Estimating Inflation Rate And Money Demand In Nigeria Using The Generalized Polynomial Regression

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ABSTRACT

Inflation plays an important role in demand for money (M1). M1 is a function of inflation rate besides the rates of return of alternative assets and real income. The study aimed to empirically investigate the role of inflation on money demand function in Nigeria. The data collected was analysed using Polynomial regression. The quarterly time series data over the period from 1990:01 through 2017:04 was obtained from the Statistical Bulletin of the Central Bank of Nigeria (CBN) for monetary aggregates ( ), consumer price index and gross domestic product. Results of polynomial regression show that the relationship between inflation and demand on is nonlinear and represents a parabola. When the inflation rate increases above 3.64 percent, relationship between inflation and demand for will become negative. Results of polynomial regression model also shows that inflation is negative in relation to money demand; when the rate of inflation is above a critical level of inflation. Relationship between inflation and money demand follows the quadratic function. Demand for is only a function of rate of inflation and real income because treasury bills rate is statistically insignificant. During the high inflation period, inflation is negatively correlated with money demand. High money growth is consistent with high inflation, a low real money demand (high money velocity). In conclusion, empirical evidence suggests that money velocity is in general volatile, contradicting the assumption of a stable money demand.

Keywords: Polynomial regression, monetary aggregates, inflation rate, money velocity

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1. INTRODUCTION

Demand for money is an important element in macroeconomic analysis, especially in constructing an optimal and identical monetary policy. Erroneous money demand estimated will make the monetary authorities take a wrong action when policy is designed and implementation of such policy will bring a disaster to the country. Therefore, there were numerous theoretical literature and empirical studies on the demand for money that has been conducted to provide more understanding about conditions and feathers of demand for money. Most of the theoretical grounds and accumulated evidence indicate that a strong link between money and price, no matter studies of period of accelerating and sustained inflation as well as studies of demand for money. The significance of the expected rate of inflation as a factor influencing the demand for money is well established. Although, it has been generally accepted that amount of money demanded responds to expected rate of inflation, the expected sign of the relationship between expected rate of inflation and demand for money still remained some controversies. Several theoretical and empirical literatures have shown a negative relationship between inflation and demand for money. Nevertheless researchers have accounted for the opposite.

There is also a possibility that the demand for money influenced by inflation positively. Recently, linear co-integration analysis has been the mainstream approach in examining the money demand function. Cagan (2015) as well as most later empirical work is essentially single equation regression and postulate a linear relationship between expected rate of inflation and demand for money. However, there is some empirical evidence suggest that Cagan money demand function does not fit well for low and high inflation period at the same time and present of a varying coefficient (Bental & Eckstein, 2013). Theoretically, there is no reason to believe that economic systems must be intrinsically linear. Empirically, there were a great number of studies showing that inflation rate causes a non-linear in the relation with demand for money. Michael et al (2014) points to the necessity to distinguish between high inflation and hyperinflation episodes in the study of money demand.

Empirical result of Lutkepohl et al (2016) shown that transition function is close to step function which implies a different adjustment for positive and negative inflation rate. Hence, the model indicates that agent react differently to positive and negative inflation rate. Test of no additional non-linearity suggest that the non-linearity was found after the estimation. Empirical results of Emiliano et al (2014) using time-series approach are consistent with cross-country evidence of study by De Grauwe and Polan (2015). Findings of both studies show that money velocity is positively correlated with money growth and inflation under high inflation. On the contrary, velocity is negatively correlated to inflation and money growth under low inflation. A low real money demand is same as high money velocity. If such a nonlinear relationship exists then it should be possible, in principle, to estimate the threshold level, at which the sign of relationship between the inflation and money demand would switch. However, the test of possibility exist of threshold level, typically is more focus on the relationship between inflation and economic growth.
This study is an attempt to empirically investigate the role of inflation on the money demand function in Nigeria. The main aim of this study is to focus specifically on the relationship between inflation and money demand.

To achieve the aim, the following objectives are sought:

i. Develop a quadratic regression model on the effect of inflation on money demand
ii. whether the relationship between inflation and money demand is nonlinear

2. LITERATURE REVIEW

Christos (2016) investigated closed economy model and concepts of the multiplier and accelerator were used and applied post Keynesian view to determine the path of income and expected inflation towards the long run equilibrium. He defined that long run value of inflation (expected and actual) is affected by size of government expenditure and nominal money supply. David (2014) used the data set from 1964 to 1981 period in case of West Germany he found that unanticipated money growth affects output and employment in case of West Germany. He found that unanticipated money growth (random walk) affects real variables such as output and employment. Wood and Micheal (2015) tested empirically that how has fiscal policy (rising public spending) asymmetrically impact on economic activity and at various stages of nominal interest rate. His paper provides new proof that Expansionary Public Expenditure in more favorable in short run growth when real interest rate is low. They also find that asymmetric effects of other macroeconomic variables such as inflation and interest rate.

Han and Mulligan (2016) effort to facilitate that the economic theory of huge government and inflation. Huge government may become the cause of high inflation rate. But they realized that positive relationship between inflation and huge size of the government in the period of war and peace, time series correlation coefficient between inflation and the size of government which has a negative correlation coefficient of inflation with other than defense expenditures. Komain (2007) used Thai-data for the year from 1993 to 2014 to find out causal association between economic development and size of government. His finding shows that no cointegration among public spending, economic growth and money supply. But unidirectional causality is found among economic growth, public spending and Qausi-money supply (M_2). Fedrick and Peter (2003) used data from 1961 to 2003 in case of Sweden to find out the relationship between government expenditure and economic growth. They divided public spending in three broad categories which are private consumption, Gross fixed capital formation and interest payment; they are all significantly effect on economic growth. Junko and Vitali (2008) evaluate of fiscal scenario based on the assumption of rapid scaling up or increase rapidly government expenditure cause to decline economic growth due to increase oil price. They used neo classical growth model to define this situation. Abdullah (2007) used data from 1973 to 2014 in case of Saudi Arabia, employing granger causality test to find association among EX, government expenditure and economic growth and his finding shows bilateral causality between the variables.

3. METHODOLOGY

3.1 Fitting of Polynomials Regression

Indeed in all of the sciences, one may have a collection of data points to which he wishes to fit some curve. There are several situations in which this arises. For instance:

a. We may wish to investigate the appropriate functionality for a set of data. Thus in chemical kinetics we may wish to determine the order of a reaction. Is it first order with respect to some reactant *(dc/dt = -kc),* or second order *(dc/dt = -kc²),* or perhaps some non-integral order (e. g., *dc/dt = -k√c).*

b. Given the (theoretical) functionality of the data, we wish to determine the coefficients for that function. Again in kinetics an example would be the determination of the rate coefficients (the "*k*"s above).

c. We wish to determine the best equation for interpolation/extrapolation, given a set of data for which there need not be any expected functionality on theoretical grounds. For instance, we may wish to calibrate a thermometer (e.g., thermocouple or thermistor) against standard points such as phase transitions, or against another thermometer (perhaps a gas thermometer).

3.1.1 Derivation

A descriptive model for curve fitting is found in the simple fitting of data to a straight line: we plot the points on a graph, then drop a (presumably transparent) straight edge on the graph and move it around until a "best" straight line is seen — the line may not pass through any of the points, yet it is "close" to almost all of them. A person may be tempted to describe this process as finding the line that minimizes the sum of deviations of the data from the fitted line. While such a description is attractive, when phrased mathematically it is found to have a serious difficulty; namely that *any* straight line will give a "perfect" fit by this criterion subject to one condition: $\Sigma f(x_i) = \Sigma y_i$

If we back up, however, to our initial descriptive model, we see that what we are in fact attempting to achieve is a minimum in the sum of absolute deviations. But when this is a minimum, unless the distribution of deviations is perverse, so also will the sum of deviations squared be near minimal, this latter criterion is easier to handle mathematically. Thus, the criterion for the "best fit" of a function to the tabular data will be that for some *f(x)* there is a minimum in the function

$X^2 = \sum[f(x_i) - y_i]^2$

For a given set of data, we will consider this X^2 to be a function *not* of *x* or *y* (since for these data *x* and *y* are fixed), but rather of the coefficients of *f(x),* which are what we in fact vary to find the best fit. Thus we have $X^2(\{a\})$ for a set of coefficients a_k in *f(x; {a}).*

From calculus, we have the necessary condition for an extremum of a function with respect to a variable: that the derivative with respect to that variable disappear (provided that the function and its derivative are continuous). Since in general we can choose such inappropriate a_ks that X^2 goes to infinity, the extremum that we find will be a minimum (note that $X^2 \geq 0$). In short, $\partial X^2 / \partial a_k = 0$ finds the best value for a_k. From this we proceed thus:

$$
\begin{aligned}
0 &= \frac{\partial}{\partial a_k} X^2 \\
&= \frac{\partial}{\partial a_k} \sum [f(x_i) - y_i]^2 \\
&= \sum \frac{\partial}{\partial a_k} [f(x_i)]^2 - \sum 2 \frac{\partial}{\partial a_k} [f(x_i) y_i] \\
&= \sum f(x_i) \frac{\partial}{\partial a_k} [f(x_i)] - \sum y_i \frac{\partial}{\partial a_k} [f(x_i)]
\end{aligned}
$$

Rearranging, we obtain

$$\sum y_i \frac{\partial}{\partial a_k}[f(x_i)] = \sum f(x_i)\frac{\partial}{\partial a_k}[f(x_i)] \qquad (3.1)$$

This is the basic equation for least-squares fitting of any functional form to any data. As examples we will apply it to two different functional forms: the generalized polynomial or power series, and the exponential function.

3.1.2 The Generalized Polynomial

As the generalized polynomial we will consider all functions that we can write as:

$$f(x) = a_1 x^{p1} + a_2 x^{p2} + \ldots + a_n x^{pn} + e \qquad (3.2)$$

where the p_i as well as the a_i are any real numbers. Then equation (1) can easily be applied, since $\partial f(x)/\partial a_k = x^{pk}$. So we may write

$$\begin{aligned}\sum y_i\, x_i^{\,p_k} &= a_1 \sum x_i^{\,p_1} x_i^{\,p_k} + a_2 \sum x_i^{\,p_2} x_i^{\,p_k} + \cdots \\ &= a_1 \sum x_i^{\,(p_1+p_k)} + a_2 \sum x_i^{\,(p_2+p_k)} + \cdots\end{aligned}$$

Similar equations can be written for all coefficients of $f(x;\{a\})$. But since the (x,y) pairs are given, the sums $\sum y_i\, x_i^{\,p_k}$ and $\sum x_i^{\,(p_1+p_k)}$ can be computed from these data, and we end up with a system of n linear equations in n unknowns (the $\{a\}$).

$$\sum y_i\, x_i^{\,p_k} = \sum_k a_k \sum x_i^{\,(p_1+p_k)} + a_2 \sum x_i^{\,(p_2+p_k)} + \cdots \qquad 1 \le k \le n \qquad (3.3)$$

The system of equations in (3.3) is particularly useful if we have access to a computer since various well documented methods exist for solving systems of linear equations, some of which can be found preprogrammed in software libraries.

$$Y = a + b\,x + e$$

$$e = (Y - (a + bx)$$

$$\sum e^2 = \sum y - an - b\sum x$$

$$y = \beta_o + \beta_1 x_1 + \beta_2\, x^2 e_1$$

$$e_1 = (Y - \beta_o - \beta_1 x_1 - \beta_2\, x^2)$$

$$e_1 = \sum(Y - \beta_o - \beta_1 x_1 - \beta_2\, x^2)$$

$$\sum e_1 = \sum Y - n\beta_o - \beta_1 \sum x_1 - \beta_2 \sum x^2$$

$$\sum e_1 = (\sum Y - n\beta_o - \beta_1 \sum x_1 - \beta_2 \sum x^2)^2$$

$$\frac{\partial \sum e_1\, 2}{\partial \beta_o} = 2\,(\sum Y - n\beta_o - \beta_1 \sum x_1 - \beta_2 \sum x^2) = 0$$

$$\sum Y = n\beta_o + \beta_1 \sum x_1 + \beta_2 \sum x^2 \qquad \mathbf{(3.3)}$$

$$\sum e_1 = \sum(Y - \beta_o - \beta_1 x_1 - \beta_2\, x^2)^2$$

$$\frac{\partial \sum e_1 2}{\partial \beta_1} = 2\sum x_1(\mathrm{Y} - \beta_o - \beta_1 x_1 - \beta_2 x^2) = 0$$

$$\sum x_1 \mathrm{Y} = \beta_o \sum x - \beta_1 \sum x^2 - \beta_2 \sum x^3 \qquad (3.4)$$

$$\frac{\partial \sum e_1 2}{\partial \beta_1} = 2\sum x^2(\mathrm{Y} - \beta_o - \beta_1 x_1 - \beta_2 x^2)$$

$$\sum x^2 \mathrm{Y} = \beta_o \sum x^2 + \beta_1 \sum x^3 + \beta_2 \sum x^4 \qquad (3.5)$$

Combine equation (3.3), (3.4) and (3.5)

$$\sum \mathrm{Y} = n\beta_o + \beta_1 \sum x_1 + \beta_2 \sum x^2 \qquad (3.6)$$

$$\sum x_1 \mathrm{Y} = \beta_o \sum x + \beta_1 \sum x^2 + \beta_2 \sum x^3 \qquad (3.7)$$

$$\sum x^2 \mathrm{Y} = \beta_o \sum x^2 + \beta_1 \sum x^3 + \beta_2 \sum x^4 \qquad (3.8)$$

From equation (3.6)

$$n\beta_o = \sum \mathrm{Y} - \beta_1 \sum x - \beta_2 \sum x^2$$

$$\beta_o = \frac{\sum \mathrm{Y} - \beta_1 \sum x - \beta_2 \sum x^2}{n}$$

Substitute the value of β_o we have

Equation (3.7) and (3.8) for equation (3.7)

$$\sum \mathrm{xY} = \sum \mathrm{x} \frac{\sum \mathrm{Y} - \beta_1 \sum x - \beta_2 \sum x^2}{n} + \beta_1 \sum x^3 + \beta_2 \sum x^3$$

$$\sum \mathrm{xY} = \frac{\sum \mathrm{x} \sum \mathrm{Y} - \beta_2 (\sum x)^2 - \beta_2 \sum \mathrm{x} \sum x^2}{n} + \beta_1 \sum x^2 + \beta_2 \sum x^3$$

$$n\sum x^2 \mathrm{Y} = \sum \mathrm{x} \sum \mathrm{Y} - \beta_1 (\sum x)^2 - \beta_2 \sum \mathrm{x} \sum x^2 + n\,\beta_1 \sum x^2 + n\,\beta_2 \sum x^3$$

$$n\sum x^2 \mathrm{Y} = \mathrm{x} \sum \mathrm{Y} - \beta_1 (n \sum x^2 - (\sum x)^2) + \beta_2 (n\sum x^3 - \sum x \sum x^2) \qquad (3.9)$$

For equation (3.8)

$$\sum x^2 \mathrm{Y} = \beta_o \sum x^2 + -\beta_1 \sum x^3 + \beta_2 \sum x^4$$

$$\sum x^2 \mathrm{Y} = \sum x^2 \left(\frac{\sum \mathrm{Y} - \beta_1 \sum x - \beta_2 \sum x^2}{n}\right) + \beta_1 \sum x^3 + \beta_2 \sum x^4$$

$$\sum x^2 \mathrm{Y} = \sum x^2 + \sum \mathrm{Y} - \beta_1 \sum x \sum x^2 \beta_2 (\sum x^2) 2 + n\beta_1 \sum x^3 + n\beta_2 \sum x^4$$

$$n\sum X^2 Y = \sum X^2 \sum Y + \beta_1 \left(n \sum X^3 - \sum X \sum X^2\right) + \beta_2 (n \sum X^4 - \left(\sum X^2\right)^2)$$

$$n\sum x^2 y - \sum x^2 \sum y = \beta_1 (n \sum x^3 - \sum x^2) + \beta_2 (n \sum x^4 - \sum x^2)^2$$

Combine equation (3.4) and (3.5)

$$n\sum xy-\sum x\sum y=\beta_1(n\sum x^2-(\sum x))^2+\beta_2(n\sum x^3-\sum x\sum x^2)$$

$$\beta_1=\frac{n\sum xy-\sum x\sum y}{n\sum x^2-(\sum x^2)}$$

$$\beta_2=\frac{(n\sum x^3-\sum x\sum x^2)}{n\sum x^2-(\sum x)^2}$$

Substitute Equation (3.6) to Equation (3.5)

$$n\sum x^2y-\sum x^2\sum \gamma=\left(\frac{n\sum x\gamma-\sum x\sum y}{n\sum x^2-(\sum x^2)}-\beta_2\frac{(n\sum x^3-\sum x\sum x^2)}{n\sum x^2-(\sum x)^2}\right)\left(n\sum x^3-\sum x\sum x^2\right)+\beta_{(2)}n\sum x^4-(\sum x^2)^2$$

$$\left(n\sum x^2-(\sum x)^2\right)\left(n\sum x^2\gamma-\sum x^2\sum y\right)=\left(\left(n\sum xy-\sum x\sum y\right)-\beta_2\left(n\sum x^3-\sum x\sum x^2\right)\right)$$
$$\left(n\sum x^3-\sum x\sum x^2\right)+\beta_2(n\sum x^4-(\sum x^2))^2$$

$$(n\sum x^2-(\sum x^2))\,(n\sum x^2\gamma-\sum x^2\sum\gamma)=\ (n\sum x\gamma-\sum x\sum\gamma)\,(n\sum x^3-\sum x\sum x^2)-$$
$$\beta_2\,(n\sum x^3-\sum x\sum x^2)(n\sum x^3-\sum x\sum x^2)$$
$$+\beta_2\,(n\sum x^4-(\sum x^2))^2$$

$$(n\sum x^2-(\sum x^2))\,(n\sum x^2\gamma-\sum x^2\sum\gamma)=\ (n\sum x\gamma-\sum x\sum\gamma)\,(n\sum x^3-\sum x\sum x^2)-$$
$$\beta_2\,(n\sum x^3-\sum x\sum x^2)(n\sum x^3-\sum x\sum x^2)+\beta_2\,(n\sum x^4-(\sum x^2))^2$$

$$(n\sum x^2-(\sum x^2))\,(n\sum x^2\gamma-\sum x^2\sum\gamma)=\ (n\sum x\gamma-\sum x\sum\gamma)\,(n\sum x^3-\sum x\sum x^2)-$$
$$\beta_2\,(n\sum x^3-\sum x\sum x^2)(n\sum x^3-\sum x\sum x^2)$$
$$+\ (n\sum x^4-(\sum x^2))2$$

$$\beta_2\ =\ \frac{(n\sum xy-\sum x\sum y)(n\sum x^3-\sum x\sum x^2)+\ (n\sum x^2-(\sum x^2))\,(n\sum x^2\gamma-\sum x^2\sum\gamma)}{(n\sum x^3-\sum x\sum x^2)\ (n\sum x^3-\sum x\sum x^2)+\ (n\sum x^4-(\sum x^2))2}$$

$$\beta_2\ =\ \frac{(n\sum xy-\sum x\sum y)(n\sum x^3-\sum x\sum x^2)+\ (n\sum x^2-(\sum x^2))\,(n\sum x^2\gamma-\sum x^2\sum\gamma)}{(n\sum x^3-\sum x\sum x^2)\ (n\sum x^3-\sum x\sum x^2)+\ (n\sum x^4-(\sum x^2))2}$$

$$\beta_1\ =\ \frac{n\sum xy-\sum x\sum y-\ \beta_2\ (n\sum x^3-\sum x\sum x^2)}{n\ \sum x^2-(\sum x^2)}$$

$$\beta_0\ =\frac{\sum\gamma-\ \beta_1\sum x-\ \beta_2\sum x^2}{n}$$

$$Y=\ \beta_0+\ \beta_1x+\ \beta_2x^2\ +\ \beta_3x^3\ +\ e_i$$

$$e_i\ =\ Y-\beta_0+\ \beta_1x+\ \beta_2x^2\ +\ \beta_3x^3$$

$$\sum e_i\ =\ \sum(\ Y-\beta_0+\ \beta_1x+\ \beta_2x^2\ +\ \beta_3x^3)$$

$$\sum e_i\, 2 = \sum (Y - \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3)^2$$

$$\frac{\partial \sum e_i\, 2}{\partial \beta_0} = 2 \sum (Y - \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3)$$

$$\sum Y = n - \beta_0 + \beta_1 \sum x + \beta_2 \sum x^2 + \beta_3 \sum x^3 \quad (3.10)$$

$$\frac{\partial \sum e_i\, 2}{\partial \beta_1} = 2 \sum x(Y - \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3)$$

$$\sum xY = \beta_0 \sum x + \beta_1 \sum x^2 + \beta_2 \sum x^3 + \beta_3 \sum x^4 \quad (3.11)$$

$$\frac{\partial \sum e_i\, 2}{\partial \beta_2} = 2 \sum x^2(Y - \beta_0 - \beta_1 x - \beta_2 x^2 - \beta_3 x^3)$$

$$\sum x^2 Y = \beta_0 \sum x^2 + \beta_1 \sum x^3 + \beta_2 \sum x^4 + \beta_3 \sum x^5 \quad (3.12)$$

$$\frac{\partial \sum e_i\, 2}{\partial \beta_3} = 2 \sum x^3(Y - \beta_0 - \beta_1 x - \beta_2 x^2 - \beta_3 x^3)$$

$$\sum x^3 Y = \beta_0 \sum x^3 + \beta_1 \sum x^3 + \beta_1 \sum x^4 + \beta_2 \sum x^5 + \beta_3 \sum x^6 \quad (3.13)$$

Combine equation (3.10) - (3.13) we have

$$\sum Y = n - \beta_0 + \beta_1 \sum x + \beta_2 \sum x^2 + \beta_3 \sum x^3$$
$$\sum xY = \beta_0 \sum x + \beta_1 \sum x^2 + \beta_2 \sum x^3 + \beta_3 \sum x^4$$
$$\sum x^2 Y = \beta_0 \sum x^2 + \beta_1 \sum x^3 + \beta_2 \sum x^4 + \beta_3 \sum x^5$$
$$\sum x^3 Y = \beta_0 \sum x^3 + \beta_1 \sum x^3 + \beta_1 \sum x^4 + \beta_2 \sum x^5 + \beta_3 \sum x^6$$

From equation (3.10)

$$\beta_0 = \frac{\sum \gamma - \beta_1 \sum x - \beta_2 \sum x^2 - \beta_3 \sum x^3}{n} \quad (3.14)$$

Substitute β_0 to equation (3.11), (3.12), and (3.13).

From equation (3.11)

$$\sum xY = \sum x \left(\frac{\sum Y - \beta_2 \sum x - \beta_2 \sum x^2 - \beta_3 \sum x^3}{n} \right) + \beta_1 \sum x^2 + \beta_2 \sum x^3 + \beta_3 \sum x^4 \quad (3.15)$$

$$n\sum xy = \sum x \sum y - \beta_1 (\sum x)^2 - \beta_2 \sum x \sum x^2 - \beta_3 \sum x \sum x^3 + n\beta_1 \sum x^2 + n\beta_2 \sum x^3 + n\beta \sum x^4 \quad (3.16)$$

4. PRESENTATION OF DATA

The data obtained from the Statistical Bulletin of the Central Bank of Nigeria, 1990-2017 are presented in the table.

4.1 Data Analysis

4.1.1 Polynomial Regression Model Analysis for M1

$$lnRm1 = -0.935^{***} + 1.116lnGDP/P^{***} - 0.018TB3^{**} + 0.051INF^{**} - 0.007INF2^{**}$$
$$se = \quad (0.271) \quad (0.036) \quad (0.008) \quad (0.022) \quad (0.003)$$
$R^2 = 0.973$ Adjusted $R^2 = 0.971$

se = Standard error
*** = Significant at 1 percent level ** = Significant at 5 percent level

The equation shows that the relationship between money demand and inflation is non-linear because INF2 is significant at 5 percent level. When the inflation rate is moderate or less than 3.64 percent, inflation is positively correlated to money demand. As inflation rate increases, money demand will be increasing but at a decrease rate. When the inflation rate is high or increase more than 3.64 percent, an increase in inflation rate will reduce the desire to hold money. Inflation will become negatively correlated to money demand.

Besides, the finding also suggests money demand is a function of inflation and inflation is an important factor and should include in the money demand function. This is because the estimates of the inflation coefficient is statistical significant at 5 percent level. Inflation is not only play an implicit role in money demand function.

However, the conflict still remains because it is believed that rate of inflation and rate of interest are closely correlated. As mention by Fisher hypothesis, when the inflation rate is moderate, variation in the inflation rate can be captured by variation in nominal interest rate. Therefore, incorporating both inflation rate and interest rate in the money demand equations often lead to multicollinearity and biased estimates of their coefficients. But, as noted, the result of individual t test shows that all of the partial slope coefficients are statistically different from zero although the R^2 is high. Hence, it will not be a problem to include both inflation rate and interest rate in a same equation because the classic symptom of multicollinearity is not existence. Income elasticity and interest elasticity are equal to 1.116 and -0.0794 respectively. Both have a correct sign and significant at 1 percent level and 5 percent level. Since R^2 can at most be 1 means that variation in the money demand is explained well by model.

4.1.2 Polynomial Regression Model Analysis for M2

$$lnRm2 = -1.734^{***} + 1.442lnGDP^{***} - 0.014TB3 + 0.068INF^{**} - 0.008INF2^{**}$$
$$se = \quad (0.327) \quad (0.044) \quad (0.009) \quad (0.027) \quad (0.003)$$
$R^2 = 0.975$ Adjusted $R^2 = 0.973$

se = Standard error

*** = Significant at 1 percent level ** = Significant at 5 percent level

The equation shows that the relationship between money demand and inflation is non-linear because INF2 is significant at 5 percent level. When the inflation rate is moderate or less than 4.25 percent, inflation is positively correlated to money demand. Inflation rate increase, money demand will be increasing but at a decrease rate. When the inflation rate is high or increase more than 4.25 percent, an increase in inflation rate will reduce the desire to hold money. Inflation will become negatively correlated to money demand. This result is consistent with the result of Threshold model. Besides, the finding also indicate that money demand is a function of inflation and inflation is an important factor should include in the money demand function if compared with discount rate of treasury bills because the estimates of the inflation coefficient is statistical significant at 5 percent level. However, the estimate of discount rate of treasury bills is statistical not significant. This insensitivity of M2 with respect to discount rate of treasury bills might be due to the certain component of M2 is interest-bearing instrument. Regarding to the report from central bank, fixed deposit is the major component in Narrow Quasi-money. Interest rate of fixed deposit is higher than discount rate of treasury bills. Therefore, it is less attractive for people to substitute money for it. Income elasticity is equal to 1.442 and the coefficient is significant at 1 percent level.

5. CONCLUSION

Inflation plays an important role in demand for M1. M1 is a function of inflation rate besides the rates of return of alternative assets and real income. The high and moderate inflation have different influence on demand for M1, following the empirical results of polynomial regression model. Results of polynomial regression show that the relationship between inflation and demand on M1 is nonlinear and represents a parabola. When the inflation rate increases above 3.64 percent, relationship between inflation and demand for M1 will become negative. Results of polynomial regression model also shows that inflation is negative in relation to money demand; when the rate of inflation is above a critical level of inflation.

Relationship between inflation and money demand follows the quadratic function. Demand for M2 is only a function of rate of inflation and real income because treasury bills rate is statistically insignificant. During the high inflation period, inflation is negative correlated with money demand. High money growth is consistent with high inflation, a low real money demand (high money velocity). The results for the high inflation are consistent with Cagan (1956) for high inflation economies. On the contrary, inflation is positive correlated with money demand for the moderate inflation period. Quantity theory of money, which states that institutional and technological features of the economy would affect velocity only slowly over time, so velocity would normally be reasonably constant in the short run. However, the empirical evidence suggests that money velocity is in general volatile, contradicting the assumption of a stable money demand.

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