IS LONG-RUN MONETARY NEUTRAL? EVIDENCE FROM INDONESIA

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Abstract

This paper examines the long-run monetary neutrality in Indonesia, mainly using annual time-series during 1970-2007. It uses Fisher-Seater methodology to analyze the research problems. Particular attention is given to integration, exogeneity, and cointegration properties of the money stock and real output. Unit-root, causality, and cointegration tests are used to identify these properties. The empirical results provide evidence to reject the long-run neutrality of money (both M1 and M2) with respect to real GDP, showing that it is inconsistent with the classical and neoclassical economics. In particular, government injections of money have long-run positive effect on real output in macroeconomy.

Keywords: Monetary neutrality, unit root, exogeneity, government injections of money
JEL classification numbers: C32, E13, E41, E51

INTRODUCTION

A question that remains an issue of interest to economists is whether a permanent change in money supply affects only nominal variables without affecting real variables. Or, simply put, "Is money really neutral?" The question, in quite a long time, rises thinking among monetary economists that injection of money or monetary expansion by the government into macroeconomy has a definite neutral effect. Among the economists, especially monetary economists, the neutrality of money becomes a long debated issue. So far, long-run neutrality is considered as something given, namely as an axiom or a logical consequence of the employed assumption both in economic theories and in the consideration for policy-making.

Lucas (1995) described the neutrality of money as a situation where the change in money supply will simply cause the change in nominal variables such as price, nominal exchange rate, and nominal wage without causing any changes in real variables such as output, consumption, investment and employment. The idea was proposed by a classical economist, Hume (1752), who stated that an increase in money supply did not cause any effect on employment, investment and output growth rate. Furthermore, the concept of superneutrality of money is used as well. It stated that a change in the rate of money supply in an economy will not alter variables of real economy, except inflation. The concept of neutrality and superneutrality differ in the changes in money stock and growth rate to changes in real variables.

The hypothesis of long-run monetary neutrality that remained an issue to be studied and tested is based, by and large, on the classical monetary theory, neoclassical model or real business cycle model. The theory proposes that money is neutral in an economy or generate no effect on real variables, since it merely affect the level of price, as Hume and Lucas suggested.

Literature on testing long-run monetary neutrality increases after the issue of monetary neutrality regains the attention from, and more intensively studied by, researchers and academicians. Researchers who have interest in monetary neutrality collected empirical evidence regarding the proposition of monetary neutrality. A number of studies has been conducted following the initial study by King and Watson (1992, 1997) and by Fisher and Seater (1993) in the United States. Similar studies were then conducted by researchers in several countries in North and South America, Australia, Asia, including South and Southeast Asia, as well as by those in Europe and Africa. The researchers, to mention but a few, include Boschen and Otrok (1994), Olekalns (1996), Haug and Lucas (1997), Serletis and Koustas (1998, 2001), Bae and Rath (2000), Shelley and Wallace (2003), Noriega et al. (2005), Wallace and Cabrera-Castellanos (2006), Chen (2007), and Puah et al. (2008). Most of the studies adopt Fisher and Seater (1993), and King and Watson (1992, 1997) methodologies, and some of them have expanded the methodologies. Especially for the case in Asian countries, a number of studies conducted by, among others, Oi et al. (2004) for the case of Japan, by Ran (2005) for Hong Kong, by Chen (2007) for South Korea and Taiwan, and by Puah et al. for the cases in 10 countries registered as the members of *South East Asian Central Banks (SEACEN) Research and Training Centre*. In some cases there is evidence found to support the existence of the neutrality of money, but no evidence of money superneutrality was found. Meanwhile, other studies found no substantial evidence that support the existence of both neutrality and superneutrality of money in certain countries. Empirical evidence in Indonesia as a member of SEACEN indicates that the assessment results rejected the existence of long-run monetary neutrality for the assessment period of 1965-2002 by using M1 against GDP.

This study aims to empirically test the proposition of long-run neutrality of money, defined either as M1 or M2, against real output rate in Indonesia. The current study uses sequential data and put the emphasis on the period after the commencement of the financial deregulation in 1983 which affects the money supply. It is motivated by the small number of research on testing long-run monetary neutrality in the developing countries of Southeast Asia including Indonesia. In the latter, this kind of research remains uncommon, and there seem no results of this kind of research that is currently published.

This paper begins with an introduction that conveys the reasons why current research that investigates the long-run monetary neutrality is important and needs to be done for the case of Indonesia. The methodology section describes the Fisher-Seater methodology and its precondition tests, which include integration, exogeneity, and cointegration. The next section presents the results of research and discussion. The last section concludes and provides some suggestions.

METHODS

Variables and Data

This study uses annual data with the time period of 1970-2007. It chooses annual rather than quarterly data, given that the former has a longer observation than the latter. This condition is more supportive for the long-run analysis. Included in the study period is lag[1] element necessary in its analysis.

Data analysis using the Fisher-Seater method began in 1983, the year of

[1] Lags are required to keep a sufficient number of observations, and in order that they do not drastically decrease as we add k to the OLS regression using Fisher-Seater methodology.

banking deregulation initiation with its June Package 1983 (Pakjun 83) assisted with lag time data until the year 1970. This policy package resulted in credit expansion and thus affects the development of M1 and M2. Both money (*m*) variables of interest should be investigated to determine the effect on real macroeconomic variables such as output (*y*), as well as on nominal variables such as prices. Real output data are based on 2000 constant prices or 2000 = 100. The real output is represented by the real gross domestic product (GDP) at 2000 constant prices. Preliminary data were obtained from the Indonesian Financial Statistics (SEKI) and the Annual Report of Bank Indonesia from various publications.

M1 variable represents the narrow definition of money supply. M1 includes currency and demand deposits, such as checks and checking accounts. M2 variable is a broad definition of money supply that includes M1 plus near monies, such as savings in commercial banks (savings deposits) and time deposits. Thus currency plus demand deposits constitute Ml, and M1 plus quasi money or time deposits constitute M2.

Integration and Exogeneity Tests

Integration level of the variables employed in the Fisher-Seater methodology will determine the appropriate form of its test. In this case, the data of money serial number and the output will determine the appropriate form of Fisher-Seater test to examine the long-run monetary neutrality.

Fisher-Seater model requires that the testing of long-run neutrality of the variables used have the same orders of integration, in this case I(1) is assumed. Therefore, in the application of Fisher-Seater methodology for this testing, it is assumed that money and output variables constitute I(1). To test the orders of integration of the data series of the variables used, we did test the unit roots by Augmented Dickey-Fuller test (ADF) and Phillips-Perron (PP).

Meanwhile, Phillips and Perron (1988) propose a nonparametric method for controlling high-order serial correlation in a series. When the ADF test corrects high order serial correlation by adding lagged difference terms on the right side of the equation, the PP test corrected *t*-statistic coefficients of γ regression AR(1) to compute the serial correlation in ε.

Furthermore, to determine that the Fisher-Seater methodology is feasible, it must be assumed that the variables of money, in this case, M1 and M2, are exogenous. M1 and M2 as *m* variables can be said exogenous if they are not influenced or caused by the *y* variable in the Granger causality test against the following form of bivariate regression:

$$y_t = \sum_{i=1}^{n} \alpha_i m_{t-i} + \sum_{j=1}^{n} \beta_j y_{t-j} + u_{1t} \quad (1)$$

$$m_t = \sum_{i=1}^{n} \lambda_i m_{t-i} + \sum_{j=1}^{n} \delta_j y_{t-j} + u_{2t} \quad (2)$$

It is assumed that disturbaces u_1 and u_2 are not correlated. Based on the equation (2) of the bivariate model, money (*m*) is said to be exogenous if the results of the estimation accept H_0: $\delta_j = 0$. The hypothesis implies that the output variable (*y*) did not cause or affect variables of money (*m*) or, conversely, that the variable of money (*m*) is not caused or influenced by the output variable (*y*).

The test rejects H_0 if statistical $F(m, n - k)$ > critical $F(m, n - k)$ at $\alpha = 5\%$, with $m,n - k$ degrees of freedom, where m = number of lags, n = number of observations, and k = number of estimated parameters. Causality test based on equation (1) and (2) to test this exogeneity refers to Hafer (1982) as presented in Gujarati and Porter (2009)[2], who use money growth (*m*) and output growth (*y*), in its examination can also be denoted as Δm and Δy, respectively.

[2] See Gujarati and Porter (2009), p. 655.

Cointegration Test

Cointegration test was conducted to determine the long-run relationship between the estimated variables. Fisher and Seater (1993) argue that monetary neutrality involve permanent changes in money supply. Therefore, according to Engle and Granger (1987), both nominal and real variables need to be I(1), but neither were cointegrated. Cointegration test in this multivariate system is Johansen's (1995) approach based on the following formulation model:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{k-1}\Delta Y_{t-k+1} + \prod Y_{t-k} + \varepsilon_t \quad (3)$$

where k = number of lags

The hypothesis test with this approach uses a statistical value refered to as the Likelihood Ratio (LR) test statistic. This test rejects H_0 stating no cointegration if the LR statistic > its critical value at selected α.

Fisher-Seater Methodology

Fisher and Seater define the long-run monetary neutrality in terms of the long-run derivative (LRD) as a change in z with respect to a permanent change in x, as follows:

$$LRD_{z,x} \equiv \lim_{k\to\infty} \frac{\partial z_{t+k} / \partial u_t}{\partial x_{t+k} / \partial u_t} \quad (4a)$$

where $\lim_{k\to\infty} \partial x_{t+k} / \partial u_t \neq 0$

Equation (A1) shows that long-run derivative is a limit of output elasticity with respect to money. If limit of denominator on equation is zero, it is no permanent change on monetary variable, then (m) = 0, therefore long-run neutrality test cannot be applied. For (m)≥1, Fisher-Seater methodology shows that equation (4a) can be written as:

$$LRD_{y,m} = \frac{(1-L)^{\langle m\rangle - \langle y\rangle} \gamma(L)\big|_{L=1}}{\alpha(L)} \quad (4b)$$

where $\alpha(L)$ and $\gamma(L)$ are functions from coefficient of Fisher-Seater's bivariate equations: $\alpha(L)=d(L)/[a(L)c(L)-b(L)c(L)]$ and $\gamma(L)=c(L)/[a(L)c(L)-b(L)c(L)]$.

According to Fisher and Seater, money is neutral on the long run (long-run neutrality, LRN), if $LRD_{y,m} = \lambda$, where $\lambda = 1$ if y is a nominal variable, and $\lambda = 0$ if y is a real variable. Meanwhile, money is superneutral in the long run (long-run superneutrality, LRSN), if $LRD_{y,\Delta m} = \mu$, where $\mu = 1$ if y is a nominal variable, and $\mu = 0$ if y is a real variable.

Fisher and Seater (1993) used bivariate system to test the long-run monetary neutrality, with money as one of the variables, subsequently known as Fisher-Seater methodology. The employed bivariate system is the following forms of two equations:

$$a(L)\Delta^{\langle m\rangle} m_t = b(L)\Delta^{\langle y\rangle} y_t + u_t \quad (5a)$$

$$d(L)\Delta^{\langle y\rangle} y_t = c(L)\Delta^{\langle m\rangle} m_t + w_t \quad (5b)$$

where $a(L)$, $b(L)$, $c(L)$ and $d(L)$ are polynominal lags, and $a_0 = d_0 = 1$ and b_0 and c_0 are unrestricted vector errors $(u_t, w_t) \sim iid$ $(0, \Sigma)$. In this methodology, it is assumed that $x_t \equiv \Delta^i m_t$ and $z_t \equiv \Delta^j y_t$ with i,j = 0 or 1. The first variable is m, which is the money supply of nominal M in natural logarithm. The second variable is y which also denoted the real and nominal variables in natural logarithms, such as real output or prices. If variables m and y were not integrated on the level, or I(0), both variables must have the same orders of integration, for example, they were integrated at the first order or I(1), which mean that both variables were integrated on the first difference. If the variable m is I(1), a proper testing would be to test the long-run neutrality, while if the variable m is I(2), the appropriate testing would be to test the long-run superneutrality.

Assuming that the variable of mon-

money supply is exogenous and the error term u_t and w_t represented series not correlated in ARIMA model, then $c(1)/d(1)$ is Bartlett estimator[3] from zero frequency coefficients in the regression of $\Delta^{(y)} y_t$ on $\Delta^{(m)} m_t$. Estimation of $c(1)/d(1)$ is given by $lim_{k\rightarrow\infty}\beta_k$, where β_k is a slope coefficient of the following ordinary least squares (OLS) regression:

$$\left[\sum_{j=0}^{k}\Delta^{\langle y\rangle} y_{t-j}\right]=\alpha_k+\beta_k\left[\sum_{j=0}^{k}\Delta^{\langle m\rangle} m_{t-j}\right]+\varepsilon_{kt} \quad (6)$$

When $(m) = (y) = 1$, long-run neutrality can be tested and thus equation (6) becomes:

$$\left(y_t - y_{t-k-1}\right)=\alpha_k+\beta_k^{'}\left(\Delta m_t-\Delta m_{t-k-1}\right)+\upsilon_{kt} \quad (7)$$

$\beta_k = 0$ in null hypothesis testing to determine the long-run neutrality. The estimation results not rejecting the null hypothesis implied that the proposition of long-run neutrality of money is empirically supported. In the discussion, the estimated value of β_k is presented together with 95% confidence interval[4], which is determined based on the standard error and *t*-distribution with degrees of freedom *n/k*.

In this paper we have re-examined the issue of long-run monetary neutrality using reduced-form test of Fisher-Seater, which is conducted via classic methods of I(0)/I(1) hypothesis. According to Fisher-Seater test employed in this paper, we have not allowed a structural break that is exogeneously determined by model in the testing of the long-run monetary neutrality hypothesis.

[3] Bartlett estimator is an infinite limit of slope coefficient.

[4] Standard error used in the estimation is a standard error from coefficient obtained from OLS estimation with consideration that number of observations is not large. Therefore, in small samples we do not use standard error obtained from estimation of Newey-West (1987).

RESULTS DISCUSSION

Variables and Data

This section begins with an analysis of the development of the main variables, namely M1, M2, and output variables. M1 and M2 variables are used to test the monetary neutrality to the real variables, i.e. the output is represented by the level of real Gross Domestic Product at constant prices (2000 = 100).

In terms of the money supply in Indonesia, both as measured by money in narrow sense (M1) and in the broad sense (M2) in Table 1, both variables, historically, showed their progress from year to year. At least within the last ten years, the amount of money M1 and M2 show significant and continuous improvement.

Table 1: M1 and M2 in Indonesia in 1998–2007 (Rp billions)

Year	M1	M2
1998	101,197	577,381
1999	124,633	646,205
2000	162,186	747,028
2001	177,731	844,053
2002	191,939	883,908
2003	223,779	955,692
2004	253,818	1,033,527
2005	281,905	1,193,215
2006	361,073	1,382,074
2007	460,842	1,643,203

Source: Indonesian Financial Statistics, Bank Indonesia

The data in this paper are from Indonesian Financial Statistics, Bank Indonesia and Statistical Year Book of Indonesia, Badan Pusat Statistik, Indonesia.

M1 is the variable that describes the liquidity of the economy. Figure 1 show that the liquidity of the economy reflected from the M1 has increased over the period of 1970-2007. The growth of M1 demonstrated also a rapid increase since the early 1990s.

Observed from its growth, M1 has a fluctuated growth rate. Figure 2 illustrated the growth rate of M1 that is relatively high compared to the growth of other macroeconomic variables such as output and prices. During the period 1971-2007 the average growth rate of M1 was 23.03%. Its highest growth occurred in the year 1972 amounted to 48.44%, while its lowest growth of 6.29% occurred in 1983. After 1983, the growth rate of M1 has increased within higher range. It seems that the banking deregulation initiated with the Package of June 1983 had its effect on the M1 growth rate. Credit expansion by the banking sector has contributed significantly to the rapid increase in M1.

At the end of the study period in 2007, the liquidity of the economy in the narrow sense (M1) grew by 27.63% above the average to reach the level of Rp. 460.842 trillion. According to the report of Bank Indonesia, the growth of domestic liquidity with M1 parameter is relatively high compared to its historical condition, which is the increasing liquidity preference of people as indicated by the accelerated growth of savings deposits.

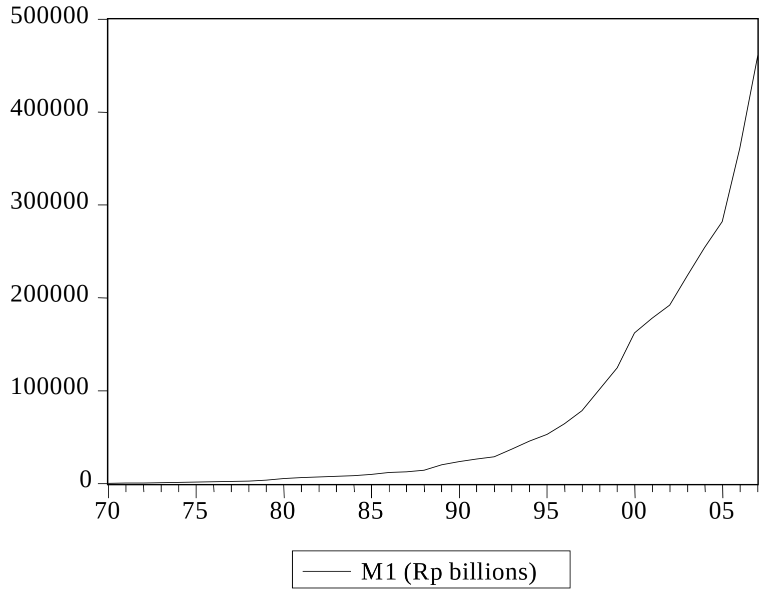

Figure 1: M1 in Indonesia, 1983-2007 (Rp billions)

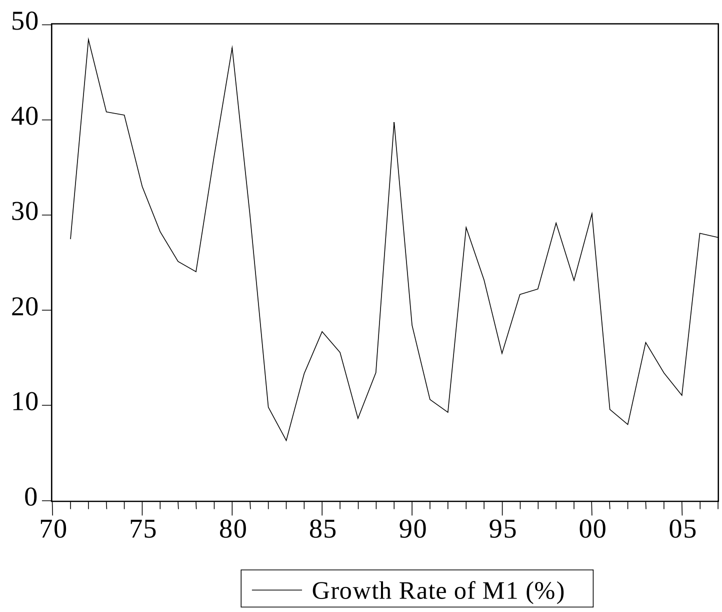

Figure 2: M1 Growth in Indonesia, 1971-2007 (% per year)

Domestic factors are quite dominant in influencing the liquidity growth. Domestic factor in the form of lending to the business sector dominates the performance of liquidity in the economy. According to the report of Bank Indonesia, at the end of 2007, total credit to the business sector has increased by 26.4% or Rp 208 trillion from the end position in 2006. In addition to internal factors, the liquidity growth in the economy is also affected by external factors, such as the growth of the Net Foreign Assets - (NFA), which increased by 27.0% or Rp. 111.4 trillion. The growth has occurred at Bank Indonesia's NFA in line with the increased foreign exchange reserves derived from oil and gas commodities due to higher oil prices.

In addition to M1, M2 is also a variable that describes the liquidity of the economy. Figure 3 shows that the liquidity of the economy, as reflected by M2, also increased with the dynamic pattern that almost identical to that of M1 over the period 1970-2007. M2 growth that tended to rise higher than that of the M1 illustrated the rapid increase for M2 in the years before the economic crisis in mid-1997.

The growth rate of M2, as well as M1, was also fluctuated. Figure 3 illustrates the growth rate of M2 growth that is relatively more extreme compared to that of M1. However, the average M2 growth during the period 1971-2007 has reached 22.49%, which is slightly lower than the average growth of M1 (23.03%). M2 highest growth was achieved in 1998 (62.35%), while its lowest growth was achieved in 2002 (4.72%). Following the year of 2002, M2 kept increasing until 2007.

In 2007, the liquidity of the economy in a broad sense (M2) has reached 18.89%. While the M2 growth remains below average, it has reached the level of Rp. 1643.203 trillion. Despite the rise in M2 growth, it is relatively lower compared to its historical conditions, with the dynamic patterns that are different from that of M1.

Figure 5 illustrates that the growth rate of output represented by real GDP, based on the base year of 2000, during the period 1970-2007 showed a tendency to increase. However, the decrease has occurred also in that period, exactly the year 1998, as a result of the economic crisis in mid-1997. In 1999, real GDP increased again although the level of real GDP was only restored in 2004 and subsequently it continued to increase until the year 2007.

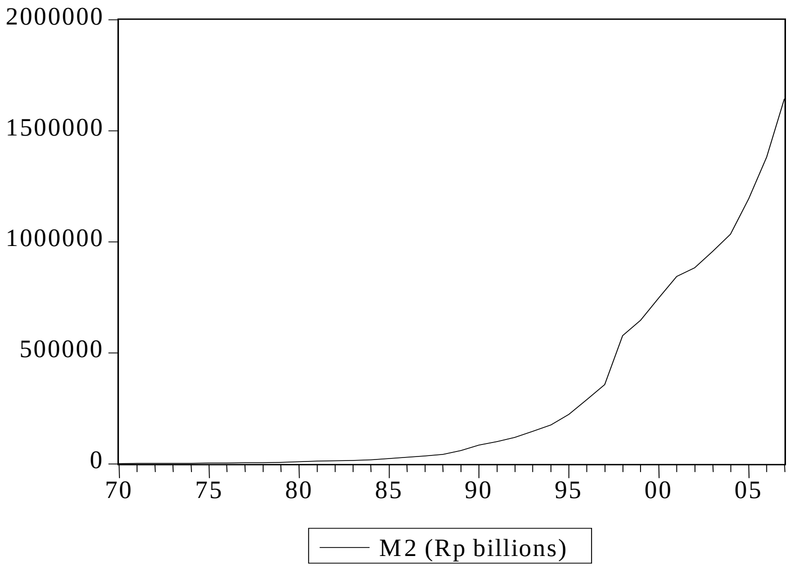

Figure 3: M2 in Indonesia, 1970-2007 (Rp billions)

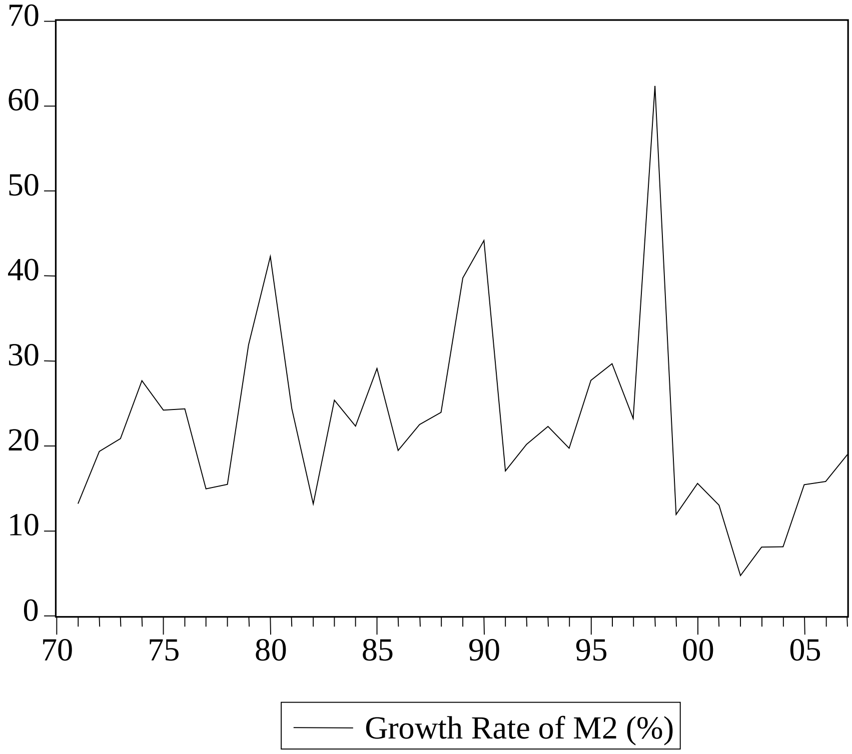

Figure 4: M2 Growth in Indonesia, 1971-2007 (% per year)

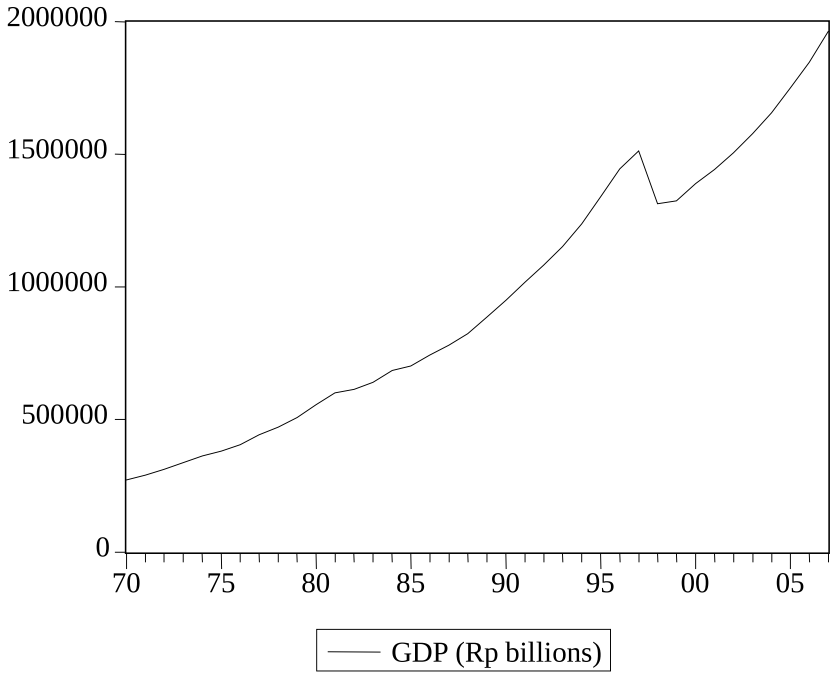

Figure 5: GDP of Indonesia at 2000 Constant Price, 1971-2007 (Rp billions)

The increase in output during the period of this study indicates that the real sector growth is reflected in the rising value of real GDP from year to year, except during the economic crisis. Overall, in normal economic conditions, figure 5 shows the growth of real sector in Indonesia with an indication of the increase in real GDP. The increase in real GDP is a better indicator that describes the economic growth than nominal GDP indicator does, since the former is already eliminated the effect of inflation. If economic growth is measured by nominal GDP, the latter was then, during economic crisis in 1998, continues to increase because it was assessed in very high prices due to inflation in that year. Therefore, this indicator can not be used to describe the macro-economic growth.

Figure 6 illustrates that with the calculation of real GDP, Indonesian output has experienced positive growth except in 1998 which has grown extremely negative to -13.13%. The graph of output growth demonstrated that during the study period the highest growth has occurred in 1980 due to the positive impact of the oil boom era with the growth rate of 9.88%. Average output growth during the period 1971 - 2007 is 5.56%.

The output as measured by real GDP in the period after the crisis regained its positive growth, though still in the range of low growth. In 1999 the output was only increased by 0.79%, well below its average, but in 2000 it has grown 4.92%, which showed early indications of the economic crisis recovery process. Its growth was then relatively stable until 2003. It is only in 2004 that the output achieved the level of 5.03% and the growth rate above 5% range lasted until 2006 before it rising at 6.32% in 2007.

Structural Changes

However, a graph showing extreme changes in data development, especially for M2 and GDP, is not necessarily provide definitive conclusions regarding the occurrence of structural changes during the observation period. Structural changes had been estimated to occur in time of economic crisis in Asia that begins with the currency crisis that subsequently spread to Indonesia.

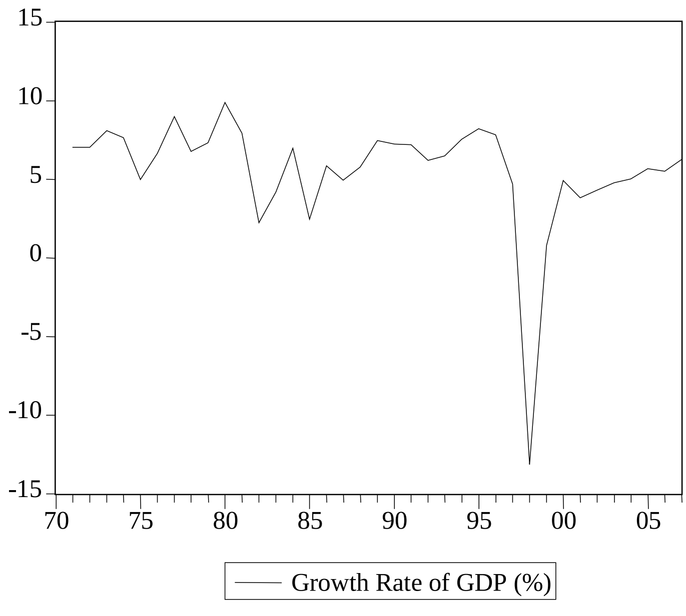

Figure 6: GDP Growth of Indonesia at 2000 Constant Prices, 19712007 (% per year)

Therefore, effort to determine the structural changes in these variables was done, among others, with the Zivot-Andrews test[5]. This test was conducted based on, especially, model C of Zivot-Andrews, considering that the model C has its superiority in estimation. The use of model C is also recommended by Sen's (2003) and Waheed's (2006) studies, compared to model A[6]. Meanwhile, Perron (1997) suggest the use of either model A or C. The test results of structural break using the Zivot-Andrews tests are presented in Table 2.

Table 2: The Results of Structural Break-Test of Zivot-Andrews (One-Break)

Variable[a]	t-statistic[b]	Break-Points[c]
m_1	-3.6169	1997
m_2	-6.2644***	1997
y	-6.1154***	1997

Notes: (1) [a] all variables at level and ln, (2) [b] estimated based on model C of Zivot-Andrews' test with $k = 1$. (3) [c] determined based on the minimum t-statistics of test simulation with λ ranging from 2/T to T-1/T, where T is the sample, (4) *** significant at 1% level, (5) Critical values of Zivot-Andrews' are -5.57; -5.08 and -4.82 for 1%, 5%, and 10% significance levels, respectively.

The result of Zivot-Andrews' unit root test of the three variables as reported in Table 2 indicate that the test results from two of the three variables rejected the unit-root null hypothesis. It means that the M2 and real GDP have experienced a structural change in 1997, while M1 variable has not.

The point in time where structural changes occur is the year 1997 for M2 and real GDP. This time point was consistent with initial expectations that structural changes will occur around the economic crisis in Indonesia, as shown in Figure 4 (extremely positive growth of M2) and Figure 6 (extremely negative of real GDP).

However, according to Fisher-Seater test employed in this paper, we have not allowed for a structural break in the estimation of long-run monetary neutrality. Because of the assumption that it is exogeneously determined by model, a structural break in the data is not taken into account in the testing of long-run monetary neutrality. Thus, the structural breaks are discussed only in the previous section.

The Orders of Integration and Exogeneity

Table 3 below demonstrated that the unit root test of variables of money (m_1 and m_2) and real outputs (y) is not stationary[7] at the level.

Through the Augmented Dickey-Fuller (ADF) test, the computed ADF values are still higher than the critical values (MacKinnon's critical values[8]) with α=5%. This test results implied that the three variables are not stationary in level or not I(0). When these variables are not I(0), this test shows that the three variables in their first differences (Δ) become stationary or integrated in the same order, that is I(1). Overall, the results of this test are also supported by the Phillips-Perron (PP) test. Test results in Table 3 show that the computed ADF and PP values decreased significantly from levels to first differences so that the value of both become smaller than the criti-

[5] This test is based on equation: $\Delta y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t$

where $DU_t(\lambda) = 1$ if $t > T\lambda$, 0 otherwise; $DT_t^*(\lambda) = t - T\lambda$ if $t > T\lambda$, 0 otherwise. $\hat{\lambda}$ parameters in the equation correspond to estimated values of the break fraction. Since, t-statistic from estimation of $\hat{\alpha}$ exceeds the critical value at break point, we may reject the unit-root null hypothesis at the chosen level of significance.

[6] See complete model in Zivot and Andrews (1992).

[7] A time series is stationary if its mean and variance do not vary systematically over time.

[8] ADF critical value for level is -2.9850; ADF critical value for first difference is -2.9969; PP critical value for level is -2.9850; PP critical value for first difference is -2.9907.

critical values. This results mean that the money (both M1 and M2) and real output variable (GDP) in the estimated model are integrated equally or I(1).

To examine the long-run monetary neutrality, either by using the M1 or M2 variables, to output variable (*y*), the application of Fisher-Seater methodology can be performed when the variable of money (M1 and M2) and the *y* variable *were* integrated equally or I(1). Since the M1 and M2 variables represent I(1), it is only relevant in the current study to test the long-run neutrality, rather than that of long-run superneutrality.

In the application of Fisher-Seater methodology, it is also assumed that M1 and M2 variables are exogenous. Therefore, this assumption must be met before using Fisher-Seater methodology to test the long-run monetary neutrality. The test results of M1 and M2 exogeneity using Grange causality test are based on the estimated equation (2) as presented in Table 4. The table shows that M1 variable provided strong evidence for exogeneity. M1 variable is exogenous since it was caused or affected by the output variable (*y*) itself.

Through the testing by one to four lags, M1 growth variable or Δm_1 is not affected by the output growth or Δy since the computed *F*-value is not significant at α=5%, which mean that the test results accept the H_0: δ_j=0. Meanwhile, the M2 variables at the same level of reliability indicated as a exogenous variable when the testing is using two to four lags, thereby it reaches the similar conclusion that H_0: δ_j=0 is accepted. The testing with one lag at α=5% shows that H_0 was rejected. In other words, the result demonstrates exogeneity representing the initial indication that M2 was not neutral prior to the testing using Fisher-Seater methodology.

Table 3: The Results of the Unit Root Variables Test in the Model

Variable	ADF	PP	Variable	ADF	PP
m_1	0.6768	0.9090	Δm_1	-4.1008	-3.9697
m_2	-1.8744	-2.0017	Δm_2	-2.1893	-3.4990
y	-0.8902	-0.9109	Δy	-3.0457	-3.5960

Notes: (1) Testing ADF: equation with a constant; 1 *lagged differences*, (2) Testing PP: equation with a constant; 3 truncation lag.

Table 4: The Results of Exogeneity Test of M1 and M2 Variables with Granger-Causality

H_0: $\delta_j = 0$	$F(m,n-k)$
$\Delta y \rightarrow \Delta m_1$	F(1;21) = 0.1704 (0.6839)
	F(2;18) = 0.5171 (0.6048)
	F(3;15) = 1.6528 (0.2196)
	F(4;12) = 1.1536 (0.3785)
$\Delta y \rightarrow \Delta m_2$	F(1;21) = 6.7289 (0.0169)
	F(2;18) = 2.9260 (0.0794)
	F(3;15) = 2.3028 (0.1186)
	F(4;12) = 1.3414 (0.3107)

Notes: (1) *m* = number of lags; *n* = number of observations; *k* = number of estimated parameters, (2) Entries in parentheses are the *p*-values.

Cointegration

Cointegration test results in Table 5 show that the nominal variables (M1 and M2) and real variables (real output) are not cointegrated. Upper part of the table include the *LR* statistic values as the cointegration test between M1 and real output variables, while the lower part includes the *LR* statistic values as the results of cointegration test of M2 and real output variables, with each of four lags.

Table 5: Cointegration Test Results

Variable Series	p	*Likelihood Ratio*	
		r = 0	r ≤ 1
m_1 y	1	8.1723	0.0004
	2	15.2775	0.0938
	3	12.4948	0.0042
	4	13.0601	0.0780
m_2 y	1	14.6569	3.6672
	2	17.4815*	3.3661
	3	14.3639	3.6485
	4	15.0626	4.4090**

Notes: (1) Assumption:
$H_1(r)$: $\Pi y_{t-1} + Bx_t = \alpha(\beta' y_{t-1} + \rho_0) + \alpha_\perp \gamma_0$,
(2) *p* = number of lags; critical value of 5 percent (r = 0) = 15.41; critical value of 5 percent ($r \leq 1$) = 3.76 (3) *: reject $H_0(r)$: no cointegration; (4) **: reject $H_0(r)$: at most one cointegration.

Johansen (1995), assuming that the data series have a linear tendency while the cointegration equation has only intercept, stated that:

$$H_1(\text{r}):\ \Pi y_{t-1} + \text{B}x_t = \alpha(\beta' y_{t-1} + \rho_0) + \alpha_\perp \gamma_0$$

Table 5 demonstrated that M1 and output variables are not cointegrated since they accept H_0 and thereby the long-run neutrality test might use Fisher-Seater methodology. Similarly, for cointegration test between M2 and output variables, it is concluded that both of them are in general not cointegrated since the accept H_0 and thereby the methodology applies also to the long-run neutrality test. However, in tests with two lags for $r = 0$, it seems that the test results reject cointegration. It is indeed an initial indication that M2 will not neutral in the long run. In addition, the cointegration test result will be valid to reject H_0 on *LR* statistic for $r \leq 1$ that rejects H_0 if *LR* statistic for $r = 0$ reject H_0 as well.

Long-Run Monetary Neutrality Tests

Table 6 provides the results of long-run monetary neutrality test of M1 variable using Fisher-Seater methodology based on equation (7). With the testing for k = *1, …., 16*, the value of β_k has increased and changed from negative to positive. The value of β_k represents the estimated response of output change as measured by real GDP (in 1n) to M1 change (in 1n) during the k+1 period. Since k = 7, then shows that β_k sign changes from negative to positive, followed by the lowering of its standard error (SE_k). The lowering of standard error caused its computed t value to increase or its p-value to decrease.

Table 6 shows that with α = 5% money (with M1 measure) become non-neutral in the long run when k = 15 and the coefficient of β_k is positive, even if with α = 10%, M1 is not neutral since k = 12. The results prove that the long-run monetary neutrality is not evident in Indonesia as indicated by M1. This means that M1 nominal variable might affect the real variable, in this case the output variable (y) in the long run.

Figure 7 presents the coefficient of β_k in k values that in accord with 95% confidence interval for the estimation using M1. The figure shows clearly the indication that M1 is not neutral by the increase of β_k and the lowering of standard error. Overall, from k = *1* to k = *16*, the coefficient of β_k increased and followed by sign change since k > 6 before ultimately evidence that M1 is not neutral when k = 12.

Table 6: Regression Results of Long-Run Real Output on M1 in Indonesia

k	β_k	SE_k	t_k	*p-value*
1	-0.1294	0.1219	-1.0617	0.2994
2	-0.2409	0.1312	-1.8360	0.0793
3	-0.2427	0.1402	-1.7318	0.0967
4	-0.1698	0.1375	-1.2352	0.2292
5	-0.1327	0.1361	-0.9745	0.3399
6	-0.0747	0.1431	-0.5218	0.6068
7	0.0054	0.1522	0.0352	0.9723
8	0.0627	0.1498	0.4183	0.6796
9	0.0830	0.1313	0.6321	0.5335
10	0.1045	0.1055	0.9906	0.3322
11	0.1240	0.0834	1.4868	0.1506
12	0.1429	0.0700	2.0432	0.0526
13	0.1463	0.0730	2.0038	0.0576
14	0.1519	0.0752	2.0207	0.0562
15	0.1917	0.0774	2.4778	0.0223
16	0.2530	0.0791	3.1976	0.0047

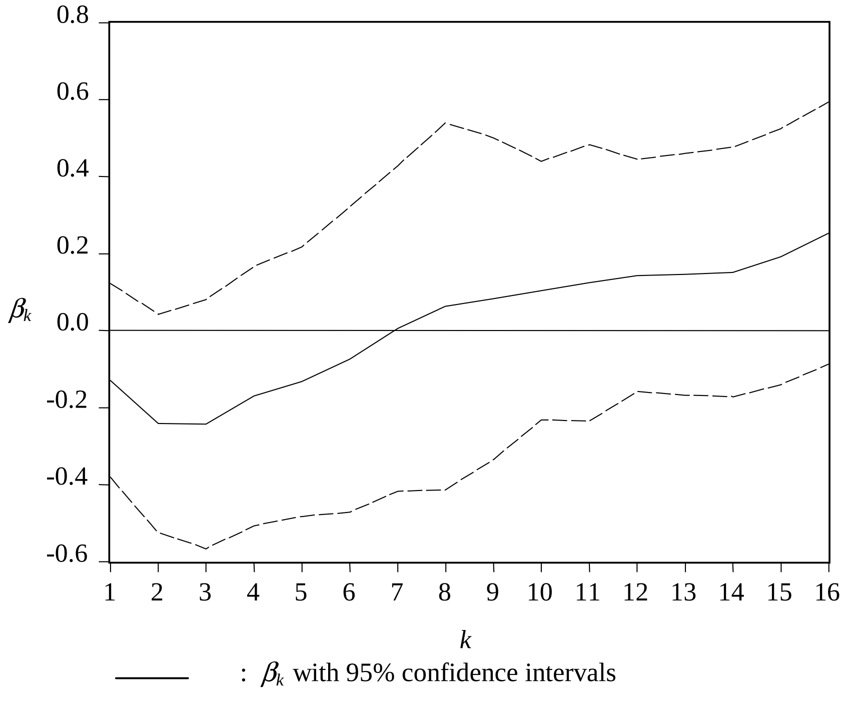

Figure 7: β_k in Long-Run Monetary Neutrality Test in Indonesia Using M1 Variable

Using Fisher-Seater methodology, this test find the evidence that money (with M1 indicator) is not neutral in affecting real variables such as output, thus reject the long-run monetary neutrality for observation period in Indonesia. With the same methodology, this empirical evidence is consistent with Puah et al. (2008) finding that M1 is not neutral in the long run in Indonesia for the period 1965 – 2002. The result is similar to that of Fisher and Seater (1993) who found that the long-run monetary neutrality was rejected for yearly data in United States.

Table 7: The Results of Long-Run Regression of Real Output to M2 in Indonesia

k	β_k	SE_k	t_k	*p-value*
1	-0.1115	0.0888	-1.2557	0.2218
2	-0.0684	0.0842	-0.8120	0.4251
3	-0.0322	0.0809	-0.3976	0.6946
4	0.0154	0.0799	0.1922	0.8492
5	0.0633	0.0799	0.7930	0.4359
6	0.1230	0.0821	1.4993	0.1474
7	0.2006	0.0838	2.3940	0.0252
8	0.2854	0.0826	3.4555	0.0021
9	0.3839	0.0803	4.7840	0.0001
10	0.3335	0.0808	4.1256	0.0004
11	0.2816	0.0824	3.4169	0.0024
12	0.2416	0.0843	2.8667	0.0087
13	0.2174	0.0855	2.5427	0.0185
14	0.2090	0.0886	2.3590	0.0281
15	0.1938	0.0963	2.0125	0.0578
16	0.2018	0.1094	1.8453	0.0806

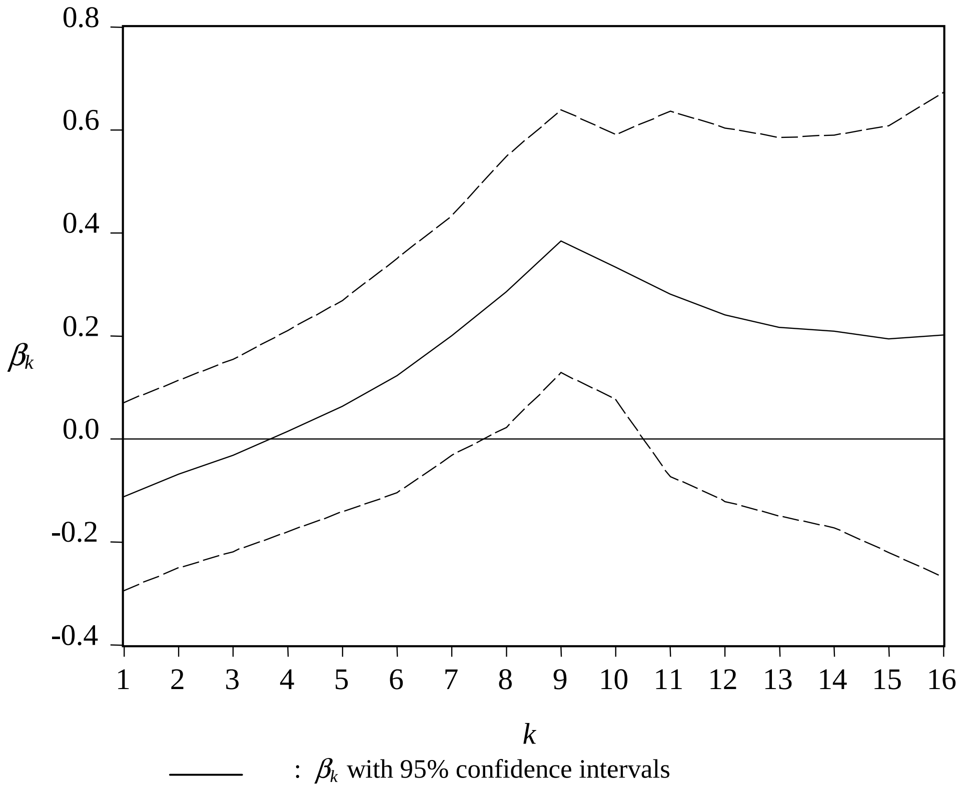

Figure 8: β_k in Monetary Neutrality Test in Indonesia Using M2 Variable

The evidence that the long-run monetary neutrality does not hold in Indonesia is also provided by M2 variable. As with M1, Table 7 shows that using k = 1,..., 16, coefficient of β_k changed from negative to positive. At k = 4, the coefficient changed its sign from negative to positive which subsequently increase before it decrease again on k = 10. However, since k > 6, coefficient of β_k was significant at α = 5% suggesting that M2 is not neutral in the long run.

Figure 8 below shows the coefficient of β_k on k values that in accordance with 95% confidence interval for estimation using M2. The figure indicates that M2 is not neutral with the increase of β_k and the lowering of standard error, and at k > 6 the coefficient is significant at α = 5%. Although lowered at k > 9, the coefficient of β_k remain significant at α = 5% up to k = 14 and remain significant at α = 10% up to k = 16.

M2 non-neutrality, as illustrated in Figure 8 at k > 6, indicates that this evidence supports the earlier M1 non-neutrality. Even with M2, monetary neutrality has been refuted through the test with k value smaller compared to k value in test with M1. It means that, the test using M2 is more sensitive and support the monetary non-neutrality with the addition if k in the initial part of the test. This is consistent with k = 12.

The quick results obtained in determining the long-run monetary non-neutrality for M2 compared to M1 might be caused by differences in measurement between M1 and M2. Since M2 has a wider measure, and includes M1 in it, it is possible that M2 element in the form of time deposits contribute positive impact on Indonesia's GDP. The increase in time deposits contributes to the third party's fund increase. The increase of the third party's fund will increase the magnitude of fund loaned to the business sector with certain loan to deposits ratio so that it might propels the economic activities in real sector to increase the GDP. Therefore, either with M1 or M2, investigation for the research period has found empirical evidence that the long-run monetary neutrality does not prevail in Indonesia.

The fact that no long-run monetary neutrality found in Indonesia, either for M1 or M2 variable, indicates that this evidence was not consistent with the proposition of monetary neutrality according to the neoclassical model and real business cycle theory and Lucas' monetary model. Those theories proposed that money is neutral in the economy that does not influence the real variables, but does have influence on the price level.

CONCLUSION

Estimation using Fisher-Seater methodology preceded with a series of unit roots test, exogeneity test, and cointegration conclude that the long-run monetary neutrality test in Indonesia can be conducted for the Indonesian data during observation period. Estimation results using Fisher-Seater methodology concluded that the long-run monetary neutrality was not hold for the case of Indonesia with annual data. This evidence was not consistent with the proposition of monetary neutrality from neoclassical model and real business cycle theory and Lucas' monetary model. These theories suggested that money was neutral in the economy that did not influence the real variables, since money affected only on price level.

The long-run monetary non-neutrality in Indonesia found in the current study was consistent with that of Puah, et al. (2008) that M1 was not neutral in the long run in Indonesia for the period 1965 – 2002. Furthermore, the long-run monetary non-neutrality in Indonesia was also supported by M2 variable. Overall, this demonstrated that the money non-neutrality tendency represented the characteristics of long-run macroeconomy in Indonesia. However, money was matter in the long run for Indonesian economy.

Suggestions

What the study significantly implies is that the monetary policy made by monetary authority to stabilize the fluctuating macroeconomy is important considering that the output will be affected by the money supply in the long run. Monetary injection in the long run will propel the output increase. However, the government monetary injections, besides their potential to increase the output, they might also caused inflation as many studies concluded. On the one hand, the monetary expansion remains important to propel the long run output increase; on the other hand, it needs to be accompanied by the tighter control over money supply to anticipate the possible inflation. This implies that monetary management must be more structured in considering both sides. Thus, within the inflation targeting framework, monetary authority might constantly focused on inflation without ignoring the importance of money supply for the long-run output increase.

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