unpredictable, as the analysis by Brainard (1967) has indicated, the monetary authority should tend to be more conservative in responding to stabilization needs.

Figure 1 Time lag of the measures of monetary policy



Source: Mehmed Muric and Tihomir Jovanovski (2012)

II. REVIEW OF LITERATURE

Bank of Thailand assesses that the impact of monetary policy on inflation incurs a 1-2 year time lag from the announcement of the policy rate decision. Transmission follows 5 main channels including interest rate,asset price,exchange rate,credit and expectations channel.Through these channels, adjustments in consumption and investment would take place and ultimately affect production and inflation.

Commenting on the change in monetary policy in May2006 in Brookes news Bulletin Dr Frank Shostak commented that the change may turn out to be not of an offsetting and stabilising nature, but rather it may end in reinforcing economic swings – leading to more instability as between 1963 to 1972 the average time lag stood at 10 months. Between 1973 to 1989 the lag was 12 months and from 1990 to present the lag is 15 months. Consider the possibility that the monetary policy time lag has lengthened further and economic activity may still stay quite strong at least until the year-end. In this case by keeping the interest target unchanged at 5 per cent Bernanke runs the risk of strengthening the money supply rate of growth and thus setting the platform for higher inflationary expectations and higher price inflation in the future.

The paper by Pétursson, Thórarinn G., (2001)discusses the process and the lags from monetary policy decisions to its effect on the economy. The findings suggest that Central Bank of Iceland monetary policy changes are in general first transmitted to domestic demand after roughly half a year, with a peak effect after one year. Policy first affects inflation after a year, with a peak effect about 1½ years after the interest rate rise. In the long run, however, monetary policy has no effects on the real economy. Broadly speaking this is consistent with other countries' experience.

Monetary policy impulses transmit through various channels, affecting different variables and different markets, and at various speeds and intensities (Loayza and Schmidt-Hebbel, 2002). For monetary policy to be effective, it is, therefore, essential to have a extensive understanding of these channels and the associated lags with them. At the same time, changes in the structure of the economy tend to alter the effects of a given monetary policy measure.

Although the diligence of inflation has declined per se in the US and the UK, the lags in the impact of systematic monetary policy actions on inflation still persist despite numerous changes in monetary policy arrangements and advances in information processing as well as financial market sophistication (Batini and Nelson, 2002).

A cross-country evidence in Report on Currency and Finance(2005) suggests that monetary policy actions affect output with a lag of almost one year while it takes nearly two years for monetary policy to have significant impact on inflation. The latter finding explains as to why inflation targeting central banks typically operate with a two-year framework for monetary policy. It must, however, be stressed that these lags are average lags and are surrounded by a great deal of uncertainty. In view of the ongoing structural changes in the real sector as well as financial innovations, the precise lags may differ in each business cycle. This may be all the more in case of countries like India where significant changes in the monetary policy operating framework as well as financial liberalization took place during the 1990s.

Fung (2002) found that, in East Asian economies such as Indonesia, Korea and Malaysia, prices decline immediately after a monetary policy tightening i.e. shorter lags and attributes this greater price flexibility in these economies to the comparatively less rigid labour markets. Thus, the Indian experience in regard to price dynamics appears to resemble the East Asian economies and these shorter transmission lags could perhaps reflect a variety of factors such as wage/price indexation and concerted policy efforts to contain inflation. Monetary policy measures in India are often supplemented with supply side measures to contain inflation, given the key role of supply shocks in the inflation process and the public

distribution system in India could also be an important contributory factor (Report on Currency and Finance,2005).

Empirical evidence from industrial countries suggests that it takes up to six months for a change in monetary policy to affect domestic demand, with a peak effect after roughly one year. It takes up to a year for a change in monetary policy to affect domestic inflation, with a peak effect after roughly 1½-2 years. In the long run, however, monetary policy only affects nominal variables and cannot maintain output growth above the growth rate of potential output. Attempts to do so will eventually only lead to persistent and even accelerating inflation.... monetary policy at any time needs to be forward-looking and based on inflation prospects for the coming 1-2 years rather than on the current inflationary developments (Pétursson, Thórarinn G., 2001).

Research by Garcia and Shaller (1995) suggests that the real effects of monetary policy may be proportionally greater during recessions than equivalent actions during booms. The paper by Batini and Nelson(2002) updates and extends Friedman's (1972) evidence on the lag between monetary policy actions and the response of inflation. Their evidence is based on UK and US data for the period 1953–2001 on money growth rates, inflation, and interest rates, as well as annual data on money growth and inflation. They reaffirm Friedman's result that it takes over a year before monetary policy actions have their peak effect on inflation. This result has persisted despite numerous changes in monetary policy arrangements in both countries. Similarly, advances in information processing and in financial market sophistication do not appear to have substantially shortened the lag. The empirical evaluation of dynamic general equilibrium models needs to be extended to include an assessment of these models' ability to account for the monetary transmission lags found in the data.

A slowdown in the business cycle reduces GDP, then consumption and then investment which takes time and does not justify the relaxation of monetary policy instantaneously. Stals (1997) by quoting a former Governor of the Reserve Bank of Australia said "There was a recognition that monetary policy had to do more than stabilize the cycle: the problem with an exclusive focus on the business cycle was that we may well stabilize the real side of the economy without stabilizing the price side of the economy". (Phillips, July 1990) and emphasized that the task of monetary policy is to promote a stable financial environment at all times, irrespective of the current phase of the business cycle. Timing monetary policy decisions to coincide rather with changes in the monetary aggregates and not with changes in real economic activity reduces the danger of a premature re-stimulation of the demand for bank credit, and a too early injection of excessive amounts of additional money. A monetary policy linked to changes in the business cycle could easily lead to the re-emergence of the harmful stop-go policies so often pursued by central banks in the 1960s.

Taking account of distinctive time-lags that exist between the implementation of monetary policies and their eventual effect on prices, monetary policy adjustments are based on the expectation of 12-18 months horizon and need reliable forecasting and monetary aggregates such as the money supply, bank credit extension, the level of interest rates and the shape of the yield curve and changes in the exchange rate provide the best indicators available in the short term to guide monetary policy decisions. So we need to explore the lagged relation amongst them. Here in this paper we are focusing only on distributed lag between money supply and prices.

III. RESEARCH METHODLOGY

The present study is based on secondary data which has been collected from various sources viz. Reserve Bank of India (RBI), Ministry Of Finance ,Ministry Of Commerce And Industry and Office Of Economic Adviser. Due to constraints in availability of quarterly data we have done the study with the help of annual data from1970-2010(our purpose to understand lagged relation can be solved with 40 year span and going way back is not of much significance) which will give overall state of affairs To review the present scenario the data has been processed. Series on WPI has been connected by splicing as base year is changing. We have chosen M_1 instead of M_3 as M_3 includes time liabilities which does not bear significant impact on prices. Moreover the results are not significantly different. We have tried to find the lag period through simple linear regression run on the log of WPI and log of M_1. We have chosen the functional form and specified the model on the basis of Akaike Information Criterion(AIC) and Schwarz's Information Criterion(SIC) as the lower, the value of these criteria, the better is the model

$$\log WPI_t = b_0 + b_1 \log M_{1t} + u_t$$

The above equations show only current relation but as we have mentioned that money supply changes affect with time lags, to identify these lags through the explanatory power of independent variable i.e. growth rate of M1 we have used regression models as under-

$$\log WPI_t = b_0 + b_1 \log M_{1t-k} + u_t \quad \text{where } k=1,2,3,4,....$$

In the above model we have not defined how far back into the past we want to go. Now to convert this infinite lag model into finite lag model we have used Ad Hoc estimation technique suggested by Alt(1942) and Tinbergen(1949) and found that the sequential procedure stops when one variable $\log M_{1t-6}$ changes sign. Hence the above distributed lag model depicts that present WPI depends on M_1 of period 't-k' where k goes from1 to 5 . In the above model log of WPI is regressed on each log of M_1 through Ordinary Least Square(OLS).

To investigate the relationship between money supply and price rise in India distributed lag model has been used and the following table shows the results

Table 1 Result of lagged regression model

$logWPI_t = b_0 + b_1 logM_{1t-k} + u_t$

Time Lag (K)	b_0 (standard error)	b_1 (standard error)	For b_1 t- statistic(p-value)	R^2	Adj. R^2	F-statistic (p-value)	RSS	AIC
Lag-1	.1382 (.056)	.519* (.011)	46.40 (.000)	.983	.982203	2153.33(.000)	.091	-3.147
Lag-2	.194 (.056)	.514* (.011)	45.54 (.000)	.982	.981998	2073.84(.000)	.083	-3.206
Lag-3	.250 (.056)	.510* (.011)	45.31 (.000)	.983	.982288	2052.96(.000)	.074	-3.296
Lag-4	.287 (.057)	.509* (.011)	43.93 (.000)	.982	.981678	1929.84(.000)	.069	-3.325
Lag-5	.302 (.061)	.512* (.013)	40.66 (.000)	.979	.979256	1653.26(.000)	.073	-3.246

Note: * indicates significance at 1% level

Source : Authors' Calculation

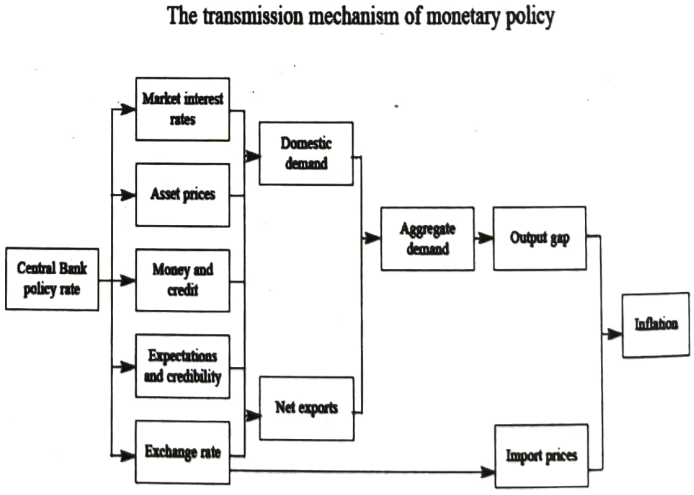
The results of lagged regression model are discussed as follows:

- The results of distributed lag model states that regression coefficient (b_1) does not change much with time. The regression coefficient is statistically significant at 1 per cent level of significance (can be noticed by its t-statistic and corresponding p-value) which implies money supply is significant variable affecting the price rise, in each time lag. Standard error is an indicator of the variance of the parameter. The standard error of parameter (b_1) is relatively low.
- To measure the 'goodness of fit' of the model, R^2 and adjusted R^2 are used. The value of R^2 and adjusted R^2 are very high throughout. This implies that money supply is significantly related to and capable of explaining more than 98 per cent of variations in prices in all time lags. Goldberger (1978) criticizes the role of correlation or R^2 or adjusted R^2 and hence we have used residual sum squares (RSS) and AIC. The lag is best when the value of RSS and AIC are minimum and in above table it is at lag-4.
- To judge the overall significance of the model, F-statistic is used. F-statistic is significant in each time lag which is reflected by its p-value. This implies money supply is significant explanatory variable in each time lag.
- Speed of decay is 0.461 and hence speed of adjustment is 0 .539.
- Median lag is 0.895 which means 50% of the total change in prices is accomplished in less than one period.
- Mean lag comes out to be 0.855.

The results of this model indicate that money supply is positively related to prices in India when time lag ranges between 1 to 4 years. It can be concluded that there is a significant relationship between past values of money supply and prices. Thus the results of this regression suggest that past values of money supply do lead to price rise.

IV. ANALYSIS OF PRICES AND MONEY AND THEIR LAGGED RELATION : Monetary policy affects its final goals of prices and output with long lags. Policies which respond only to the current state of the economy may be destabilizing and monetary authorities while framing the policy are required to be forward-looking in their approach.. The transmission lags are not only long but often also found to be variable because of ongoing financial deregulation, liberalization and innovations. Like many other Emerging Market Economies monetary policy in India is also witnessing noteworthy changes in its operating procedures and instruments.

Figure 2 The transmission mechanism of monetary policy



Source: Pétursson, Thórarinn G., (2001)

Transmission lags are average lags and are surrounded by a great deal of uncertainty and with ongoing structural changes in the real sector as well as financial innovations and heightened volatility in the international economy, the precise lags may differ in different business cycles. Bank of England (1999) remarks are quite contextual in this regard and become all the more relevant: "the actual outcome of any policy change will depend on factors such as the extent to which it was anticipated, business and consumer confidence at home and

abroad, the path of fiscal policy, the state of the world economy, and, the credibility of the monetary policy regime itself". In view of significant structural changes in the economy, a study based on a long-period may be subject to the problem of structural breaks and the results may not fully reflect the current lags in the transmission.

The lags may depend on factors such as the extent to which market participants foresaw the actions i.e. expectations, how they interpret their impact on future economic prospects and their predictions of the Central Bank's future actions as well as its credibility. Hence they can vary from one period to another.

V. CONCLUSION

In summary, the lag in the dependence of prices on monetary growth is indicative of the lagged effect on expenditures and income. This indirect measure of the income lag of monetary policy suggests that the main effects occur over a period. This is consistent with other evidence pointing to a long distributed lag. Our results pertain to the average lag and do not indicate how variable it is over time. The problems such lags pose for an effective flexible monetary policy are obvious, and raise serious questions about its use for offsetting short-run fluctuations in prices. To have confidence in the appropriateness of particular policy measures, we need to know the pattern of income responses which they will produce and what would happen with no change in policy.

As suggested by Volker Hahn (Feb2010) the central bank can use communication as a substitute for monetary policy when its hands are tied due to long lags between monetary policy implementation and its effects on inflation and output i.e. increased transparency can come to rescue. He further argued that central banks may not be able to affect the economy in the very short term due to long time lags between policy implementation and its impact on output and prices. Then communication may be used as an alternative means of influencing these economic variables. As monetary policy works with a time lag, it is most effective if it is based on forecasts is suggested by Svensson (2009).

VI POLICY IMPLICATIONS FOR MONETARY POLICY

Monetary policy has various kinds of effects e.g. short term and long term and we need to know about them. Monetary policy stances affect the money supply in the economy which further affects the macro economic scenario of the nation. Short run implications are more important for financial markets but for real sector long run implications play more vital role. In our present study of distributed lags we have found that money supply affects prices over long period of time. It has significant implications for both monetary and fiscal policy. Although there are continuous reforms since 1990s which led to freeing of monetary policy from the automatic monetisation of government's debt but even Fiscal Responsibility and Budgetary Management Act of 2003 which promised a vacation of primary financing of fiscal deficit by RBI is not proving very successful. 'Debt management considerations of ensuring a smooth passage of the borrowing programme of the government, at minimum costs and roll over risks, make the overall monetary management difficult when large and growing borrowing year after year puts pressure on the absorptive capacity of the market and on liquidity management'(Reddy, 2005). So fiscal policy in India needs to take into account the long distributed lag for the matter of inflation control.

Monetary policy should also be more vigilant in the light of above analyzed facts. Its policy stances should be based on critically scrutinized forecasting models to control inflation. Monetary policy should be made more autonomous, transparent and independent of fiscal policy. If need be separate Debt Management Board can be constituted. For a smooth transition institutional processes should be revamped. In post Global Financial Crises unfolding, international conditions are posing newer threats and we need to be more careful on inflation front as despite officially and non officially the statements of controlling inflation are proving wrong and eroding faith of general public. Money supply changes keep affecting prices over long period of time and we need to understand this distributed time lag behavior and take steps accordingly.

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