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Lags in Monetary Policy in the Philippines

by

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Abstract

Friedman (1960, 1963), using his and Anna Schwartz's study of monetary movements and the business cycles studied by the National Bureau of Economic Research (NBER) concluded that "monetary changes have their effect only after a considerable lag and over a long period and that the lag is rather variable (Friedman, 1960)." This paper studies whether such proposition holds for Philippines by examining the optimal length of monetary policy lags in the Philippine economy. A polynomial distributed lag structure is specified for M3 to arrive at estimates for the lagged effects of money on prices, output and interest rates. For the Philippines, the optimal lag length of the effect of M3 on consumer prices is found to be 6 months. The lagged effects of M3 on nominal GDP, real GDP and the 91-day Treasury Bill rate are estimated to be 4 quarters, 9 quarters and 5 months, respectively.

JEL Classification: Monetary Policy; Price Level; Inflation; Central Banks and Their Policies; Time Series Models

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Cayetano Paderanga, Jr. and Jose Antonio Tan III[1]

The Bangko Sentral ng Pilipinas under Republic Act No. 7653 is charged with maintaining "price stability conducive to sustainable economic growth." The Monetary Board often considers the lags in the effects of monetary policy in determining the status[2] of the economy and in choosing its actions. Faced with trade-offs among its main variables of concern, the importance of these lags are especially magnified when there is little leeway available among these variables.

1.0 Background

Lags in the effect of macroeconomic policies have been seriously discussed in the literature for some time. Friedman (1960, 1963), using his and Anna Schwartz's study of monetary movements and the business cycles studied by the National Bureau of Economic Research (NBER) concluded that "monetary changes have their effect only after a considerable lag and over a long period and that the lag is rather variable (Friedman, 1960)." He concluded that "peaks in the rate of change in the stock of money tend to precede peaks in general business by about 16 months and troughs in the rate of change in the stock of money to precede troughs in general business by about 12 months." These findings, together with other results of their analysis then led him to suggest that monetary actions are poorly adapted to counter-cyclical policy making. This gave rise to what is now called *the k-percent rule* where he suggested that the money stock be made to grow at a constant rate.

Friedman's suggestion to avoid discretionary (monetary) policy making in the short run has not gone unchallenged. There have been three discernible types

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[1]Member, Monetary Board, and Bank Officer VI, respectively. Bangko Sentral ng Pilipinas. With the secretarial assistance of Ms. Shirley Tablico.

[2]In some cases, it judges whether the current situation in prices could be due to earlier developments and its monetary activities.

of criticisms. The first type of criticism focuses on the accuracy of causality. Tobin (1970) formulates in more detail what he calls the "ultra-Keynesian" and "Friedman" models. Simulating the analytical effects of the models, he questions whether the coincidences identified are really "lags," rather than "leads." Culbertson (1960) wonders whether "other forces may operate in a systematic way to present an appearance of lag." This line of criticism is, probably, another way of saying that the model is not adequately specified as to allow isolating causation that is being asserted, a criticism often directed at historical and similar models which avoid detailed model specification.

The second type of criticism questions the variables and the method that Friedman uses for determining the lag. He identifies the maximum rate of increase in money supply with a change in monetary policy and the absolute maximum in output. Culbertson has questioned the appropriateness of using coincidences between a flow (rate of increase in money supply) and a stock (income rather than rate of increase in income)[3] Culbertson also questions what lag is being measured by the variables that Friedman has identified. The lag of a policy action is "the time between the action and the point at which things begin to go differently" and not necessarily the peak of the business cycle[4].

The third type of criticism focuses on the empirical estimate of the lag. Culbertson determines from "broad experience" that "anti-cyclical monetary, debt-management, and fiscal adjustment can be counted on to have their predominant direct effects within three to six months." Tanner (1969) formulates a simple aggregate dynamic model which includes one-quarter lags for both money supply and output. He then uses two-stage least squares to estimate the structural equations for money and output. For policy purposes he states that the object of policy is to change "income from what it would have been in the absence of discretionary monetary policy." He examines the time path of the different variables and

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[3]Friedman (1960: 452) states that income is a flow and, therefore, the peak of income is a peak in a flow in much the same way that the peak increase in money supply is a peak in a flow variable.

[4]Perhaps, more accurately, the correct lag is the period between the completion of policy action and the desired effect, whatever that may be.

concludes that "the bulk of the effects on aggregate demand of monetary policy can occur within three to six months of the change in the money supply.

Gibson (1970) estimated, with a distributed lag function, the impact of money stock changes on interest rate levels and changes in interest rates. He found that money stock changes first had a negative impact on interest rates which had a lag between 3 months (changes in M1) and 3 to 5 months (M2). This is followed by a positive effect on interest rates. The second lag, defined as the period during which the algebraic sum of the changes (coefficients) added up to zero, varied between 6 (for M1 changes) to 6 to 9 months (M2 changes). He interpreted this as confirmation for Culbertson's (1960) guess from casual empiricism.

2.0 The Philippine Experience

2.1 Some Monetary and Real Trends

The Philippines has had a tumultuous monetary experience over the last fifteen years. Until the eighties, the Philippines had a highly regulated financial system. In 1980 a financial reform program was initiated. The initial reform was to introduce universal banking designed to reduce the fragmentation of financial markets and improve the mobilization of financial resources. Soon after interest rates were liberalized. While the reform program did encourage financial deepening from 1981 to 1982, as shown by the ratio of M3 to nominal GDP (See Figure 1[5]), the full effects of these reforms were not immediately felt as the country experienced a series of bank failures triggered by the unexpected exit from the country by a highly indebted business tycoon. The monetary reform program further suffered a setback with economic crises from 1983 to 1985. Figure 1 clearly shows the adverse effects of the crisis on the financial system. It also took

[5]Average quarterly M3 is used. Please note that there may be inconsistencies in the M3 data from 1981 to 1985 and 1986 to 1995, since there were some changes in the definitions in 1986. Also note that the real and nominal values for GDP are not seasonally adjusted, hence the seasonality of the series is quite noticeable.

more than a decade before the 1981-82 levels of financial deepening were reattained.[6]

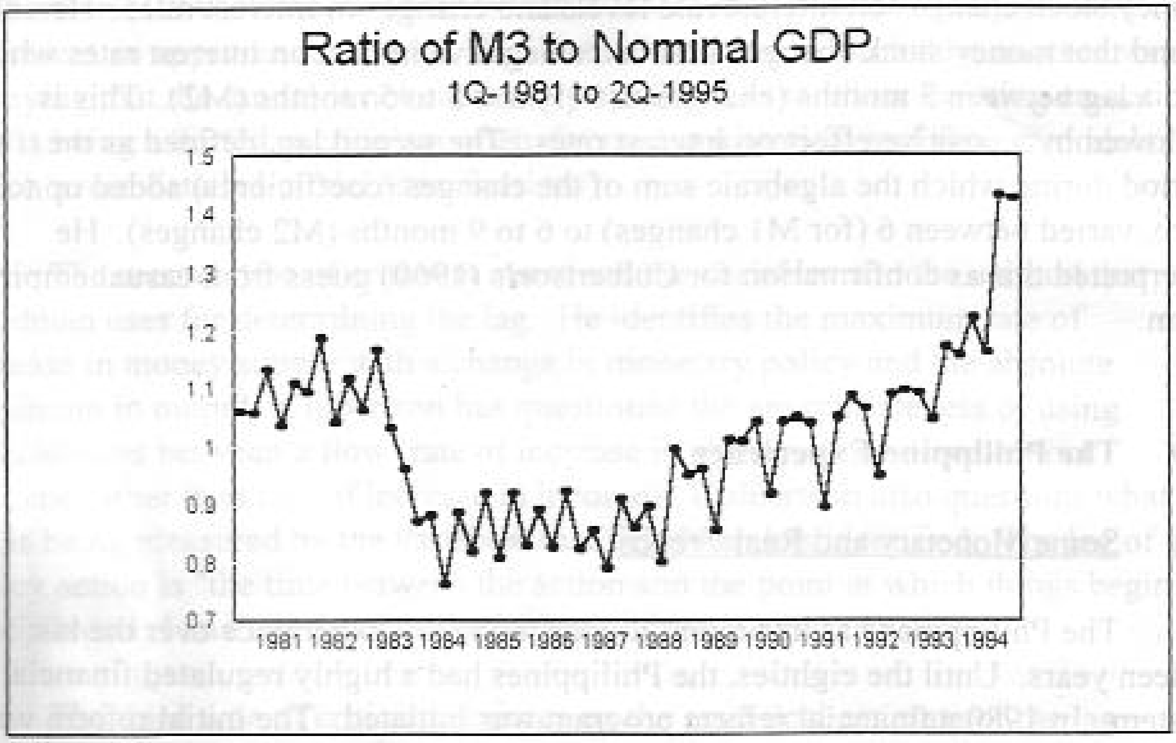

Figure 1

The variability in the monetary stance of the last fifteen years can be seen from the monetary regime changes over this period. It appears that there were several monetary regimes since 1981, changing from expansionary to tight money regimes, in response to the swings in the inflation rate. Figure 2 shows that 1981 was a high money growth year. Consequently, inflation was also high. High inflation led to a slight tightening of money in the following year, resulting in lower inflation rates. Then, the crisis hit the economy, leading to inflation rates of over 50 percent. A very tight monetary stance was adopted to curb inflation. A single-digit money growth prevailed for most of the crisis period. The recovery in

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[6]Some quarters may argue that the high M3 to nominal GDP for the first semester of 1995 may not due to financial deepening but simply a case of excess liquidity.

1986 was accompanied by a loosening of monetary growth. This allowed for the liquidity and financial deepening requirements of the economy. By 1988, M3 was growing at almost 30 percent. Inflation crept in, consequently, another series of stabilization policies, among which is tight monetary policy, had to be instituted. Recently, money growth has again strengthened.

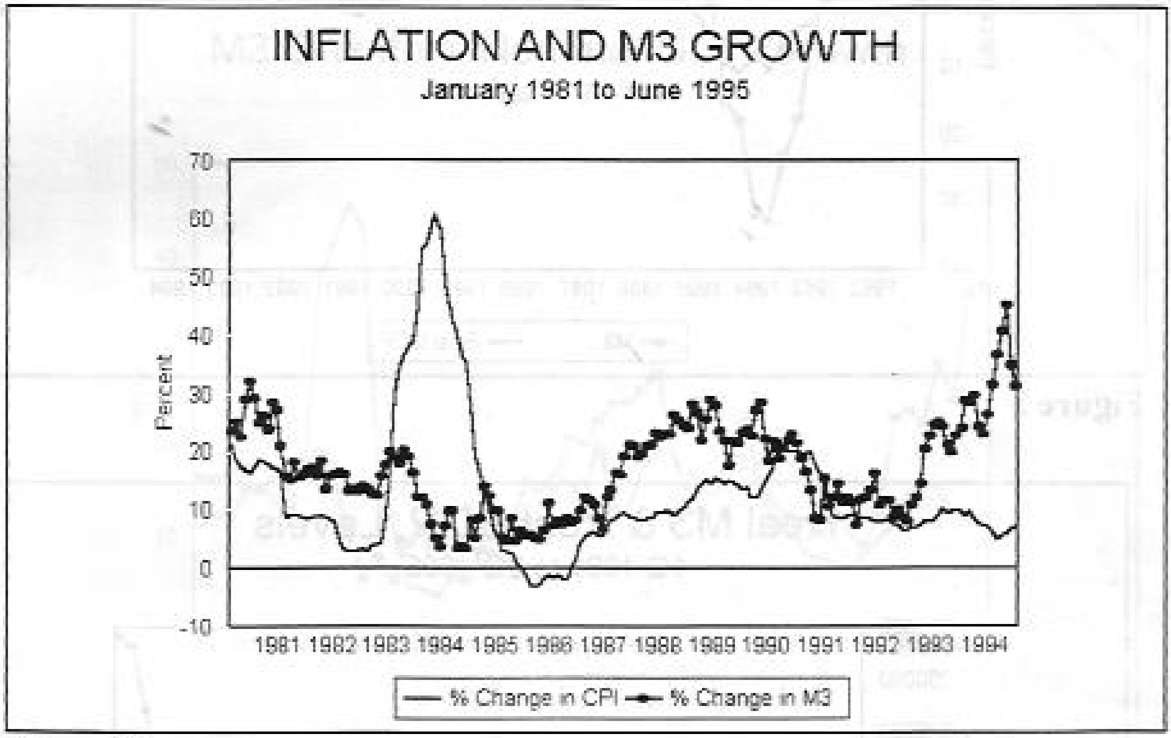

Figure 2

The importance of the financial sector to economic growth can further be seen by comparing the growth rates of money and prices. Figure 3 indicates that real GDP growth and real M3 growth tend to move in the same direction. A similar relationship is depicted by real M3 and real GDP levels (See Figure 4). In periods of tight liquidity, the economy contracts. Growth is permitted once real liquidity constraints are eased.

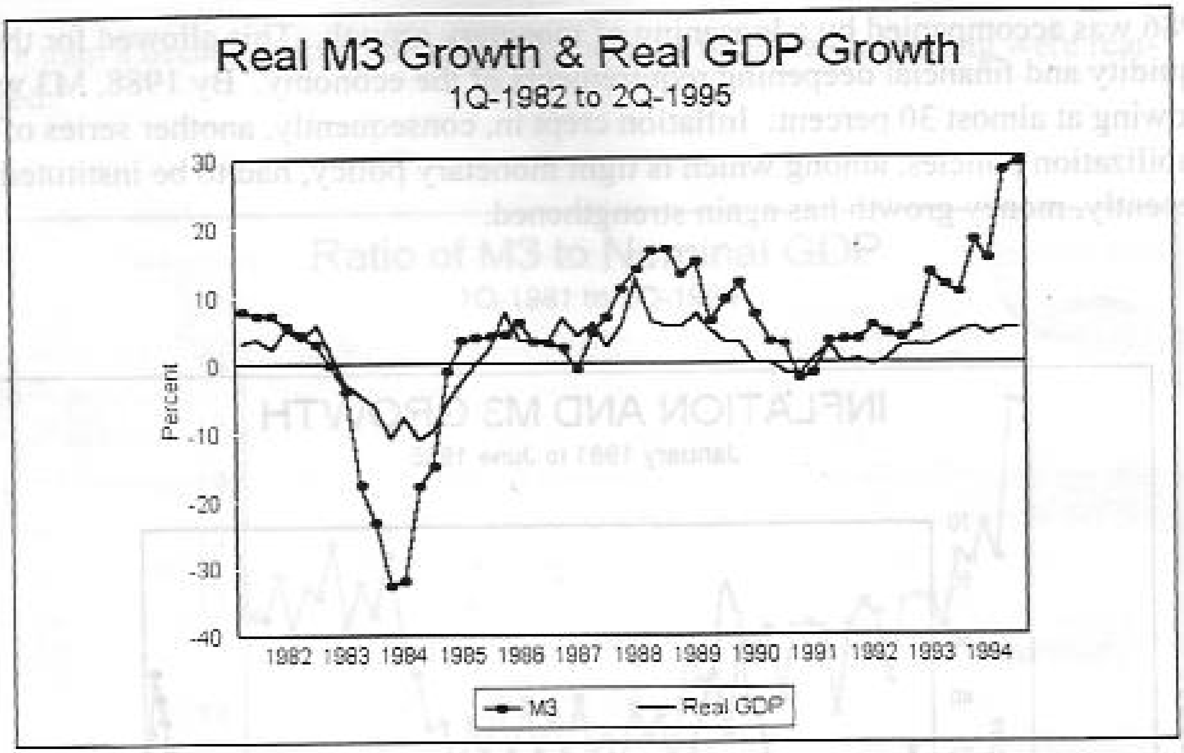

Figure 3

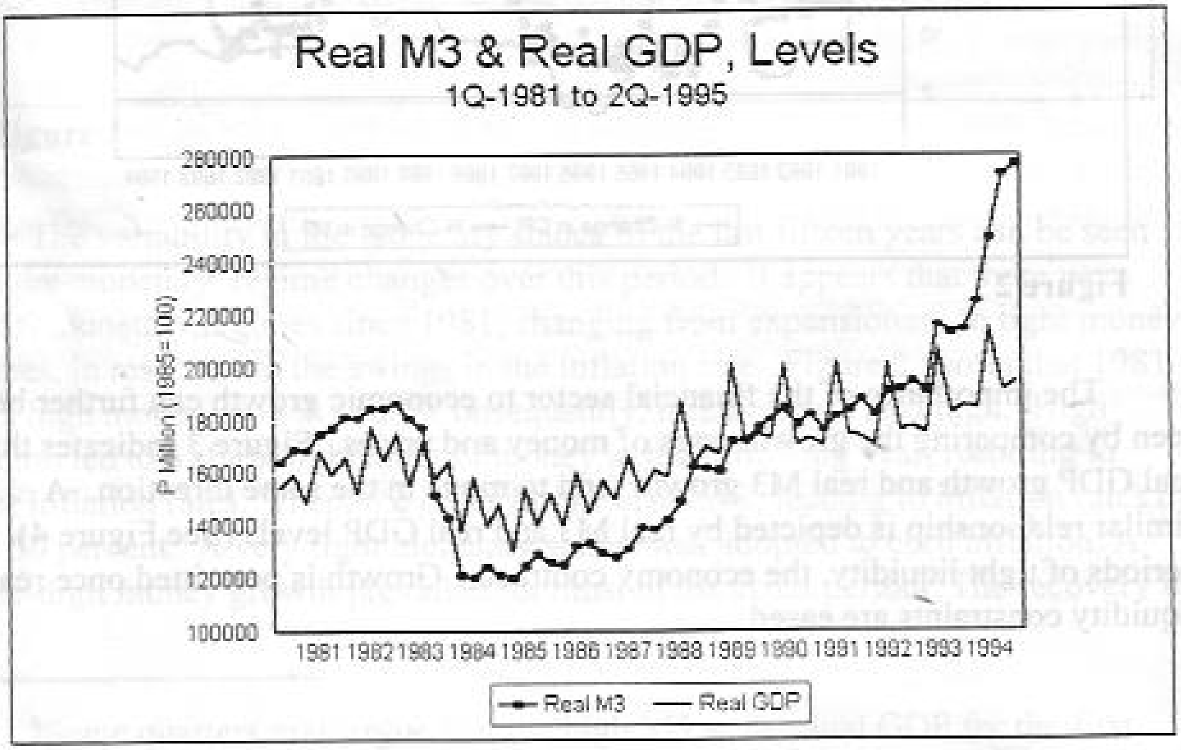

Figure 4

The procyclical relationship is also observed for nominal money and nominal GDP (See Figure 5).[7] What needs to be ascertained is to what extent is the relationship contemporaneous and to what degree are the real changes effects of nominal money growth, if there are any. In the absence of any real changes, nominal money growth translates to inflation.

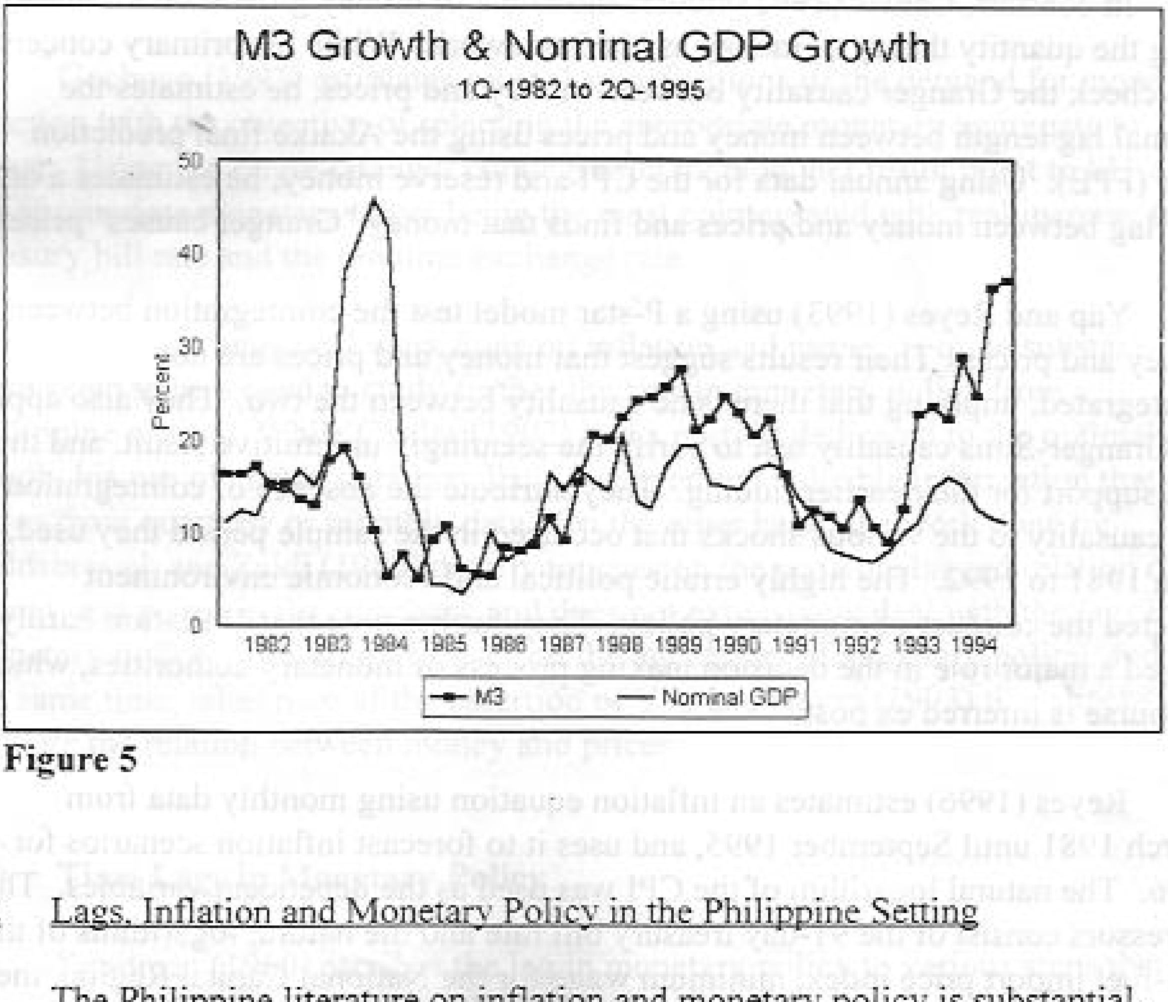

Figure 5

2.2 Lags, Inflation and Monetary Policy in the Philippine Setting

The Philippine literature on inflation and monetary policy is substantial. The more recent literature deals with the causes of inflation as well as the appropriate choice of monetary targets. Using Philippine data, Lim (1987) estimates a reduced-form specification of the price equation with real bank loans as one of the

[7]A similar proposition is asserted by quantity theorists.

regressors. He finds that coefficient for this variable is negative implying that the working capital effects of monetary policy affects the supply-side more than the demand-side. He concludes that the initial impact of monetarist prescriptions is to increase inflation. A decline in inflation follows only after the economy is brought to deep recession. He also concludes the quantity theory of money is oversimplified and neglects the transmission channel of credit.

In contrast, Canlas (1992) studies the effect of money growth on inflation using the quantity theory of money as his framework. While his primary concern is to check the Granger causality between money and prices, he estimates the optimal lag length between money and prices using the Akaike final prediction error (FPE). Using annual data for the CPI and reserve money, he estimates a one-year lag between money and prices and finds that money "Granger causes" prices.

Yap and Reyes (1993) using a P-star model test the cointegration between money and prices. Their results suggest that money and prices are not cointegrated, implying that there is no causality between the two. They also apply the Granger-Sims causality test to verify the seemingly unintuitive result, and they find support for their earlier finding. They attribute the absence of cointegration and causality to the various shocks that occurred in the sample period they used, from 1981 to 1992. The highly erratic political and economic environment affected the conduct of monetary policy. They further note that "Inflation hardly played a major role in the decision making process of monetary authorities, which of course is inferred ex post."

Reyes (1996) estimates an inflation equation using monthly data from March 1981 until September 1995, and uses it to forecast inflation scenarios for 1996. The natural logarithm of the CPI was used as the dependent variables. The regressors consist of the 91-day treasury bill rate and the natural logarithms of the non-fuel import price index, minimum wage for the National Capital Region, the logarithm of the 3-month moving average of the M3 to GNP ratio and the wholesale posted price of petroleum products. A shock variable for the rice shortage of September 1995 is included. Two autoregressive terms are included to reflect adaptive expectations. Except for the treasury bill rate, all regressors had correct and significant coefficients (at 5 percent). Among the results is that a 1 percent increase in the moving average of the M3 to GNP ratio results in a 0.028 percent rise in the CPI.

Several demand for money functions for the Philippines have also been estimated. Goldsbrough and Zaidi (1989) estimates a quarterly demand for money function using Hatanaka's residual adjusted Aitken estimator. Among the regressors is a one-year lagged rate of inflation representing expected inflation. This may imply that there is a one-year lag between money and inflation. They further test the demand for money equations for stability. Their empirical estimates suggest that the underlying parameters for the demand for money functions may have shifted in 1983 or 1984.

Gochoco (1993) estimates several specifications of the demand for money function with the objective of selecting the appropriate monetary aggregate to target. Using the Engle-Granger cointegration method, her result point to M1 as the appropriate monetary target being the most cointegrated with real income, the treasury bill rate and the nominal exchange rate.

While the empirical work done on inflation and money is quite substantial, there seem to be a need to study further the lags in monetary policy from a Philippine setting. While Canlas (1992) had a portion dedicated to the optimal lag length, his use of annual data may have averaged out valuable information that arises from quarterly or monthly data. On the other hand, the work done by Goldsbrough and Zaidi (1989) merely touches on the possible lagged relation of money and prices in the periphery and does not extensively deal with the lags in monetary policy. This study focuses on the lag effects of monetary policy, and at the same time, takes note of the assertion of Yap and Reyes (1993) that shocks obscure the relation between money and prices.

3.0 Time Lags in Monetary Policy

Friedman (1960) ascribes the lag in monetary policy to various steps that have to ensue for a (monetary) policy to be taken, for the monetary variables chosen to change, and (only subsequently) for the target macroeconomic variable to respond. The various steps are shown in Chart 1.

Chart 1[8]

Observation Lag

↓

Interpretation Lag

↓

Decision Lag

↓

Implementation Lag

↓

Effectiveness Lag

The observation lag is the lag between an economic event and observing that event. The interpretation lag is the time lapse between observing the economy and begin able to decide how much information the observation provides. The decision lag is the time lag between observing and interpreting economic conditions and deciding on what policy action to do. The implementation lags are time lapses between a decision and a policy action. Finally, effectiveness lags are the time lapses from the implementation of a policy decision to its effect on target variables. There are usually two stages in the effectiveness lags, namely, the impact and dynamic effects. The impact effects are the instantaneous effects on policy on targets. On the other hand, dynamic effects are the drawn-out effects that take place as other economic agents respond to the policy actions.

4.0 Lag estimation methods

The estimation of lag length of the impact of economic policies is a major concern for policy effectiveness. By knowing the lag lengths of the various instruments in a policymaker's menu, he is able to choose the appropriate tool or combination of tools to arrest or stimulate an economic condition. While looking for the optimal lag length is highly regarded as important, there is no unanimously accepted approach in the estimation of lag lengths. Two approaches to lag length

[8]Based on Parkin and Bade (1992).

estimation can be identified. One uses parametric methods, such as regression analysis, the other uses non-parametric methods which are usually distribution-free, such as the test for independence.

4.1 Parametric Methods: The Polynomial Distributed Lag

Parametric methods in estimating lag lengths involve the application of regression analysis. The specification of lags can be as simple as adding lagged terms in a regression, without an *a priori* assumption regarding the coefficients of the lagged terms. However, the possibility that high collinearity between the current and lagged variables exists, hence, the parameter estimates no longer possess the desired properties. A solution to this is to use distributed lags. Tanner (1969) estimates the lag effects of monetary policy by employing a generalized form of the negative binomial lag distribution. Another solution is the use of polynomial distributed lags such as the Almon lag (Maddala 1992).

Consider

$$y_t = b + \beta_0 x_t + \beta_1 x_{t-1} + ... + \beta_k x_{t-k} + u_t \qquad (1)$$

where y is the outcome variable and x is the monetary aggregate. Estimates yielded by the direct estimation of equation (1) may possess the problem of multicollinearity, thus making the β_i's unreliable. Following Almon, we can specify that the β_i's follow a polynomial of degree r in i:

$$\beta_i = \alpha_0 + \alpha_1 i + \alpha_2 i^2 + ... + \alpha_k i^r \qquad (2)$$

where i = 1, 2, 3, ...,k. Using equation (2), equation (1) can rewritten as:

$$\begin{aligned} y_t = b &+ (\alpha_0 + \alpha_1(0) + \alpha_2(0)^2 + ... + \alpha_k(0)^r)x_t \\ &+ (\alpha_0 + \alpha_1(1) + \alpha_2(1)^2 + ... + \alpha_k(1)^r)x_{t-1} \\ &+ ... + \\ &(\alpha_0 + \alpha_1(k) + \alpha_2(k)^2 + ... + \alpha_k(k)^r)x_{t-k} + u_t \end{aligned} \qquad (3)$$

Simplifying and grouping terms,

$$y_t = b + \alpha_0 z_{0t} + \alpha_1 z_{1t} + \alpha_2 z_{2t} + \ldots + \alpha_r z_{rt} \qquad (4)$$

where $z_{0t} = \sum_{i=0}^{k} x_{t-i}$, $z_{1t} = \sum_{i=0}^{k} i x_{t-i}$, $z_{2t} = \sum_{i=0}^{k} i^2 x_{t-i}, \ldots, z_{rt} = \sum_{i=0}^{k} i^r x_{t-i}$. Instead of regressing equation (1), equation (4) is estimated. The estimates of the β_i's can be derived from equation (2). Endpoint restrictions, such as $\beta_{-i}=0$ and $\beta_{k+i}=0$, can also be imposed to guarantee that periods before and/or after the lag interval have no effect on the dependent variable. However, Judge *et al* (1985:359) notes that "these [endpoint] constraints may imply restrictions for the possible lag shapes the researcher has no intention to impose."

Maddala (1992) suggests that the appropriate lag length can be chosen on the basis of the maximum $\bar{R}^2$ that can be generated in estimating the unconstrained regression. The procedure is as follows. The unconstrained regression (i.e. equation (1)) can be regressed with varying lag lengths, from which the optimal lag length that is chosen based on the criterion of maximizing $\bar{R}^2$. Judge et al. (1985) suggest using (minimizing) the Akaike Information Criterion and the Schwarz Criterion as other bases for choosing the lag length.

To choose the degree of the polynomial, following Maddala (1992), we construct $z_{0t}, z_{1t}, z_{3t}, \ldots$ as defined in equation (4). We then regress the y_t as a function of the z_{it}'s starting with the higher degree polynomials and drop the higher terms until we are able to reject the null hypothesis, $\alpha_i = 0$.

Criticisms

Parametric methods are often criticized because the assumptions used, such as normality of residuals, homoscedasticity, nonautocorrelation, and identification are considered stringent. Uselton (1974), for example, asserts that even under the assumption that the money stock is an accurate indicator of the timing of monetary policy, "the [stringent] assumptions underlying any parametric analysis, the effects of data aggregation and the effects of averaging time series data over successive periods" tend to invalidate the study. He asserts that, given the assumptions required, parametric estimation are peculiarly unsuited for such exercises as time series analysis[9]. He notes that a solution to one of the violations of the classical assumptions may cause other problems, e.g., attempts to purge auto-correlation by first differencing may lead to a loss vital information from the dataset[10]. These criticisms though are not exclusive for the estimation of lag lengths, but rather encompasses the entire sphere of regression analysis.

Objections have also been raised against the aggregation that occurs during the compilation of monetary data. This procedures is said to make the usual properties and assumptions underlying regression analysis inappropriate for such data. Uselton (1974) asserts that consistency in aggregation requires that "knowledge of the 'macro-relation' (the function relating the aggregates), and the values of the aggregate independent variables, would lead to the same value of the aggregate dependent variable as a knowledge of the micro-relations and of the values of the individual independent variables[11]." If microeconomic data are to be aggregated for use in a regression analysis, the behavioral assumptions underlying the microeconomic relationships postulated must be consistent with the relationships reflected in the macroeconomic model. He uses illustrative examples to show the general requirements for consistent aggregation are not likely to be met. Bryan (1967) also found that aggregating bank excess reserve changes over decision units and time periods lengthened the observed lags.

Finally, Uselton (1974) observes that averaging of time series data over successive periods is damaging to the analysis of timing relationships because it could change the frequency and regularity of peaks and troughs in the original series.

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[9]Time series analysis has since developed substantially since he wrote the study in 1974 but this section discusses dangers present in the use of parametric analysis.

[10]This example is not taken from Uselton (1974).

[11]Green (1964) as quoted in Uselton (1974).

4.2 Non-Parametric Methods: Chi-square Test

Uselton (1974) argues that the inappropriateness of parametric methods for the measurement of lags requires the use of non-parametric methods. His method starts with an examination of the minutes of the Federal Open Market Committee (FOMC) to find out the monetary policy stance of the monetary authorities. The accounting of the lag begins with the decision-making process of the FOMC. He then identifies a vector of targets, which includes real output and income, prices, interest rates and wages, assigning ranks to the actions of the FOMC and the target vector based on the first difference of the variables. The relationships between monetary policy actions and target variables are established in his theoretical framework. For instance, money and real output are derived to be positively related. To test the strength of the lag, a contingency table is constructed, and a chi-square test is applied to verify whether the first difference of the target variable is independent of the monetary policy action. This test is repeated for different lag lengths. A significant chi-square statistic rejects the null hypothesis of independence.

Results of the Uselton study tend to support the findings of shorter (rather than longer) lags in the effects of monetary policy. He finds that the lag effect of monetary policy on real income and output is about seven months or less. He finds this to be nearly symmetric for both monetary contraction and expansion. Wages and prices are generally unresponsive to monetary policy. The lag effect of expansionary monetary policy on long-term bond yields are significant only on the seventh month. In fact, monetary restraint has no significant effects.

Critique

Uselton's (1974) method has its own weaknesses. First, in place of the "stringent" assumptions need for parametric (regression) analysis, he substitutes strong, potentially arbitrary judgments made by the researcher about the character and impact of the Federal Open Market Committee (FOMC) decisions and changes in the target variables.

Second, Uselton implies that what is important as far as influencing target variables is concerned are FOMC intentions (even if correctly interpreted), rather than the instrument variables identified by economic theory. It is debatable whether expressions of intention rather than actual changes in monetary variables are the correct instruments. There is the further question of how successful the manager of the trading desk is in implementing the FOMC's instructions.

Third, the analysis actually carried out still uses aggregated series (at least across decision units)[12].

Finally, no record equivalent to the FOMC minutes and related papers are available for the Philippines. Before July 3, 1993, when the Central Bank of the Philippines was replaced by the Bangko Sentral ng Pilipinas, open market operations, intervention in the foreign exchange market, and decisions on discount rates were largely decided by the Central Bank governor and a (very) few assistants[13]. In the new Bangko Sentral ng Pilipinas, policy actions have gradually been discussed more actively in Monetary Board meetings. However, the "detailed reports by professional economists, opinions of [Monetary Board members], final vote of the [Monetary Board],"[14] and the detailed summary record of these discussions are not all available. While summary minutes of the Monetary Board on policy matters are public, these may not be enough for the judgmental exercise he used. Besides, these were confidential prior to July 3, 1993.

5.0 Empirical Results

For the reasons discussed in the preceding section, parametric methods were used to estimate the lags in Philippine monetary policy. Using regression tech-

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[12]While basic conditions for aggregation have been known for some time (see Hicks, 1939 and Muth, 1964), researchers have frequently used aggregated series.

[13]At least during the period January 1990 to June 1992, when the first author sat as an *ex-officio* member of the Monetary Board for the National Economic and Development Authority. The discount rate was passed upon by the Monetary Board but discussion was perfunctory.

[14]Refer to Uselton (1974), p. 75. Appropriate substitutions have been made by the authors.

niques, a polynomial distributed lag of instruments (money stock or reserve money) along the Almon lag structure are used to explain changes in target variables such as nominal and real gross domestic product, prices and interest rates. Thus, in the estimation that follows, only the implementation and effectiveness lags are captured. It must likewise be noted that no endpoint constraints are used since there is no *a priori* assumption of the lag shapes.

Four target variables are chosen: nominal GDP, real GDP, prices and interest rates. M3 or domestic liquidity is chosen as the indicator of monetary policy. The earliest consistent data available for M3 is January 1986. The 91-day treasury bill rate is used as the representative interest rate.

5.1 Effect on nominal and real GDP

In estimating the lag lengths of the effect of monetary policy on nominal and real GDP, the following specification was adopted:

$$YGR_t = b + \sum_{i=0}^{k} \beta_i M3GR_{t-i} + u_t \tag{5}$$

where YGR= year-on-year growth rate of nominal GDP or real GDP, M3GR=year-on-year growth rate of M3, i=number of lagged periods.

Quarterly data was used in the estimation of the regression equations for nominal and real GDP growth.[15] A second degree Almon lag with a lag length of 4 quarters was chosen for the nominal GDP growth equation. The results are given in Table 1 and the lag coefficients for M3 are charted in Figure 6.[16]

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[15]Growth rates are computed on a year-on-year basis.

[16]"**" and "*" indicate that the coefficient is statistically significant at 1% and 5%, respectively.

Table 1
Nominal GDP Growth: 1Q-1989 TO 2Q-1995

	Estimated Coefficient	t-statistic	
Constant	6.797610	1.5651	
M3GR	0.046881	0.55596	
$M3GR_{-1}$	0.169374	3.03268	**
$M3GR_{-2}$	0.171329	2.47583	*
$M3GR_{-3}$	0.052747	0.85771	
$M3GR_{-4}$	-0.186374	-1.84849	
R^2	0.800		
Adjusted R^2	0.773		
DW	1.064[17]		
AR1	0.855	8.275	**
Degree of polynomial	2		
Sum of lag coefficients	0.254		

While the optimal lag length is estimated to be 4 quarters, only first and second quarter lags are statistically significant. This suggests that the impact of monetary policy on nominal GDP occurs over a period of 2 quarters and tapers off in the succeeding two quarters.

[17] The DW statistic is located in the indeterminate area.

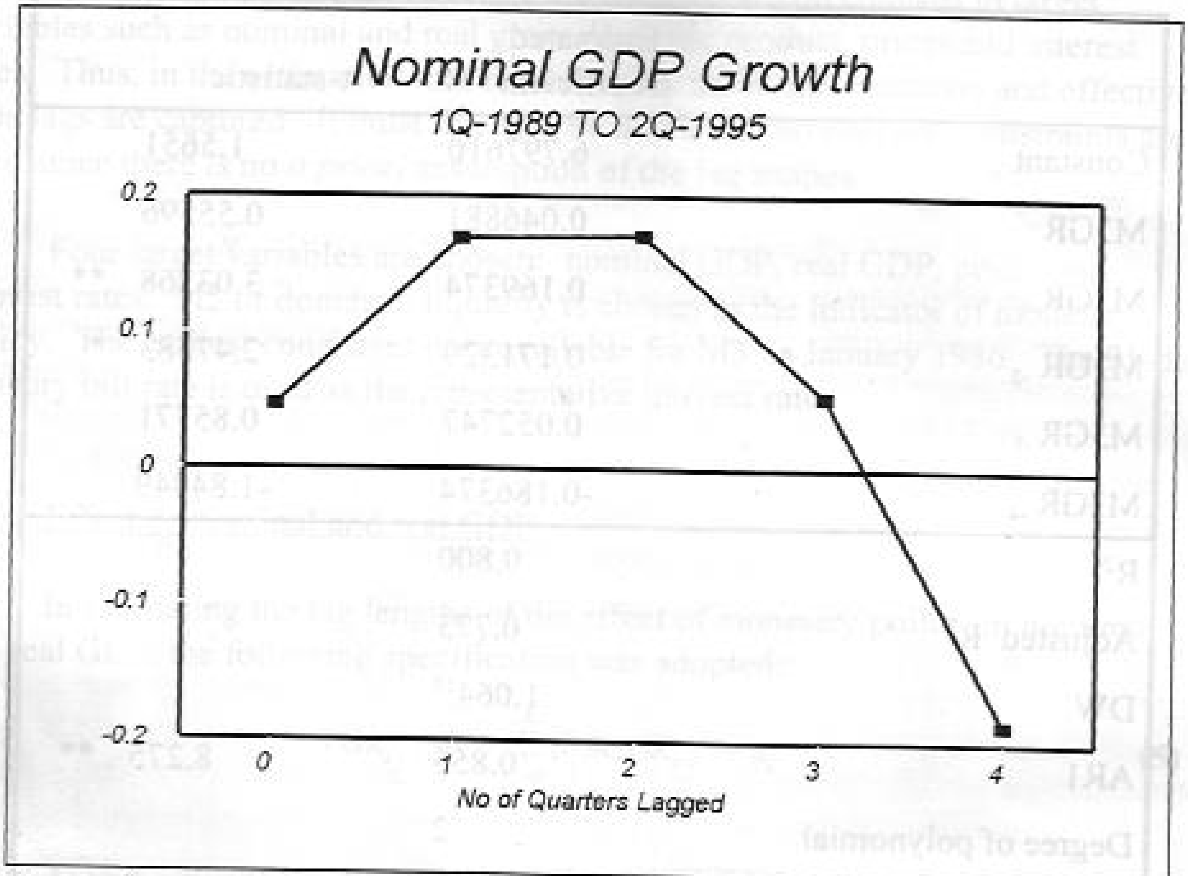

Figure 6

The impact of monetary policy on real GDP take is estimated to be longer. The lag length which maximizes the $\bar{R}^2$ is 9 quarters, more than double that of nominal GDP. The results are shown in Table 2 while the coefficients are graphed in Figure 7.

Table 2
Real GDP Growth: 3Q-1989 to 2Q-1995

	Estimated Coefficient	t-statistics	
C	11.731900	6.06661	**
M3GR	-0.121367	-2.21158	*
$M3GR_{-1}$	-0.057422	-1.65739	
$M3GR_{-2}$	0.023947	0.74144	
$M3GR_{-3}$	0.081472	3.06597	**
$M3GR_{-4}$	0.091370	3.13392	**
$M3GR_{-5}$	0.047334	1.68228	
$M3GR_{-6}$	-0.039457	-1.43169	
$M3GR_{-7}$	-0.140349	-3.80126	**
$M3GR_{-8}$	-0.209201	-5.63931	**
$M3GR_{-9}$	-0.182397	-2.60381	**
R^2	0.857		
Adjusted R^2	0.817		
DW	2.438		
F	21.534 **		
Degree of polynomial	4		
Sum of coefficients	-0.506		

The instantaneous impact of monetary policy on real GDP is negative. This might imply that any change in monetary policy surprises economic agents which in turn could be inflationary depending on how expectations can easily be adjusted. If inflation is fueled, GDP, in real terms, falls.

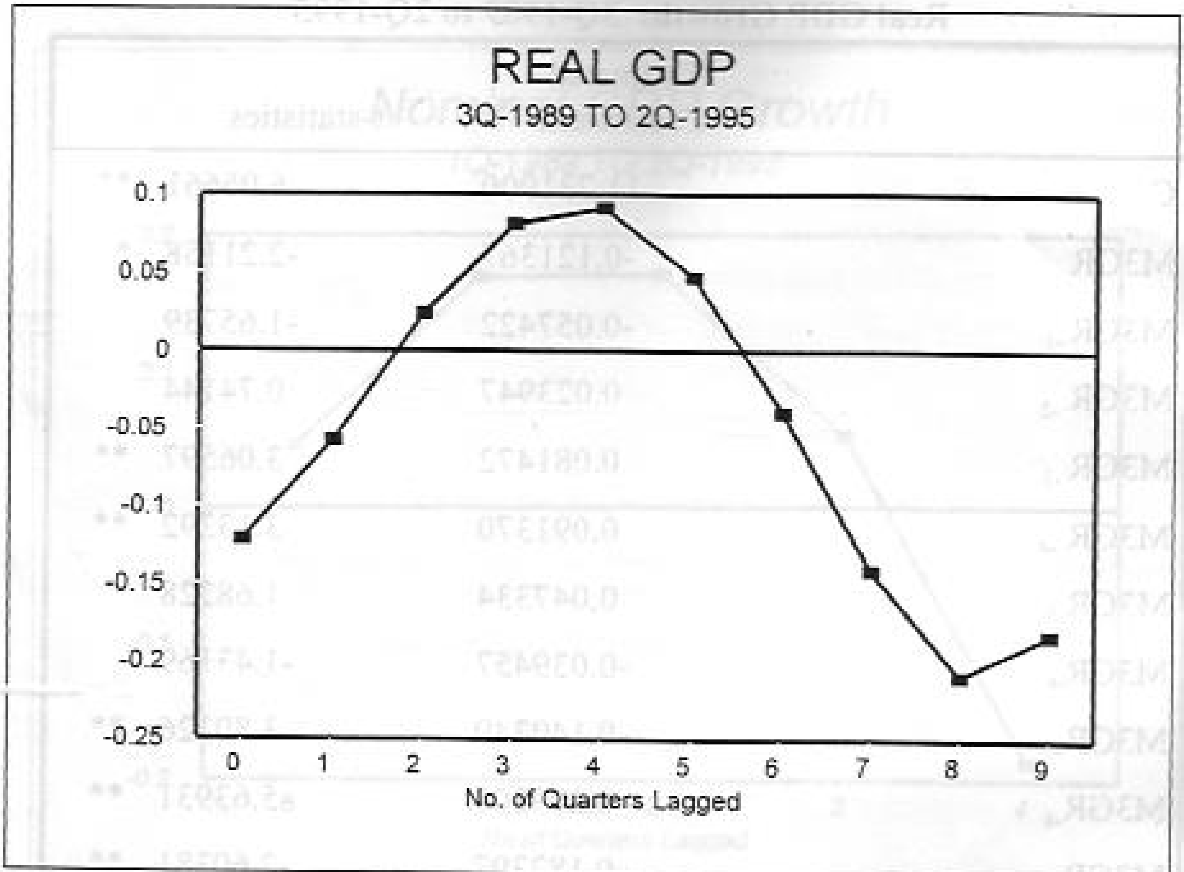

Figure 7

Figure 7 and Table 2 show that the coefficients of lagged M3 become positive and significant only after a lag of 3 quarters. However, earlier results show that nominal GDP reacts to monetary policy during the first two lagged quarters, Hence, taken together, expansionary monetary policy is likely to be inflationary anytime between the current period and third lagged quarter. Inflation then tapers off after real effects are felt.

The significant and negative lagged coefficients for the sixth to the ninth quarters suggest that continuous monetary expansion is inflationary. After the fourth lagged quarter, changes in M3 no longer affect nominal GDP while real GDP falls, hence, if the other factors affecting nominal GDP are held constant, prices must have risen. These inferences, however, are not conclusive since the robustness of the estimates may be questionable. The negative coefficients may have resulted from omitted variables correlated with M3 growth. Also, inferences regarding inflationary effects are derived indirectly - by analyzing the effects on nominal and real GDP. In the next sections, we directly estimate the relation between prices and money.

5.2 Effect on Prices

Monthly data are utilized in the estimation of the price equations. Instead of using growth rates, logarithmic transforms of the consumer price index (CPI; 1988=100) and M3 are used.[18] Other variables affecting inflation such as wages (W), import prices (PM), and interest rates (TB) are also included.[19] The price equation is specified as:[20]

$$\ln CPI_t = b + \sum_{i=0}^{k} \beta_i \ln M3_{t-i} + \sum_{j=1}^{m} \gamma_j \ln CPI_{t-j} + \alpha_1 \ln W_t + \alpha_2 \ln PM_t + \alpha_3 \ln TB_t + u_t \qquad (6)$$

where i=number of lagged months for M3, j=number of lagged months for CPI. The autoregressive terms are included to reflect the formation of (adaptive) inflationary expectations.

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[18]Estimation problems were encountered when year-on-year and month-on-month growth rates were used.

[19]The wage index (rebased to 1988=100) for non-agricultural workers of the Quarterly Survey of Establishments and peso import price index (rebased to 1988=100) of the Quarterly National Income Accounts were used as indicators. Conversion from lower to higher frequency was done using the repetition method (Gaynor and Kirkpartick, 1994). The 91-day Treasury Bill rate is used as the indicator for interest rates.

[20]A "pure" function using only lagged variables of the logarithm of M3 was estimated earlier but was dropped due to possible omitted regressors problems. The estimates from this pure function are shown in Appendix A. The optimal lag length changed from five months to six months.

Equation (6) is estimated using data January 1987 to June 1995. The regression results are shown in second and third columns of Table 3 and the monetary coefficients are charted in Figure 8. The adjusted R^2 indicates that the regressors explain 99 percent of the variation of the logarithmic transform of CPI. The Durbin h (alternative) and Lagrange Multiplier tests indicate the absence of first and second order serial correlation.

The optimal monetary lag length is six months, however, only the fourth and sixth month lags are significant at 5 percent. The effect of monetary changes in inflation for the contemporaneous period and the two succeeding months are positive (although not significantly different from zero at 5 percent). Negative coefficients are estimated from the third lagged month to the fifth lagged month.[21] A significant and positive coefficient is estimated for the sixth lagged month.[22]

The autoregressive components of the equation are no longer statistically significant beyond the second lagged month, i.e., m=2. This may imply that inflationary expectations persist for a month, and makes a correction in the following month. Import prices positively and significantly affect prices are shown by its estimated coefficient. Both wage and interest rate have the correct signs but are insignificant.

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[21]The negative coefficient may either be due to the credit effect (supply-side) effect or simply, an adjustment for overshooting (see footnote 21).

[22]The results are suggestive of an overshooting phenomenon. Note that the sum of lag coefficients is close to zero (= 0.022), indicating that the lag coefficients nearly offset each other. After being inflationary in the first three quarters, prices adjust to correct the overshooting. However, there is an over-adjustment, resulting in another upward swing in the prices in the sixth and last lagged month. At the end of the sixth month, prices are just slightly above the initial price level.

Table 3
ln CPI

	Estimated Coefficient (2)	t-statistic (3)	Estimated Coefficient (4)	t-statistic (5)
C	-0.119	-2.515 *	-0.106	-2.287 *
ln M3	0.001	0.065	-0.003	-0.165
ln $M3_{-1}$	0.015	1.721	0.014	1.584
ln $M3_{-2}$	0.006	0.628	0.007	0.658
ln $M3_{-3}$	-0.011	-1.784	-0.009	-1.591
ln $M3_{-4}$	-0.021	-2.069 *	-0.019	-1.926
ln $M3_{-5}$	-0.009	-0.999	-0.008	-0.874
ln $M3_{-6}$	0.040	2.472 *	0.040	2.480 *
ln CPI_{-1}	1.124	11.486 **	1.144	11.803 **
ln CPI_{-2}	-0.203	-2.188 *	-0.234	-2.601 *
ln W	0.012	1.243	0.021	2.769 **
ln PM	0.035	4.525 **	0.038	4.943 **
ln TB	0.003	1.300		
R^2	0.9997		0.9997	
Adjusted R^2	0.9997		0.9997	
Degree of polynomial	3		3	
Sum of lag coefficients (M3)	0.022		0.022	
Durbin h alt.	0.522	0.601 a/	0.269	0.788 a/
LM (1 lag)	0.398	0.528 a/	0.219	0.640 a/
LM (2 lags)	2.236	0.327 a/	1.714	0.424 a/
F-statistic	36605.0 **		40877.0 **	

a/ level of significance

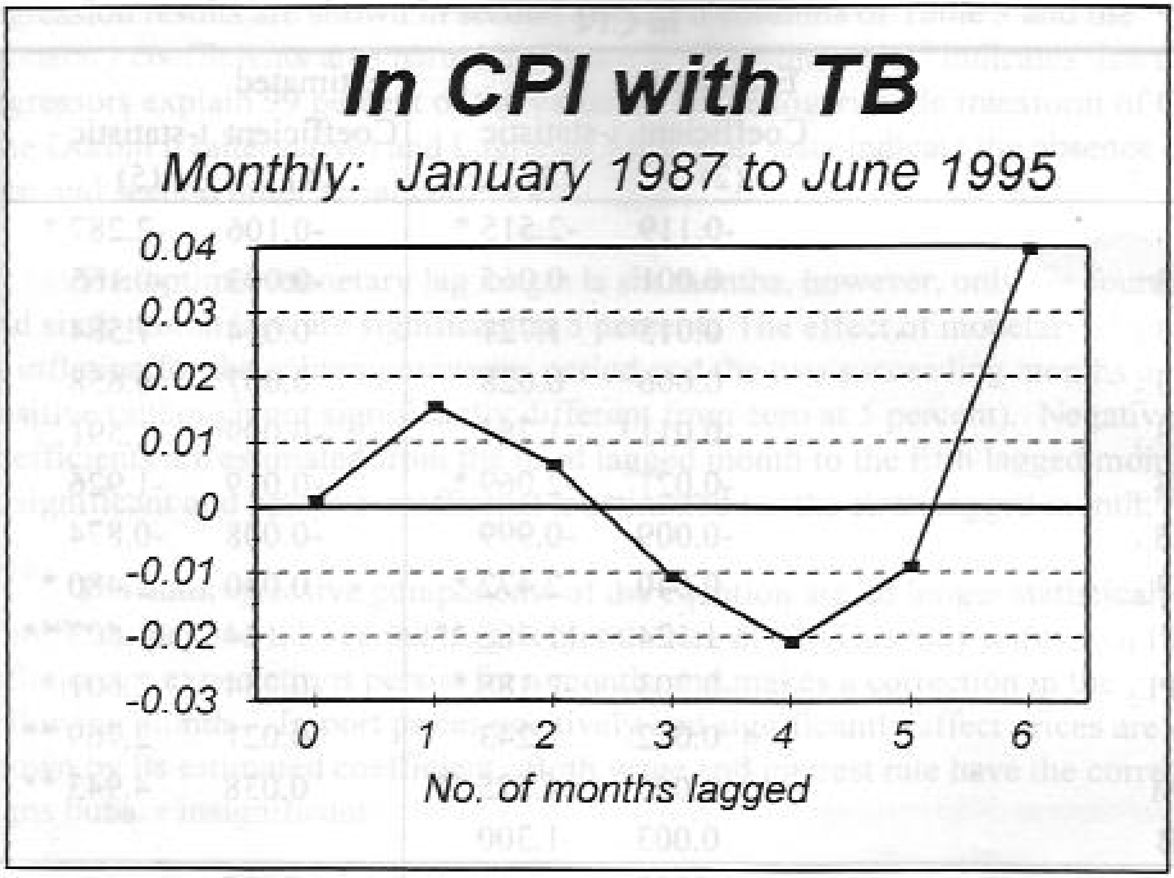

Figure 8

The insignificant coefficient for the interest rate is consistent with the results of Reyes (1995, 1996).[23] Likewise, using the same data and sample period, regressions similar to Reyes show that the treasury bill rate is insignificant (The results are shown in Table 4). The insignificance of the interest rate may have resulted from the correlation between money (M3) and interest rates (91-day Treasury Bill rate).

[23]Reyes (1996) uses the logarithm of the 3-month moving average of the M3 to GNP ratio while Reyes (1995) uses the current M3 to GNP ratio.

Table 4 presents the results of the re-estimation of the Reyes (1995, 1996) equations using data from January 1987 to June 1995. However, modifications[24] have to made to permit the use of this paper's data. The results suggest that a moving average representation of excess demand (M3/GDP) is inferior to a contemporaneous representation (although in Reyes (1996) this variable is significant).

Table 4
Re-estimation of the Modified Reyes Equations

	1996		1995	
	Estimated Coefficient (2)	t-statistic (3)	Estimated Coefficient (4)	t-statistic (5)
C	-0.001	-0.039	0.025	1.557
ln W	0.020	2.250 *	0.022	2.441 *
ln PM	0.033	4.100 **	0.035	4.416 **
ln $[(M3/GDP) + (M3/GDP)_{-1} + (M3/GDP)_{-2}]/3$	0.001	0.077		
ln M3/GDP			0.013	2.204 *
ln TB	0.0001	0.853	0.0002	1.157
ln CPI_{-1}	1.190	12.501 **	1.141	12.019 **
ln CPI_{-2}	-0.243	-2.669 **	-0.202	-2.233 *
R^2	0.9997		0.9997	
Adjusted R^2	0.9997		0.9997	

[24]The modifications are as follows: (1) the compensation index for non-agricultural workers of the Quarterly Survey of Establishments is used instead of the minimum daily wage; (2) the peso import price index proxy for the implicit price index for imports of non-fuels and the wholesale posted price of petroleum products; and (3) no shock variable for the rice crisis is incorporated.

Durbin h alt.	0.727	0.467 a/	1.560	0.119 a/
LM (1 lag)	0.673	0.412 a/	2.529	0.112 a/
LM (2 lags)	2.93	0.231 a/	3.651	0.161 a/
F-statistic	50439.8 **		53015.5 **	

a/ level of significance

Another regression run is made on equation (6) with the treasury bill rate excluded. The results are shown in the fourth and fifth columns of Table 3. With the exclusion of the interest rate, the wage coefficient becomes significant at 1 percent. The lag structure remains the same, except that only the coefficient of the sixth lagged month is significant. The monetary lag coefficients are graphed in Figure 9.

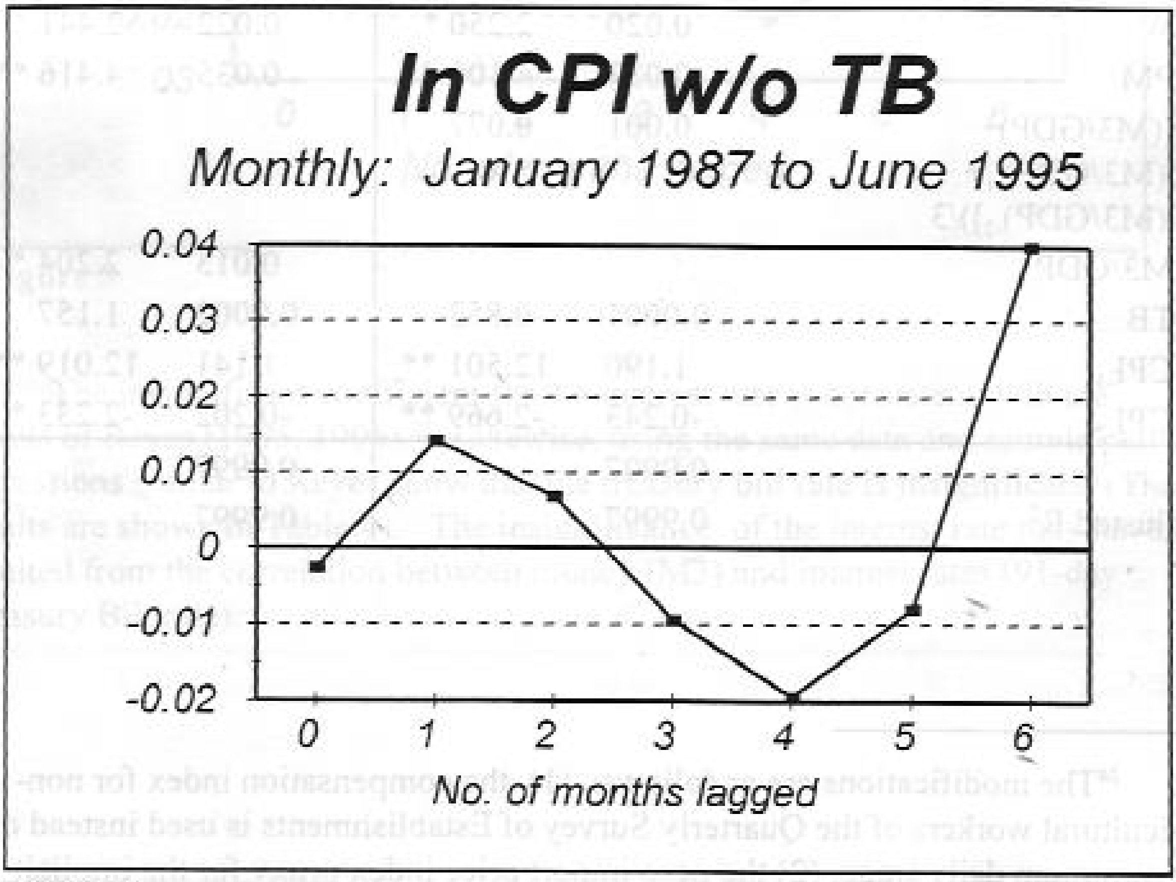

Figure 9

5.3 Effect on Interest Rates

Another important economic variable is the interest rate. While the Philippine monetary authorities do not target the interest rate, it interesting to see the lag relationship between money and interest rates. The interest rate equation is specified as:

$$\ln TB_t = b + \sum_{i=0}^{k} \beta_i \ln M3 + \sum_{j=1}^{m} \gamma_m \ln TB_{t-j} + u_t \tag{7}$$

where *TB* is the 91-day Treasury Bill rate. Similar to prices, the autoregressive scheme is included to reflect adaptive expectations. Equation (7) is estimated using data from January 1987 to June 1995.

The regression results are give in Table 5 and the lag coefficients are charted in Figure 10. The optimal lag length is 5 months. The single lag autoregressive scheme is found to be appropriate. The results indicate that there is no significant contemporaneous monetary effect on interest rates. After a month, a negative monetary impact is estimated. However, this is insignificant at 5 percent (although significant at 10 percent). Significant effects start on the third lagged month. However, contrary to Gibson (1970), the initial significant effects are positive.[25] It is only in the fifth and last lagged month that the money has a negative impact. The positive effect may be attributed to the Fisher effect in which money growth fuel inflationary expectations, hence, interest rates rise. The negative impact arises from the Keynesian thesis that loose money reduces interest rates.

[25]Please see the last paragraph of Section 1.0 of this paper.

Table 9
ln TB

	Estimated Coefficient	t-statistic
C	0.549	1.949
ln M3	0.252	0.918
ln $M3_{-1}$	-0.387	-1.744
ln $M3_{-2}$	-0.057	-0.311
ln $M3_{-3}$	0.486	2.649 **
ln $M3_{-4}$	0.486	2.188 *
ln $M3_{-5}$	-0.813	-2.905 **
ln TB_{-1}	0.936	29.824 **
R^2	0.904	
Adjusted R^2	0.899	
Degree of polynomial	4	
Sum of lag coefficients (M3)	-0.031	
Durbin h	1.465	0.143 a/
Durbin h alt.	1.522	0.128 a/
LM (1 lag)	2.415	0.120 a/
LM (2 lags)	3.424	0.180 a/
F-statistic	180.3 **	

a/ level of significance

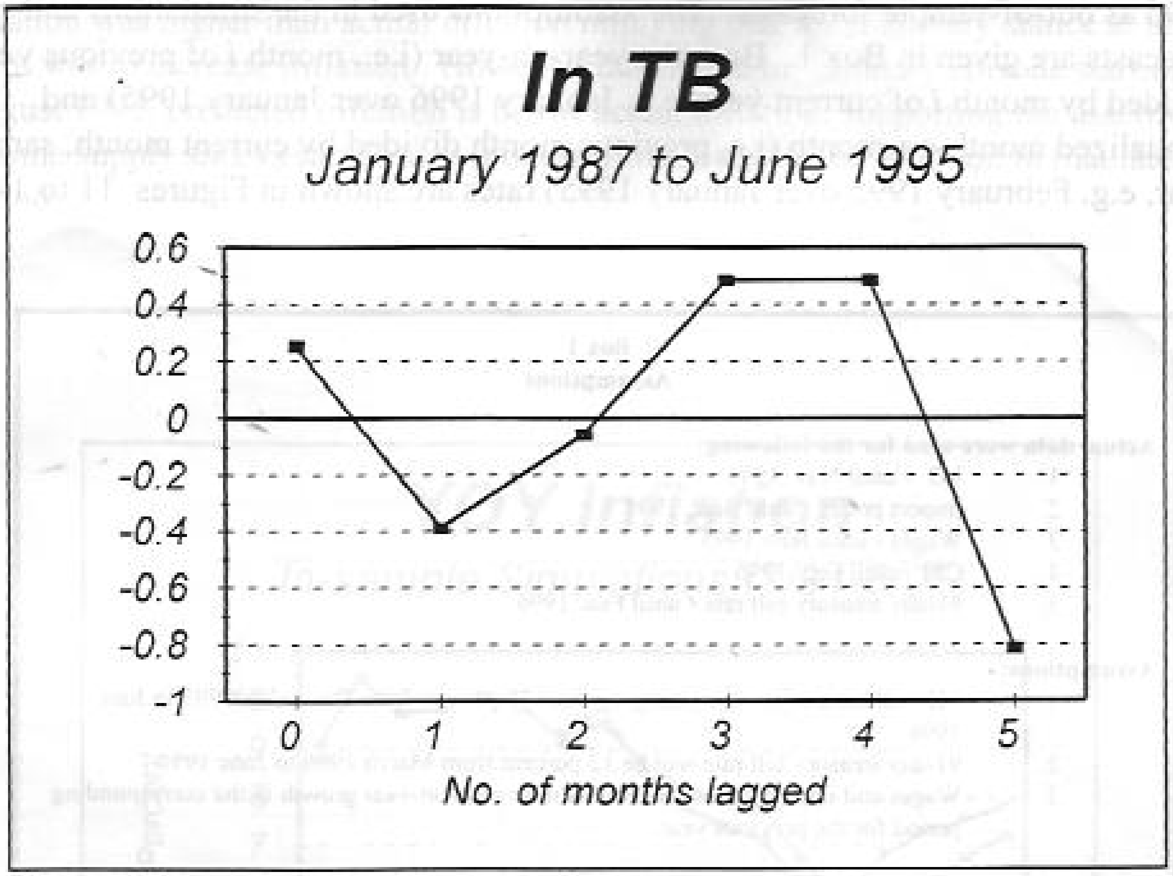

Figure 10

The interest rate results, though, are not very robust since the high adjusted R^2 is attributable to the autoregressive term. Table 9 shows that the t-statistic for lagged interest rate is very significant. The inclusion of contemporaneous and lagged (logarithmic) CPI in equation (7) results in insignificant t-ratios for these variables. Preliminary regressions without the autoregressive terms (with and without the price variables) yield a low adjusted R^2 and serially correlated errors.

6. Preliminary Use for Policy Analysis

The preceding monetary lag function (equation (6) excluding the 91-day Treasury Bill rate) is applied to an actual recent period, July 1994 to June 1996, with July 1994 to June 1995 as in-sample simulations[26] and July 1995 to June 1996 as out-of-sample forecasts. The assumptions used in the simulations and forecasts are given in Box 1. Both the year-on-year (i.e., month *i* of previous year divided by month *i* of current year, e.g. January 1996 over January 1995) and annualized month-on-month (i.e. previous month divided by current month, same year, e.g. February 1995 over January 1995) rates are shown in Figures 11 to 14.

Box 1
Assumptions

Actual data were used for the following:

1. M3 - until Nov. 1995
2. Import prices - until Sept. 1995
3. Wages - until June 1995
4. CPI - until Feb. 1996
5. 91-day treasury bill rate - until Feb. 1996

Assumptions:

1. M3 will have a year-on-year growth of 25 percent from December 1995 to June 1996
2. 91-day treasury bill rate will be 13 percent from March 1996 to June 1996
3. Wages and import prices will follow their year-on-year growth in the corresponding period for the previous year:

	Wages	Import prices
3Q-1995	7.72	
4Q-1995	7.88	4.15
1Q-1996	10.55	3.95
2Q-1996	8.15	4.40

In evaluating the tacking capability of the equation, the Root Mean Square Percentage Error (RMSPE) is computed. It appears that the forecasting equation tracked CPI well with an RMSPE of 0.67 percent. The RMSPEs for year-on-year (YOY) and month-on-month (MOM) are higher, but this is expected since these are rates of change. The simulated and forecasted numbers and their corresponding RMSPEs are reported in Appendix B.

[26] A dynamic simulation was performed.

The graphs indicate that during the July 1994-June 1995 period predicted inflation was higher than actual inflation implying that the monetary stance at this point was to increase inflation. However, during the inflationary episode starting August 1995, predicted inflation is below actual inflation, supporting the assertion that the supply shocks rather than monetary impulses fueled inflation in that later period.

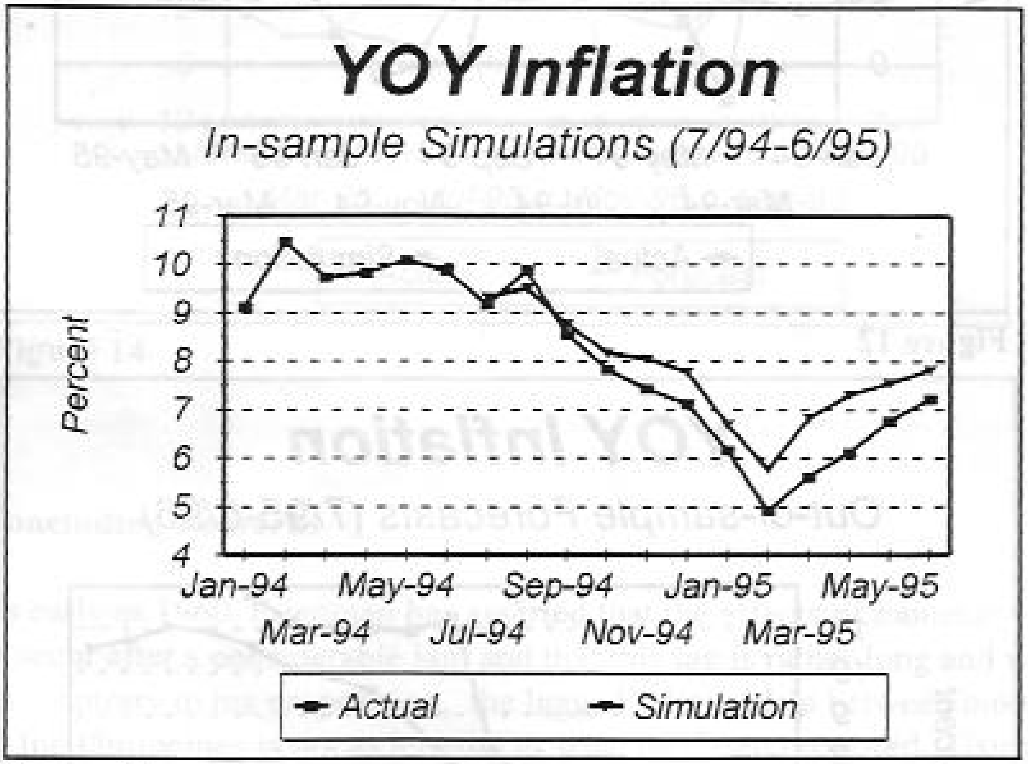

Figure 11

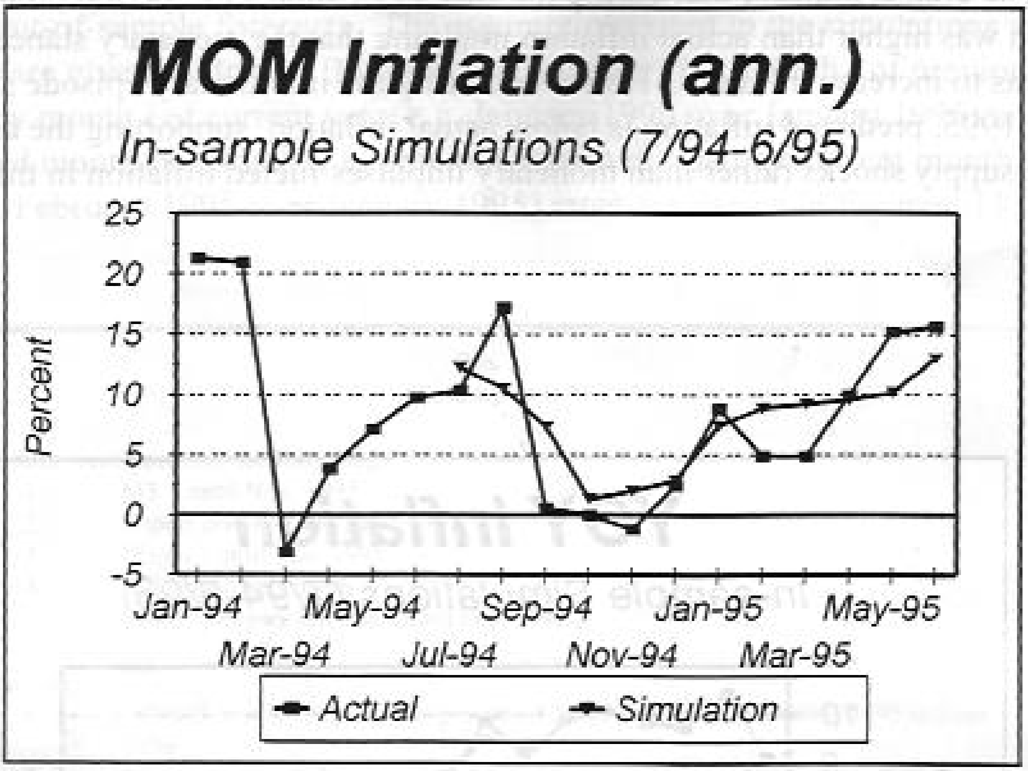

Figure 12

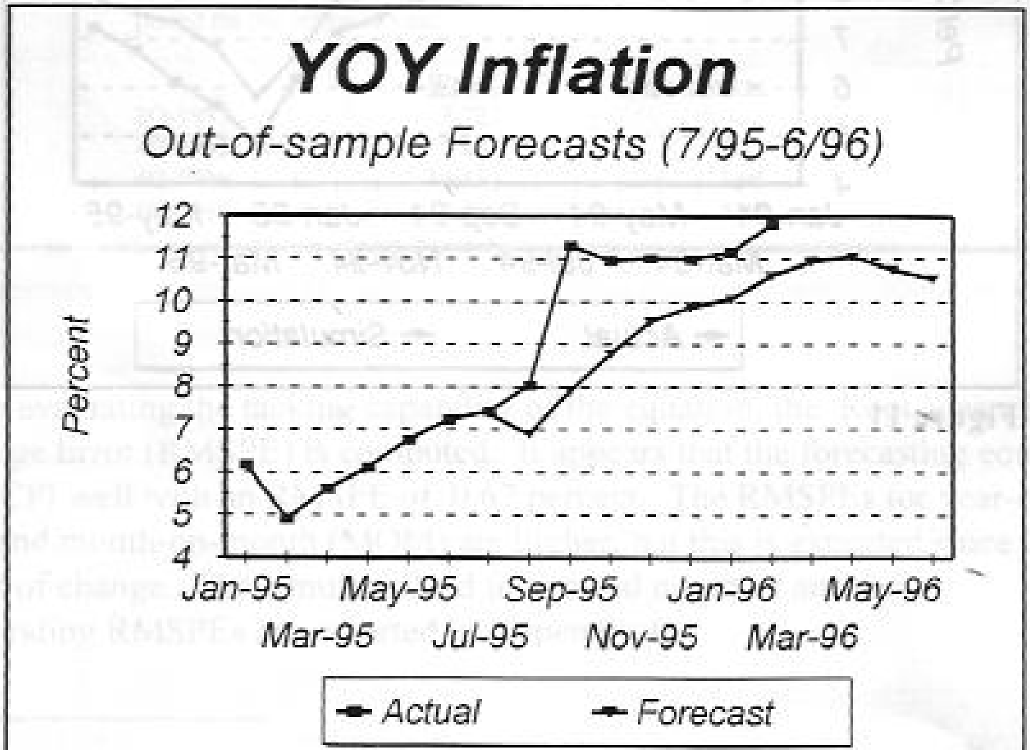

Figure 13

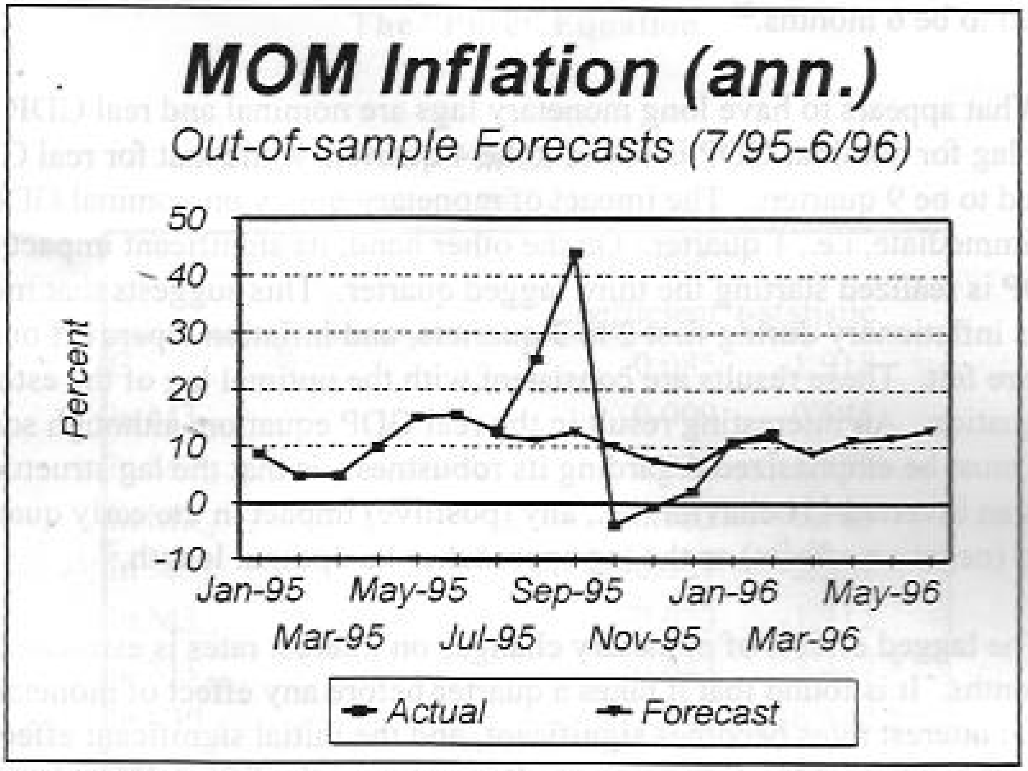

Figure 14

7. Concluding Remarks

As early as 1960, Friedman has asserted that the effects of monetary changes occur after a considerable lag, and that this lag is rather long and variable. However, contrary to his proposition, the lagged relationship between money and prices in the Philippines is not as lengthy as what has been proposed. Using the Almon technique in estimating polynomial distributed lags[27], it is found that the

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[27]There is need for more data, e.g., minutes of the Monetary Board meetings, to be able to use non-parametric tests, and these data are not readily available in the Philippines.

optimal lag of the effects of monetary policy on prices is rather short, and is estimated to be 6 months.[28]

What appears to have long monetary lags are nominal and real GDP. The optimal lag for nominal GDP is found to be 4 quarters while that for real GDP is estimated to be 9 quarters. The impact of monetary policy on nominal GDP is almost immediate, i.e., 1 quarter. On the other hand, its significant impact on of real GDP is realized starting the third lagged quarter. This suggests that monetary policy is inflationary during first 2 to 3 quarters, and inflation tapers off once real effects are felt. These results are consistent with the optimal lag of the estimated price equation. An interesting result in the real GDP equation, although some caution must be emphasized regarding its robustness, is that the lag structure exhibits an inverted-U behavior, i.e., any (positive) impact in the early quarters is reversed (negative effects) as the lag approaches its optimal length.[29]

The lagged effects of monetary changes on interest rates is estimated to last for 5 months. It is found that it takes a quarter before any effect of monetary policy on interest rates becomes significant, and the initial significant effect is positive, indicative of the Fisher effect. It is not until the fifth and last lagged month that a Keynesian (negative) relationship between money and interest rates is felt. However, the results of the interest rate equation are not very robust since a large part of the explanatory power is attributable to the autoregressive term.

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[28] A qualification has to be made with regard to these results. First, there are several monetary regimes that existed with the 1987-1995 sample period, and these could have muddled the relationship between money and prices. Also, the estimated optimal lag length must be thought of the average optimal lag across the different monetary regimes since the lags may vary in each regime. Therefore, it may be interesting to look at the behavior of the price equation under the different monetary regimes. This, however, is beyond the scope of this paper.

[29] As mentioned in earlier sections, this significant negative coefficients may be due to omitted variables which are correlated with M3.

Appendix A
The "Pure" Equation

ln CPI
January 1987 - June 1995

	Estimated Coefficient	t-statistic
C	-0.085	-1.918
ln M3	0.009	0.545
ln $M3_{-1}$	0.020	1.552
ln $M3_{-2}$	-0.002	-0.183
ln $M3_{-3}$	-0.027	-2.527 *
ln $M3_{-4}$	-0.023	-1.712
ln $M3_{-5}$	0.043	2.437 *
ln CPI_{-1}	1.436	16.542 **
ln CPI_{-2}	-0.470	-5.471 **
R^2	0.9996	
Adjusted R^2	0.9996	
Degree of polynomial	3	
Sum of lag coefficients (M3)	0.0203	
Durbin h alt.	0.7209	0.471 a/
LM (1 lag)	0.5591	0.455 a/
LM (2 lags)	0.8596	0.651 a/
F-statistic	42210.2 **	

a/ level of significance

Appendix B
Simulation and Forecast Results

Table B-1
In-sample Simulations

	CPI		YOY Inflation		MOM Inflation (ann)	
	Actual	Simulated	Actual	Simulated	Actual	Simulated
Jul 1994	195.30	195.58	9.17	9.32	10.38	12.28
Aug 1994	197.90	197.22	9.88	9.51	17.20	10.56
Sep 1994	198.00	198.39	8.55	8.77	0.61	7.34
Oct 1994	198.00	198.61	7.84	8.17	0.00	1.32
Nov 1994	197.80	198.94	7.44	8.06	-1.21	2.02
Dec 1994	198.20	199.41	7.14	7.79	2.45	2.92
Jan 1995	199.60	200.61	6.17	6.71	8.81	7.42
Feb 1995	200.40	202.04	4.92	5.78	4.92	8.89
Mar 1995	201.20	203.52	5.62	6.84	4.90	9.20
Apr 1995	202.80	205.07	6.12	7.31	9.97	9.53
May 1995	205.20	206.74	6.76	7.56	15.16	10.17
Jun 1995	207.70	208.86	7.23	7.82	15.64	13.03
RMSPE		0.67		11.65		3.8×10^{26}

Table B-2
Out-of-sample Forecasts

	CPI		YOY Inflation		MOM Inflation (ann)	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
Jul 1995	209.80	209.69	7.42	7.37	12.83	12.11
Aug 1995	213.80	211.54	8.03	6.89	25.44	11.15
Sep 1995	220.40	213.65	11.31	7.91	44.03	12.65
Oct 1995	219.70	215.37	10.96	8.77	-3.75	10.05
Nov 1995	219.60	216.67	11.02	9.54	-0.54	7.52
Dec 1995	220.00	217.80	11.00	9.89	2.21	6.44
Jan 1996	221.90	219.69	11.17	10.06	10.87	10.92
Feb 1996	224.10	221.69	11.83	10.62	12.57	11.51
Mar 1996		223.24		10.95		8.72
Apr 1996		225.22		11.05		11.16
May 1996		227.29		10.77		11.62
Jun 1996		229.60		10.54		12.90

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