Dynamics Linkages among Money, Output, Interest Rate and Price: The Case in Malaysia

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Abstract

This paper aims to examine the factors of monetary policy transmission that affecting output and inflation variability in Malaysia. By using quarterly data from 1980 to 2008, the results suggest that money is a lead output indicator and is also essential to curb inflation and maintain high growth rate in GDP. Interest rate is found as another important intermediate target in the monetary policy transmission mechanism in affecting output variability. The absence of causality from real GDP to price suggests that the excess of aggregates demand generated by increase in real GDP is absorbed by growth in aggregate supply.

Keywords: M2, Interest Rate, Price, Dynamics Linkages, Malaysia

I. Introduction

Malaysia has sustained significant economic growth with more than 8% increase in real GDP for the past nine years before the 1997 Asian financial crisis. Prolong to the rapid economic progress since 1988, rising inflation expectations has been one of the major arising issues currently experienced by policy makers. In this context, Malaysia has been relatively successful in maintaining a low inflation environment (approximately 3.4%) with relatively high GDP growth (approximately 9.3%) per annum for the period 1990-1997(refer to Table 1).

Undeniable that monetary policy has played a major role in maintaining this low inflation, and thereby supporting the conditions for high rate of real output growth. These conditions did not persist over an extended period as 1998 episode of financial crisis has brought severe turmoil to Malaysia, with massive depreciation of local currency and thus caused a sharp increase in domestic price.

Prior to the mid-1990s, the monetary policy strategy had been implemented base on targeting monetary aggregates (M1, M2 or M3). Government first started focused targeting with M1 and shift in focus to M3 when the financial liberalization and innovation has rendered M1 less reliable for policy targeting. Evidence proves that velocities of M1 and M3 and their average values over the last ten year have diverged from their long trend (refer to table 2). Even though M2 showed divergent trend, nevertheless the divergence is comparatively smaller than that of M3. Thus, we employ M2 as monetary targets to examine its efficiency in attaining the stability of output growth and low inflation rate.

Few policy issues and questions arise and remain unresolved. What is the correct choice of a tradeoff between output variability and inflation variability? Do M2 play important role to minimize the tradeoff between these two variables' variability? Is monetary aggregate still an efficient and adequate as policy target? If not, is interest rate targeting is another potential channel for policy targeting?

Thus, this paper aims to examine the dynamic linkages among the money, output, interest rate and inflation to ascertain the importance of the monetary policy transmission mechanism by using Malaysia data. In particular, the specific objectives of this paper are:

1. To investigate if money aggregates (M2) is essential to curb inflation and maintain high growth rate in GDP.

2. To determine if interest rate is another important channel in the monetary policy transmission mechanism in affecting output and inflation variability.

The remainder of this paper is organized as follow: First section focus on the brief introduction about Malaysia economy in 1990's and the economic problems that still remain unresolved. Section 2 reviews empirically the studies and previous researches in related field. In section 3, a discussion on the theoretical framework of money view of monetary policy transmission mechanism is given. Data and the variables will be determined in section 4. All the results and findings are analyzed empirically in section 5. Last Section briefly concludes the implications of the findings for monetary transmission mechanism.

2. Literature Review

Most of the early researches demonstrated the causality between money supply and income (Sims C. A., 1972, William et. al., 1976, Barro R.J., 1978). Recent years, the research work has expended by utilizing more economical and financial variables, such as interest rates and prices to explain the dynamic causality between money and economy activity.

Using auto-regression test and variance decompositions approach to test on United States data 1960 to 1990, Friedman and Kuttner (1992) found the significant relationships between money and real income or prices separately. Their result indicating cointegration of real income and real money with the effect of interest rates and concluded that M1 aggregate statistically does have predictive power over income.

Tan and Baharumshah (1999) found M1 and M3 appear to have significant effect on output and prices using VECM but not in M2. This contradicts with Azali and Matthews (1996) results that they present evidences of causality between money (M2) and output in the post-liberalization, money dominated credit. Thus, this paper is aiming to test on the power of M2 in predicting output to enhance latter's finding.

Sims (1980, 1992) challenge the monetarist (rational expectation monetarists) results that unanticipated money affects output (e.g. Baro, 1978). The studies show that when the nominal interest rate is included in the analysis, money loses its predictive power, implying monetary ineffectiveness. Therefore, we attempt to investigate if interest rate, yet another potential channel as policy targets.

Besides theoretical issues, we also highlight the importance of discussing the methodological issues. Certain analyses include Tan and Cheng (1995) did not examine time series properties of the variables, namely the presence of unit root, cointegration, which might lead to misspecification and invalid inferences (see Masih and Masih, 1996). Friedman and Kuttner (1993) have included time trends properties (e.g. none time trends, linear time trends, and linear and quadratic time trends) examining on the extended Stock-Watson's' equations. Likewise, Azali and Matthews (1999) have utilized the augmented Dickey-fuller (ADF) procedures to conduct the null hypothesis of a unit root.

Friedman and Kuttner (1993) employing the standard Granger-causality tests to examine causal relationship among variables. While the standard Granger-causality has been a popular tool for empirical testing relationship between monetary policy and aggregate output, the cointegration is also a popular test (Tan and Baharumshah, 1999). Cointegration indicates presence or absence of Granger-causality but does not indicate the direction of causality between variables. In our paper, the direction is obvious that all the exogenous variables are lag value that may affect endogenous variable (see Section VI).

In short, it is also our purpose to employ Granger Causality test in this study to ascertain the importance of monetary policy transmission mechanism. Certainly, this approach offered a simple procedure, which requires estimating an augmented VAR model in the straight forward way WALD Test, by comparing the F-computed value to the critical value.

3. Theoretical Framework

This study focus on money view of *monetary policy transmission mechanism* which are complemented from two basic theories: *Quantity Theory of Money* and the *IS-LM Model*.

The Quantity Theory of Money

The classical economist's view of inflation revolved around the Quantity Theory of Money, by Irving Fisher in his Purchasing Power of Money (1911). The theory can be succinctly stated by referring to the infamous "*equation of exchange*", these two economists introduced:

MV = PT

where:

M is the amount of money in circulation;

V is the velocity of circulation of that money;

P is the average price level and

T is the level of transactions taking place.

Classical economists suggested that V would be relatively stable and T would (as we have seen above) always tend to full employment. Therefore, they came to the conclusion that:

$M\uparrow \rightarrow P\uparrow$

Since V and T are fixed and M is exogenous, then increase in the supply of money will lead to an exactly proportionate increase in the price level. The message was simple: control the money supply to control inflation. Similarly is the case for our study in examining the relationship among money, output, interest rate and prices. If output remain unchanged or monetary expansion is greater than the output growth over periods, eventually will lead to price pressures.

IS-LM Model

In general, the linkages among money, output, interest rate and money can be revealed by using the illustration of the Classical IS-LM framework. For this purpose, this paper will discuss and analyze on the effects of a monetary expansion (refer to figure 1).

(a) The economy is in general equilibrium at point E. Output equals the full-employment level of 1000, the real interest rate is 5%, and the price level is 100.

(b) With the price level fixed, a 10% increase in the nominal money supply, *M*, raises the real money supply, *M/P*, and shifts the *LM* curve down from LM^1 to LM^2. At point *F*, the intersection of *IS* curve and new *LM*, LM^2, the real interest rate has fallen to 3%, which raises the aggregate demand for goods. If firms produce extra output to meet the increase in aggregate demand, output rises to 1200 (higher than full-employment output of 1000).

(c) Because aggregate demand exceeds full-employment output at point *F*, firms raise prices. A 10% rise in *P*, from 100 to 110, restores the real money supply to its original level and shifts the *LM* curve back to its original position, LM^1. This returns the economy at point *E*, where output again is at its full-employment level of 1000, but the price level has risen 10% from 100 to 110.

Under the classical assumption, prices are flexible, the adjustment process is rapid. The economy is effectively self-correcting, automatically returning to its full-employment after a shock moves it away from general equilibrium (Note 1). Indeed, if respond to increased demand by rising prices rather than by temporarily producing more (earlier assumed), the adjustment process would be almost immediate. Conversely, according to Keynesian's argument, however, *sluggish adjustment of prices* (and of wages, the price of labor) might prevent general equilibrium from being attained for a much longer period, perhaps several years.

In brief, Keynesians believe in the monetary neutrality in the long run (after price adjusted) but not in the short run whereas Classical model is more accepting of the view that money is neutral even in the relatively short run. Therefore, our study is necessary to investigate the dynamic relationship among money, output, interest rate, and prices for policy implications.

Monetary Policy Transmission Mechanism: Money View

When the *Quantity Theory of Money* and *IS-LM model* are both complemented together, we have results of the primarily *money view of monetary policy transmission mechanism*. The money view places emphasis on the changes in the monetary aggregate affecting the output via interest rate channel. This transmission of monetary policy through interest rate mechanism has been a standard feature in the traditional Keynesian model. This traditional Keynesian view of how a monetary tightening is transmitted to the real economy can be characterized by a schematic diagram (Mishkin, 1995):

$$M\downarrow \Rightarrow IR\uparrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$$

This diagram indicates that a contraction of monetary policy ($M\downarrow$) leads to a rise in real interest rate ($IR\uparrow$), which in turn raises the cost of capital, thereby causing a decline in investment spending ($I\downarrow$). Further, it leads to a decline in aggregate demand and a fall in output ($Y\downarrow$).

John Taylor (1995) argues that interest rate channel of monetary transmission is a key component of how monetary policy effects are transmitted to the economy. In his model, contraction of monetary policy raises the short-term nominal interest rate. The real long-term interest rate rises as well, at least for a time through a combination of sticky prices and rational expectations. Eventually these higher real interest rates lead to a decline in business fixed and housing investment, consumer durable expenditure and inventory investment, which finally inserts decline in aggregate output.

4. Data

This study is based on quarterly time series data for the period 1980 to 2008. M2 is defined as M1 (narrow money) plus fixed and savings deposit of the private sector placed with Central Bank and Commercial banks, negotiable certificates of deposit and Central Bank deposit. The output is measured by Gross National Product (*GDP*). For the measure of inflation rate, the Consumer Price Index (*CPI*) is used. On the other hand, the Three Months Treasury bill-rate (3 months T-bill rate) is proxy to interest rate examined in the study.

The data were extracted from International Financial Statistics, Quarterly Bulletin of Bank Negara Malaysia and website http://www.bnm.gov.my. In later on, all of the series are transformed into logarithm form. All of the analysis in this study is conducted using the EViews program.

5. Estimated Model and Hypothesis

Estimated Models

For the purpose of examining the dynamic causality among the four variables, below four estimated models are formed (refer to table 3).

Hypothesis

Based on the four models and the objectives of the paper, we examine the hypothesis as showed in table 4.

In WALD-Test, if the computed F-statistic distributed for the lagged independent variables are significant (whether statistically significant at 5% level), causality from independent variable to dependent variable can be established by rejecting the null hypothesis.

6. Empirical Results

In this paper, we employed a few methods to capture the dynamic linkages between money, output, interest rates and prices.

Unit Root Test of Stationarity

We first tested for stationarity and the order of integration of the variables. The unit root property of the series data is essential for cointegration and causality analysis. To test the presence of unit root in the series, we use the augmented Dickey-Fuller (ADF) test based on a standard regression with a constant.

Table 5 presents the results of the unit root for the variables in levels and first-difference (with trend and without trend). The results indicate that the null hypothesis was rejected at the first-difference. Obviously, the results implied that all variables are stationary in their first-differences. This condition is strictly required in the causality test and VAR.

Engle-Granger (EG) Cointegration Test

Having established the order of integration of the individual series, we proceed to test for cointegration. The idea was to determine whether the stochastic trends in involving variables that contain unit roots have long run relationship. This paper applied the two-step cointegration suggested by Engle and Granger. First, we run the following cointegrating regression:

$$M_t = \alpha_1 + \alpha_{11}Y_{t-1} + \alpha_{12}M_{t-1} + \alpha_{13}IR_{t-1} + \alpha_{14}P_{t-1} + e_{1t}$$

The null hypothesis is that no variables are co-integrated. The second step is to test of the residuals e_{it} (where i = 1,2,3,4) via ADF technique. If e_{it} is found to be consistent with I(0), one may claim that co-integration exist between the variables. The same process is repeated for the rest of estimation models.

If the absolute computed ADF test value exceeds critical values at significant level 5%, null hypothesis (H_0:e_{it} has unit root) will be rejected. The conclusion would be that the estimated e_{it} is stationary. Refer to Table 6, the output of our findings show that at significant level 5%, e_{1t} does not has unit root, thus the variables in Model 1 are cointegrated. Conversely, e_{2t} , e_{3t} and e_{4t} are stationary, thus no variables in Model 2, 3 and 4 are cointergrated.

Granger Causality Test

As Granger (1998) points out, if there is a cointegrating vector among variables, there must be causal relation among these variables at least in one direction. If the variables are not cointegrated, we will use a standard Granger causality test. In this context, we will employ WALD test on Model 2, 3 and 4, comparing F-statistic with its critical value at degree of freedom (1,44).

As the F-statistic reported in Table 7, money (M2) does granger cause output which is relevant to the theory, that is, money is a lead output indicator. The monetary aggregates are non-neutral at least in the short run which agrees with Classical economists. Hence, policy makers could influence the sustainable output growth with money supply stimulus.

Money target is causal to price level. This results similarly also in along with conclusion of Quantity Theory of Money; "money supply expansions only cause price inflation." Classical and Keynesians also came to the identical conclusion, money is neutral after the prices adjust properly back to general equilibrium, and therefore it has no effect on real variables exception for price level. The significance of this hypothesis is very important for policy makers to properly conduct policy measurements to attain inflationary.

Interest rate is causal to output implying that interest rate channel is yet another important intermediate targets in complementing with monetary targets. Both targets should complement as an effective intermediate target selected by the Central Bank, depending on the sources of fluctuations in economy conditions and in the money supply. If the relationship between consumer and business spending and investment decisions and the interest rate is stable, interest rate targets offer a more predictable way to stabilize economic fluctuations. However, if the relationship between the demand for money and other assets and the interest rate is stable, targeting M2 offers a more predictable condition with respect to its goal.

Limitation and Improvement

Due to the cumbersome of many other causality tests (such as VECM), Engle-Granger approach is still wisely used by researches. Undoubtedly, the procedure is sensitive to the choice of dependent variable and lag chosen in the cointegrating regression especially for the multivariate models. Similarly, when it comes to extracting the residual from the cointegrating vector, E-G approach will take the arbitrary choice of dependent variable and is sensitive to the variable being normalized (Masih and Masih, 1997). These problems also can be minimized to certain extent by select the lag structure carefully based on appropriate test and diagnostic checking on the error term for each regression model (Tan and Baharumshah, 1999).

It has been argued that testing for Granger-causality in multiple time series, the F-test in a regression context for determining whether some parameters of the model are jointly zero. Causality test (VAR model) is not valid when the variables are integrated and the test statistic does not have a standard distribution (Gujarati, 1995). This happened to Model 1 in this paper. This limitation may be avoided by Monte Carlo experiment which included three alternative test procedures, presented in Zapata and Rambaldi (1997). The experiment provides evidence that the MWALD test has comparable performance in size and power to the Likelihood Ratio.

Although cointegration indicates presence or absence of Granger-causality of two variables, it does not indicate the direction of causality. To get better view of relationship, we need to take this problem into account for the future studies.

VII. Conclusion

The result of this paper suggests that money is a lead output indicator and is also essential to curb inflation and maintain high growth rate in GDP. Interest rate is found as another important intermediate target in the monetary policy transmission mechanism in affecting output variability. The absence of causality from real GDP to price suggests that the excess of aggregates demand generated by increase in real GDP is absorbed by growth in aggregate supply. Government has taken lots of endeavor to solved the problem of bottlenecks of infrastructure and shortage of labors, thus, it is expected that the growth rate of GDP will continuously increase in the near future after sample period.

In respectively, it is imperative in this paper to highlight that policy makers should not under-value other factors in money matter, which influence economical growth. Monetary policy itself is inadequate to achieve sustainable economic growth with price stability and external equilibrium. However, it can be more effective if there is a coordination of trade, fiscal and exchange rate policies.

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Notes

Note 1. The Proposition that a free-market economy with flexible prices is automatically self-correcting is consistent with Adam Smith's invisible-hand idea.

Table 1. Growth Rate in GDP and Inflation for Malaysia, 1990-2000

Year	%GDP	%Inflation
1991	9.5	3.0
1992	8.9	5.1
1993	9.9	3.3
1994	9.2	3.8
1995	9.8	3.4
1996	10.0	3.3
1997	7.3	3.1
1998	-7.4	5.3
1999	6.1	2.5
2000	8.3	2.7

Source: Figures calculated from BNM Quarterly Economic Bulletin

Table 2.Growth in monetary aggregates: M1, M2 and M3 for Malaysia, 1990-2000

Year	%M1	%M2	%M3
1991	11	15	15
1992	13	19	20
1993	38	22	24
1994	11	15	13
1995	12	24	22
1996	17	20	21
1997	5	23	19
1998	-15	2	3
1999	36	14	8
2000	7	5	5

Source: Figures calculated from BNM Quarterly Economic Bulletin

Table 3. The estimated models (unrestricted)

Dependent variable Independent variables
Model 1: $M_t = \alpha_1 + \alpha_{11}Y_{t-1} + \alpha_{12}M_{t-1} + \alpha_{13}IR_{t-1} + \alpha_{14}P_{t-1} + e_{1t}$
Model 2: $IR_t = \alpha_2 + \alpha_{21}Y_{t-1} + \alpha_{22}M_{t-1} + \alpha_{23}IR_{t-1} + \alpha_{24}P_{t-1} + e_{2t}$
Model 3: $P_t = \alpha_3 + \alpha_{31}Y_{t-1} + \alpha_{32}M_{t-1} + \alpha_{33}IR_{t-1} + \alpha_{34}P_{t-1} + e_{3t}$
Model 4: $Y_t = \alpha_4 + \alpha_{41}Y_{t-1} + \alpha_{42}M_{t-1} + \alpha_{43}IR_{t-1} + \alpha_{44}P_{t-1} + e_{4t}$

where M_t = money supply (M2) at time t ; Y_t = real output (GDP) at time t ; IR_t = interest rate at time t ; P_t = inflation rate at time t ; e_t = error term at time t ;

Table 4. The research hypothesis based on estimated models

Model	Null Hypothesis		Alternative Hypothesis	
1	(i) *(Y⇏M)*	$H_0 : \alpha_{11} = 0$	(i) *(Y⇒M)*	$H_a : \alpha_{11} \neq 0$
	(ii) *(IR⇏M)*	$H_0 : \alpha_{13} = 0$	(ii) *(IR⇒M)*	$H_a : \alpha_{13} \neq 0$
	(iii) *(P⇏M)*	$H_0 : \alpha_{14} = 0$	(iii) *(P⇒M)*	$H_a : \alpha_{14} \neq 0$

To the test causality from output (*Y*), interest rate (*IR*) and inflation rate (*P*) respectively to money (*M*).

2	(i) *(Y⇏IR)*	$H_0 : \alpha_{21} = 0$	(i) *(Y⇒IR)*	$H_a : \alpha_{21} \neq 0$
	(ii) *(M⇏IR)*	$H_0 : \alpha_{22} = 0$	(ii) *(M⇒IR)*	$H_a : \alpha_{22} \neq 0$
	(iii) *(P⇏IR)*	$H_0 : \alpha_{24} = 0$	(iii) *(P⇒IR)*	$H_a : \alpha_{24} \neq 0$

To test the causality from Output (*Y*), inflation rate (*P*), and money (*M*) respectively to interest rate (*IR*).

3	(i) *(Y⇏P)*	$H_0 : \alpha_{31} = 0$	(i) *(Y⇒P)*	$H_a : \alpha_{31} \neq 0$
	(ii) *(IR⇏P)*	$H_0 : \alpha_{32} = 0$	(ii) *(IR⇒P)*	$H_a : \alpha_{32} \neq 0$
	(iii) *(M⇏P)*	$H_0 : \alpha_{33} = 0$	(iii) *(M⇒P)*	$H_a : \alpha_{33} \neq 0$

To test the causality from output (*Y*), interest rate (*IR*),and money (*M*) respectively to inflation rate (*P*).

4	(i) *(IR⇏Y)*	$H_0 : \alpha_{42} = 0$	(i) *(IR⇒Y)*	$H_a : \alpha_{42} \neq 0$
	(ii) *(P⇏Y)*	$H_0 : \alpha_{43} = 0$	(ii) *(P⇒Y)*	$H_a : \alpha_{43} \neq 0$
	(iii) *(M⇏Y)*	$H_0 : \alpha_{44} = 0$	(iii) *(M⇒ Y)*	$H_a : \alpha_{44} \neq 0$

To the causality from interest rate (*IR*), inflation rate (*P*), and money (*M*) respectively to output (*Y*).

where, ⇏ (independent variable does not granger-causality dependent variable)

⇒ (independent variable does granger-causality dependent variable)

Generally, the null hypothesis and the alternative hypothesis can be shown as the following:

H_0: Independent variable does not Granger-causality dependent variable

H_a: Independent variable does Granger-causality dependent variable

Table 5. Unit Root Test

	ADF Test	
	constant	constant
Variables	with trend	without trend
Levels		
ln IR	-1.3741	-2.2397
ln M	-2.0058	-0.3783
ln P	-1.4564	-0.5107
ln Y	-1.7794	-1.6579
e_t	-2.3640	-2.3588
First Difference		
ln IR	-8.0349*	-8.0436*
ln M	-5.5504*	-6.1093*
ln P	-6.9304*	-5.4273*
ln Y	-3.3273*	-3.4473*
e_t	-7.3083*	-7.2742*

Notes: The null hypothesis is that the series is I(1). The critical value for rejection is -2.92 at a significant level 5% for the model without trend and -3.51 with trend. These values are provided by EViews output based on MacKinnon(1996) one-sided p-values. *denotes significant at level 5%

Table 6. Engle-Granger Cointegration Test

	ADF Test	
constant	constant	
Variables	with trend	without trend
Levels		
e_{1t}	-6.6618*	-6.5764*
e_{2t}	-2.3641	-2.3588
e_{3t}	-2.1525	-2.1283
e_{4t}	-2.7707	-2.9695

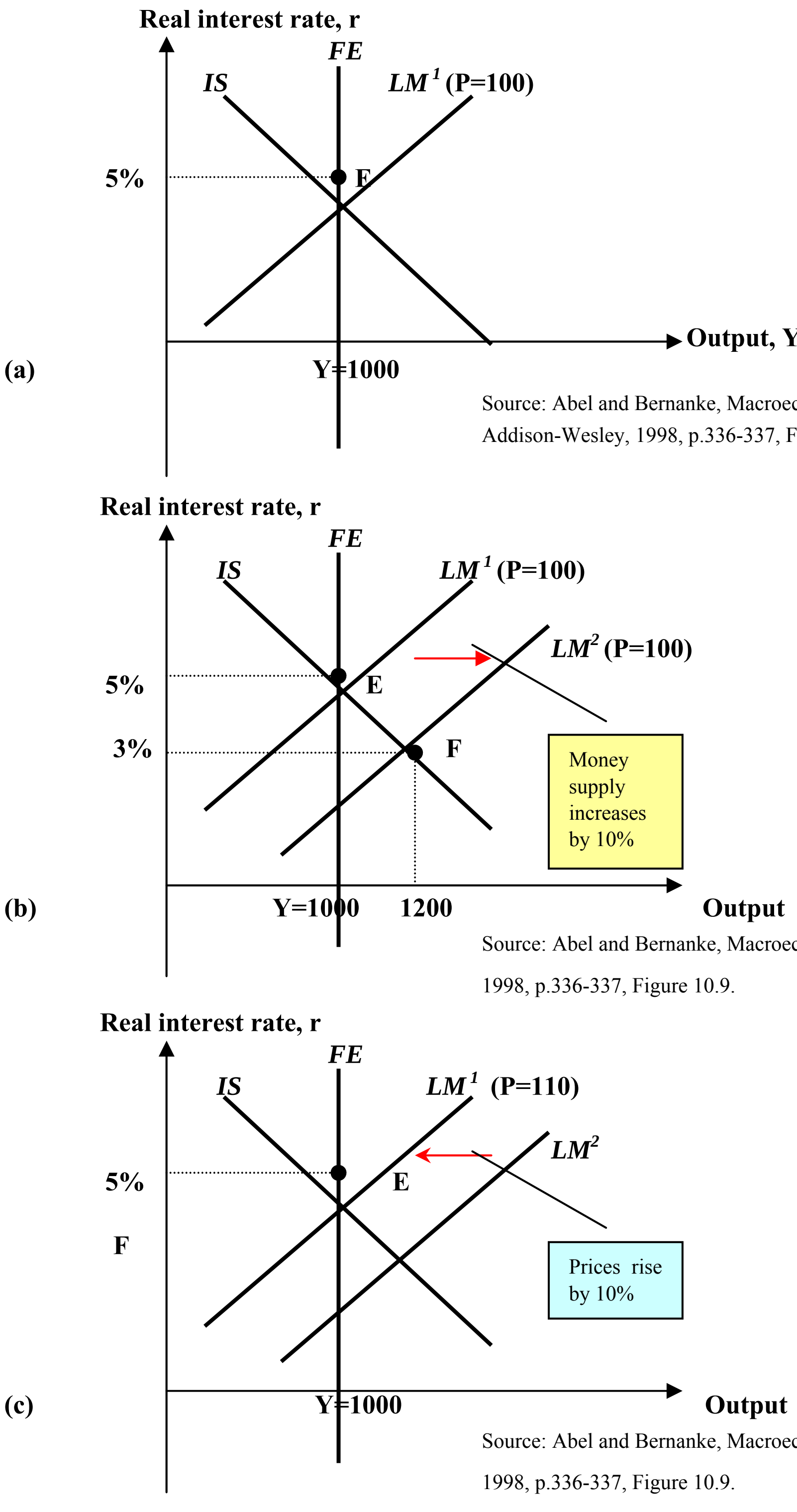
Notes: The null hypothesis is that the series is I(1). The critical value for rejection is -2.92 at a significant level 5% for the model without trend and -3.51 with trend. These values are provided by EViews output based on MacKinnon(1996) one-sided p-values. *denotes significant at level 5%

Table 7. WALD-Test: F-Statistic of Causality with Future Lag

Causal Relationship	F-Statistics	Results
Model 2		
$Y_{t-1} \Rightarrow IR$	0.0871	No causality
$M_{t-1} \Rightarrow IR$	4.3303*	M does granger cause IR
$P_{t-1} \Rightarrow IR$	8.6095*	P does granger cause IR
Model 3		
$Y_{t-1} \Rightarrow P$	1.9799	No causality
$M_{t-1} \Rightarrow P$	15.4371*	M does granger cause P
$IR_{t-1} \Rightarrow P$	3.4319	No causality
Model 4		
$M_{t-1} \Rightarrow Y$	10.0665*	M does granger cause Y
$IR_{t-1} \Rightarrow Y$	4.2679*	IR does granger cause Y
$P_{t-1} \Rightarrow Y$	0.6778	No causality

Notes: degree of freedom is (1, 44). The critical value of F-statistic for rejection is 4.08 at a significant level 5%. *denotes significant at level 5%.

Appendices



Source: Abel and Bernanke, Macroeconomics, Addison-Wesley, 1998, p.336-337, Figure10.9.

Source: Abel and Bernanke, Macroeconomics, Addison- Wesley, 1998, p.336-337, Figure 10.9.

Source: Abel and Bernanke, Macroeconomics, Addison- Wesley, 1998, p.336-337, Figure 10.9.

Figure 1. Effects of a monetary expansion