UNIVERSITY OF THE PHILIPPINES
SCHOOL OF ECONOMICS

Discussion Paper No. 0508 September 2005

An Assessment of the Usefulness of Money for Policy in the Philippines

by

*Maria Socorro Gochoco- Bautista**

*Professor, School of Economics
University of the Philippines

AN ASSESSMENT OF THE USEFULNESS OF MONEY FOR POLICY IN THE PHILIPPINES

Maria Socorro Gochoco-Bautista*
School of Economics
University of the Philippines
Diliman, Quezon City 1101, Philippines
msgb@up.edu.ph

Abstract

This study assesses the usefulness of money for policy in the Philippines. The basic idea behind the use of monetary aggregates for policy is that observed fluctuations in money anticipate movements in the ultimate objective of monetary policy, such as inflation control. The stability of key empirical relationships, including the behavior of velocity and the presence of cointegrating relationships among money and variables of interest to policymakers are examined. In general, results indicate that the stability of the behavior of velocity and the presence of cointegrating relationships involving money and other variables of interest do not do much damage to the potential usefulness of money for policy. The ability of money to predict inflation is examined using Granger causality tests and an unrestricted VAR that examined the relative contribution of innovations in money to the variance of the forecast errors in inflation. In general, money's ability to predict inflation is less clear-cut and seems to be dependent on the ordering and lag lengths of the variables used in the VAR and the definition of money used.

*The author wishes to thank the sponsors and participants of the Asian Economic Panel Meeting held in March 2005 in Tokyo, Japan and Carlos C. Bautista for research assistance.

AN ASSESSMENT OF THE USEFULNESS OF MONEY FOR POLICY IN THE PHILIPPINES

Maria Socorro Gochoco-Bautista
School of Economics
University of the Philippines
Diliman, Quezon City 1101, Philippines
msgb@up.edu.ph

1 Introduction

The Philippine central bank, Bangko Sentral ng Pilipinas (BSP), abandoned monetary targeting and shifted to inflation targeting in 2002. Inflation targeting involves adjusting a policy instrument, such as an interest rate, to respond directly to deviations of expected inflation from its target, rather than achieving a desired inflation rate by meeting a monetary target. At the time of the announcement in 2000, it was unclear whether there were cogent reasons for the shift, or whether this move was simply a band wagon effect following what other countries such as Korea and Thailand had done. Monetary policy in the Philippines had, in principle, been anchored on monetary targeting to control inflation since the 1980s. The Philippines, like Thailand, previously targeted base money by setting a floor for foreign reserves and a ceiling on net domestic assets. In practice, however, evidence points to previous attempts by monetary authorities to simultaneously maintain a stable and typically overvalued peso. This practice was not unique to the Philippines. In general, monetary policy in East Asia prior to the Asian Crisis in 1997 involved some combination of both monetary and exchange rate targeting.

The BSP's pursuit of multiple objectives, particularly when capital is mobile internationally as occurred beginning in the early 1990s, and possible instabilities in key empirical relationships, resulted in higher and more variable rates of inflation in the Philippines compared with many of its neighbors in East Asia.[1] In the period 1980-1989, for example, the average annual inflation rate in the Philippines was 13.3 percent with a standard deviation of 11.2 percent, the only country in this particular group with double-digit figures. The next worse performer, Indonesia, had an annual average rate of inflation in the same period of 9.1 percent with a standard deviation of 3.5 percent. In the period 1990-2000, the annual average inflation rate in the Philippines was 8.0 percent with a standard deviation of 3.3 percent. While these figures are somewhat of an improvement from the earlier period, the Philippines' record remains the second worst performance for countries in the sample after Indonesia, whose average annual rate of inflation increased to 12.0 percent with a standard deviation of 11.9 percent in the same period.

The literature on the macroeconomic policy role of monetary aggregates "has waxed and waned in terms of an almost exclusive focus on them to complete disregard."[2] The basic idea behind the use of monetary aggregates for policy is that observed fluctuations in money anticipate movements in the ultimate objective of monetary policy, such as inflation or output growth. Whether this is indeed so is an empirical question. Monetary aggregates may have a role, at the very least, as information variables to guide the conduct of monetary policy.

---

[1] Moreno and Glick, 2001, p. 22. The sample of countries includes Korea, Indonesia, Malaysia, Singapore, Thailand, and the Philippines.

[2] Estrella and Mishkin, 1997, p. 279.

Even if movements in money do not always signal future movements in prices and output, however, monetary authorities could still use the information contained in unexpected movements in money growth in the policymaking process in a flexible way, rather than as a strict target variable, and decide by how much to change the instrument variable.[3] The assumption is that unexpected fluctuations in money allow policymakers to anticipate movements in and provide information about unobserved movements in prices, real output, or both. Hence, monetary authorities will change their instrument variable to counter such aberrant deviations of money and restore money to its designated path.

In the context of the Philippines and other countries in the region, several factors may have complicated the conduct of monetary policy by possibly affecting the stability of key empirical relationships.[4] These include: financial or technological developments that have created close substitutes for money which affect the elasticity of money demand and the ability of monetary authorities to control money; large capital inflows, such as occurred in the early 1990s, and reversals during the Asian Crisis which may affect velocity, inflation, and output, especially given the limited ability of monetary authorities to sterilize capital inflows; changes in inflationary expectations which could affect velocity and money demand; and the effect of financial crises on the availability of capital from banks versus non-bank financial institutions and on velocity.

This study assesses the usefulness of money for policy in the Philippines. The first section of the paper briefly discusses the conduct of monetary policy in the Philippines. The second section examines the stability of empirical relationships over time. It first examines the behavior of velocity. The methodology employed uses a Markov-switching technique to detect where the most likely breaks in velocity occurred and whether the smoothed probabilities of these switches from one growth state to another are significant. Next, whether a stable relationship exists between money and variables of interest to policymakers in the sense of these variables being cointegrated with one another is examined. If variables are cointegrated, then there exists a long-run equilibrium relationship among them so that a shock to the system brings these variables back to trend. In the third section, both Granger causality tests and a variance decomposition of inflation using an unrestricted VAR are used to examine the ability of money to predict inflation. The summary and conclusions of the study are in the final section.

2 The Monetary Framework in the Philippines in the 1980s and 1990s[5]

Under the monetarist framework that formed the basis of the IMF's financial programming approach, including its program with the Philippine Government, controlling the growth of the money supply was the key to controlling inflation. This was the basic approach that had been in use in the Philippines since the mid-1980s.

Consider the Quantity Theory of Money (QTM) equation of exchange $MV=PY$, where M is the stock of money, V is the income velocity of money, P is the price level, and Y is the level of real income or output. Given target values for the rate of inflation, real GNP growth, and estimates of

[3] Friedman and Kuttner, 1996, p. 94.

[4] Moreno and Glick, 1991, pp. 6-8.

[5] This section is drawn from Gochoco-Bautista and Canlas, 2003, pp. 79-85.

the income velocity of money, the rate of growth of the money supply (M) can then be derived (residually) to ensure equilibrium in the money market.

BM is related to M via the money multiplier i.e.,

$$M = \text{money multiplier} \times BM$$

Given the money multiplier, once M is known from the simple QTM equation of exchange, BM can be used to meet the target M.

Hence, there are two key relationships to controlling inflation. These are (1) the relationship between the intermediate target or M, and inflation and (2) the relationship between the operating target or BM, and the intermediate target, M. The BSP used M3, a broad measure of money, as its intermediate target.

Casual empiricism suggests that over the period 1980-91, the central bank was not engaged in strict monetary aggregate targeting. Rather, exchange rate targeting was practiced, in conjunction with an output-growth objective. The central bank used its foreign reserves to keep the target exchange rate within a narrow band. In addition, the financing of persistent public sector deficits added to the difficulty of meeting monetary targets.

These multiple objectives gave rise to an inflation and output growth performance during the period 1980-1991 that left much to be desired. Both the financing of the public sector deficit and the collapse of the peso led to excessive money creation and to very high rates of inflation. Erratic monetary policy produced wild swings in the inflation rate marked by episodes of double-digit inflation lasting for 2 to 3 years. From 1983 to 1985, for instance, inflation was exceedingly high, reaching a peak of about 42 percent in 1984. The monetary authorities responded by severely contracting money and driving domestic interest rates to historically high levels.

Growth in real GDP was also uneven during the period 1980-91. The monetary contraction used to quell inflation in the early 1980s led to a major recession that lasted for two years, 1984-85, the first in the postwar economic history of the Philippines, following the assassination of Benigno Aquino in 1983 and the moratorium on external debt service beginning in 1984. In 1991, there was another recession, albeit milder than the one in the early 1980s.

The collapse of the central bank's defense of the peso, particularly in 1983, was extremely costly to the economy. The central bank incurred large losses. Between 1983 and 1986, these losses hampered the central bank's ability to conduct monetary policy. These losses were hidden in so-called 'suspense accounts' in the books of the central bank. By the end of 1986, the balance on these suspense accounts amounted to approximately P170B, with counterpart liabilities of a corresponding amount.[6] The servicing of these liabilities implied a continuous injection of money into the economy. Under the IMF program with monetary targets, these injections of money then had to be mopped up by the floatation of treasury bills whose proceeds were immediately deposited with the central bank to prevent inflationary effects.

The Philippines made a modest re-entry into international capital markets with a series of re-schedulings of Paris Club Debt beginning in 1985 and the implementation of a debt-to-equity program beginning in 1986. The country agreed to a 2-year IMF Program beginning in 1986. Only in the early 1990s was the country able to float bonds and some international equity issues, but

---

[6] Paderanga, 1996, p. 2.

the country has yet to get back to an investment grade credit rating by international credit rating agencies.

In 1992, the foreign exchange market was liberalized. This entailed the elimination of restrictions in the current account and greatly diminished restrictions on the inward and outward movement of capital flows. The capital account virtually became open.

Capital flows showed particularly large increases in 1993 and 1994, compared to the levels prior to capital account liberalization in 1992, and rose dramatically in 1996, right before the Asian Crisis. As a percentage of GDP, from 1.23 percent in 1988, capital inflows rose to 3.43 percent of GDP in 1989, then to 6.85 percent in 1991. In 1994, these inflows surged once more to 7.4 percent of GDP and by 1996, to about 10 percent of GDP before the massive retreat of capital in 1997.[7] In general, the capital account was larger and more volatile in the 1990s. Portfolio inflows, in particular, increased in the more recent period, exceeding direct investment flows in the third quarter of 1989 for the first time. It bears emphasizing, however, that the size of capital inflows to the Philippines was smaller than those in countries like Malaysia and Thailand, and also came later.

In 1993, Republic Act No. 7653 was enacted establishing an independent central monetary authority, the Bangko Sentral ng Pilipinas or BSP.[8] Under its charter, the mandated duty of the BSP is to maintain price stability. The losses of the old central bank were transferred to a Board of Liquidators so as not to impair the functioning of new BSP.

Guinigundo (2000) states that large fluctuations in velocity, particularly following foreign exchange market liberalization in 1992, weakened, and in some cases, led to the breakdown of the relationship between monetary aggregates and their ultimate goal variables. As an example, he cites the deceleration in the rate of inflation from 9 percent in 1994 to 8.1 percent in 1995, despite the historically high rates of liquidity growth in 1994 and 1995, as a break from the past. He attributes the good inflation performance in part to supply side factors such as the favorable agricultural harvest in 1994 and the easing of power shortages.

The supposed weakening of the key relationships underlying the monetary targeting framework led the BSP to adopt what it calls a ''modified framework'' beginning in the second semester of 1995. This modified framework apparently attempted to enhance the effectiveness of monetary policy ''by complementing monetary aggregate targeting with some form of inflation targeting, placing greater emphasis on price stability in lieu of rigidly maintaining the intermediate monetary targets.''[9] This approach evidently ''reduces the risk of monetary policy being either too tight or too loose, as may happen with strict adherence to a traditional base money program.''[10]

Certain key modifications were introduced into the monetary targeting framework over the next four years and are covered in so-called adjustment clauses in the agreement with the IMF:

---

[7] Gochoco-Bautista and Canlas, 2003, p.87.

[8] Gochoco-Bautista and Canlas, 2003, p. 91.

[9] Guinigundo, 2000, p7. This section is drawn from Gochoco-Bautista and Canlas, 2003, pp. 92-95.

[10] Guinigundo, ibid.

1. It appears that the main change is that the modified framework allows base money (BM) levels to go beyond target as long as the inflation targets are met. As Guinigundo states, "As long as inflation adheres to the program monthly path, the base money limits are automatically increased by the amount of the excess of net international reserves over the program targets. This provides an automatic mechanism for the BSP to respond to unexpected increases in the real demand for money coming from improvements in the external sector of the economy."[11]

2. "An excess of one or more percentage points of inflation over the program induces a mopping up operation by the BSP to bring down base money to the previous month's level. If actual inflation exceeds targets for three consecutive months, then the entire monetary program is reviewed."[12]

What are the differences between this modified framework minus the adjustment clauses, and the original monetary targeting framework? Under the modified framework, base money automatically increases when there are capital inflows that tend to raise net international reserves. No sterilization measures are undertaken to reduce the expansionary effect on the money supply. By not countering this expansionary effect on money arising from capital inflows as long as inflation is below target, the BSP passively adapts to what is happening to the money supply as a result of capital inflows. It appears that a more flexible approach to monetary targeting was practiced.

When inflation is higher than target for three months, the authorities go into high gear. They undertake "mopping up operation to bring down base money to the previous month's level if there is an excess of one or more percentage points of inflation over the program."[13] In fact, if "actual inflation exceeds targets for three consecutive months, then the entire monetary program is reviewed." It appears that while inflation targets are "hard" targets, BM targets are not.

Conversations with monetary officials also seem to confirm that the BM targets are not really "hard" targets. It is said that the very high ceilings on BM are set to give the authorities a lot of leeway. The modified framework was further revised to place a limit on the amount of allowable adjustment in the base money ceilings if there was an overperformance in the BSP holdings of net international reserves (NIR) as these intensified beginning in 1994. In particular, BM limits would be increased by the full amount of the first US$500M of overperformance over the NIR target, translated into pesos at the average exchange rate prevailing in the month concerned, and by half of any additional overperformance.[14] This means that the authorities would not sterilize capital inflows, simply raise their BM target and accept the increase in BM in the relevant period, but that the increase in BM would be limited to the first US$500M over the NIR ceilings and then by half that amount for succeeding capital inflows. Guinigundo further states, "Limiting the allowable adjustment in base money ceilings on account of capital inflows was another step towards greater emphasis on reining inflation through controlling money growth." [15]

---

[11] Guinigundo, ibid.

[12] Guinigundo, ibid.

[13] Guinigundo, 2000, p.7.

[14] Guinigundo, ibid.

[15] Guinigundo, ibid.

3 The Stability of Empirical Relationships

3.1 The Behavior of the Income Velocity of Money

We examine the behavior of the income velocity of money, i.e., the ratio of nominal GDP to money, as significant breaks in its trend may lead to a break down in the relationship between money, prices, and output. An examination of the occurrence, direction, and timing of breaks in the stochastic trend of velocity may lead to better explanations of the behavior of velocity. The empirical analysis involves estimating the stochastic trend of velocity using a Markov regime switching methodology and examining the smoothed probabilities of changes in velocity.[16] The model is a two-state Markov regime switching model that endogenously determines structural breaks in the velocity of money using a generalized Hamilton model due to Lam (1990) and implemented by Kim and Nelson (1999) through state space methods. Quarterly data for CPI (1994 base year), real GDP, M1, and M3 from 1981 to 2003, and for reserve money or monetary base (RM) from 1985 to 2003, are used to calculate velocity of money. The data are seasonally-adjusted using the X-12 procedure.

In this study, we examine the behavior of M1, M3, and RM velocity. There are several reasons for the use of different measures of money. First, the factors cited earlier that may have affected the stability of velocity's trend may have done so to varying degrees depending on the measure of money used. The impact of capital flow volatility, for example, most directly affects base money and may give independent information on monetary conditions. Second, the choice of the particular monetary aggregate to use for policy is an empirical issue. In theory, a narrower monetary aggregate would be assumed to have a closer link to inflation, as narrow money is held primarily for transactions purposes while broader money measures partly reflect the holding of money as a store of wealth. Some empirical studies have validated the usefulness of targeting a relatively narrow monetary aggregate. Gochoco (1993), for example, finds that only M1 is cointegrated with interest rates, output, and the exchange rate. Guinigundo's (2000) study likewise implies that narrower monetary aggregates are to be preferred as targets since broader aggregates tend to adjust more slowly towards equilibrium after a shock. [17]

Despite such evidence, however, the BSP used M3 or total liquidity as its intermediate target until the shift to inflation targeting. In order to have control over its intermediate target, the BSP has an operating target with which to affect M3. The BSP's operating target was base money (BM), defined as reserve money (RM) plus reserve-eligible government securities, liquidity reserves, and reserve deficiency.[18] RM represents liabilities of the central bank and consists of currency in circulation and reserve deposits of banks and other deposit-taking non-bank financial intermediaries.

The log of the velocity of money, or the ratio of nominal GDP to money, is obtained for each of the three measures of money. Results of the Adjusted Dickey-Fuller tests in **Table 1** indicate that the log level of velocity is non–stationary while its first difference is. This means that the velocity of money is an I(1) variable. For the Markov switching regime methodology, the log level of the velocity of money is used as it is non-stationary.

---

[16] See Appendix A for a discussion of the methodology.

[17] Guinigundo, 2000, p. 11.

[18] Because of data availability problems, we use RM instead of BM in this study. RM appears to be more closely related to the textbook definition of high-powered money.

Figure 1 shows the plots of the smoothed probability of a low growth state, the actual and estimated stochastic trend, and the cyclical component or the difference between the actual and estimated stochastic trend, for each of the three measures of velocity of money as well as other variables.

In general, the stochastic trends of velocity using both M1 and M3 show a decline from the mid-1980s to the more recent period. This is consistent with growing monetization of the economy. Annual average rates of inflation had fallen to 8 percent in the period 1990-2000 from 13.3 percent in the period 1980-1990.[19] The stochastic trend of M1 velocity is declining particularly from 1987.1 to 1999.4, a period in which there is apparently no break in the stochastic trend of M1 velocity and a high probability of a low growth state. It is also a period in which the probability of a low growth state for M1 itself is generally low. Similarly, the stochastic trend of M3 velocity is declining from 1989.1 to 1997.4, a period in which the probability of a low growth state for M3 velocity is likewise high, with no significant break in its stochastic trend. It is also a period in which the probability of a low growth state for M3 is low except for around 1992. Hence, over time, M1 and M3 velocity exhibited declining stochastic trends and stability as there were no significant stochastic trend breaks. The possible exceptions to this are the early 1980s in which the country experienced it worst post-war economic crisis, and around 2000 under the Estrada Administration, which was ousted shortly thereafter in the EDSA II Revolution of January 2001.

The behavior of RM velocity, whose data start in 1985, is different from the cases above as it exhibits no consistent trend over time. The stochastic trend of RM velocity shows a significant break around 1994, from a steeply declining trend in the mid-1980s to early 1990s.[20] After 1994, the stochastic trend of RM velocity reverses and begins to rise. After liberalizing the foreign exchange market in 1992, the Philippines experienced its most intense period of capital inflows between 1994 and 1996, with capital inflows amounting to 10 percent of GDP in 1996.[21] In the period 1990 to 1996, total capital inflows averaged 6.6 percent of GDP compared to only 2.3 percent in the period from 1985-1989.[22] Beginning in about 1994 or prior to the Asian Crisis, the monetary authorities attempted to sterilize these inflows. Unlike Moreno and Glick's results (2001, p.10), therefore, rising capital inflows particularly around 1994 are seemingly associated with a break in the behavior of RM velocity. The log of the nominal exchange rate (pesos per dollar) had a very low probability of low growth in 1994, but this had been the case since 1991 until the crisis in 1997. Thus, it appears that exchange rate movements cannot be used to explain the change in the trend of RM velocity around 1994.

Apparently, the behavior of RM velocity is being driven largely by the behavior of RM itself whose stochastic trend shifted downwards around this period and whose smoothed probability also showed a change in 1994. The probability of a low growth state for the log of RM became very high beginning in 1994 in contrast to the earlier period. The probability of a low growth state remained high for nominal output throughout.

---

[19] Moreno and Glick, 2001, p. 22. This is also gleaned from the very high probability of a low growth state for the log of CPI in the 1990s as seen in Figure 1.

[20] It is unclear whether basically the same stochastic trend would be observed if date for the early 1980s were available.

[21] Gochoco-Bautista and Canlas, 2001.

[22] Moreno and Glick, 2001, p.21.

It is less difficult to explain an increase in velocity as domestic currency tends to be disposed of when capital inflows reversed during the Asian Crisis and its immediate aftermath. Lower inflation volatility would also be expected to increase velocity to the extent that it reduces the need to hold precautionary balances. Another possible reason for the increase in velocity especially during or after the crisis is if monetary authorities do not provide liquidity injections to banks and available capital is reduced as firms shift away from credit constrained banks. There is some evidence that monetary authorities in the Philippines chose not to provide greater liquidity to banks during the crisis and its immediate aftermath.[23]

3.2 Cointegration

Cointegration is useful in testing for the presence of equilibrium relationships among variables so that a shock will not allow variables to trend away from each other.[24] The cointegration procedure used here is the Johansen method.[25] The two tests for detecting cointegration are the trace test and the Eigenvalue test.

Three different models are used: the first model (2-variable) includes logs of money and the price level; the second model (3-variable) includes the logs of money, the price level, and real output; the third model (4-variable) includes the logs of money, the price level, real output, and the exchange rate. As usual, three different measures of money are used and the estimation is carried out over the full period sample, selected sub-periods, and pre- and post-Asian Crisis periods. The selected periods are those in which a particular measure of income velocity of money is relatively stable in the sense of the absence of a stochastic trend break. They are the following: 1987.1 to 1999.4 for M1, 1989.1 to 1997.4 for M3, and 1986.2 to 1992.4 for RM. The idea for using these selected sub-periods is to see whether the stability of velocity matters for cointegration or not.

The results of the tests for cointegration are shown in **Table 2 .** The numbers in the table indicate the number of cointegrating vectors found. * indicates significance at the 5 percent level while ** indicates significance at the 1 percent level. The letter E gives the number of cointegrating vectors and levels of significance for the Eigenvalue test.

The full period results show that among the three measures of money, M1 and RM, and hence, narrower measures of money, are cointegrated with either the log of the price level or both the logs of the price level and real output. When the model includes the exchange rate, only when RM is used is there a cointegrating relationship among all the variables. Hence, as far as the full sample results are concerned, RM is the only measure of money that is consistently cointegrated with the other variables.

When the selected periods are used, there are a few differences. Now, M1 is not cointegrated with either the price level or both the price level and real output. However, all three measures of money display cointegrating relationships using the 4-variable model (money, inflation, output, exchange rate). The results for the selected sub-period also show that the 4-variable model is the best model. Again, however, RM displays consistent cointegration with the other variables regardless of the model used.

---

[23] Gochoco-Bautista and Bautista, 2005.

[24] As in Moreno and Glick's 2001 study, interest rates are not included because in some cases, they are not market-determined and may therefore be misleading.

[25] See Appendix B for a discussion of the methodology.

For the pre-Asian Crisis period, there is much evidence of cointegration across different measures of money and different models. Only M3 in a 3-variable model shows no cointegrating relationship. Once again, the results show that the 4-variable model is the best model and that RM shows consistent cointegration with the other variables regardless of the model used.

It is only in the post-Asian Crisis period that different results from the previous ones are obtained. RM is no longer cointegrated with the other variables in the 2- and 3-variable models but continues to be cointegrated with both variables and the exchange rate in the 4-variable model. M1 is no longer cointegrated with inflation in the 2-variable model. Surprisingly, M3 is now cointegrated with the other variables across models.

To summarize, the cointegration results, in general, show that a 4-variable model is better than the other models; narrower measures of money, particularly RM, generally tend to display more cointegrating relationships with other variables relative to other measures of money; in the pre-Asian Crisis period, money generally displayed a cointegrating relationship with other variables in more cases while in the post-Asian Crisis period, only M3, a broader measure of money, did so consistently across models.

The finding of cointegration between a broader measure of money and other variables in the post-Asian Crisis period is unlike Moreno and Glick’s (2001, p.19) result for Korea. They surmise that the development of alternatives to money has not been great enough to destabilize the relationship between the narrower definition of money and inflation. Nevertheless, as is true of their results, money generally displays a stable relationship with inflation and other variables in the 1990s.

4 Does Money Predict Inflation and Output?

4.1 Granger Causality Tests

The simplest tests relating the information content of money to inflation or output involve bivariate Granger causality tests. In carrying out the Granger causality tests, the first difference of the logs of the variables are used as unit root tests indicate that the variables are stationary in first difference form. The estimation uses four lags and the entire sample period of 1981.1 to 2003.4 (beginning in 1985 for RM) as well as sub-periods. Only those relationships found to be significant at least at a 10 percent level are considered to meet the criteria of useful information content. The results are as follows:

Full sample results for the period 1981.1 to 2003.4

M1 growth $\rightarrow$ Y growth

Inflation $\rightarrow$ Y growth

Y growth $\rightarrow$ Inflation

Depreciation $\rightarrow$ RM growth

Depreciation $\rightarrow$ Inflation

Hence, the full sample results indicate that while M1 growth Granger causes output growth, it does not directly Granger cause inflation. Rather, both output growth and currency depreciation Granger cause inflation.

When the early 1980s crisis period is excluded so that the sample period considered in **1987.1 to 2003.4**, the following results are obtained:

M1 growth $\rightarrow$ Y growth

Inflation $\rightarrow$ Y growth

Y growth $\rightarrow$ M3 growth

M3 growth $\rightarrow$ Y growth

M3 growth $\rightarrow$ Inflation

Y growth $\rightarrow$ Inflation

The only difference here from the full sample results is that M3 growth Granger causes both inflation and output growth. This is the only instance in which any measure of money is found to Granger cause inflation. It differs from the results obtained by Moreno and Glick (2001, p.14) in which both base money and M2 help predict inflation prior to 1990 and also had highly significant results during the Asian Crisis period.

For RM growth, Granger causality was tested pre and post 1994, where velocity had apparently experienced a trend break. Over the period **1981.1 to 1993.4** the results are as follows:

Inflation $\rightarrow$ output growth

Output growth $\rightarrow$ Inflation

For the post 1994 period using RM, no significant Granger causal relationships are found.

For the **pre-Asian crisis period of 1981.1 to 1997.2**, the following result is obtained:

Depreciation $\rightarrow$ Inflation

For the **post-Asian crisis period of 1997.3 to 2003.4**, the following results are obtained:

Inflation $\rightarrow$ Depreciation

Depreciation $\rightarrow$ Inflation

Hence, if the sample is broken around the time of the Asian Crisis, inflation is Granger caused by currency depreciation only, one of the results also obtained using the full sample.

In general, the results across different measures of money indicate that output growth Granger causes inflation, except if the sample period is broken around 1997, in which case currency depreciation Granger causes inflation. However, money growth, using either M1 or M3 growth, is also generally found to Granger cause output growth. M3 growth and currency depreciation sometimes directly Granger cause inflation.

4.2 Variance Decomposition

Another way to assess the predictive content of money and its importance in explaining inflation is to examine the contribution of orthogonalized innovations in money to the variance of the forecast error in inflation using a standard unrestricted VAR methodology. These orthogonalized innovations are obtained by applying a Choleski decomposition to the variance covariance matrix of residuals of the model, with inflation ordered first and other variables successively added in the different models used. In the two-variable model, inflation is ordered first and money growth is ordered second; in the three-variable model, real output growth is added to these and ordered third; and in the four-variable model, the depreciation rate is added to these and ordered last. Uniforms lags of four are used for each of the variables in the models. The models are estimated using the first differences of the logs of the variables.

Table 3 shows the percentage of the variance of the forecast error in inflation explained by innovations in money and the two other variables using the different models over full and sub-period samples. The entries in the columns show the largest contribution of orthogonalized innovations in money and the two other variables in explaining the variance of the forecast error in inflation over a 7-period horizon.

The full sample results show that when only money innovations are used to explain the variance of the forecast error in inflation, only 4 to 5 percent of the latter is explained. In the three variable-model with output growth, output growth explains more of the variance of the forecast error in inflation, especially when the measure of money used is RM growth. Innovations in money growth, regardless of the measure of money used, only explain between 3 to 5 percent of the variance of the forecast error in inflation. When the 4-variable model including currency depreciation is used, the latter explains a greater proportion (12 percent and 15 percent) of the variance of the forecast error in inflation, except when RM growth is used as the measure of money. These results are compatible with the earlier findings of both real output growth and currency depreciation Granger causing inflation using the full sample. When innovations in RM growth are used in the 4-variable model, output growth explains 12 percent of the variance of the forecast error in inflation while money only explains 2.19 percent. While these results are compatible with the earlier finding of cointegration among the variables using a 4-variable model and RM growth, the findings do imply that innovations in money growth, regardless of the measure of money used, explain only a small proportion of the variance of the forecast error in inflation over the entire sample period.

Unrestricted VARs were also estimated over selected periods in which income velocity for each of the three measures of money were relatively stable based on their stochastic trends. These periods are also listed in **Table 3**. For M3 in particular, and to some degree RM, the contribution of innovations in money growth to explaining the variance of the forecast error in inflation are much higher than those obtained using the full period sample. These seem to confirm the notion that when velocity is relatively stable, as it is in these selected periods, money would have a more direct role in explaining inflation. Only innovations in M1 growth fare less well when compared to the results for M1 in the full sample. In the 3-variable model, innovations in M3 growth dominate those in output growth in explaining the variance of the forecast error in inflation. However, in the 4-variable model, output growth innovations, rather than those in money growth, are the dominant contributors to the variance of the forecast error in inflation, except in the case of M3, in which innovations in currency depreciation are dominant. When RM growth is used in the 4-variable model, innovations in RM growth dominate innovations in currency depreciation but amount to only about a third of the effect of output growth innovations. Hence, in general, innovations in money growth are not the dominant factor explaining the variance of the forecast error in inflation.

In the Pre-Asian Crisis period, innovations in money are generally dominated by those in currency depreciation using M1 and M3, or output growth using RM growth. In the post-Asian Crisis period, the highest contributions of money growth innovations to the variance of the forecast error in inflation are obtained e.g., 26.3 percent for M3 growth in the 3-variable model, compared to other sub-periods or the full sample. M1 growth innovations actually dominate output growth innovations in the 3-variable model. Innovations in currency depreciation dominate the other variables in a 4-variable model using M1 or M3. Output growth innovations dominate RM growth innovations in explaining the variance of the forecast error in inflation in the 4-variable model, but not by much (23 percent versus 19 percent).

In general, innovations in money growth are not the dominant contributors to the variance of the forecast errors in inflation from the perspective of the full sample and different sub-periods. Innovations in currency depreciation generally are the most important. This is consistent with the earlier findings of Granger causality between currency depreciation and real output growth Granger causing inflation. In the post-Asian Crisis period, innovations in money growth seem to generally account for a larger share of the variance of the forecast errors in inflation compared with those in the pre-Asian Crisis period.

4.3 Sensitivity Tests

The variance decomposition results in the previous section were subjected to sensitivity tests to see whether they are robust with respect to changes in the number of lags and the ordering of the variables used. The original ordering of the variables put inflation first, followed by money growth, real output growth, and finally, the currency depreciation rate, using different types of models, i.e., 2-, 3-, or 4- variable. In this section, different lag lengths and an alternative ordering of the variables are used.

Tables 4 and 5 show the results obtained using the original ordering, in which inflation is ordered first before money growth and the other variables, but 3 or 5 lags of the variables are used, respectively. The results using these different lag lengths are in bold print, while the original results with 4 lags are found next to them.

The results in Table 4 using 3 lags show no major differences from the original ones using 4 lags for the full period. For the selected periods, and the pre and post-Asian Crisis periods, in general, the proportion of the variance of the forecast errors in inflation explained by innovations in money growth declined. In some cases, the ranking of the different variables in terms of the proportion explained changed somewhat. In the 4-variable model using M1 growth, for example, innovations in currency depreciation now dominate compared with innovations in output growth originally. Innovations in M3 growth are about as important as those in currency depreciation when M3 growth is used.

The results for the pre-Asian Crisis period are essentially the same as the original ones except for the smaller proportions of the forecast variance of inflation explained by money growth. In the post-Asian Crisis period, however, the proportions of the forecast variance of inflation explained by any measure of money growth, declined dramatically, except in one case in which it increased. The post-Asian Crisis period, which includes the Asian Crisis period, is that in which the differences in the two sets of results are quite large. Nevertheless, between the pre-and post-Asian Crisis periods, the proportion of the forecast variance explained by money growth in the latter are larger than in the former, a result similar to the original ones when 4 lags are used. In general, therefore, when 3 rather than 4 lags are used, the proportion of the forecast variance of inflation explained by innovations in money growth is smaller.

Table 5 shows the results obtained when 5 rather than 4 lags are used. The results show that when longer lags are used, the proportion of the forecast variance in inflation explained by money growth increases in most cases. The full period results do not show very large differences except in the case of RM growth. When a 3-variable model is used, innovations in RM growth explain 16.30 percent of the variance of the forecast error in inflation compared with 4.54 percent previously. There is a slight change in the ranking of output growth innovations and those in currency depreciation in the 4-variable model.

For the selected periods, there are dramatic increases in the proportion of the variance of inflation explained by innovations in RM growth. In the 4-variable model, this proportion rises to 43.86 percent from 10.6 originally, and becomes the variable whose innovations account for the largest proportion of the variance in inflation.

For the pre-Asian Crisis period, the main difference is likewise the large increases in the proportion of the variance in inflation explained by innovations in RM growth. Again, RM is the variable whose innovations account for the largest proportion of the variance in inflation. For the post-Asian Crisis period, the same result is obtained. In the 4-variable model, innovations in RM growth explain 66.21 percent of the forecast variance in inflation. In contrast to the original results, innovations in currency depreciation account for a very small proportion of the forecast variance in inflation.

To summarize, when a longer lag length such as 5 is used, the proportion of the forecast variance in inflation explained by innovations in money growth increases and those in RM growth increase dramatically and dominate the other variables in doing so. This is compatible with the earlier positive finding regarding cointegration among the variables in the full period regardless of the model when RM is the measure of money used.

Next, an alternative ordering in which innovations in money growth are put first, followed by those in the inflation rate, real output growth, and currency depreciation, is used. These results are shown in **Tables 6, 7, and 8**. These tables show the results using this alternative ordering when 3, 4, or 5 lags are used, respectively. The results are shown in bold print next to the results obtained with the same lag length but using the original ordering in which innovations in inflation are ordered first. The change in ordering reflects a change in the assumption regarding which variable is most exogenous. When innovations in money growth are order first, by construction, it is assumed that money is the exogenous variable.

Table 6 shows the results using this alternative ordering with 4 lags and compares it with the results using the original ordering. For the full period, there is only one striking difference. There are very large increases in the proportion of the variance of the forecast error in inflation explained by innovations in M1 growth, e.g., 34.54 percent versus 6.93 percent in the 4-variable model. The rest of the results for the full period are the same. Similarly, there are no major differences in the results for the selected periods.

For the pre-Asian Crisis period, again, the striking difference is the very large increases in the numbers for M1 growth, e.g., 41.49 percent versus 9.81 percent in the 4-variable model. Otherwise, the rest of the results are basically the same as the original ones. For the post-Asian Crisis period, there are larger numbers for M1 and M3 growth although not as dramatic as in the previous case, while the numbers for RM growth are somewhat more mixed when compared with the original results. In both cases the results for the rest of the variables are largely identical with the original results.

Table 7 shows the results obtained when 3 lags are used in conjunction with the alternative ordering versus the original ordering. Again, for the full period, the difference in the results is the large numbers for innovations in M1 growth when the alternative ordering is used. Those for RM growth likewise increase. Again, both these results seem to be compatible with the earlier finding of cointegration among the variables for the full period when either M1 or RM growth is used. For the selected periods, the results for innovations in M1 growth are much larger than the original results; those on M3 growth decline somewhat while those on RM growth are similar to those obtained using the original ordering.

For the pre-Asian Crisis period, the previous results also apply, i.e., there are large increases in the proportion of the forecast variance in inflation explained by innovations in M1 growth and to some extent, those RM growth as well. The exception to this seems to be the innovations in M3 growth, whose numbers fell slightly. Similarly, in the post-Asian Crisis period, there are large increases in the proportion of the forecast variance in inflation explained by innovations in M1 growth and to some extent, those RM growth as well. In both periods, innovations in currency depreciation in most cases, and those in real output growth in a few cases, explain the greatest proportion of the forecast variance in inflation.

In general, therefore, when the alternative ordering and shorter lags, i.e., 3, are used, the most striking result is the relatively large increase in the proportion of the forecast variance in inflation explained by innovations in M1 growth. However, in no case is money growth the most important factor explaining the forecast variance in inflation.

Table 8 shows the results when the alternative ordering versus the original ordering is used in conjunction with longer lags, i.e., 5. In general, the results show that the proportion of the forecast variance in inflation explained by innovations in money growth, especially those in M1 and to some extent those in RM, increase in both the full period and selected periods. As in the earlier results, when 5 lags are used, innovations in RM growth explain the largest proportion of the forecast variance in inflation. Only when M1 or M3 are used are innovations in currency depreciation the most important.

For the pre-Asian Crisis period, again the striking difference is the large increases in the proportion explained by innovations in M1 growth. Both innovations in M1 and RM growth now dominate the other variables when a 4-variable model is used. For the post-Asian Crisis period, innovations in both M3 and RM growth dominate the other variables in explaining the variance of the forecast error in inflation. This is compatible with the earlier finding of cointegration using these measures of money in this period. In the case of 4-variable model, innovations in RM growth account for 68.02 percent of the variance of the forecast error in inflation.

To summarize, in general, when the alternative ordering in which innovations in money growth are ordered first, the proportion of the variance of the forecast error in inflation explained by money increases, and dramatically so for M1 growth. Only when longer lags such as 5 are used, however, do innovations in money growth, particularly those in RM growth, dominate the other variables in explaining the variance of the forecast error in inflation. Thus the findings generally favor the use of longer lags and narrower definitions of money, namely, either RM growth or M1 growth.

5 Summary and Conclusions

This study examines the usefulness of money for policy in the Philippines. In terms of the stability of key empirical relationships, the behavior of velocity and the presence of cointegrating relationships among money and variables of interest to policymakers were examined. The ability of money to predict inflation was examined using Granger causality tests and an unrestricted VAR that examined the relative contribution of innovations in money to the variance of the forecast errors in inflation.

The stability of the behavior of velocity was examined using a Markov switching model and looking in particular at the smoothed probabilities of changes in velocity. The measure of money used is relevant to the results obtained. When the log of either M1 or M3 is used, velocity was found to have been generally stable over the period 1987-2000, with a declining stochastic trend. When the log of RM is used, there appears to be a significant change in the smoothed probability of velocity around 1994. The trend in RM velocity is declining until about 1994 after which it increases. Nevertheless, the results show that at least some measures of money give rise to a measure of income velocity that displays a degree of stability over a fairly long period of time.

The cointegration results showed that a long run relationship exists among the logs of money (particularly narrower definitions of money especially RM), real output growth, price level, and the exchange rate. This finding regarding cointegration of money with other variables of interest occurred more often and across different models in the pre-Asian Crisis period than in the post-Asian Crisis period. In the post-Asian Crisis period, RM growth was cointegrated with the other variables in the 4-variable model only. Only a broader measure of money, M3, was consistently cointegrated with the other variables across models in the post-Asian Crisis period.

In general, the results indicate that the stability of the behavior of velocity and of the empirical relationships involving money and other variables of interest do not do much damage to the potential usefulness of money for policy. However, the measure of money that gives rise to these results is not consistent. More often than not, RM is the most appropriate especially with regard to the results of the cointegration tests, even though there appears to be a break in the stochastic trend of RM velocity around 1994. Breaking the sample around the time of the Asian Crisis appears to give rise to contrasting results. Perhaps the Asian Crisis shock was greater than any other event such as foreign exchange market liberalization, the growth of money substitutes and the apparent breaks in velocity etc.

In terms of the ability of money to predict inflation using Granger causality tests, the results showed that in general, money growth does not directly Granger cause inflation. Output growth does. In some periods, however, M3 does Granger cause inflation. When the sample period is broken around the time of the Asian Crisis in 1997, currency depreciation is shown to Granger cause inflation. Hence, the Granger causality results are less favorable to the usefulness of money for predicting inflation directly although it may affect other variables that do so.

The variance decomposition results from an unrestricted VAR in which the innovations in inflation were ordered first, and one or more of the following were next, namely, money growth, then real output growth, and finally the depreciation rate showed that in general, innovations in money growth are not the dominant contributors to the variance of the forecast errors in inflation (at best accounting for about 19 percent only) from the perspective of the full sample and different sub-periods. The higher percentages obtained for money growth innovations in explaining the variance of the forecast errors in inflation were obtained when the estimation was done over the periods in which income velocity was relatively stable based on the earlier results. Generally, however, innovations in output growth or in currency depreciation were found to account for most of the variance of the forecast errors in inflation. Nevertheless, innovations in RM growth seem to account for a fair amount of the variance of the forecast errors in inflation in the post-Asian Crisis period, comparable to that accounted for by innovations in currency depreciation.

Sensitivity tests in which different lags lengths and an alternative ordering of the variables were used in the variance decomposition of the forecast variance of inflation. While some findings remained the same, there were some important differences from the original results. One is that in general, when a longer lag length is used, the proportion of the forecast variance in inflation explained by innovations in money growth increases. Indeed, those in RM growth increase dramatically and dominate the other variables in doing so. Conversely, when shorter lags are used, the proportion of the forecast variance in inflation explained by innovations in money growth generally decline. The second result is that when an alternative ordering of the variables is used in which innovations in money growth are ordered first, the proportion of the forecast variance in inflation explained by innovations in M1 growth, and to some extent those in RM growth, rise dramatically, regardless of lag length. Only when longer lags are used in conjunction with this alternative ordering do innovations in RM growth dominate all the other variables in explaining the forecast error of the variance in inflation.

In general, the results indicate that the stability of the behavior of velocity and the presence of cointegrating relationships involving money and other variables of interest do not do much damage to the potential usefulness of money for policy. However, the measure of money that gives rise to these results is not consistent. More often than not, RM is the most appropriate especially with regard to the results of the cointegration tests, even though there appears to be a break in the stochastic trend of RM velocity around 1994. Breaking the sample around the time of the Asian Crisis appears to give rise to contrasting results. Perhaps the Asian Crisis shock was greater than any other event such as foreign exchange market liberalization, the growth of money substitutes and the apparent breaks in velocity etc.

On the other hand, the variance decomposition results show that in general, other variables such as output growth and currency depreciation generally contain more useful information for predicting inflation than money does. Furthermore, the ability of money to predict inflation is not completely invariant to the ordering of the variables and the lag lengths used. More positive findings as regards a role for money in explaining inflation are obtained when a narrower definition of money, longer lags, and a model that also includes currency depreciation and real output growth are used. These findings seem to be compatible with the following implications of the Quantity Theory of Money: (1) the use of money as a medium of exchange rather than as a store of wealth or for precautionary demand being related to the rate at which the price level increases; and (2) the long and variable lags of the effects of money on the economy.

Overall, therefore, the usefulness of money for controlling and predicting inflation is not a foregone conclusion. The importance of variables such as real output growth and currency depreciation in explaining inflation suggests that possibly supply side channels, in addition to demand side channels, may be important, and that the channels by which money growth affects inflation have become more complicated and less direct. As such, relying solely on monetary aggregates to predict and influence inflation may not be warranted.

References

Bautista, C.C., 2003. "Estimates of output gaps in four Southeast Asian countries." Economics Letters, 80, pp. 365-371.

Estrella, Arturo and Frederic S. Mishkin, 1997. "Is there a role for monetary aggregates in the conduct of monetary policy?" Journal of Monetary Economics, 40, pp. 279-304.

Friedman, Benjamin M. and Kenneth N. Kuttner, 1996. "A Price Target for U.S. Monetary Policy? Lessons from the Experience with Money Growth Targets." Brookings Papers on Economic Activity, vol. 1, pp. 77-146.

Gochoco, Maria Socorro, 1993. "Are Money, Interest Rates, Output and the Exchange Rate Cointegrated? Implications for Monetary Targeting." The Philippine Review of Business and Economics XXX No.1, June, pp. 91-101.

Gochoco-Bautista, Maria Socorro and Dante Canlas, 2003. "Monetary and Exchange Rate Policy," in Balisacan, Arsenio M. and Hal Hill, eds. The Philippine Economy: Development, Policies, and Challenges. Oxford University Press, New York, USA, pp. 77-105.

Gochoco-Bautista, Maria Socorro and Carlos C. Bautista, 2005. "Monetary policy and exchange market pressure: The case of the Philippines." Journal of Macroeconomics, vol. 27, No. 1, pp. 153-168.

Guinigundo, Diwa C., 2000. "Problems and Issues on Inflation Targeting: The Case of the Philippines," Paper presented during the BSP public hearings on Inflation Targeting, unpublished manuscript, March.

Intal, Ponciano S. Jr. and Gilberto M. Llanto. "Financial Reform and Development in the Philippines, 1980-1997: Imperatives, Performance, and Challenges," PIDS Discussion Paper Series No. 98-02, January 1998.

Johansen, Soren, 1991. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models." Econometrica, 59, pp. 1551-80.

Johansen, Soren and Katarina Juselius, 1990. "Maximum Likelihood estimation and Inference on Cointegration with Application to the Demand for Money." Oxford Bulletin of Economics and Statistics, 52, pp. 169-209.

Kim, C.J. and C. Nelson, 1999. State-Space Models with Regime Switching. The MIT Press, Cambridge, Massachusetts, USA.

Lam, Pok-Sang, 1990. "The Hamilton model with a general autoregressive component." Journal of Monetary Economics, 26, pp.409–432.

Moreno, Ramon and Reuven Glick, 2001. "Is money still useful for policy in East Asia?" Paper presented at the 14th Pacific Basin Central Bank Conference, Seoul, Korea, November 14-17.

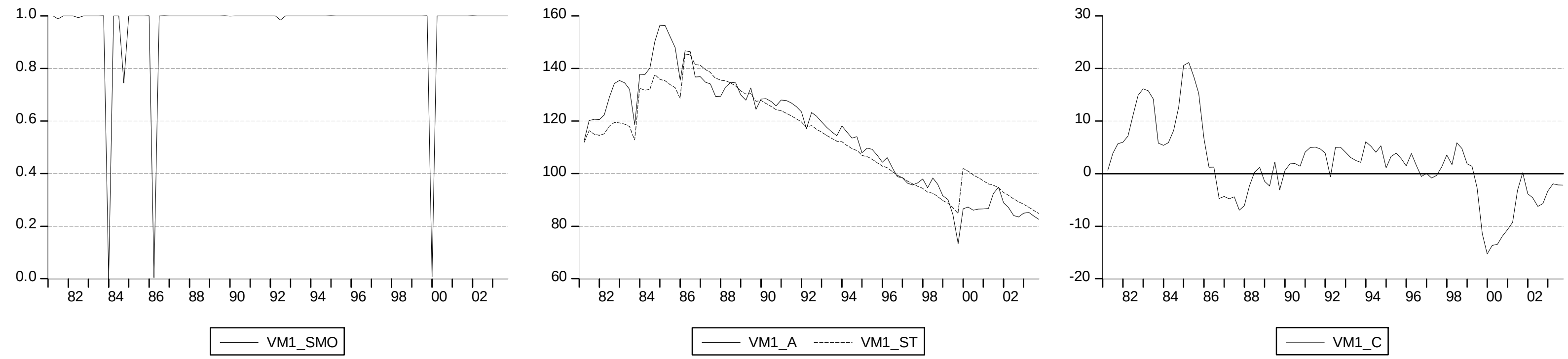
Paderanga, Cayetano. "Philippine Financial Developments: 1980-1995," in Fabella, Raul V. and Kazuhisa Ito, eds. Financial Sector Issues in the Philippines, Institute of Developing Economies, Tokyo, 1996, 1-26.

Table 1
Unit Root Tests

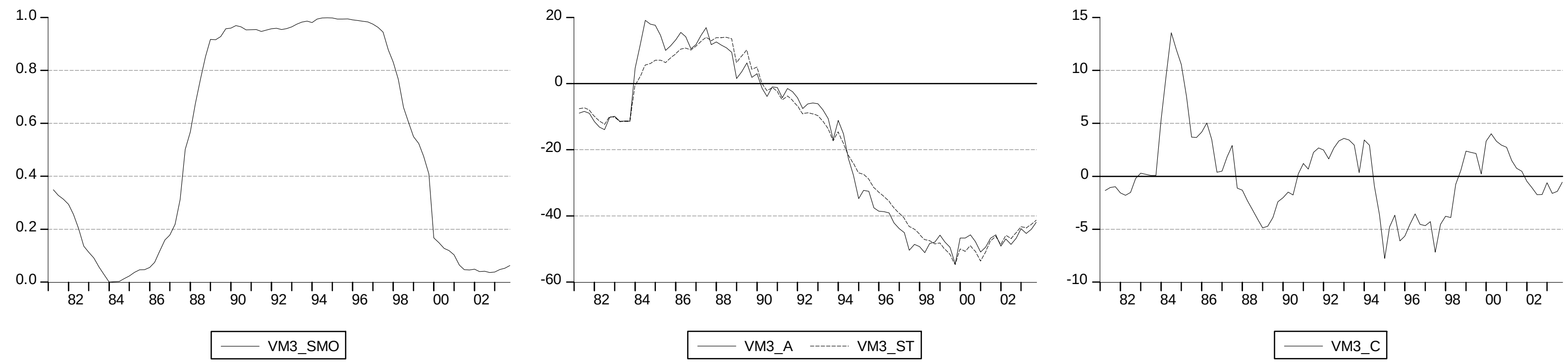
	Log Difference			Log Levels		
	ADF	P-value	opt lag	ADF	P-value	opt lag
CPI						
no exog	-2.782	0.006	1	2.151	0.992	2
constant	-3.819	0.004	1	-1.840	0.359	2
const,trend	-4.118	0.009	1	-2.006	0.590	2
M1						
no exog	-1.378	0.155	5	7.503	1.000	0
constant	-9.613	0.000	0	0.060	0.961	0
const,trend	-9.565	0.000	0	-3.283	0.076	0
M3						
no exog	-1.130	0.234	5	11.848	1.000	0
constant	-8.287	0.000	0	-1.103	0.712	0
const,trend	-8.322	0.000	0	-0.215	0.992	0
Q						
no exog	-2.116	0.034	3	1.359	0.956	4
constant	-2.521	0.114	3	0.063	0.961	4
const,trend	-2.772	0.212	3	-3.291	0.075	4
RM						
no exog	-11.014	0.000	0	-3.490	0.011	1
constant	-2.577	0.011	2	5.380	1.000	1
const,trend	-12.136	0.000	0	-1.370	0.862	1
V_M1						
no exog	-10.862	0.000	0	-0.734	0.396	0
constant	-10.860	0.000	0	-0.554	0.874	0
const,trend	-11.059	0.000	0	-3.589	0.036	0
V_M3						
no exog	-8.275	0.000	0	0.286	0.767	0
constant	-8.301	0.000	0	-0.422	0.900	0
const,trend	-8.305	0.000	0	-1.734	0.728	0
V_RM						
no exog	-11.471	0.000	0	-1.142	0.229	1
constant	-11.470	0.000	0	-2.911	0.049	1
const,trend	-12.194	0.000	0	-2.344	0.406	1
Y						
no exog	-1.057	0.260	7	2.961	0.999	5
constant	-4.191	0.001	5	-2.532	0.112	6
const,trend	-4.882	0.001	5	-3.332	0.068	4

FIGURE 1: SMOOTHED PROBABILITY, STOCHASTIC AND ACTUAL TREND, AND CYCLE

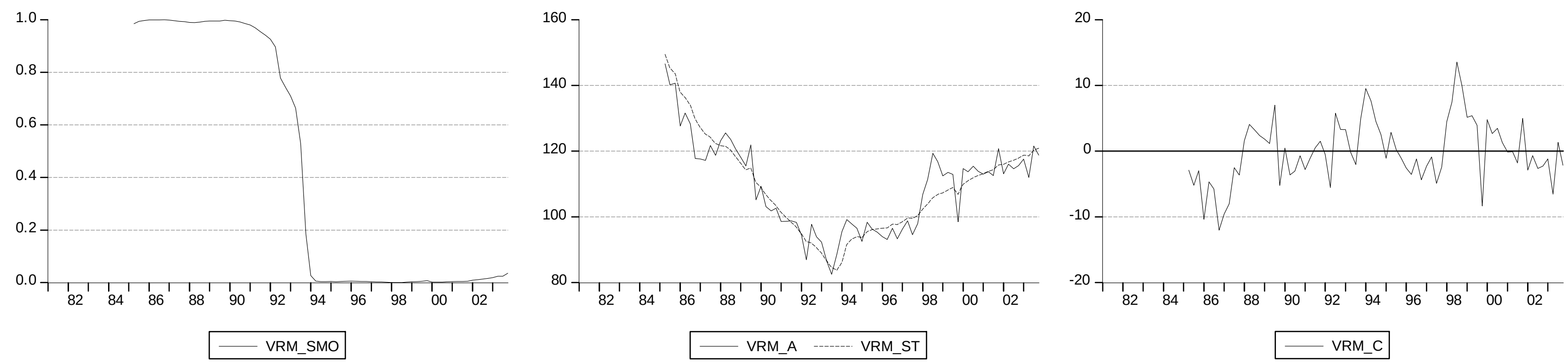
LOG VELOCITY M1



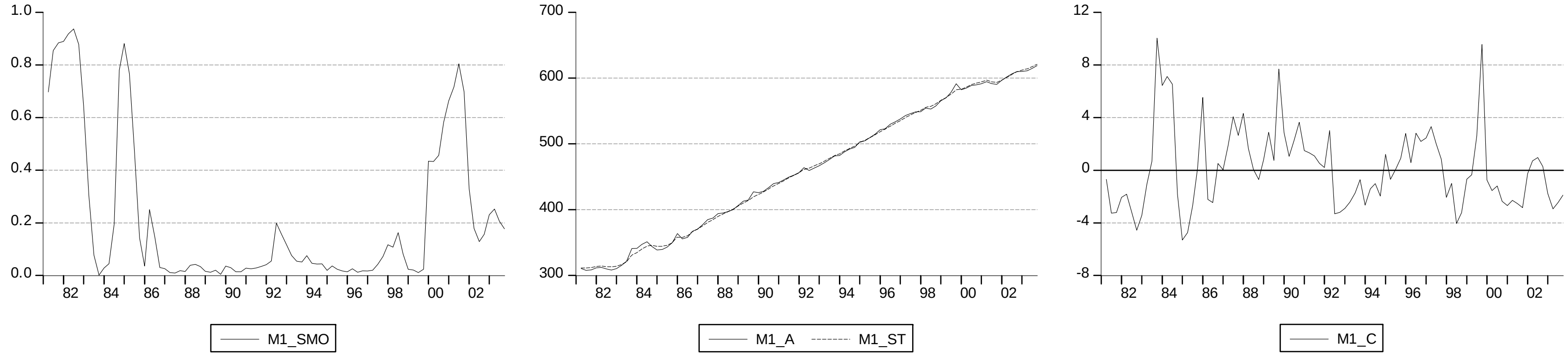
LOG VELOCITY M3



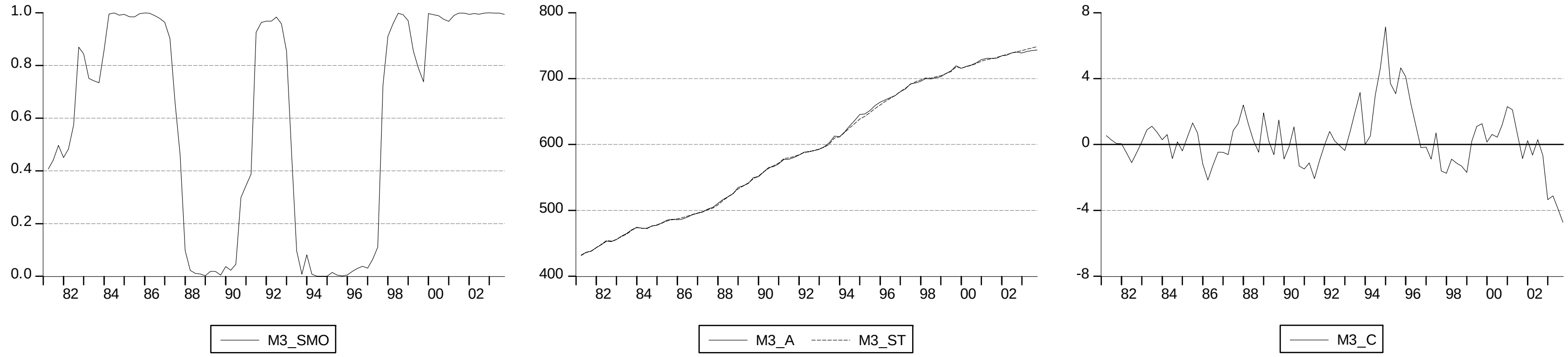
LOG VELOCITY RM



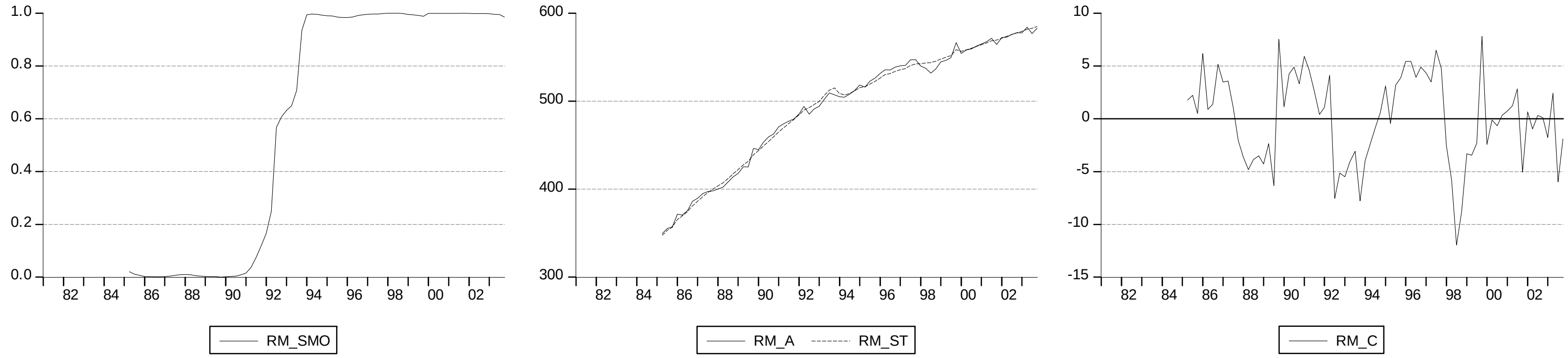
LOG M1



LOG M3

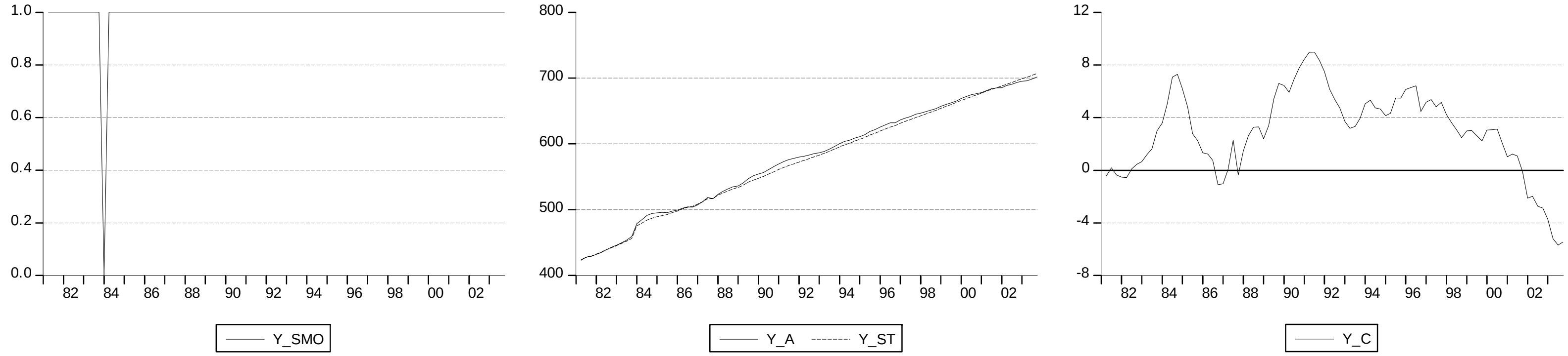


LOG RM

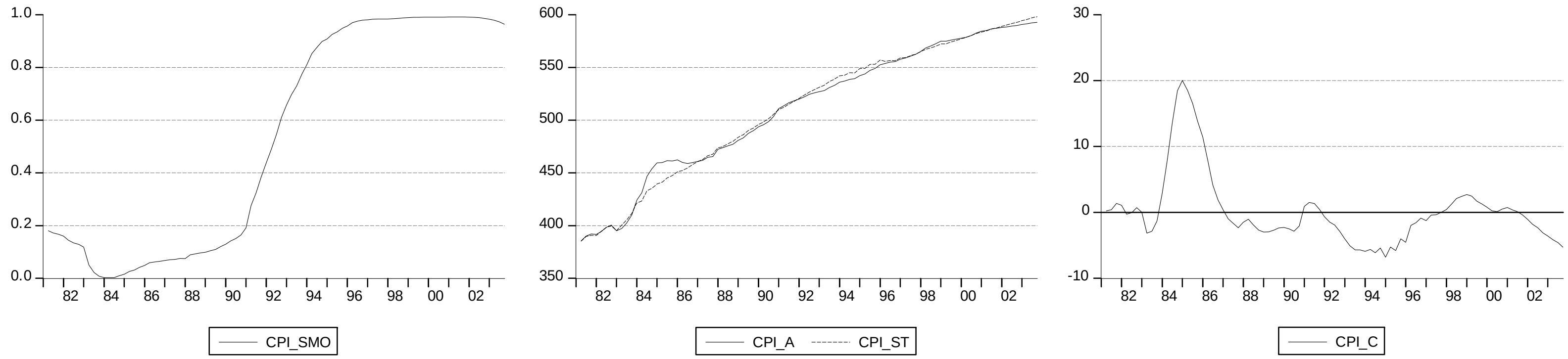


21

LOG NOMINAL OUTPUT



LOG CPI



LOG EXCHANGE RATE

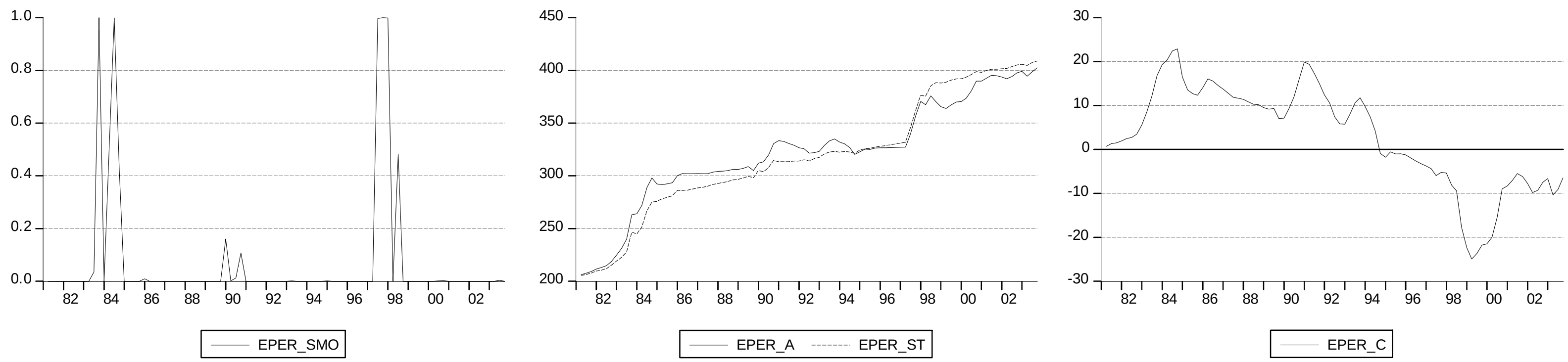


Table 2 **COINTEGRATION RESULTS**[26]			
Full Period 1982.2-2003.4 except for RM (1986.2-2003.4)			
	2Variable	3 Variable	4Variable
M1	1*,1E*	1*	None
M3	None	None	None
RM	1*,**,1E*	1*	4*,3**,2E*,1E**
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987.1-1999.4)	None	None	2*,**, 2E*,**
M3 (1989.1-1997.4)	None	None	2*,**, 2E*,**
RM (1986.2-1992.4)	1*,1E*	3*, 2**	4*,**, 4E*,**
Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	2*,**, 2E*,**	3*, 2**, 3E*	3*, 2**, 3E*, 2E**
M3	1*,**, 1E*,**	None	1*, 1E*
RM	1*,**, 1E*,**	3*,**, 3E*,**	4*, 3**, 4E*, 3E**
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4Variable
M1	None	1*,**, 1E*	4*, 3**, 4E*, 3E**
M3	2*,**, 2E*	1*,**	4*, 3**, 4E*, 3E**
RM	None	None	4*, 3**, 4E*, 3E**

[26] The 2-Variable model includes the logs of M and P; the 3-Variable include these and the log of real output; the 4-Variable model includes these plus the log of the exchange rate. The numbers in the table indicate the number of cointegrating vectors found. * indicates significance at the 5 percent level while ** indicates significance at the 1 percent level. The letter E gives the number of cointegrating vectors and levels of significance for the Eigenvalue test.

Table 3 **Variance Decomposition Results: Percentage of Inflation Variance Explained**			
Full Period: Original Ordering with 4 Lags			
	2 Variable	3 Variable	4 Variable
M1	5.65	5.33	6.93
Q		6.56	4.72
E			12.12
M3	5.43	3.26	5.25
Q		6.64	5.26
E			15.04
RM	4.14	4.54	2.19
Q		13.63	11.97
E			4.27
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	1.26	2.22	5.7
Q		15.24	13.59
E			8.9
M3 (1989.1-1997.4)	20.9	18.4	16.9
Q		2.6	7.08
E			26.3
RM (1986.2-1992.4)	2.23	7.16	10.6
Q		25.6	33.8
E			4.3

Table 3, continued

Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	8.66	7.30	9.81
Q		8.51	8.03
E			22.32
M3	3.16	2.15	4.62
Q		7.13	9.31
E			34.07
RM	2.26	1.70	2.15
Q		13.87	14.84
E			5.29
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4 Variable
M1	19.21	26.43	5.99
Q		16.86	9.91
E			35.36
M3	25.72	15.79	7.08
Q		35.73	13.63
E			27.96
RM	8.06	18.54	16.4
Q		30.49	18.32
E			19.75

Table 4
Variance Decomposition Results: Percentage of Inflation Variance Explained

Full Period: Original Ordering with 3 Lags versus Original Ordering with 4 Lags			
	2 Variable	3 Variable	4 Variable
M1	**4.8** 5.65	**5.19** 5.33	**6.75** 6.93
Q		**7.57** 6.56	**5.60** 4.72
E			**12.93** 12.12
M3	**5.4** 5.43	**4.37** 3.26	**7.19** 5.25
Q		**5.60** 6.64	**5.70** 5.26
E			**15.16** 15.04
RM	**3.34** 4.14	**3.04** 4.54	**2.34** 2.19
Q		**7.07** 13.63	**6.78** 11.97
E			**2.76** 4.27
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	**0.97** 1.26	**0.57** 2.22	**3.18** 5.7
Q		**7.94** 15.24	**8.04** 13.59
E			**10.09** 8.9
M3 (1989.1-1997.4)	**16.32** 20.9	**15.78** 18.4	**16.00** 16.9
Q		**2.89** 2.6	**2.94** 7.08
E			**16.59** 26.3
RM (1986.2-1992.4)	**0.54** 2.23	**1.93** 7.16	**2.09** 10.6
Q		**11.24** 25.6	**14.70** 33.8
E			**10.29** 4.3

Table 4, continued

Pre-Asian Crisis Period 1982.2-1997.2						
	2 Variable		3 Variable		4 Variable	
M1	**5.45**	8.66	**5.89**	7.30	**7.15**	9.81
Q			**11.83**	8.51	**10.51**	8.03
E					**23.52**	22.32
M3	**2.96**	3.16	**2.83**	2.15	**6.00**	4.62
Q			**7.14**	7.13	**12.75**	9.31
E					**31.33**	34.07
RM	**2.48**	2.26	**1.47**	1.70	**1.47**	2.15
Q			**9.23**	13.87	**9.78**	14.84
E					**2.58**	5.29
Post-Asian Crisis Period 1997.2-2003.4						
	2 Variable		3 Variable		4 Variable	
M1	**2.96**	19.21	**5.13**	26.43	**6.45**	5.99
Q			**10.87**	16.86	**31.98**	9.91
E					**37.07**	35.36
M3	**13.04**	25.72	**11.16**	15.79	**11.06**	7.08
Q			**12.61**	35.73	**33.00**	13.63
E					**27.26**	27.96
RM	**3.42**	8.06	**3.85**	18.54	**8.78**	16.4
Q			**11.36**	30.49	**25.98**	18.32
E					**46.64**	19.75

Table 5 **Variance Decomposition Results: Percentage of Inflation Variance Explained**			
Full Period: Original Ordering with 5 Lags versus Original Ordering with 4 Lags			
	2 Variable	3 Variable	4 Variable
M1	**5.21** 5.65	**5.00** 5.33	**9.09** 6.93
Q		**7.88** 6.56	**6.93** 4.72
E			**11.42** 12.12
M3	**7.46** 5.43	**5.44** 3.26	**8.99** 5.25
Q		**7.41** 6.64	**7.71** 5.26
E			**15.42** 15.04
RM	**15.78** 4.14	**16.30** 4.54	**9.26** 2.19
Q		**9.31** 13.63	**7.00** 11.97
E			**7.07** 4.27
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	**3.99** 1.26	**3.76** 2.22	**9.76** 5.7
Q		**11.95** 15.24	**9.41** 13.59
E			**21.75** 8.9
M3 (1989.1-1997.4)	**21.62** 20.9	**17.69** 18.4	**13.40** 16.9
Q		**5.64** 2.6	**18.84** 7.08
E			**48.91** 26.3
RM (1986.2-1992.4)	**36.03** 2.23	**31.51** 7.16	**43.86** 10.6
Q		**11.58** 25.6	**16.32** 33.8
E			**17.64** 4.3

Table 5, continued

Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	**6.99** 8.66	**7.43** 7.30	**11.15** 9.81
Q		**13.37** 8.51	**14.85** 8.03
E			**22.56** 22.32
M3	**4.16** 3.16	**2.57** 2.15	**4.06** 4.62
Q		**9.90** 7.13	**16.67** 9.31
E			**33.94** 34.07
RM	**14.90** 2.26	**12.67** 1.70	**19.19** 2.15
Q		**9.71** 13.87	**7.86** 14.84
E			**11.71** 5.29
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4 Variable
M1	**15.97** 19.21	**23.42** 26.43	**3.56** 5.99
Q		**16.27** 16.86	**30.05** 9.91
E			**1.91** 35.36
M3	**38.05** 25.72	**13.28** 15.79	**13.38** 7.08
Q		**31.47** 35.73	**5.70** 13.63
E			**10.10** 27.96
RM	**11.84** 8.06	**12.33** 18.54	**66.21** 16.4
Q		**35.44** 30.49	**20.64** 18.32
E			**0.72** 19.75

Table 6 Variance Decomposition Results: Percentage of Inflation Variance Explained			
Full Period: Alternative Ordering with 4 Lags versus Original Ordering with 4 Lags			
	2 Variable	3 Variable	4 Variable
M1	**28.52** 5.65	**28.35** 5.33	**34.54** 6.93
Q		**6.56** 6.56	**4.72** 4.72
E			**12.12** 12.12
M3	**5.44** 5.43	**2.56** 3.26	**5.27** 5.25
Q		**6.54** 6.54	**5.26** 5.26
E			**15.04** 15.04
RM	**5.61** 4.14	**6.53** 4.54	**4.25** 2.19
Q		**13.63** 13.63	**11.75** 11.97
E			**4.27** 4.27
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	**2.23** 1.26	**2.82** 2.22	**6.84** 5.7
Q		**14.51** 15.24	**13.11** 13.59
E			**8.9** 8.9
M3 (1989.1-1997.4)	**16.85** 20.9	**14.61** 18.4	**14.06** 16.9
Q		**2.37** 2.6	**6.69** 7.08
E			**26.32** 26.3
RM (1986.2-1992.4)	**2.23** 2.23	**6.00** 7.16	**9.96** 10.6
Q		**24.99** 25.6	**32.00** 33.8
E			**4.33** 4.3

Table 6, continued

Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	**38.29** 8.66	**38.09** 7.30	**41.49** 9.81
Q		**8.51** 8.51	**8.03** 8.03
E			**22.32** 22.32
M3	**2.76** 3.16	**1.92** 2.15	**3.86** 4.62
Q		**7.13** 7.13	**11.43** 9.31
E			**34.07** 34.07
RM	**4.14** 2.26	**3.93** 1.70	**3.60** 2.15
Q		**13.87** 13.87	**14.84** 14.84
E			**5.29** 5.29
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4 Variable
M1	**19.70** 19.21	**32.21** 26.43	**31.43** 5.99
Q		**16.40** 16.86	**9.91** 9.91
E			**36.56** 35.36
M3	**35.89** 25.72	**22.84** 15.79	**22.26** 7.08
Q		**35.73** 35.73	**13.63** 13.63
E			**27.96** 27.96
RM	**10.76** 8.06	**23.80** 18.54	**13.67** 16.4
Q		**30.49** 30.49	**18.32** 18.32
E			**19.75** 19.75

Table 7 **Variance Decomposition Results: Percentage of Inflation Variance Explained**			
Full Period: Alternative Ordering with 3 LAGS versus Original Ordering with 3 Lags			
	2 Variable	3 Variable	4 Variable
M1	**27.62** 4.80	**28.31** 5.19	**33.85** 6.75
Q		**7.57** 7.57	**5.60** 5.60
E			**12.96** 12.93
M3	**5.75** 5.40	**3.53** 4.37	**7.70** 7.19
Q		**6.05** 5.60	**4.65** 5.70
E			**15.16** 15.16
RM	**4.63** 3.34	**5.21** 3.04	**5.14** 2.34
Q		**7.07** 7.07	**6.78** 6.78
E			**2.76** 2.76
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	**2.12** 0.97	**2.06** 0.57	**5.35** 3.18
Q		**7.94** 7.94	**8.04** 8.04
E			**10.09** 10.09
M3 (1989.1-1997.4)	**13.75** 16.32	**12.80** 15.78	**12.58** 16.0
Q		**2.89** 2.89	**2.94** 2.94
E			**16.59** 16.59
RM (1986.2-1992.4)	**0.64** 0.54	**1.95** 1.93	**3.39** 2.09
Q		**11.24** 11.24	**14.70** 14.70
E			**10.29** 10.29

Table 7, continued

Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	**35.28** 5.45	**36.38** 5.89	**37.96** 7.15
Q		**11.83** 11.83	**10.91** 10.51
E			**23.52** 23.52
M3	**2.44** 2.96	**2.23** 2.83	**5.50** 6.00
Q		**6.58** 7.14	**12.75** 12.75
E			**31.33** 31.33
RM	**4.02** 2.48	**4.07** 1.47	**3.66** 1.47
Q		**9.23** 9.23	**9.78** 9.78
E			**2.58** 2.58
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4 Variable
M1	**4.27** 2.96	**5.51** 5.13	**24.80** 6.45
Q		**10.87** 10.87	**31.98** 31.98
E			**37.07** 37.07
M3	**16.61** 13.04	**11.45** 11.16	**16.82** 11.06
Q		**12.61** 12.61	**33.00** 33.00
E			**26.94** 27.26
RM	**13.12** 3.42	**23.96** 3.85	**8.96** 8.78
Q		**11.36** 11.36	**25.98** 25.98
E			**46.64** 46.64

Table 8 **Variance Decomposition Results: Percentage of Inflation Variance Explained**			
Full Period: Alternative Ordering with 5 Lags versus Original Ordering with 4 Lags			
	2 Variable	3 Variable	4 Variable
M1	**30.58** 5.21	**28.59** 5.00	**36.17** 9.09
Q		**7.88** 7.88	**6.93** 6.93
E			**11.42** 11.42
M3	**6.75** 7.46	**4.98** 5.44	**8.64** 8.99
Q		**7.41** 7.41	**7.71** 7.71
E			**15.42** 15.42
RM	**16.84** 15.78	**17.95** 16.30	**12.21** 9.26
Q		**9.31** 9.31	**7.00** 7.00
E			**9.46** 7.07
Selected Periods			
	2 Variable	3 Variable	4 Variable
M1 (1987-1999)	**7.57** 3.99	**4.71** 3.76	**12.28** 9.76
Q		**11.95** 11.95	**9.41** 9.41
E			**21.75** 21.75
M3 (1989.1-1997.4)	**19.49** 21.62	**15.57** 17.69	**12.80** 13.40
Q		**5.64** 5.64	**18.84** 18.84
E			**48.91** 48.91
RM (1986.2-1992.4)	**36.20** 36.03	**36.49** 31.51	**43.30** 43.86
Q		**11.58** 11.58	**16.32** 16.32
E			**17.64** 17.64

Table 8, continued

Pre-Asian Crisis Period 1982.2-1997.2			
	2 Variable	3 Variable	4 Variable
M1	**38.77** 8.66	**34.80** 7.30	**38.14** 9.81
Q		**13.37** 8.51	**14.85** 8.03
E			**22.56** 22.32
M3	**3.89** 3.16	**3.36** 2.15	**3.81** 4.62
Q		**8.77** 7.13	**16.67** 9.31
E			**33.91** 34.07
RM	**15.29** 2.26	**13.39** 1.70	**18.92** 2.15
Q		**9.71** 13.87	**7.86** 14.84
E			**11.71** 5.29
Post-Asian Crisis Period 1997.2-2003.4			
	2 Variable	3 Variable	4 Variable
M1	**17.22** 19.21	**25.18** 26.43	**13.22** 5.99
Q		**16.27** 16.86	**32..16** 9.91
E			**1.91** 36.56
M3	**49.62** 25.72	**26.19** 15.79	**22.05** 7.08
Q		**31.47** 35.73	**5.55** 13.63
E			**10.10** 27.96
RM	**12.00** 8.06	**44.10** 18.54	**68.02** 16.4
Q		**35.44** 30.41	**20.64** 18.32
E			**0.58** 19.75

Appendix A[27]

The original model of Hamilton (1989) assumes that the series of interest contains a unit root and analyzes economic fluctuations as the outcome of switches from one state to another. An unobserved first-order Markov process governs the change in state. Lam (1990) extended Hamilton's model to model processes whose AR component need not have a unit root.

The variable of interest, q_t, can be decomposed into its stochastic trend, x_t, and cycle, z_t.

$$q_t = x_t + z_t \qquad (1)$$

The trend component, x_t, can be modeled as a random walk with drift that evolves according to a two-state Markov process, in which the binary variable, s_t, represents either a high growth state or a low growth state of the series in question at time t. The probability that state j follows state *i* is given by the transition probabilities $p_{ij} = \Pr(s_t = j \mid s_{t-1} = i)$ where $\Sigma_j\, p_{ij} = 1$, j=0,1.

$$x_t = x_{t-1} + \mu_0 + \mu_1 s_t \qquad \mu_1 > 0 \qquad (2)$$

The cycle, z_t, is modeled as

$$\phi(L) z_t = \varepsilon_t \qquad \varepsilon_t \sim N(0, \sigma^2) \qquad (3)$$

If one of the roots of $\phi(L) = 0$ is unity, then x_t and z_t are not identified and the model reverts to the original Hamilton model.

Kim (1994) uses state space techniques on Lam's extension so that (1) is the measurement equation and (2) and (3) are the transition equations. His smoothing algorithm used in this study yields approximate maximum likelihood estimates close to those of Lam. One of its outputs is the probability of occurrence of a state for each period given information up to the end of the sample and is known as the smoothed probability. In our study, the plot of the smoothed probability shows the probability of a low growth state.

[27] See Bautista, 2003, pp. 366-367.

Appendix B

The method used to test for cointegration and estimate the cointegrating vector is the VAR maximum likelihood technique of Johansen and Juselius (1990).

Their method analyzes the relationship among q quarterly or monthly nonstationary (I(1)) or stationary (I(0)) variables using the following vector autoregression (VAR) system:

(1) $$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \dots + \Gamma_{\kappa-1} \Delta X_{t-(k-1)} + \Pi \Delta X_{t-k} + \mu + \varepsilon_t$$

Where X_t is a (q,1) vector of observations on the q variables at time *t*, μ is a (q,1) vector of constant terms for each equation, and ε_t is a (q,1) vector of error terms. Γ_i and Π (q,q) are matrices of coefficients. The long-run relationships in the data are captured in the Π matrix. If the rank of Π is between 0 and q, (denoted z), then there are z linear combinations of the variable in the system that are I(0) (cointegrated). In this situation, Π can be decomposed into two (q,z) matrices α and β such that $\Pi = \alpha \beta'$ where β contains the coefficients of the cointegrating vectors and α is the matrix of coefficients on the cointegrating vectors (speed-of-adjustment coefficients) in each equation. The system (1) is estimated by Full Information Maximum Likelihood (FIML), to enable us to recover the coefficients.

Johansen (1991) constructs two tests for determining the rank of Π, the "trace" test and the "maximum eigenvalue" test. Johansen and Juselius (1990) present tables of asymptotic critical values for the two test statistics. In addition, Johansen (1991) demonstrates that tests of restrictions on the coefficients of β have chi-squared asymptotic distributions conditional on the order of cointegration being correct.