MONETARY TARGETING IN A LIBERALISED FINANCIAL ENVIRONMENT

Song Ouk-Heon

The SEACEN Centre
The South East Asian Central Banks
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FOREWORD

Monetary targeting has been widely used as a tool for implementing monetary policy since the concept was first introduced in mid-1970s. The countries adopting the monetary targeting try to achieve the final targets such as price stability or economic growth rate by setting and keeping intermediate targets for monetary aggregates. Meanwhile, one of the important issues related to monetary targeting is whether or not the relationship between monetary targets and the final targets is stable. If the relationship is not stable, the monetary targeting loses its usefulness. Since the mid 1980s, many developed and developing countries have experienced the structural changes in the financial system that followed deregulation, which were often cited as one of the main factors influencing the stability between intermediate and ultimate targets. In addition, several SEACEN member countries have directly experienced the economic and financial crises since 1997, which had unprecedented and serious impacts. Under these circumstances, it would be timely to evaluate the effectiveness of monetary targeting.

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Dr. Subarjo Joyosumarto
Executive Director
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Executive Summary

The countries adopting the monetary targeting try to achieve the final targets such as economic growth and price stability, by setting the intermediate target for monetary aggregates and by keeping it on the track. In order for monetary targeting to be viable, there must exist a stable relationship between money and the final targets, which is based on the assumption that velocity of money is constant or at least predictable. The predictability of velocity of money is dependent upon existence of a stable money demand function. With existence of a stable money demand function, the monetary targeting would improve the effectiveness of monetary policy. Since monetary targeting was adopted, numerous empirical studies have been undertaken to check the stability of money demand function. The most likely cause of instability of money demand seems to be a rapid pace of financial innovation or liberalization. Meanwhile, the instability of money demand function provided a reason why several developed countries either de-emphasized or dropped the monetary targeting. The purpose of this paper is to check whether the traditional monetary targeting in SEACEN countries is still viable in a liberalized financial environment. If not, it is time to search for an alternative to monetary targeting and examine the merits and de-merits of the alternative.

According to the empirical study, only the Philippines has the stable money demand function and the other countries do not, among six countries (Indonesia, Korea, Malaysia, Philippines, Taiwan, and Thailand). Unstable money demand functions could reduce the effectiveness of monetary policy and are attributable, in part, to financial liberalization. In line with this, four out of six countries - Indonesia, Korea, Philippines and Thailand - recently adopted inflation targeting as an alternative. The adoption of another alternative, however, does not guarantee achievement of the final target (i.e., price stability). Instead, each central bank must make a lot of effort to enhance the effect of monetary policy under a chosen framework of monetary policy: e.g., finding an effective transmission mechanism and effective policy instruments to achieve policy objectives.

CHAPTER 1

Introduction

Until the early 1970s, central banks in major industrialized countries had carried out monetary policy mainly in terms of interest rates or quantitative credit restrictions. However, rising inflation during the 1970s made central banks interested in the empirical relationship between money growth and price inflation, in order to contain inflation. In this context, the Bundesbank was a starter to announce a target for money growth, which introduced it in late 1974 (Neumann, 1996). Subsequently, monetary targeting became a popular framework for monetary policy implementation around the world.

The countries adopting the monetary targeting try to achieve the final targets such as economic growth and price stability, by setting the intermediate target for monetary aggregates and by keeping it on the track. In order for monetary targeting to be viable, there must exist a stable relationship between money and the final targets, which is based on the assumption that velocity of money is constant or at least predictable. The predictability of velocity of money is dependent upon existence of a stable money demand function, which would mean that velocity of money is highly predictable, and that a change in the quantity of money will produce a predictable change in aggregate spending, becoming the primary determinant of nominal income. With existence of a stable money demand function, the monetary targeting would improve the effectiveness of monetary policy. Since monetary targeting was adopted, numerous empirical studies have been undertaken to check the stability of money demand function. In the United States, the M1 money demand function began to severely over-predict the demand for money starting in 1974, which was labeled "Missing Money" by Goldfeld (1976). Since then, there were various attempts to produce a stable money demand function, which has not been successful. The most likely cause of instability of money demand seems to be a rapid pace of financial innovation or liberalization. Meanwhile, the instability of money demand function provided a reason why several developed countries either de-emphasized or dropped the monetary targeting. In the 1990s, many countries began to adopt

inflation targeting as an alternative to monetary policy framework. The number of inflation targeting countries is now increasing.

In most SEACEN countries, monetary targeting has been used during the last two decades. The financial systems, prior to financial liberalization that started in the 1980s, shared many similar characteristics: for example, interest restrictions, domestic credit controls, high reserve requirements, underdeveloped money and capital markets, and controls on international capital flows. With excessive controls and regulations, it was hard to achieve efficient resource allocation and rapid economic growth. Since the 1980s, most countries have liberalized their financial systems with a relaxation of capital controls and a shift toward more flexible exchange arrangements. The general objectives of financial liberalization were to enhance efficiency through a greater reliance on market forces as well as to improve the effectiveness of monetary policy (Azizah, 1993). In addition to financial liberalization, several SEACEN countries have directly experienced the economic and financial crises since 1997, which was unprecedented and serious, and the other SEACEN countries have been indirectly affected by these crises, which might have constrained the effectiveness of monetary policy through a shift in money demand.

Amid these changes in financial environment, several countries (Indonesia, Korea, The Philippines, and Thailand) recently adopted inflation targeting,[1] reflecting the recent trend of monetary policy framework that seems to give increasing focus on inflation targeting with decreasing focus on monetary targeting. Besides, Singapore is using the exchange rate targeting and Malaysia is focused on interest rates. At this point of time, it would be desirable to evaluate the monetary targeting in the SEACEN countries. The purpose of this paper is to check whether the traditional monetary targeting in SEACEN countries is still viable in a liberalized financial environment. If not, it is time to search for an alternative to monetary targeting and examine the merits and de-merits of the alternative.

1. Some countries cannot be classified as a pure inflation targeter but as in-between, since they are setting the annual target of monetary aggregates with the announcement of annual inflation target.

The paper is organized as follows. Chapter 2 provides a theoretical review on the appraisal of monetary targeting, which will briefly summarize the theory on money demand as well as the theoretical review of econometric methodology. Chapter 3 presents the results of empirical study to assess the usefulness of existing monetary targeting, which includes the estimation of demand for money function, the movements of velocity of money, and the relationship between money and final goal variables such as real income and the price levels. Chapter 4 introduces other alternative targeting frameworks including inflation targeting. The merits and de-merits of other alternatives will also be examined. Chapter 5 contains the concluding remarks.

CHAPTER 2

Theoretical Review on the Appraisal of Monetary Targeting

2.1 Monetary Targeting Framework

The central bank has certain goals of monetary policy such as economic growth or price stability but cannot directly influence these goals, since there is time lag for a certain type of monetary policy to have an impact on the final goals. The central bank uses a set of tools, which are open market operations, changes in the discount rate, and changes in reserve requirements. With these tools, the monetary authority has an impact on a set of variables called "operating targets": for example, reserves, monetary base, or overnight interest rates, which are more responsive to the policy tools. In-between the operating targets and the final goals, there is another set of variables called "intermediate targets," such as the monetary aggregates (M1, M2, or M3) or interest rates. Monetary targeting means that monetary aggregates are used as intermediate targets to affect the final target. Thus, under the monetary targeting framework, the central bank first influences, through a set of tools, the operating targets, which have an impact on the monetary aggregates as the intermediate target, and then affect the final policy goals.

There are three criteria for choosing an intermediate target: measurability, controllability and predictability (refer to Mishkin, 1992). First, quick and accurate measurement of an intermediate target variable is necessary and important, since the intermediate target would be useful only if it signals rapidly when monetary policy is off track from the goal. Monetary aggregates can be measured relatively accurately, although they are subject to revision, so that they satisfy the first criterion. Second, an intermediate target variable must be able to be controlled effectively by the central bank. Among candidates for intermediate target variables, the central bank has better control over the monetary aggregates and interest rates than nominal GDP. The central bank can affect monetary aggregates, especially narrow monetary aggregates, which is not perfect, while it can set interest rates by directly affecting the price of bonds through open market operations. Interest rates seem

better choices than monetary aggregates. The central bank, however, cannot set real interest rate since it does not have control over expected inflation. In that sense, it cannot be said that interest rates dominate monetary aggregates as intermediate target. Third, the most important characteristic for a useful target variable is that the variable must have a predictable impact on a goal of monetary policy. For the linkage of the money stocks with the goals (such as output, employment, and the price level), there has been much debate in the academic profession. However, the evidence seems to favor a closer link of these goals with the money supply than with other candidates for an intermediate target such as interest rates, thus providing support to the use of monetary aggregates as intermediate targets.

In consideration of these criteria, a monetary aggregate seems to be a good variable for the intermediate target, which provides the validity of using monetary targeting as a nominal anchor for the conduct of monetary policy. By the way, in order for the monetary targeting to be a useful strategy, there must be a stable and reliable relationship between money growth and the final goal variables such as inflation or the growth rate of GDP. This relationship can be examined by testing the existence of a stable money demand function.

2.2 Demand for Money Function

There are different kinds of theories on the demand for money function. Based on the quantity theory of money developed by the classical economists, Fisher (1911) suggests that the demand for money is a function of income, and interest rates have no effect on the demand for money, while a group of classical economists in Cambridge, England, including Marshall and Pigou, did not rule out effects of interest rates. Through the liquidity preference theory of Keynes (1936), the inventory theoretic approach of Baumol (1952) and Tobin (1956), and the liquidity preference of Tobin (1958), the Keynesian economists argue that demand for money depends upon income as well as interest rates. If money demand is affected by interest rates, this theory implies that velocity has substantial fluctuations due to changes in interest rates. Thus, from this Keynesian

point of view, velocity is not a constant and also unpredictable so that nominal income might be affected by other factors than the quantity of money. Meanwhile, Friedman's (1956) modern quantity theory of money has two major differences from Keynes': he views the demand for money as insensitive to interest rates; the money demand function is stable and does not undergo substantial shifts, indicating that velocity is predictable and providing a quantity theory conclusion that money is the primary determinant of aggregate spending.[2]

From the various kinds of theories on demand for money, one important issue that distinguishes theories of money demand is the sensitivity of the demand for money to changes in interest rates. If interest rates do not influence the demand for money, then velocity is more likely to be a constant or at least predictable, so that the quantity theory view that aggregate spending is determined by money supply would be true. Otherwise, the link between money and aggregate spending will be unclear. Another issue is the stability of money demand function. If the money demand function is unstable and undergoes substantial shifts, then velocity is unpredictable and money supply may not be closely linked to aggregate spending. To explain these issues, suppose that Income velocity (V) is defined as: [3]

$$V = \frac{P \times Y}{M} \tag{2-1}$$

where P is the price level, Y real income, and M monetary stock. The income velocity of money is the number of times the stock of money is turned over per year in financing the annual flow of income. In other words, income velocity means the ratio of nominal

2. Besides, there are theories of money demand by the overlapping generations model of Sargent and Wallace (1982), and by shopping time model of McCallum (1989).

3. Another concept is "transactions velocity" that is the ratio of total transactions to money balances. Total transactions are much greater than GNP, because many transactions do not contribute to GNP. Thus, transactions velocity is higher than income velocity (Dornbusch and Fischer, 1990).

income to the nominal money stock. This definition of velocity of money becomes the *equation of exchange* by multiplying both sides of the definition by M:

$$M \times V = PxY \tag{2-2}$$

This equation of exchange is an identity, since a rise in M could be offset by a fall in V that leaves MV unchanged. If velocity were constant in the short-run as the classical economists thought, the equation of exchange describes the *quantity theory of money*. That is, nominal income (PxY) is determined by movements in the quantity of money as:

$$M = k \times PY, \tag{2-3}$$

where $k=(1/V)$. The classical economists also thought that aggregate output produced in the economy (Y) would remain at the full employment level, with the assumption of flexible prices. Thus, if both V and Y are fixed, the price level is proportional to the money stock. On the other hand, income velocity does not seem to be constant according to the money demand function of *Keynesian theory*. Keynesian money demand function is expressed as:

$$\frac{M}{P} = L(i,Y), \tag{2-4}$$

where M is money stock, P the price level, i interest rate, Y real income, and $L(\cdot)$ demand for real balances. If we substitute the Keynesian money demand function for M in equation (2-1), we obtain:

$$V = \frac{PxY}{M} = \frac{PxY}{PxL(i,Y)} = \frac{Y}{L(i,Y)} \tag{2-5}$$

From equation (2-5), income velocity is the ratio of the level of real income to the demand for real balances. Velocity is a func-

tion of real income and the interest rate. If interest rates do not affect the demand for money function, then velocity is more likely to be a constant, which supports the quantity theory view that nominal income is determined primarily by movements in the quantity of money. On the contrary, Keynesians argue that money demand is sensitive to interest rates so that velocity is not constant and is positively related to interest rates: that is, a rise in interest rates will cause velocity to rise.

In the equation (2-5), if the income elasticity of the demand for money were one, then the demand for real balances would change in the same proportion as income. In this case, velocity would be stable, which is not affected by changes in real income. If the income elasticity of the money demand were less than one, velocity would rise with increases in real income and vice versa. Thus, the relationship between real income and velocity depends on the income elasticity of the demand for money.

With respect to these issues, if velocity were constant or predictable, the classical theory would be acceptable so that nominal income is determined mainly by money stock. There have been numerous empirical studies on money demand undertaken in developed countries as well as developing economies, reporting the unstable relationship since the 1980s. In the United States, the M1 money demand function began to severely over-predict the demand for money starting in 1974. Goldfeld (1976) labeled the phenomenon of instability in the demand of money function, "The Case of the Missing Money." Since then, there were various attempts to produce a stable money demand function: for example, different forms of money demand function have been tried, including long-term interest rates and rates of return on equity. However, these efforts have not been successful. The most likely cause of instability of money demand seems to be the rapid pace of financial innovation or liberalization (Rasche, 1987; Poole, 1988; Mishkin, 1992).

2.3 Econometric Methodology

In the past, the short-run demand for money function has been estimated using the partial adjustment model, which typically treats

the real money demand as a dependent variable and includes, as explanatory variables, real income and interest rates as well as the first order lag of the dependent variable. In the mid-1970s, this model began to expose problems in analyzing the money demand function as major divergences emerged between the actual and forecast values. This conventional method is criticized for imposing a restriction on the data generation processes (DGP) in the dynamic specification (Yoshida, 1990). Meanwhile, the *error-correction model* (ECM) has merits by eliminating prior restrictions on the model's lag structures. Thus, the ECM will be taken in the paper for the estimation of the short-run money demand function, which needs some explanation on econometric methodology associated with the use of this model.

Much conventional econometric theory assumes stationarity of the variables. However, not all economic time series are stationary. The problem that can arise when performing regressions with clearly non-stationary series is called "spurious regression":[4] given two completely unrelated but non-stationary series, regression of one on another will tend to produce an apparently significant relationship (for a review, see Banerjee et. al, 1993; Granger and Newbold, 1974). With non-stationary data, there are two ways to induce stationarity; one is to difference data and the other is to remove a trend from data. Differencing data between these two will be used in the paper. Before building a model, we can use unit root tests to check whether data series are stationary or not as a first step.

2.3.1 Unit Root Tests[5]

Using the definition of integration, a non-stationary data x_t that becomes stationary after differencing d times is said to be integrated of order d, and denoted $x_t \sim I(d)$. According to this representation, the stationary series is expressed by $I(0)$. A non-stationary data

4. "Spurious regression" was first identified by Granger and Newbold (1974). In their Monte Carlo experiment, regressions were conducted on two independent and mutually unrelated random walk variables and produced significant t-values in 77 out of 100, indicating a causal relationship between the two variables.

5. The contents on the unit root tests, cointegration and error correction mechanism were abstracted from the author's dissertation, Song (1996).

series that needs first differencing to become stationary is denoted by *I(1)*. A large number of macro economic time series data are classified as *I(1)* process (see Nelson and Plosser, 1982; Perron, 1988).

Comparing the *I(0)* process with the *I(1)*, the *I(0)* process has a finite variance, an innovation has only a temporary effect on the value of the process, and the autocorrelations decrease steadily in magnitude. For the *I(1)* process, the variance goes to infinity as time *t* goes to infinity, an innovation has a permanent effect on the value of the process, and the theoretical autocorrelations go to one as time t goes to infinity (for a review, see Engle and Granger, 1987).

Suppose that a data generating process x_t is expressed as AR(1):

$$x_t = \beta x_{t-1} + u_t \qquad u_t \sim iid(0,\sigma^2) \tag{2-6}$$

If the null hypothesis was H_0: $|\beta|<1$, the test would be simple by comparing t-statistic with critical values, since the t-statistic has a standard normal distribution. Here, we test the true hypothesis of H_0: $\beta=1$, so the traditional t-statistic is no longer applied, since the distribution of the test statistic is not asymptotically normal or even symmetric (see Banerjee et al., 1993). The test statistic is compared with the critical value, tables of which are reported in Dickey and Fuller (1979) containing tables for three kinds of unit root tests: no constant, constant, and constant and time trend. The test procedure, called the Dickey-Fuller (DF) tests, estimates the following equation:

$$\Delta x_t = (\beta - 1)x_{t-1} + u_t \tag{2-7}$$

The unit root tests can be extended to an AR(p) process such as:

$$x_t = \sum_{i=1}^{p} \beta_i x_{t-i} + u_t \tag{2-8}$$

For an AR(p) process, the unit root test can be constructed with a regression model such as:

$$\Delta x_t = (\beta - 1)x_{t-1} + \sum_{i=1}^{p-1} \gamma \Delta x_{t-i} + u_t \qquad (2\text{-}9)$$

Here, the coefficient $(\beta\text{-}1)$ is used to test for a unit root. This procedure is called the augmented Dickey-Fuller (ADF) tests. The purpose of the ADF tests is to use lagged changes in the dependent variable to capture auto-correlated and omitted variables which would otherwise appear in the error term (Banerjee et al., 1993). By allowing the data generating process to take the form of equation (2-9) rather than the much more restricted form of equation (2-7), the class of models, to which unit root tests are applied, has been expanded. As p is generally unknown, it is safer to take p to be a fairly generous number in equation (2-9) so that the residual term is approximately white noise. If too many lags are present, the regression suffers from some loss in efficiency while if there are too few lags, then it may imply some remaining autocorrelation (Banerjee et al., 1993). As in the Dickey-Fuller tests, we can test three cases in equation (2-9): no constant, constant, constant and trend. As a generalization of the Dickey and Fuller procedure, Said and Dickey (1984) provided a test procedure valid for a general ARMA process in the errors so that we can apply it not only to models with AR parts in the errors but also to models with AR and MA polynomials in the errors. Their procedure yields test statistics with the same critical values as those tabulated by Dickey and Fuller.

Another procedure was offered by Phillips and Perron (Phillips, 1987; Phillips and Perron, 1988). Rather than taking account of extra elements in the DGP by adding them to the regression model, Phillips suggested accounting for the autocorrelation that would be present when these terms are omitted, through a non-parametric correction to the standard statistics. While the Dickey-Fuller procedure aims to retain the validity of the tests based on white-noise errors in the regression model, the Phillips procedure modifies the statistics after estimation in order to account for the effect that autocorrelated errors will have on the results (for a review, see Banerjee et al., 1993; Phillips and Perron, 1988; Phillips, 1987).

2.3.2 Co-integration and Error Correction Mechanism

In estimating money demand functions, first, the long-run behavior of the monetary aggregate is examined by using co-integrating regression. It would be too strict to require that equilibrium exist in every single period. However, the short-run movements of monetary aggregates are not irrelevant. If the short-run behavior of money is largely uncorrelated with movements in the variables of policy object, the usefulness of a long-run relationship is likely to be severely impaired. Thus, the short-run demand for money will be also estimated through the error correction mechanism.

The *cointegration* analysis tests the existence of the long run equilibrium among the economic variables. In demand for money function, it is checked whether there exists a stable long-run relationship between monetary aggregates, income and interest rate. To explain cointegration, let us assume two series x_t and y_t, both of which are non-stationary, i.e., I(1), evolving according to the following data generating process:

$$x_t + \alpha y_t = u_t \qquad u_t = u_{t-1} + \varepsilon_{1t} \tag{2.10}$$

$$x_t + \beta y_t = e_t, \qquad e_t = \rho e_{t-1} + \varepsilon_{2t}, \qquad |\rho| < 1, \tag{2.11}$$

where the vector $[\varepsilon_{1t}, \varepsilon_{2t}]'$ is distributed identically and independently as a bivariate normal with:

$$E(\varepsilon_{1t}) = E(\varepsilon_{2t}) = 0;$$
$$var(\varepsilon_{1t}) = \sigma_{11}; \qquad var(\varepsilon_{2t}) = \sigma_{22}; \qquad cov(\varepsilon_{1t}, \varepsilon_{2t}) = \sigma_{12}.$$

In general, any linear combination of two I(1) series is also I(1), as shown in equation (2.10), where series $\{u_t\}$ is a random walk. If there exists a relationship like equation (2.11), linear combination $\{x + \beta y\}$ becomes stationary series I(0), because $\{e_t\}$ is stationary. In this example the vector $[1 \ \beta]'$ is called the co-integrating vector and the two series are said to be in the long-run equilibrium when $x + \beta y = 0$. In an equilibrium state, economic variables have no tendency to change in the long run, whereas they may not be in equilibrium in the short run and thus drift apart. The univariate

quantity $z_t = x_t + \beta y_t$ is called the equilibrium error that contains useful information, since on average the system will move towards that equilibrium if it is not already there. Thus, the error z_t should be a useful explanatory variable for the next direction of movement of dependent variable x_t (see Banerjee et al., 1993).

The cointegrated series can be represented by error correction models (ECM), known as *Granger's representation theorem*, which states that if a set of non-stationary variables is cointegrated, there always exists an ECM representation among the variables (Granger, 1983; Engle and Granger, 1987).

For estimation of the ECM, Engle and Granger (1987) proposed a two-step procedure. In the first step, the parameters of the cointegrating vector are estimated by running the static regression in the levels of the variables, that is, cointegrating regression. In the case of two variables (x and y), for example, the cointegrating regression is run as:

$$y_t = c + \beta x_t + u_t$$

Secondly, to test for cointegration, we check whether the residual u_t is stationary or not under the null hypothesis of no cointegration. As in the unit root tests, we apply the augmented Dickey-Fuller test for the residual in the cointegrating regression. When the null hypothesis of no-cointegration is rejected, in other words, the residual term is stationary, the cointegrating vector among the variables is said to exist, which imply that there is a stable long-run relationship among these variables. The error correction term is obtained from the cointegrating regression:

$$z_t = y_t - c - \beta x_t$$

In the second step, the model is estimated using the error correction term (z_{t-1}):

$$\Delta y_t = -\gamma_1 z_{t-1} + A_1(L)\,\Delta x_t + A_2(L)\,\Delta y_t + e_{1t}$$

$$\Delta x_t = -\gamma_2 z_{t-1} + B_1(L)\,\Delta x_t + B_2(L)\,\Delta y_t + e_{2t}$$

where e_{1t} and e_{2t} are white noise and $|\gamma_1| + |\gamma_2| \neq 0$. In both steps, OLS is applied.

CHAPTER 3

Appraisal for Monetary Targeting

Monetary policy can be affected, through parameter changes of the money demand function, by financial liberalization. Thus, the financial liberalization in the SEACEN countries will be first introduced briefly. In evaluating the usefulness of monetary targeting, the demand for money function will be examined in the paper, using the error correction model (ECM) and then, the graphical analysis of income velocity will be presented to check some implications obtained from the demand for money function. In addition to the estimation of money demand function, the effects of monetary aggregates on the final goal variables will be checked. For this purpose, money's contribution to output and prices will be presented using the vector auto-regression (VAR).

3.1 Financial Liberalization in Selected SEACEN Countries

Financial liberalization has been implemented or is taking place in many countries, which have different objectives: to lower transactions costs, to promote competition among financial institutions, to fight sluggish economic growth, and so on. Financial liberalization, with technological advances such as the introduction of credit cards and ATMs, may cause money demand to respond more rapidly to interest rate changes, thereby influencing on the monetary policy of each country. In consideration of the impact on the monetary policy, measures taken to develop the financial market are introduced by country.

Indonesia

Indonesia undertook a series of comprehensive reforms in the mid-1980s to combat sluggish growth in the early part of the decade. Faced with deteriorated terms of trade and widened imbalances between external and internal sectors, the government switched its development strategy from the import-substitution policies of the 1960s and 1970s to an export-led growth policy. Financial liberalization had two stages. The first stage, begun in 1983, eliminated all credit ceilings, removed interest rate controls on deposit rates at

state-owned banks, and curtailed the central bank's liquidity credit programs. The second stage, begun in 1988, focused on promoting competition in the financial sector. It permitted new entry into the banking sector, allowed additional branches, eased the requirements for becoming a foreign exchange bank, reduced the amount that state-owned enterprises were required to deposit in state-owned banks, and lowered the reserve requirement while raising minimum paid-in capital requirements.

The majority of financial assets are held by the banking sector. Equities are the most common financial instruments traded on the stock markets. The ratio of market capitalization to outstanding bank loans grew from 0.33 percent in 1988 to 46 percent in 1993 but trading is still very thin. The bond market is underdeveloped, despite an absence of regulatory impediments. Most bonds are bought by institutional investors, which hold them until maturity, resulting in an inactive secondary market. This implies that Indonesia is still in the early stage of financial sector development (Dobson and Jacquet, 1998).

Korea

Although Korean had carried out efforts to liberalize the financial sector since the early 1980s with emphasis on privatization, deregulation of market entry, and expansion of business scope, the progress of financial liberalization had been rather slow. As the shift of the current account into surplus from 1986 to 1989 served as the momentum for the full-scale pursuit of financial liberalization, interest rate deregulation was attempted in December 1988, but within a few months the rates skyrocketed and the majority of reforms were reversed. In 1993, the government outlined a five-year program of gradual financial sector deregulation in the Blueprint for Financial Reform. Under the plan, all interest rate controls, except those on demand deposits, were scheduled to be removed by 1997. Other principal measures include reducing controls on capital flows, giving banks greater autonomy in managing their business, and reducing policy loans from the central bank.

The share of assets held by commercial banks has fallen dramatically since the 1970s, while the stock market has expanded rapidly since the mid-1980s. Since 1986, Korea has made greater use of government bonds to manage money supply and, since 1989, the corporate debt market has become an important source of capital for Korean firms. In 1995, the value of traded bonds was roughly 50 percent greater than the value of traded stocks.

Malaysia

Financial sector reform in Malaysia followed a severe financial sector crisis, in the early and the mid 1980s, due to deteriorating terms of trade and an increasing number of non-performing loans. To promote greater efficiency, the central bank made the ringgit freely convertible in 1986 as a means to adjust the balance of payments. The bank also reformed its export credit refinance scheme, reduced reserve requirement ratios of commercial banks introduced more flexible interest rates, and abolished deposit rate controls. These measures helped the country to overcome the financial sector crisis.

Commercial banks accounted for about 40 percent of financial sector assets in 1993. Trading volume of the stock market has rapidly increased since it was founded in 1973. The bond market is small and its trading is particularly sluggish in the secondary market. The corporate bond market is very small (Dobson and Jacquet, 1998).

Philippines

After the country experienced several banks collapses in the early 1980s, comprehensive financial reforms in the Philippines were introduced in 1981-1984: restrictions on financial intermediation were lifted, market-oriented credit and monetary policies were implemented, all interest rates were gradually liberalized, and agricultural credit programs were eliminated. Despite these reforms, interest rates continue to be subsidized and credit is directed. Compared to those of other ASEAN countries, the Philippine financial system is underdeveloped and has a legacy of government control (Dobson and Jacquet, 1998).

The banking system dominates the financial sector, accounting for more than 80 percent of total financial assets. The equity market is thin, highly concentrated in the stocks of five companies. The bond market, dominated by government bonds, also is thin.

Taiwan

Prior to the mid-1980s, the government's goal was to industrialize and transform the basic economic structure from subsistence agriculture to industry: as a result, the financial system was highly repressed. In 1987, capital controls were lifted, the undervalued exchange rate was freed up, trade policy was liberalized, and tariff and non-tariff barriers were reduced. The New Banking Law Reforms in 1989 were aimed at strengthening regulatory controls over financial sector and helping banks become more competitive. Major reforms included steps toward privatizing commercial banks and removing controls on interest rates.

The majority of financial assets continue to be held by government-controlled banks. The equity market has become deeper over the last 15 years, while the bond market has been less developed than the equity market, because of the low level of government bond issues and strict regulation on the bond issue of private companies.

Thailand

Thailand began to liberalize its financial markets in the early 1990s to support the market-oriented, export-led development policy. In the mid-1980s, priority was given to economic and financial stability rather than to financial reform. Once the financial system was stabilized, the government embarked on its first three-year plan of financial liberalization (1990-1992). The reform package consisted of four components: interest rate deregulation, prudential regulation, the reforms to deal with financial innovation in the primary and secondary capital markets, and the reforms of the interbank clearing system. The second three-year plan (1993-95) largely supported the reforms of the first plan.

Commercial banks have held just under 70 percent of financial assets. The capital market remains underdeveloped: in 1992, the outstanding value of stocks and bonds was only 10 percent of financial intermediaries' outstanding credit. In other words, companies rely more on intermediation than on securitization to raise capital.

3.2 Money Demand Function

3.2.1 Data and Unit Root Tests

In the empirical study, real money, real income and interest rate will be used in logarithmic form. Two monetary aggregates are chosen for each country, including one used for the intermediate targeting variable. To make a real stock of money, CPI (Consumer Price Index) is used. As the proxy variable for real income, real GDP (Gross Domestic Product) is selected except Thailand, where Manufacturing Production Index (MPI) is chosen due to data availability. The interest rate is the opportunity cost variable of holding money.[6] There seems no answer to which rate must be chosen between the short-term and longer-term interest rate. On the one hand, it is argued that the long-term rate is a better indicator, in the sense that it is more representative of the average rate of return on capital in the economy. On the other hand, it is asserted that the short-term rate is a closer substitute for money than the long-term rate, because of short maturity (Laidler, 1977). The bond markets in the SEACEN countries have not been well developed so that there is not much choice of investment instruments. In this study, market interest rate that is considered to be adequate to each country's situation was selected with the help of each central bank.[7]

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6 In the demand function for broad money, the interest rate differential between the own rate of return on quasi money and the rate of an asset to be held instead of quasi money could be used as the opportunity cost of money. However, market interest rate of each country is used in this paper, as in other empirical studies, due to data availability and reflecting underdevelopment of bond markets in the SEACEN countries.

7 As the market interest rate, the rate used in the other empirical study or the rate in consultation with each central bank was chosen.

The empirical study will not cover all member countries of the SEACEN Center. Since the main purpose is to evaluate monetary targeting in the SEACEN countries, the empirical study will include the cases of the countries adopting or having adopted monetary targeting.[8] This paper will present the cases of six countries that have or had annual targets for monetary aggregates in consideration of data availability: Indonesia, Korea, Malaysia, the Philippines, Taiwan and Thailand.

Among the six countries, four countries excluding Malaysia and Taiwan shifted their monetary policy frameworks to inflation targeting from monetary targeting. Indonesia and Thailand selected inflation targeting as the change to flexible exchange rate system from managed floating had caused the monetary policy to be less effective (Bank of Thailand, 2000; Alamsyah et al., 2000).[9] Korea moved to inflation targeting with the revision of the central bank act in 1998 but it also uses monetary target. In the Philippines, the financial liberalization in 1993 weakened the effectiveness of monetary policy, forcing to adopt a modified framework, beginning in 1995, that complements monetary targeting with some form of inflation targeting (Guinigundo, 1999).[10] The Monetary Board has recently approved the shift to inflation targeting by 2001, considering that basic conditions are in place and that inflation targeting offers advantages.

Meanwhile, Malaysia shifted its focus from monetary targeting to interest rate targeting in the mid-1990s, considering that the liberalization of interest rates led to a more market-oriented determination process of interest rates, and that the role of interest rates had been enhanced by financial deregulation and liberalization measures (BNM, 1999). Unlike the other five countries, Taiwan is still taking the monetary targeting approach.

8. Refer to monetary policy implementation of SEACEN countries in Appendix A.

9. Indonesia started to announce inflation target from year 2000 according to the new central bank act, and it had announced the annual intermediate M1 target until last year.

10. BSP announced the shift to inflation targeting by 2001.

Indonesia

The data sample period is from 1983: Q1 to 1999: Q3 for the variables of the real monetary aggregates (RM1, RM2), real GDP (RGDP), and interest rate (INT1: 3-month Time Deposit rate; INT2: Call Money Rate). The starting period of data sample was selected reflecting that financial deregulation of domestic interest rates was undertaken in 1983. Before testing the long-run relationship, the unit root test for each variable is undertaken. The result of the unit root test is shown in Table 3-1I. There are two types of unit root tests in the table: one is the Augmented Dickey-Fuller (ADF) test and the other, the Phillips-Perron (P-P) test.

In the ADF test, we have to specify the number of lagged first difference terms to add to the test regression. The usual advice is to include lags sufficient to remove any serial correlation in the residuals (EViews, 1994). Here, eight lags are chosen, considering the quarterly data are used. Starting from lag eight, the highest lag is selected, whose coefficient is significant. The Table 3-1I shows the ADF statistics, with the number of lagged dependent variables in parenthesis. The unit root tests are applied to the levels and the first differences of all the data series. Each test is also undertaken for the case including constant and for the case with both constant and trend respectively. Judging from the ADF test statistics, the null hypothesis of a unit root cannot be rejected for the levels of all variables at the 5 percent significance level. For the first differences of variables, however, the null hypothesis of a unit root is rejected for all variables at the 5 percent significance level.

For the P-P test, we have to specify the truncation lag, that is, the number of periods to account for the serial correlation. According to the Newey-West correction in this paper, the lag number q is obtained as the following based on the number of observations (Eviews, 1994):

$$q = floor\ \{4 \times (T/100)^{2/9}\},$$

where T is the number of observation and the 'floor' function means the largest integer not exceeding the argument. In the case

of Indonesia, q is set to 3. Each test is also undertaken for the case including constant and for the case with both constant and trend respectively. Table 3-1I shows a modified t-statistic to account for the serial correlation in the residual. In the table, the null hypothesis of a unit root cannot be rejected for the levels of all the variables at the 5 percent significance level, while the null hypothesis is rejected for the first differences of all data series at the 5 percent significance level.

Summarizing the results from the two kinds of tests, all the variables are considered to have unit roots. Thus, first differencing is necessary to make the variables stationary.

Korea

The sample period of data is from 1982: Q1 to 1999: Q3 for the variables of the real monetary aggregates (RM2, RM3), real GDP (RGDP), and interest rate (INT: 3-year corporate bond yields). The starting period was chosen in order to exclude the effect of the second oil crisis. The results of two types of the unit root tests are shown as in Table 3-1K: the ADF test and the P-P test.

In the ADF test for the levels of RM2 and RGDP, there is no rejection of the null hypothesis of a unit root for two cases with constant and with constant and trend. For the levels of RM3 and INT, the null hypothesis of a unit root is rejected at the 5 percent significance. For the first differences of the data, the null hypothesis of a unit root is rejected at the 5 percent significance level for all variables.

For the P-P test, we set 3 as the number of the truncation lag, according to the Newey-West correction. The null hypothesis of a unit root cannot be rejected for the levels of all the variables except interest rate (INT), at the 5 percent significance level.

Summarizing the results from the two kinds of tests, all the variables are considered to have unit roots as the following reason. For the levels of interest rate, the ADF test cannot reject the null hypothesis of a unit root in the case with constant and trend at the

5 percent significance level, while the P-P test can reject. In the P-P test of the levels of the interest rate, the test statistic is marginally greater than the critical values in the case of constant and trend at the 5 percent level of significance. Thus, the interest rate is assumed to be non-stationary here and first differencing is necessary to make all variables stationary.

Malaysia

The sample period of data is from 1983: Q1 to 1999: Q4 with the variables of the real monetary aggregates (RM1, RM3), real GDP (RGDP), and interest rate (INT1: 3-month Fixed Deposit rate; INT2: 3-month Inter-Bank Market Rate). The starting period was chosen in order to exclude the effect of the second oil crisis. The results of two types of the unit root tests are shown as in Table 3-1M.

In the ADF test for the levels of all variables, there is no rejection of the null hypothesis of a unit root, in the cases with constant and with constant and trend. For the first differences of the data, the null hypothesis of a unit root is rejected at the 5 percent significance level for all variables.

For the P-P test, we set 3 as the number of the truncation lag, according to the Newey-West correction. The null hypothesis of a unit root cannot be rejected for the levels of all the variables, at the 5 percent significance level. For the first differences of the data, the null hypothesis of a unit root is rejected at the 5 percent significance level for all variables.

Summarizing the results from the two kinds of tests, all the variables are considered to have unit roots. Thus, first differencing is necessary to make all variables stationary.

Philippines

The sample period of data is from 1987: Q1 to 1999: Q3 due to data availability for the variables of the real monetary aggregates (RM1, RM3), real GDP (RGDP), and interest rate (INT: 6-month Treasury Bill rate). The results of two types of the unit root tests are shown as in Table 3-1P.

Table 3-1I
Unit Root Tests for Indonesia

	Levels ($\tau\mu$)	Levels ($\tau\tau$)	Diff ($\tau\mu$)	Diff ($\tau\tau$)
[ADF Tests]:				
RM1	-0.36 [0]	-2.24 [0]	-6.51 [0] **	-6.43 [0] **
RM2	-0.89 [0]	-1.81 [2]	-9.10 [0] **	-9.12 [0] **
RGDP	-1.61 [0]	0.59 [0]	-6.88 [0] **	-7.11 [0] **
INT1	-1.87 [0]	-1.97 [0]	-4.23 [4] **	-4.01 [4] *
INT2	-2.31 [0]	-3.16 [2]	-7.99 [0] **	-7.93 [0] **
[P-P Tests]:				
RM1	-0.46	-2.62	-6.57 **	-6.49 **
RM2	-0.89	-1.63	-9.09 **	-9.10 **
RGDP	-1.45	0.12	-7.01 **	-7.20 **
INT1	-2.45	-2.64	-3.79 **	-3.69 *
INT2	-2.61	-2.80	-8.01 **	-7.96 **

Notes: 1.Critical values (C.V.): No Trend (Trend)
1% -3.52 (-4.09)
5% -2.90 (-3.47)
2.In ADF tests, the number in [ ] denotes the lag order of a lagged dependent variable, which is significant.
3.tm denotes the case with constant, and tt denotes the case with constant and trend.
4.* denotes 5% significance and ** 1% significance.

Table 3-1 K
Unit Root Tests for Korea

	Levels ($\tau\mu$)	Levels ($\tau\tau$)	Diff ($\tau\mu$)	Diff ($\tau\tau$)
[ADF Tests}:				
RM2	0.05 [1]	-3.46 [1]	-4.20 [6] **	-4.14 [6] **
RM3	-7.33 [0]**	1.55 [4]	-4.35 [0] **	-6.80 [0] **
RGDP	-2.31 [0]	-0.70 [0	-6.35 [0] **	-6.66 [0] **
INT	-3.23 [0]*	-3.24 [0]	-5.58 [0] **	-5.54 [0] **
[P-P Tests]:				
RM2	0.06	-2.69	-5.33**	-5.29**
RM3	-5.99**	0.85	-4.20**	-6.84**
RGDP	-2.01	-1.02	-6.44**	-6.70**
INT	-3.57**	-3.65*	-5.58**	-5.56**

Note: Critical values (C.V.): No Trend (Trend)
1% -3.52 (-4.08)
5% -2.90 (-3.47)

In the ADF test, the null hypothesis of a unit root cannot be rejected for the levels of all variables at the 5 percent significance level. For the first differences of the data, the null hypothesis of a unit root is rejected at the 5 percent significance level for all variables.

For the P-P test, we set 3 as the number of the truncation lag, that is, the number of periods to account for the serial correlation, according to the Newey-West correction. The null hypothesis of a unit root cannot be rejected for the levels of all the variables at the 5 percent significance level. For the first differences of the data series, the null hypothesis is rejected at the 5 percent significance level.

Summarizing the results from the two kinds of tests, all the variables are considered to have unit roots. Thus, first differencing is necessary to make the variables stationary.

Taiwan

The sample period of data is from 1982: Q1 to 1999: Q4 for the variables of the real monetary aggregates (RM1B, RM2), real GDP (RGDP), and interest rate (INT: rate on 1-30 days commercial papers (secondary market)). The results of two types of the unit root tests are shown as in Table 3-1C.

Table 3-1M
Unit Root Tests for Malaysia

	Levels ($\tau\mu$)	Levels ($\tau\tau$)	Diff ($\tau\mu$)	Diff ($\tau\tau$)
[ADF Tests}:				
RM1	-0.61 [4]	-1.76 [4]	-4.16 [3] **	-4.12 [3] **
RM3	-0.66 [6]	-2.23 [6]	-7.33 [0] **	-7.28 [0] **
RGDP	-0.23 [1]	-1.77 [1]	-5.87 [0] **	-5.83 [0] **
INT1	-2.29 [1]	-2.32 [1]	-4.90 [0] **	-4.89 [0] **
INT2	-1.66 [0]	-1.73 [0]	-5.21 [0] **	-5.19 [0] **
[P-P Tests]:				
RM1	-0.68	-1.55	-5.87 **	-5.82 **
RM3	-0.40	-1.69	-7.45 **	-7.41 **
RGDP	-0.22	-1.70	-5.97 **	-5.93 **
INT1	-1.94	-1.96	-4.98 **	-4.96 **
INT2	-2.26	-2.31	-5.12 **	-5.10 **

Note: Critical values (C.V.):	No Trend	(Trend)
1%	-3.52	(-4.08)
5%	-2.90	(-3.47)

Table 3-1 P
Unit Root Tests for the Philippines

	Levels ($\tau\mu$)	Levels ($\tau\tau$)	Diff ($\tau\mu$)	Diff ($\tau\tau$)
[ADF Tests}:				
RM1	0.51 [4]	-2.78 [4]	-6.94 [0] **	-4.72 [3] **
RM3	-0.04 [0]	-1.57 [0]	-6.52 [0] **	-6.46 [0] **
RGDP	-1.28 [4]	-3.12 [5]	-8.28 [0] **	-8.29 [0] **
INT	-1.54 [0]	-2.38 [0]	-5.87 [0] **	-5.96 [0] **
[P-P Tests]:				
RM1	0.36	-2.51	-7.07 **	-7.30 **
RM3	-0.10	-1.75	-6.55 **	-6.49 **
RGDP	-1.47	-2.57	-8.37 **	-8.41 **
INT	-1.70	-2.42	-5.80 **	-5.89 **

Note: Critical values (C.V.):	No Trend	(Trend)
1%	-3.57	(-4.15)
5%	-2.92	(-3.50)

In the ADF test, the null hypothesis of a unit root cannot be rejected for the levels of all the variables at the 5 percent significance level. For the first differences of the data, the null hypothesis of a unit root can be rejected at the 5 percent significance level for all variables.

For the P-P test, we set 3 as the number of the truncation lag, according to the Newey-West correction. The null hypothesis of a unit root cannot be rejected for the levels of all the variables at the 5 percent significance level. For the first differences of the data series, the null hypothesis can be rejected at the 5 percent significance level.

Summarizing the results from the two kinds of tests, all the variables are considered to have unit roots. Thus, first differencing is necessary to make the variables stationary.

Thailand

The sample period of data is from 1987: Q1 to 1996: Q4 due to data availability for the variables of the real monetary aggregates (RM1, RM2), manufacturing production index (MPI) as a proxy for real income, and interest rate (INT: inter-bank rate).[11] The test results of two types of the unit root tests are shown in Table 3-1T.

In the ADF test, the null hypothesis of a unit root cannot be rejected for the levels of all the variables at the 5 percent significance level. For the first differences of the data, the null hypothesis of a unit root can be rejected at the 5 percent significance level for all variables.

For the P-P test, we set 3 as the truncation lag, according to the Newey-West correction. The null hypothesis of a unit root cannot be rejected for the levels of all the variables except interest rate at the 5 percent significance level. For interest rate, the null

11. The actual variable of intermediate target is M2A.

hypothesis can be rejected for the levels in the case of constant at the 5 percent significance level, but in the case of constant and trend, it is nearly rejected at the same value as the 5 percent critical value. For the first differences of the data series, the null hypothesis can be rejected at the 5 percent significance level.

Summarizing the results from the two kinds of tests, the level of the interest rate cannot be rejected at the 5 percent critical value in the ADF test, while it can be in the P-P test. Thus, all the variables are considered to have unit roots and first differencing is necessary to make the variables stationary.

3.2.2 Long-run and Short-run Money Demand Functions

Next step is to estimate the long-run behavior of money demand function using co-integrating regression. It would be too strict to require that equilibrium exist in every single period, although the short-run movements of monetary aggregates are not totally irrel-

Table 3-1 C
Unit Root Tests for Taiwan

	Levels (τμ)	Levels (ττ)	Diff (τμ)	Diff (ττ)
[ADF Tests]:				
RM1B	-1.73 [1]	-1.42 [1]	-4.24 [0] **	-4.46 [0] **
RM2	-4.93 [1]**	0.10 [0]	-4.35 [0] **	-7.11 [0] **
RGDP	-1.26 [3]	-1.70 [3]	-6.47 [0] **	-6.61 [0] **
INT	-3.13 [4]*	-3.26 [0]	-10.78 [0] **	-10.80 [0] **
[P-P Tests]:				
RM1B	-1.91	-1.07	-4.23 **	-4.47 **
RM2	-6.49**	-0.03	-4.28 **	-7.08 **
RGDP	-1.11	-0.81	-6.54 **	-6.65 **
INT	-3.17*	-3.06	-11.10 **	-11.18 **

Note: Critical values (C.V.):	No Trend	(Trend)
1%	-3.52	(-4.08)
5%	-2.90	(-3.47)

Table 3-1 T
Unit Root Tests for Thailand

	Levels ($\tau\mu$)	Levels ($\tau\tau$)	Diff ($\tau\mu$)	Diff ($\tau\tau$)
[ADF Tests}:				
RM1	-1.48 [1]	-2.93 [0]	-8.24 [0] **	-8.33 [0] **
RM2	-0.90 [4]	-1.65 [4]	-5.67 [0] **	-5.76 [1] **
RGDP	-3.39 [1]*	-2.45 [1]	-7.98 [0] **	-9.31 [0] **
INT	-2.60 [3]	-2.60 [3]	-8.41 [0] **	-8.30 [0] **
[P-P Tests]:				
RM1	-1.54	-2.94	-8.18 **	-8.29 **
RM2	-1.39	-2.40	-5.64 **	-5.72 **
RGDP	-3.66**	-2.53	-7.75 **	-9.24 **
INT	-3.56*	-3.52*	-9.06 **	-8.95 **

Note: Critical values (C.V.):	No Trend	(Trend)
1%	-3.60	(-4.20)
5%	-2.94	(-3.52)

evant. If the short-run behavior of money is largely uncorrelated with movements in the variables of policy object, the usefulness of a long-run relationship is likely to be severely impaired. Thus, the short-run demand for money is also important and will be estimated through the error correction mechanism. As a type of the model, the simple Keynesian type model will be estimated to check the issues on money demand function.

A. Indonesia

For the estimation of the ECM type function by the Engle-Granger two-step method, the cointegrating regression is run to test if there exists any long-run relationship among the variables. The residual from the regression is examined, using the ADF test, to see if it is stationary or not. The existence of stationarity of the residual implies that there exists a cointegration relationship. The results of cointegrating regression are reported in Table 3-2I(A). [12]

12. For the estimation of RM1 money demand, 3-month Time Deposit Rate is used and for RM2 money demand, Call Money Rate is used, because time deposit rate is not the opportunity cost but the own rate of RM2.

First, the cointegration test was undertaken for the real stock of money (RM1) that had been used as an intermediate target variable till 1999. The cointegration relation is not found between real money, real GDP, and interest rate (3-month Time Deposit Rate), by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. The sign of the estimated coefficient of real income is the same as *a priori* theoretical prediction but the coefficient of interest rate is positive to the contrary of expectation. The long-run real income elasticity (1.19) is almost one, implying that income velocity would be stable.[13]

For the real stock of money (RM2), the cointegration relation is not found between real money, real GDP, and interest rate (Call Money Rate), by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. The long-run real income elasticity is 2.11 and significant. However, the coefficient of interest rate is positive, which is the opposite of the theoretical prediction.[14]

The short-run money demand function is estimated for RM1 and RM2 without the error correction term, because the cointegrating relationship does not exists for both monetary aggregates. The short-run money demand equation in Table 3-3I(B) is derived by *general-to-specific* approach. In this approach, regressors with insignificant coefficients are eliminated using t-statistics, starting from four lags.[15] Then, a simpler model without insignificant coefficients is re-estimated. The signs of the estimated coefficients are the same as the theoretical prediction and also statistically significant, except of the coefficient of interest rate in case of RM2. The estimated

13. In the equation (2-5) in Chapter 2, if the income elasticity of the demand for money were one, then the demand for real balances would change in the same proportion as income. In this case, velocity would be stable, which is not affected by changes in real income. If the income elasticity of the money demand were less than one, income velocity would rise with increases in real income and vice versa.

14. A few other variables such as dummy variable, trend, and inflation were taken into account but the sign of interest rate was still positive.

15. Four lags are generally suggested in most empirical study using quarterly data.

coefficients show that real GDP growth has a positive effect on the real money demand and that an increase in interest rates has a negative effect.

In the diagnostic statistics, there is no sign for serial correlation based on the Breusch-Godfrey Lagrange Multiplier (LM) test statistic.[16] This statistic is used to test correlations of higher orders in the models with lagged dependent variables, as an alternative to Ljung-Box Q-statistic that was proved to have low power (Maddala, 1992; Davies and Newbold, 1979). To check for the existence of heteroskedasticity, the LM test for autoregressive conditional heteroskedasticity (ARCH) in the residuals was undertaken.[17] The statistic indicates no heteroskedasticity. In the normality test, the Jarque-Bera statistic was used, which has a distribution with two degrees of freedom under the null hypothesis of normally distributed errors. The statistic indicates normal distribution.

The Chow forecast test for parameter constancy estimates the model for a sub-sample comprised of the first T_1 observations. The estimated model is then used to predict the values of the dependent variable in the remaining T_2 observations (over three years here). A large difference between the actual and predicted values casts doubt on the stability of the estimated relation over the two sub-samples, indicating a structural change. The LR test statistic is used, which has an asymptotic χ^2 distribution with degrees of freedom equal to the number of forecast points T_2 under the null hypothesis of no structural change. Judging from the test statistic, the money demand function estimated here cannot pass the Chow test for parameter stability, indicating the existence of the structural changes. The Chow test failure can be attributable in part to financial liberalization and also to the recent economic crisis, since the estimation includes the economic crisis period.[18] Thus, re-estimation of both

16. The LM statistic is asymptotically distributed as a $\chi^2(p)$, where p is lag order of the residuals.

17. The lag order was set to 4 as in the serial correlation test.

18. Because the poor results can be due to missing variables, several variables such as inflation, a variable to capture financial liberalization (M2/M1) etc. were included for estimation, which was not satisfactory.

the short-run and long-run money demand function is undertaken to see the result for the period (1983. Q1~1996. Q4) excluding the period of the economic crisis, and to check whether there exists a stable money demand function.

The re-estimated long-run money demand function is presented in the Table 3-2I(C). The coefficients have the same signs as theoretical prediction and those of real income are statistically significant. However, the long-run cointegration relation does not exist between real money, real GDP, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at the 5% significance level.

Due to non-existence of a cointegration relation, the short-run demand for money function is re-estimated without an error correction term as shown in Table 3-2I(D). The Chow test for parameter stability is passed with other diagnostic tests. However, some coefficients are not statistically significant, although the coefficients of real GDP and interest rate have the same signs as theoretical prediction. In money demand function for RM1, the coefficients of real income and interest rate are not significant, while in the demand function for RM2, only the coefficients of interest rate are significant. These poor results such as insignificant coefficients with non-existence of cointegration relation can be attributed to financial liberalization. Since the 1980s, Indonesia has tried to introduce or to intensify the use of open market operations and now has a short-term paper market of sufficient depth to conduct traditional open market operations (Dekel and Pradhan, 1997). In June 1983, Indonesia deregulated domestic interest rates and increased the flexibility of monetary management. In 1988, the second round of financial measures was initiated, aimed at enhancing financial sector efficiency and boosting the capital market (Azizah, 1993).

B. Korea

The cointegrating regression is run to test if there exists any long-run relationship between the variables, the results of which are reported in Table 3-2K(A). In the cointegration test for the real stock of money, RM3, that is an intermediate target, the cointegration

Table 3-2I(A)
Cointegration Tests for Indonesia
(83.Q1-99.Q3)

	Dependent Variable			
	RM1		RM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-14.40	(-46.35)	-23.62	(-56.61)
RGDP	1.19	(41.19)	2.11	(54.44)
INT	0.06	(1.64)	0.13	(5.14)
R2	0.97		0.98	
Adj- R2	0.97		0.98	
DW	0.64		0.67	
F-Statistic	927.46		1703.93	
	Dependent Variable: Residual			
t-value of residual	-3.14		-2.76	
Cointegration2	No		No	

Notes: 5% Critical value for the cointegration test depends on the number of sample size (n) and the number of variables (v) (Engle and Yoo, 1987):

	v=3	v=4
n=50	-4.11	-4.35
n=100	-3.93	-4.22

Table 3-2I(B)
Short-run Money Demand Functions for Indonesia
(1983. Q1~99. Q3)

	Dependent Variable			
	DRM1		DRM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-0.002	(-0.35)	0.02	(4.23)
ΔRMt-1	-	-	-0.24	(-2.01)
ΔRMt-2	0.17	(1.58)	-	-
ΔRGDPt-1	0.67	(3.12)	0.59	(3.33)
ΔRGDPt-2	0.53	(2.39)	0.63	(3.24)
ΔINTt	-0.12	(-2.63)	-0.02	(-1.07)
R2	0.42		0.33	
Adj-R2	0.38		0.28	
DW	2.10		2.06	
F-statistic	11.30		7.52	
Breusch-Godfrey, $\chi^2(4)$:	0.99 [0.91]		4.79 [0.31]	
ARCH, $\chi^2(4)$:	4.13 [0.39]		15.09 [0.005]	
Jarque-Bera, $\chi^2(2)$:	0.74 [0.69]		17.92 [0.0001]	
Chow Test, $\chi^2(9)$:	34.29 [0.001]		49.31 [0.00]	

Note: In diagnostic statistics, the number in bracket denotes the marginal significance level.

Table 3-2I(C)
Cointegration Tests for Indonesia
(83.Q1 ~ 96.Q4)

	Dependent Variable	
	RM1	**RM2**
Constant	-13.59 (-39.09)	-22.61(-66.56)
RGDP	1.14 (41.84)	2.05 (72.60)
INT	-0.04 (-0.78)	-0.02 (-0.56)
R^2	0.97	0.99
Adj- R^2	0.97	0.99
DW	0.38	0.37
F-Statistic	885.10	2754.15
	Dependent Variable: Residual	
t-value of residual	-2.94	-2.30
Cointegration[2]	No	No

Note: Critical values for the cointegration test (Engle and Yoo, 1987):

	5%	10%
n=50, v=4	-4.35	-4.02

Table 3-2I(D)
Short-run Money Demand Functions for Indonesia
(83.Q1 ~ 96.Q4)

	Dependent Variable			
	ΔRM1		ΔRM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	0.01	(1.50)	0.02	(2.75)
ΔRM_{t-1}	0.22	(1.82)	-	-
ΔRM_{t-2}	-	-	0.33	(2.44)
$\Delta RGDP_t$	-	-	0.25	(1.04)
$\Delta RGDP_{t-1}$	0.27	(0.89)	-	-
ΔINT_t	-	-	-0.04	(-2.52)
ΔINT_{t-1}	-0.08	(-1.22)	-0.03	(-2.11)
R^2	0.11		0.20	
Adj-R^2	0.06		0.14	
DW	2.00		1.92	
F-statistic	2.07		3.15	
Breusch-Godfrey, $\chi^2(4)$:	0.17 [0.99]		3.60 [0.46]	
ARCH, $\chi^2(4)$:	2.86 [0.58]		4.16 [0.39]	
Jarque-Bera, $\chi^2(2)$:	0.73 [0.70]		0.57 [0.75]	
Chow Test, $\chi^2(9)$:	7.63 [0.81]		6.66 [0.88]	

relation is not found between real money, real GDP, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. The signs of the estimated coefficients are the same as *a priori* theoretical prediction. The long-run real income elasticity (2.14) is much greater than one, implying a declining trend in the income velocity. The coefficient of the interest rate (-0.02) is not statistically significant. The estimation result is the same as that of empirical study undertaken by Chun (1998), in which he could not find a stable long-run money demand function.

For the real stock of money (RM2), the cointegration relation is not found between real money, real GDP, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. The signs of the estimated coefficients are the same as theoretical prediction. The long-run real income elasticity is 1.43, which is significant and greater than unity, indicating a decrease in income velocity trend. The coefficient of the interest rate, -0.24, is statistically significant, showing that the interest rate also seems to be an important variable in the long-run demand for real money. The result for RM2 is compared with that of Chun (1998), where the income elasticity was 0.74 and the elasticity of interest rate was –0.038, which shows a smaller income elasticity and a less sensitive elasticity of interest rate. The main difference is that Chun (1998) did not include the economic crisis period.

In Table 3-2K(B), the short-run money demand functions are represented without error correction term, because of non-existence of the cointegration relation. The short-run money demand equations are derived by *general-to-specific* approach starting from four lags as generally suggested in most empirical study using quarterly data. The coefficients are the same as theoretical prediction. For RM2, the coefficients of the short-run money demand function show that real GDP growth has a positive effect on real money demand with a relatively significant coefficient; that an increase in interest rates has a negative effect on real money demand with a statistically significant coefficient. For RM3, the coefficients in the short-run money demand function are statistically significant: real GDP growth

has a positive effect on real money demand; an increase in interest rates has a negative effect.

In the diagnostic statistics, there is no sign for serial correlation only for RM2, based on the Breusch-Godfrey Lagrange Multiplier (LM) test statistic. To check for the existence of heteroskedasticity, the result of a LM test of indicates no heteroskedasticity in two money demand functions. The Jarque-Bera statistic passed the normality test. However, the two money demand functions cannot pass the Chow test for parameter constancy, indicating the existence of structural changes. The Chow test failure can also be attributable in part to financial liberalization and also the recent economic crisis, since the estimation includes the economic crisis period.[19] Thus, re-estimation of the short-run and long-run money demand function (RM2 and RM3) was undertaken for the period (1982. Q1~1996. Q4) excluding the period of the economic crisis, to check whether there exists a stable money demand function.

As seen in the Table 3-2K(C), the signs of the coefficients are the same as theoretical prediction but the long-run cointegration relation does not exist between real money (RM2 or RM3), real GDP, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at the 5% significance level.

In Table 3-2K(D), the re-estimated short-run demand for money functions are shown without the error correction term, because of a non-existence of cointegration relation. The Chow test for parameter stability is passed with other diagnostic tests and the sign of interest rate is the same as theoretical prediction and is statistically significant, indicating an increased role of interest rate. However, the coefficients of real GDP are not statistically significant, implying that real GDP has no role in the demand for money function.

For two monetary aggregates, real GDP does not play an important role. These poor performances in the short-run money demand function, with non-existence of cointegrating relationship,

19. Because the poor results can be due to missing variables, several variables were included for estimation, which was not satisfactory.

could be attributable partly to financial liberalization, because the economic crisis period was not included in the re-estimation. Although financial liberalization efforts had been carried out since the early 1980s with an emphasis on privatization, deregulation of market entry, and expansion of business scope, their progress had been slow. The full-scale pursuit of financial liberalization began with the shift of the current account into surplus in 1986. In the 1990s, an 'Interest Rate Deregulation Plan' was formulated to bring about the phased liberalization of all interest rates until 1996, with deregulation of banking business (BOK, 2000).

Table 3-2K(A)
Cointegration Tests for Korea
(82.Q1-99.Q3)

	Dependent Variable			
	RM1		RM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-8.43	(-23.77)	-15.97	(-77.42)
RGDP	1.43	(55.35)	2.14	(142.90)
INT	-0.24	(-4.59)	-0.02	(-0.69)
R2	0.98		0.997	
Adj- R2	0.98		0.997	
DW	0.14		0.48	
F-Statistic	1787.45		11300.43	
	Dependent Variable: Residual			
t-value of residual	-2.17		-3.07	
Cointegration	No		No	

Note: 5% Critical value for the cointegration test (Engle and Yoo, 1987):

	v=3	v=4
n=50	-4.11	-4.35
n=100	-3.93	-4.22

Table 3-2K(B)
Short-run Money Demand Functions for Korea
(1982. Q1~99. Q3)

	Dependent Variable			
	ΔRM2		ΔRM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	0.02	(5.38)	0.01	(3.48)
ΔRM_{t-1}	0.23	(2.19)	0.44	(4.14)
$\Delta RGDP_{t}$	0.18	(1.63)	-	-
$\Delta RGDP_{t-1}$	-	-	0.15	(1.47)
$\Delta RGDP_{t-3}$	-	-	0.20	(1.88)
ΔINT_{t}	-0.07	(-4.28)	-0.04	(-2.78)
R^2	0.36		0.41	
Adj-R^2	0.33		0.37	
DW	2.14		2.43	
F-statistic	12.72		11.47	
Breusch-Godfrey, $\chi^2(4)$:	5.76 [0.22]		11.56 [0.02]	
ARCH, $\chi^2(4)$:	2.98 [0.56]		2.98 [0.56]	
Jarque-Bera, $\chi^2(2)$:	0.42 [0.81]		0.26 [0.88]	
Chow Test, $\chi^2(9)$:	28.07 [0.005]		21.81[0.04]	

Table 3-2K(C)
Cointegration Tests for Korea
(82.Q1 ~ 96.Q4)

	Dependent Variable			
	RM2		RM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-7.85	(-66.84)	-15.85	(-97.03)
RGDP	1.34	(158.19)	2.13	(180.92)
INT	-0.10	(-4.78)	-0.001	(-0.05)
R^2	0.99		0.99	
Adj- R^2	0.99		0.99	
DW	0.66		0.70	
F-Statistic	13197.12		17043.13	
	Dependent Variable: Residual			
t-value of residual	-3.31		-3.51	
Cointegration	No		No	

Note: Critical values for the cointegration test (Engle and Yoo, 1987):

	5%	10%
n=50, v=3	-4.11	-3.73

Table 3-2K(D)
Short-run Money Demand Functions for Korea
(82.Q1 ~ 96.Q4)

	Dependent Variable			
	ΔRM2		ΔRM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	0.02	(4.56)	0.02	4.03)
ΔRM_{t-1}	0.22	(1.61)	0.34	(2.92)
$\Delta RGDP_{t}$	0.08	(0.56)	-	-
$\Delta RGDP_{t-1}$	-	-	0.12	(0.85)
$\Delta RGDP_{t-4}$	-	-	0.14	(1.27)
ΔINT_{t}	-0.04	(-1.82)	-0.02	(-1.19)
ΔINT_{t-1}	-	-	-0.04	(-1.83)
ΔINT_{t-2}	-0.15	(-1.47)	-	-
R^2	0.19		0.30	
Adj-R^2	0.13		0.24	
DW	2.01		2.14	
F-statistic	3.24		4.71	
Breusch-Godfrey, $\chi^2(4)$:	7.36 [0.12]		3.79 [0.44]	
ARCH, $\chi^2(4)$:	2.11 [0.72]		1.74 [0.78]	
Jarque-Bera, $\chi^2(2)$:	0.27 [0.87]		0.06 [0.97]	
Chow Test, $\chi^2(9)$:	12.52 [0.40]		15.65 [0.21]	

C. Malaysia

The results of the cointegration tests are shown in Table 3-2M(A).[20] For real money (RM1), the cointegration relation is not found between real money, real GDP, and interest rates (3-month Fixed Deposit Rate), by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent significance level. A variable (M3/M1) is included to capture the effect of financial liberalization and innovation as in Hataiseree (1993).[21] As financial liberalization is going on, the public shifts funds away from relatively low interest-bearing money (M1) to higher interest-yielding money (M2 or M3). The negative sign of the coefficient of the variable (M3/M1) means that financial liberalization could have negative impact on narrow real money demand (RM1) by shifting money from M1 to M3. For real money (RM3), the cointegration relation is not found between real money, real GDP, and interest rates (3-month Interbank Money Market Rate), by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent significance level.

In the two long-run money demand functions, the signs of the coefficients are the same as theoretical prediction. The long-run real income elasticity is greater than one (1.47 for RM1 and 1.54 for RM3), implying a declining trend in income velocity. The coefficients of interest rates are not significant in this long-run money demand functions.

The short-run money demand functions were estimated as seen in Table 3-2M(B). Because of non-existence of cointegration relation, the error correction term is not included in the short-run money demand functions. For RM1 demand function, coefficients of real income and interest rate are significant and have the same signs as theoretical prediction. In the diagnostic statistics, the short-run demand function passes three tests for serial correlation, heteroschedasticity, and normality, but does not pass the Chow test

20. For the estimation of RM1 money demand, 3-month Fixed deposit Rate is used and for RM3 money demand, 3-month Interbank Money Market Rate is used, because Fixed Deposit Rate is not the opportunity cost of RM3 but the own rate.

21. The inclusion of this variable shows a good result in Malaysia and Thailand as in Hataiseree (1993), while the inclusion of the variable is not satisfactory in the other countries' estimation.

for parameter constancy, indicating the existence of structural changes, which need re-estimation excluding Asian crisis period to check whether the failure of Chow test depends on financial liberalization or on the Asian crisis.

For RM3 demand function, coefficients of real income and interest rate are significant but the signs of interest rate are plus, which is different from theoretical prediction. In the diagnostic statistics, there is no sign for serial correlation and Chow test for parameter constancy is passed, implying there is no structural changes, while the heteroskedasticity test indicates the existence of heteroskedasticity and the Jarque-Bera statistic does not accept normal distribution.[22]

Re-estimation of cointegration regression was undertaken for RM1 for the period excluding the Asian crisis, because of the failure of Chow test. In the cointegration regression of Table 3-2M(C), coefficients are significant and have the same signs as theoretical prediction. However, a long-run cointegration relation does not exist between real money (RM1), real GDP, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at 5 percent significance level.

In the short-run demand function of Table 3-2M(D), coefficients of real income and interest rate are significant and have the same signs as theoretical prediction. The diagnostic statistics indicate no serial correlation, no heteroskedasticity, and no structural changes, while the Jarque-Bera statistic does not accept normal distribution.

In summary, cointegrating relation does not exist for RM1 and RM3. The short-run money demand function for RM1 does not pass the Chow test for structural change, while that for RM3 pass but coefficients are not the same as predicted. These poor results could be attributable, in part, to financial liberalization or innovation, since the estimation excluding the period of the Asian crisis is also not satisfactory. The results are consistent with BNM (1999), which mentions that until the mid-1990s, monetary targeting was working but after this, it was not, owing to fluctuations of capital flows and financial liberalization measures including interest rates.

22. The test for heteroskedasticity is rejected for higher lags than four.

Table 3-2M(A)
Cointegration Tests for Malaysia
(83.Q1-99.Q4)

	Dependent Variable			
	RM1		RM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-8.46	(-60.03)	-8.45	(-33.53)
RGDP	1.47	(100.91)	1.54	(63.90)
INT	-0.23	(-0.90)	-0.25	(-0.55)
M3/M1	-0.57	(-15.43)	—	—
R^2	0.99		0.98	
Adj- R^2	0.99		0.98	
DW	0.46		0.20	
F-Statistic	3588.84		2056.79	
	Dependent Variable: Residual			
t-value of residual	-3.40		-2.99	
Cointegration	No		No	

Note: 5% Critical value for the cointegration test (Engle and Yoo, 1987):

	v=3	v=4
n=50	-4.11	-4.35
n=100	-3.93	-4.22

Table 3-2M(B)
Short-run Money Demand Functions for Malaysia
(1983. Q1~99. Q4)

	Dependent Variables			
	ΔRM1		**ΔRM3**	
	Coefficient	**(t-ratio)**	**Coefficient**	**(t-ratio)**
Constant	-0.02	(-3.15)	0.02	(3.60)
ΔRM_{t-2}	-	-	0.19	(1.61)
ΔRM_{t-4}	-	-	-0.26	(-2.15)
$\Delta RGDP_{t}$	1.31	(5.74)	0.26	(1.67)
$\Delta RGDP_{t-1}$	-	-	0.26	(1.69)
$\Delta RGDP_{t-2}$	1.03	(4.10)	-	-
ΔINT_{t}	-1.93	(-2.92)	-	-
ΔINT_{t-1}	-	-	0.49	(1.69)
ΔINT_{t-2}	-0.53	(-0.88)	-	-
ΔINT_{t-3}	-	-	0.50	(1.60)
R^2	0.54		0.27	
Adj-R^2	0.51		0.20	
DW	2.07		2.03	
F-statistic	17.72		3.58	
Breusch-Godfrey, $\chi^2(4)$:	1.17 [0.88]		9.24 [0.06]	
ARCH, $\chi^2(4)$:	4.96 [0.29]		14.49 [0.006]	
Jarque-Bera, $\chi^2(2)$:	3.97 [0.14]		203.46 [0.00]	
Chow Test, $\chi^2(9)$:	29.28 [0.004]		6.50 [0.89]	

Table 3-2M(C)
Cointegration Tests for Malaysia
(83.Q1 ~ 96.Q4)

	Dependent Variable: RM1	
	Coefficient	**(t-ratio)**
Constant	-8.57	(-38.29)
RGDP	1.47	(85.98)
INT	-0.62	(-2.19)
M3/M1	-0.45	(-6.27)
R^2	0.99	
Adj- R^2	0.99	
DW	0.56	
F-Statistic	2651.61	
	Dependent Variable: Residual	
t-value of residual	-3.03	
Cointegration	No	

Table 3-2M(D)
Short-run Money Demand Functions for Malaysia
(83.Q1 ~ 96.Q4)

	Dependent Variable: ΔRM1	
	Coefficient	**(t-ratio)**
Constant	0.005	(0.67)
ΔRM_{t-3}	0.29	(2.28)
ΔRM_{t-4}	-0.28	(-2.11)
$\Delta RGDP_{t-2}$	1.06	(3.57)
ΔINT_{t}	-1.05	(-1.55)
R^2	0.28	
Adj-R^2	0.23	
DW	1.85	
F-statistic	4.95	
Breusch-Godfrey, $\chi^2(4)$:	1.65 [0.80]	
ARCH, $\chi^2(4)$:	0.44 [0.98]	
Jarque-Bera, $\chi^2(2)$:	8.59 [0.01]	
Chow Test, $\chi^2(9)$:	19.91 [0.07]	

D. The Philippines

The results of cointegrating regression are reported in Table 3-2P(A). For the real stock of money, RM3, that is an intermediate target, the cointegration relationship is found between real money, real GDP and interest rate, by rejecting the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. The existence of the cointegration indicates that there is a stable long-run relationship among variables. The signs of the estimated coefficients are the same as *a priori* theoretical prediction. The long-run real income elasticity is more than two, implying a declining trend in the income velocity. The coefficient of the interest rate is statistically significant, showing that the interest rate also seems to be an important variable in the long-run demand for real money.

For the real stock of money, RM1, the cointegration relation is found between real money, real GDP and interest rate at the significance level of between 5 percent and 10 percent. The existence of the cointegration indicates that there is a stable long-run relationship among variables. The signs of the estimated coefficients are the same as *a priori* theoretical prediction. The long-run real income elasticity is almost two, implying a declining trend in the income velocity. The coefficient of the interest rate is significant, showing that the interest rate also seems to be an important variable in the long-run demand for real money.

The estimation results of the paper are compared with those of empirical study in Guinigundo (1999), where the income elasticity for RM1 was 1.72 and the elasticity of interest rate was –0.009, while the income elasticity for RM3 was 2.21 and the elasticity of interest rate was –0.012. Although the income elasticity is similar, the interest rate elasticity of this paper shows more sensitivity than that of Guinigundo.

The short-run money demand equations are expressed using the error correction model (ECM), since there exists a cointegration relation for both monetary aggregates. The short-run money demand equations for RM1 and RM3 in Table 3-2P(B) are derived by

general-to-specific approach starting from four lags. The coefficients in the short-run money demand function for RM1 and RM3 are statistically significant and are the same as theoretical prediction: real GDP growth has a positive effect on real money demand; an increase in interest rates has a negative effect; and the error correction term has a negative effect. The estimated coefficients of the error correction term are -0.38 for RM1 and -0.30 for RM3, implying that one third or about forty percent of the previous discrepancies between the actual and the desired money holdings is corrected each quarter.

The two money demand equations passed the diagnostic tests except the Chow test. There is no sign for serial correlation based on the Breusch-Godfrey Lagrange Multiplier (LM) test statistic. The result of the LM test of heteroskedasticity indicates no heteroskedasticity in two money demand functions. The Jarque-Bera statistic passed the normality test. In the Chow test for parameter constancy, RM3 passed the test but RM1 did not, indicating a possibility of structural changes. The Chow test failure may be attributed in part to financial liberalization and to the economic crisis. Thus, re-estimation for RM1 was undertaken for the period (1987. Q1~1996. Q4) excluding the period of the economic crisis.

As seen in the Table 3-2P(C), a long-run cointegration relation exists between real money (RM1), real GDP, and interest rate, by rejecting the null hypothesis of non-stationarity of the residual term at the 5% significance level. The signs of the coefficients are the same as theoretical prediction.

The short-run demand for money function re-estimated is shown in Table 3-2P(D). The Chow test for parameter stability is passed with other diagnostic tests, indicating no evidence for structural changes. The estimated value of the coefficient of the error correction term is -0.64 and statistically significant, indicating that more than a half of the previous discrepancies between the actual and desired money holdings is corrected each quarter. The coefficients of real GDP and interest rate have the same signs as theoretical prediction and are statistically significant.

The Philippine case shows good results: the cointegration relation exists for RM1 and RM3, coefficients of the money demand functions are significant and the same as theory.

Table 3-2P(A)
Cointegration Tests for The Philippines
(87.Q1-99.Q3)

	Dependent Variable			
	RM1		RM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-16.25	(-27.10)	-23.00	(-29.04)
RGDP	1.96	(41.10)	2.62	(41.72)
INT	-0.13	(-6.21)	-0.14	(-5.08)
R^2	0.98		0.98	
Adj- R^2	0.98		0.98	
DW	0.99		1.02	
F-Statistic	1043.21		1049.46	
	Dependent Variable: Residual			
t-value of residual	-3.86		-4.40	
Cointegration	Yes		Yes	

Notes: Critical value for the cointegration test (Engle and Yoo, 1987):

	5%	10%
n=50, v=3	-4.11	-3.73

Table 3-2P(B)
Short-run Money Demand Functions for The Philippines
(1987. Q1~99. Q3)

	Dependent Variable			
	ΔRM1		ΔRM3	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	0.004	(0.86)	0.02	(3.09)
ΔRM_{t-3}	0.21	(1.60)	0.36	(2.88)
$\Delta RGDP_{t}$	0.58	(2.39)	0.63	(2.80)
$\Delta RGDP_{t-2}$	0.38	(1.68)	0.43	(2.01)
ΔINT_{t}	-0.07	(-2.58)	-0.02	(-0.83)
ΔINT_{t-1}	-	-	-0.06	(-2.12)
ΔINT_{t-2}	-0.03	(-1.03)	-	-
EC_{t-1}	-0.38	(-3.72)	-0.30	(-3.79)
R^2	0.41		0.43	
Adj-R^2	0.32		0.35	
DW	2.09		1.98	
F-statistic	4.68		5.36	
Breusch-Godfrey, $\chi^2(4)$:	0.96 [0.92]		0.09 [0.99]	
ARCH, $\chi^2(4)$:	7.03 [0.13]		6.37 [0.17]	
Jarque-Bera, $\chi^2(4)$:	0.98 [0.61]		2.31 [0.32]	
Chow Test, $\chi^2(4)$:	25.67 [0.01]		12.01 [0.45]	

Table 3-2P(C)
Cointegration Tests for The Philippines
(87.Q1 ~ 96.Q4)

	Dependent Variable: RM1	
	Coefficient	**(t-ratio)**
Constant	-13.85	(-19.66)
RGDP	1.76	(30.79)
INT	-0.14	(-7.01)
R^2	0.97	
Adj- R^2	0.97	
DW	1.42	
F-Statistic	560.92	
	Dependent Variable: Residual	
t-value of residual	-4.49	
Cointegration	Yes	

Table 3-2P(D)
Short-run Money Demand Functions for The Philippines
(87.Q1 ~ 96.Q4)

	Dependent Variable: ΔRM1	
	Coefficient	**(t-ratio)**
Constant	0.001	(0.09)
ΔRM_{t-3}	0.34	(2.84)
$\Delta RGDP_{t}$	0.77	(3.63)
$\Delta RGDP_{t-2}$	0.34	(1.73)
ΔINT_{t}	-0.05	(-1.62)
EC_{t-1}	-0.64	(-5.37)
R^2	0.55	
Adj-R^2	0.49	
DW	2.04	
F-statistic	8.20	
Breusch-Godfrey, $\chi^2(4)$:	4.62 [0.33]	
ARCH, $\chi^2(4)$:	3.50 [0.48]	
Jarque-Bera, $\chi^2(2)$:	2.25 [0.33]	
Chow Test, $\chi^2(9)$:	8.48 [0.75]	

E. Taiwan

The results of cointegrating regression are reported in Table 3-2C(A). The cointegration relation is not found by failing to reject the null hypothesis of non-stationarity of the residual term for both monetary aggregates (RM1B and RM2). The non-existence of the cointegration relation may be attributable to financial liberalization, which was undertaken since the mid-1980s.

For the real stock of money (RM1B), the estimated coefficients have the same signs as *a priori* theoretical prediction and are statistically significant. The long-run real income elasticity is greater than one (1.42), implying a declining trend in the income velocity. The coefficient (-0.13) of the interest rate is significant, showing that the interest rate also seems to be an important variable in the long-run demand for real money. The results are compared with those of Wu and Shea (1993) with a larger income elasticity (1.86) and interest rate coefficient (-0.11).

In the real stock of money (RM2), the estimated coefficients have the same signs as *a priori* theoretical prediction and are statistically significant. The long-run real income elasticity is greater than one, indicating a declining trend in the income velocity. The coefficient of the interest rate is significant, showing that the interest rate also seems to be an important variable in the long-run demand for real money.

In Table 3-2C(B), the short-run demand for money equation is represented for two money stocks (RM1B and RM2) without the error correction term, because of non-existence of cointegration relation. The coefficients in the short-run money demand functions for RM1B and RM2 are statistically significant and have the same signs as theoretical prediction: real GDP growth has a positive effect on real money demand; an increase in interest rates has a negative effect.

In diagnostic statistics, the money demand function for RM2 passed all the test: no serial correlation, no heteroscadasticity, normal distribution and no structural change. For RM1B, the statistics indi-

cate the possibility of serial correlation and heteroscadasticity.[23] The Jarque-Bera statistic and the Chow test for parameter constancy are passed.

Table 3-2C(A)
Cointegration Tests for Taiwan
(82.Q1-99.Q4)

	Dependent Variable			
	RM1B		RM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-9.76	(-13.79)	-13.81	(-38.91)
RGDP	1.42	(29.65)	1.78	(74.46)
INT	-0.13	(-1.95)	-0.07	(-2.22)
R^2	0.93		0.99	
Adj- R^2	0.93		0.99	
DW	0.05		0.08	
F-Statistic	468.94		2908.90	
	Dependent Variable: Residual			
t-value of residual	-2.15		-1.16	
Cointegration	No		No	

23. The heteroskedasticity test is undertaken for lag 4. For other lags (1~3), the results indicate no heteroskedasticity.

Table 3-2C(B)
Short-run Money Demand Functions for Taiwan
(1982. Q1~99. Q4)

	Dependent Variable			
	ΔRM1B		ΔRM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	-0.02	(-1.99)	0.003	(0.71)
ΔRM_{t-1}	-	-	0.47	(4.44)
ΔRM_{t-2}	0.44	(4.31)	-	-
ΔRM_{t-3}	-	-	0.23	(2.09)
$\Delta RGDP_{t}$	0.90	(2.48)	0.36	(1.98)
$\Delta RGDP_{t-1}$	0.78	(2.15)	-	-
ΔINT_{t}	-0.06	(-3.47)	-0.02	(-2.14)
ΔINT_{t-1}	-0.05	(-3.01)	-	-
R^2	0.49		0.49	
Adj-R^2	0.46		0.46	
DW	1.53		2.16	
F-statistic	12.89		15.83	
Breusch-Godfrey,	$\chi^2(4)$:	10.46 [0.03]	8.76 [0.07]	
ARCH,	$\chi^2(4)$:	9.58 [0.05]	6.31 [0.18]	
Jarque-Bera,	$\chi^2(2)$:	0.59 [0.75]	1.78 [0.41]	
Chow Test,	$\chi^2(9)$:	11.16 [0.52]	8.08 [0.78]	

F. Thailand

The results of cointegrating regression are reported in Table 3-2T(A). For both of the real money (RM1 and RM2), the cointegration relations are not found between real money, MPI, and interest rate, by failing to reject the null hypothesis of non-stationarity of the residual term at the 5 percent level of significance. In Thailand, financial liberalization began in the early 1990s, which may be one reason for the non-existence of the cointegration relation. For the real money, RM1, a variable (M2/M1) is also added, as in Malaysia, in order to reflect the effect of financial innovation and liberalization.

The signs of the estimated coefficients are the same as *a priori* theoretical prediction. The long-run real income elasticity is greater than one (1.21 for RM1 and 1.33 for RM2), implying a declining trend in the income velocity. The coefficient of the interest rate is significant (-0.05 for both RM1 and RM2), showing that the interest rate also seems to be an important variable in the long-run demand for real money. The coefficient of (M2/M1) is significant and as negative as it is expected, indicating that people, faced with financial innovation, are shifting money from low interest-bearing deposits to higher interest-yielding deposits.

These results are compared with Hataiseree (1993), where cointegration relationships were found for both monetary aggregates; the income elasticity was significant (1.40 for RM1 and 1.73 for RM2) and the interest rate elasticity was also significant with –0.01 for RM1 and –0.06 for RM2. The difference of the results is partly due to the fact that the same data were not used in both studies; for instance, real GDP was used in Hataiseree's paper, instead of Manufacturing Production Index (MPI).

Short-run money demand equations for two money stocks (RM1 and RM2) are represented without the error correction terms, since the cointegration relations for both monetary aggregates (RM1 and RM2) do not exist. The short-run money demand equations in Table 3-2T(B) are derived by *general-to-specific* approach starting from

four lags. The coefficients have the same signs as theoretical prediction.

For RM1, real income has a positive effect on real money demand but its coefficients are not statistically significant; an increase in interest rates has a negative effect with significant coefficients. For RM2, the coefficients in the short-run money demand functions are statistically significant: real income has a positive effect on real money demand; an increase in interest rates has a negative effect

The two money demand equations passed the diagnostic tests. There is no sign for serial correlation based on the Breusch-Godfrey Lagrange Multiplier (LM) test statistic. The result of the LM test of heteroskedasticity indicates no heteroskedasticity in two money demand functions. The Jarque-Bera statistic passed the normality test. As in the case of the Philippines, the two money demand functions passed the Chow test for parameter constancy.

3.2.3 Summary

The results of the estimation of money demand functions are summarized in Table 3-3. In the cointegration test, the cointegrating relationship does not exist for five countries (Indonesia, Korea, Malaysia, Taiwan, and Thailand), while it does exist only for the Philippines. In the estimation of the short-run demand for money functions, six money demand functions (two for Indonesia, two for Korea, one for Malaysia, one for The Philippines) cannot pass the Chow test for parameter constancy, when the data include the economic-crisis period. Thus, re-estimation of the long-run and short-run money demand functions was undertaken for the period excluding the economic crisis.

According to the re-estimation results, the cointegration relation does not exist again for this shortened period in the five cases of Indonesia, Korea and Malaysia, while it does for the Philippines, while the short-run money demand function does pass the Chow test in six cases, indicating no structural changes for short-run money demand functions. However, in short-run money demand

Table 3-2T(A)
Cointegration Tests for Thailand
(87.Q1-96.Q4)

	Dependent Variable			
	RM1		**RM2**	
	Coefficient	**(t-ratio)**	**Coefficient**	**(t-ratio)**
Constant	-2.73	(-38.02)	-2.65	(-30.92)
RGDP	1.21	(37.13)	1.33	(69.43)
INT	-0.05	(-3.22)	-0.05	(-2.96)
M2/M1	-0.70	(-10.37)	-	-
R^2	0.99		0.99	
Adj- R^2	0.99		0.99	
DW	0.96		0.79	
F-Statistic	1187.66		2438.24	
	Dependent Variable: Residual			
t-value of residual	-3.69		-3.21	
Cointegration	No		No	

Note: Critical vallue for the cointegration test (Engle and Yoo, 1987):

	5%	10%
n=50, v=3	-4.11	-3.73
n=50, v=4	-4.35	-4.02

Table 3-2T(B)
Short-run Money Demand Functions for Thailand
(1987. Q1~96. Q4)

	Dependent Variable			
	ΔRM1		ΔRM2	
	Coefficient	(t-ratio)	Coefficient	(t-ratio)
Constant	0.008	(0.85)	0.01	(2.07)
ΔRM_{t-1}	-	-	0.34	(2.47)
ΔRM_{t-2}	0.40	(2.52)		
$\Delta RGDP_{t}$	0.26	(0.90)	0.21	(1.87)
$\Delta RGDP_{t-1}$	-	-	0.12	(1.05)
ΔINT_{t}	-0.07	(-3.91)	-0.03	(-4.58)
ΔINT_{t-1}	-0.03	(-1.47)	-	-
ΔINT_{t-4}	-	-	-0.02	(-2.01)
R^2	0.37		0.49	
Adj-R^2	0.30		0.41	
DW	2.32		1.90	
F-statistic	5.07		6.04	
Breusch-Godfrey, $\chi^2(4)$:	4.26 [0.37]		4.67 [0.32]	
ARCH, $\chi^2(4)$:	7.10 [0.13]		1.02 [0.91]	
Jarque-Beria, $\chi^2(2)$:	0.09 [0.96]		1.01 [0.60]	
Chow Test, $\chi^2(9)$:	9.46 [0.66]		15.05 [0.24]	

functions of Indonesia and Korea, the results are not satisfactory by showing that the coefficients of real GDP are not statistically significant, although those of interest rate are significant. In Malaysia and the Philippines, the coefficients of real income and interest rate are statistically significant with the same signs as theoretical prediction.

In summary, the cointegration relation of the long-run money demand function exists only for the Philippines. During the estimation periods (after the mid-1980s or the early 1990s), financial liberalization in the selected SEACEN countries was undertaken, which could be one reason for non-existence of the cointegration relation in most countries. In the short-run money demand function, the Chow test for parameter stability is passed for 12 cases but some coefficients are not significant for four cases. The Philippines is the only country with good estimation results. To confirm the results of this country, Vector Error Correction Model (VECM) was again used to check existence of the cointegration relation as in Appendix B, which supports the results.

Table 3-3
Summary of estimation of Money Demand Functions

		Total Period		Until 1996	
		Cointegration	S-R (Chow)	Cointegration	S-R (Chow)
Indonesia	RM1	No	No	No	Yes
	RM2	No	No	No	Yes
Korea	RM2	No	No	No	Yes
	RM3	No	No	No	Yes
Malaysia	RM1	No	No	No	Yes
	RM3	No	Yes	—	—
Philippines	RM1	Yes	No	Yes	Yes
	RM3	Yes	Yes	—	—
Taiwan	RM1B	No	Yes	—	—
	RM2	No	Yes	—	—
Thailand	RM1	No	Yes	—	—
	RM2	No	Yes	—	—

3.3 Velocity of Money

Most graphs in Figure 3-1 show that velocity of money is in downward trend.[24] In Indonesia, velocity of M2 shows a clear downward trend from 1982, while velocity of M1 has a relatively stable pattern in the 1980s. These graphical findings are consistent with those obtained from the long-run cointegrating relation: the income elasticity of RM2 is greater than two, indicating a decrease in velocity of money as real income grows, while that of RM1 is close to one,[25] implying a stable velocity of money.

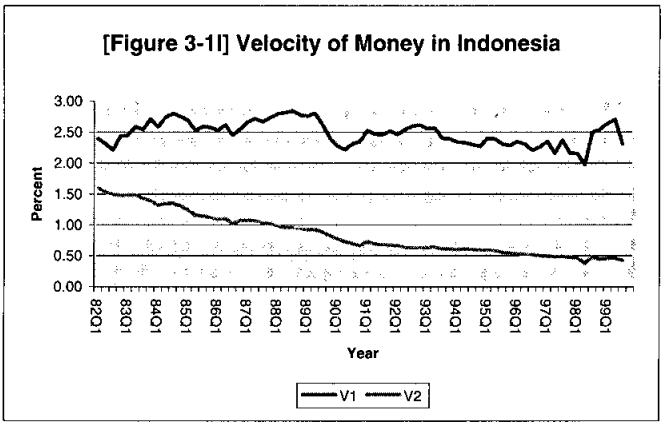
On the graph of Korea, velocity of M2 is showing a gradual decline, while that of M2 has a rapid decline since the mid-1990s. The graphs are consistent with the results of the cointegrating regression: income elasticity of monetary demand function is greater than one (that is, 1.36 for RM2 and 2.14 for RM3, respectively). Meanwhile, velocity of M1 in Malaysia is showing a downward trend up to 1996 and then, a rapid increase after the Asian crisis, while velocity of M3 has a gradual- downward trend, which is consistent with income elasticity of greater than one.

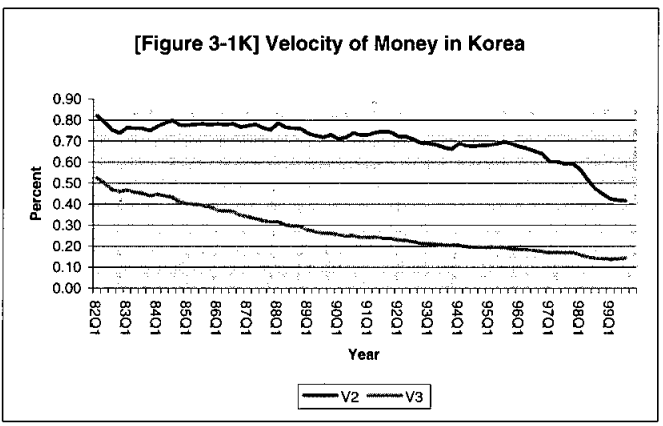
In the Philippines, the velocity of M1 shows a rapid decline after the mid 1980s on the graph, while that of M3 has a slow and gradual decline. These results are compared with the income elasticity (1.96 for RM1 and 2.62 for RM3) in the cointegration test. On the graph of Taiwan, velocity of M1B shows a rapid decline until 1989 and then a stable pattern, while velocity of M2 is showing a gradual downward trend. These results are consistent with the coefficient of real income (1.42 for RM1B and 1.78 for RM2, respectively).

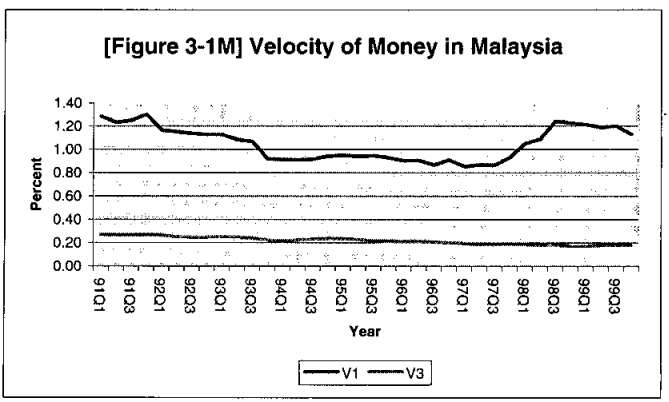
24. The case of Thailand is not represented, because MPI was used instead of GDP in the paper.

25. In another test of cointegration that was undertaken due to the failure of Chow test, the income elasticity is close to one.

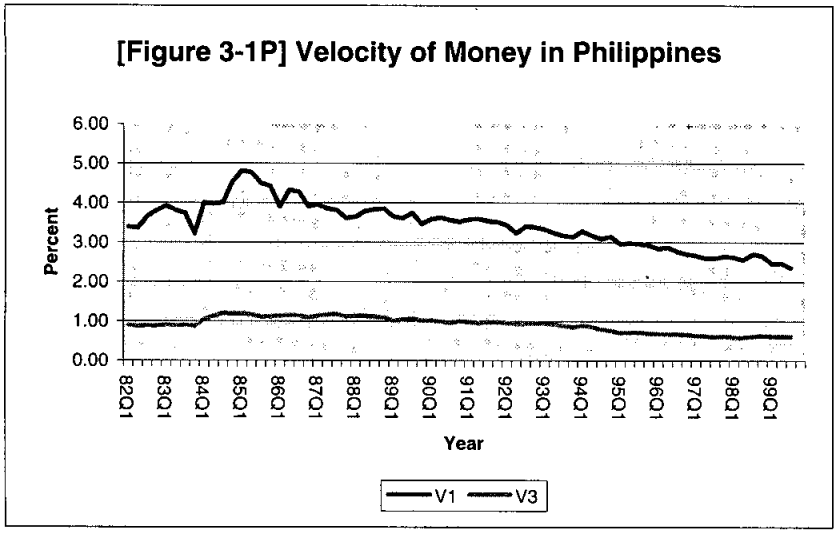
[Figure 3-1]

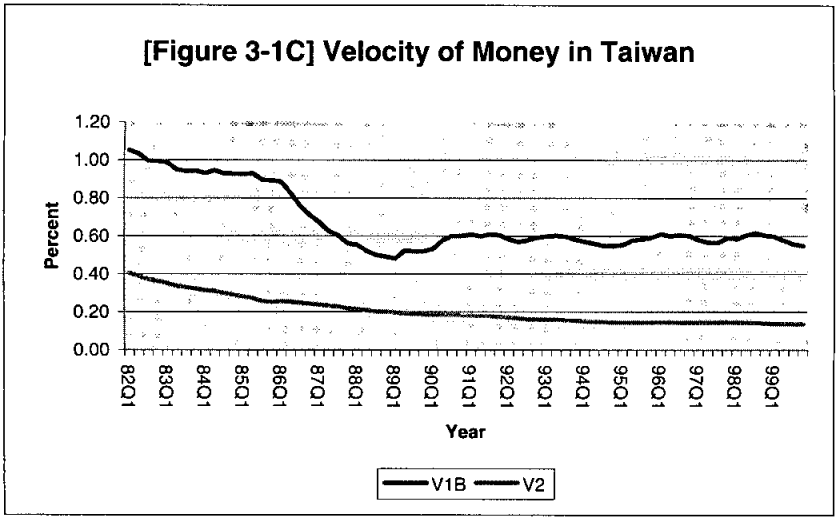

[Figure 3-1I] Velocity of Money in Indonesia
Percent
3.00
2.50
2.00
1.50
1.00
0.50
0.00
82Q1 83Q1 84Q1 85Q1 86Q1 87Q1 88Q1 89Q1 90Q1 91Q1 92Q1 93Q1 94Q1 95Q1 96Q1 97Q1 98Q1 99Q1
Year
V1 V2


[Figure 3-1K] Velocity of Money in Korea
Percent
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
82Q1 83Q1 84Q1 85Q1 86Q1 87Q1 88Q1 89Q1 90Q1 91Q1 92Q1 93Q1 94Q1 95Q1 96Q1 97Q1 98Q1 99Q1
Year
V2 V3


[Figure 3-1M] Velocity of Money in Malaysia
Percent
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
91Q1 91Q3 92Q1 92Q3 93Q1 93Q3 94Q1 94Q3 95Q1 95Q3 96Q1 96Q3 97Q1 97Q3 98Q1 98Q3 99Q1 99Q3
Year
V1 V3

[Figure 3-1] (Cont.)





Summarizing, the graphical findings on velocity of money are consistent with the results obtained from income elasticity in the cointegration tests. On the whole, velocity of money is not stable and shows a downward trend, most of which look like the trend stationary series.

3.4 Money, Income, and Prices

As another way to appraise the usefulness of monetary targeting, the relationship of a monetary aggregate to ultimate target such as output or price level is examined. For this purpose, variance decomposition of three-variable VAR (vector auto-regression) with four lags on each variable will be shown in the following graphs only for the cases of four countries (Indonesia, Korea, Malaysia, and Taiwan) due to data availability.[26] The variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR.

Through the variance decomposition, the contribution of monetary shock to subsequent movements in real output and prices can be seen. The first contribution is obtained from the estimation of the first 40 samples (1983.Q1~1992.Q4, in Indonesia), which indicates the respective percentages of output and prices accounted for by money at a two-year (8-quarter) horizon in the variance decomposition.[27] The second contribution is the number at a two-year (8-quarter) horizon in the variance decomposition from the estimation of the next 40 samples (1983.Q2~1993.Q1, in Indonesia). In the

26. For this purpose, at least 60 samples of data are needed. The VAR method introduced here is the same as Friedman (1996).

27. Eighth quarter is based on the assumption that it takes about two years for money supply to affect real income and prices.

same way, the contributions of money to real output and prices are obtained. The order of orthogonalization of VAR places real output (RGDP) first, prices (CPI) second, and money third.[28] The first result of contribution of money in the figure starts from 1992.Q4 in case of Indonesia, because the first 40 sample observations are from 1983.Q1 to 1992.Q4.

In the figure 3-2I of Indonesia, contribution of money (M1) to real income (RGDP) was relatively well explained until the end of 1997. The money's contribution was dropped suddenly and remained small since 1998, which coincides economic crisis period of 1997. For price fluctuations, money's contribution showed a similar pattern: its contribution on price fluctuations was high until the end of 1997 but was dropped after this point of time. The peak contribution for output is 28%, while it is 24% for prices.[29]

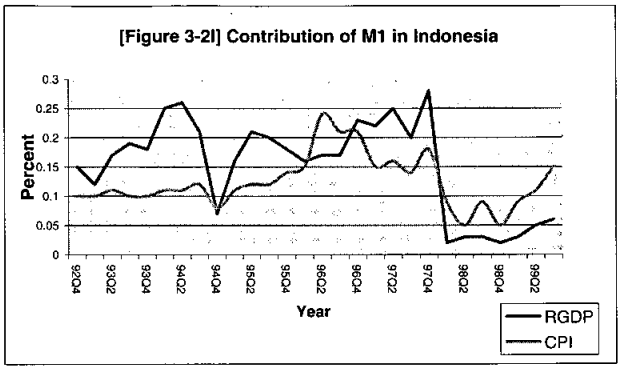
In Korea of Figure 3-2K, money's (M3) contribution to real output was well described. Its contribution to price fluctuations remained small until the end of 1995 and then increased. The peak contribution for output is 33%, while it is 26% for prices. Before the crisis, M2 has been used as a target variable for a long time, and M3 was replaced for M2 right after the outset of the economic crisis of 1997. Thus, the graphical analysis validates the current use of the broadest money (M3).

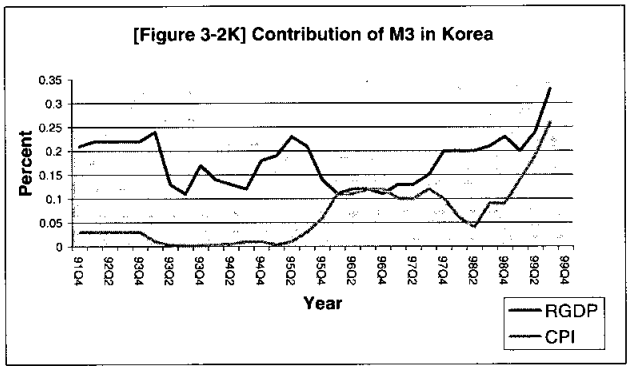
In Figure 3-2M of Malaysia, money's (M3) contribution to real output was not high, moving up and down from the 5 percent level, while money's contribution to price was higher than that to real output, fluctuating at higher than 10 percent level up to 1997. The graph shows that money's contribution level shifted down after the end of 1997.

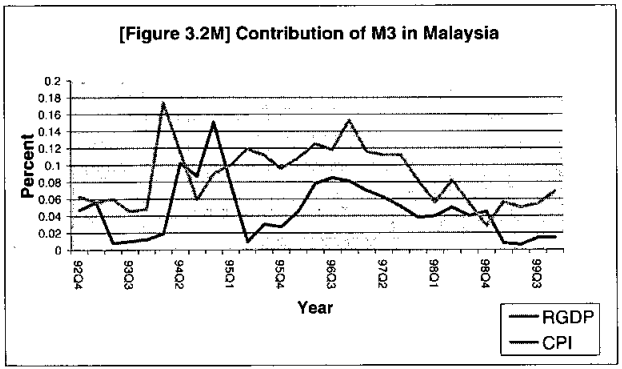
28. In order to avoid serial correlation problems of innovations in the VAR system, the orthogonalization is used: that is, the method of making the innovations uncorrelated so that the innovation of each equation can be interpreted as one for the equation only. The errors are usually orthogonalized by a Cholesky decomposition so that the covariance matrix of resulting innovations is diagonal. The disadvantage of this method is that changing the order of equations could dramatically change the results of VAR such as the impulse response or variance decomposition.

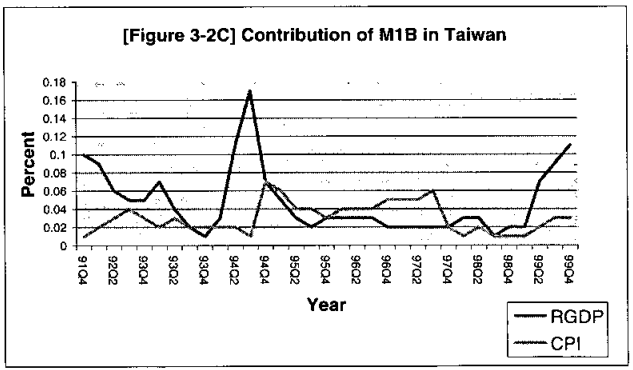
29. According to Friedman (1996), the peak contribution was 11% for output and 13% for prices in the U.S., although the sample observations were different.

[Figure 3-2]


[Figure 3-2I] Contribution of M1 in Indonesia
Percent
Year
RGDP
CPI


[Figure 3-2K] Contribution of M3 in Korea
Percent
Year
RGDP
CPI


[Figure 3.2M] Contribution of M3 in Malaysia
Percent
Year
RGDP
CPI


[Figure 3-2C] Contribution of M1B in Taiwan
Percent
Year
RGDP
CPI

In Taiwan of Figure 3-2C, the money's (M1B) contribution to real output fluctuations remained smaller than those of the other two countries, which remains less than 10 percent over most of the period of data observation. The money's contribution to price fluctuations was smaller than that to output variability. The peak contribution for output is 17%, while it is 7% for prices.

In summary, money's contributions to real income and the price level are mixed for three countries. In Indonesia, real income and prices were relatively well explained, especially before the economic crisis. Right after the crisis, the power of explanation dropped rapidly and then seemed on the recovery. In Korea, real income was explained well by money stock, while price fluctuations began to have a close relation to money after the mid-1990s. In Malaysia, money's contribution to the price level was higher than that to real income, which became deteriorated after the Asian crisis. In Taiwan, money's contribution was low over the total data observation, compared with the other countries. On the whole, the relationship between money, real income and prices does not seem to be explained well.

CHAPTER 4

Alternatives to Monetary Targeting

The estimation results of money demand functions and money's contribution to income and prices under the monetary targeting regime are not satisfactory in selective SEACEN countries. Such disappointment from monetary targeting is considered to have provided a motive, in part, for several advanced countries to adopt inflation targeting as an alternative in the early 1990s. Since then, the number of inflation targeting countries is showing an increasing trend. On the other hand, some countries are using other alternatives in SEACEN countries: for example, exchange rate targeting in Singapore and interest rate targeting in Malaysia. In this chapter, other alternatives to monetary targeting will be introduced.

4.1 Inflation Targeting

4.1.1 The Importance of Price Stability

One of the important issues related to monetary policy implemented during the past decades is whether there exists long-run tradeoff between inflation and unemployment: that is, the existence of the long-run Philips curve.[30] According to Friedman (1968) and Phelps (1968), there is no long-run tradeoff between two variables, which contributed to realizing the importance of price stability. They admit that higher inflation might stimulate the economy, for short periods, with lower unemployment. For example, wage rates are negotiated every year or every two-year basis according to labor contracts so that wage rates are fixed until the next negotiation. When prices rise unexpectedly as a result of the expansionary monetary policy, the profit of firms will increase, which gives firms an incentive to produce more goods due to a decline in the real cost of production. However, firms cannot take a benefit from this

30. As other reasons for setting price stability as the primary goal of monetary policy, Bernanke et al. (1999) mentioned (1) Friedman's observation that monetary policy works only with long and variable lags, (2) increased understanding of the importance of central bank credibility, and (3) a growing belief among economists that low inflation helps to promote economic efficiency and growth in the long run.

situation for longer periods. Once workers realize that inflation has risen, they will demand more rapid increases in wages to compensate for the loss in purchasing power. As the rate of increase in wages matches the rate of increase in prices, the profit of firms will return to normal. Thus, in the long run, only the inflation rate has been affected by the expansionary monetary policy; output and unemployment have returned to normal. In other words, the benefits of monetary policy to reduce unemployment are largely transitory, while the costs (higher inflation) are permanent. This awareness has moved policymakers toward a greater focus on price stability, especially in the long run. In that sense, there is a rationale for taking inflation targeting as a new strategy of monetary policy.

4.1.2 Operational Issues

There are some operational issues that arise, in general, in the implementation of inflation targeting: (1) the choice of the price index; (2) the choice of the numerical values for the targets; (3) the time horizon for the target; (4) an inflation target versus a price-level target (for detail discussions, refer to Bernanke et al., 1999; Brunila et al., 1995). First issue is related to the choice of the price index among the consumer price index (CPI), the producer price index (PPI), and GDP deflator. The CPI is mostly used in inflation targeting countries, as it is simple and well known to the public, while the "core" or "underlying" inflation is used in some countries, which strips out energy and agricultural items from the CPI. To select the core inflation, the central bank must explain to the public how the price index is constructed. Once a specific price index is chosen, it must be used consistently in order to get credibility from the public.

Second, with regard to the numerical value of the inflation target, targeting the inflation rate at zero has some problems. According to studies of inflation in the United States, the CPI overstates inflation from 0.5 to 2.0 percentage points per year (Bernanke et al., 1999). Because of this measurement bias, the target would have to be greater than zero. Another argument is that a zero inflation target might turn the economy into deflation. The economy of deflation might raise serious liquidity and solvency problems,

leading to financial instability. In that sense, undershooting a zero-inflation target (i.e., deflation) seems more costly than overshooting a zero-inflation target. These risks suggest that the inflation target should be set above zero. In most of the inflation targeting countries, it is set around 1% to 3% per year.

Third, a target of less than one year is not meaningful, because inflation is not controllable by monetary policy at such short horizons. A target of more than four years is also meaningless, since the targets would lose credibility. The shorter the time horizon for the target is, the less ambiguity there is in the central bank's communication with the public. Within the range of one to four years, it would be desirable for the central bank to choose the time horizon for the target.

Fourth, the inflation targeting and price-level targeting work differently when there are external shocks, which prevent target achievement. Policymakers would try to eliminate past deviations from the target, as the aim of monetary policy is to stabilize the price level. Under the price level targeting, periods of past inflation would lead to future deflation, and vice versa. In contrast to the price level targeting, inflation targets are period-by-period targets under the inflation targeting, so that bygones are bygones. That explains the reason why inflation targeting is favored.

4.1.3 The Performance of Inflation Targeting Countries

It is not easy to evaluate the performance of inflation targeting countries, since we cannot know what would have occurred in a country, if inflation targeting had not been adopted. Bernanke et al (1999) used two approaches for four OECD countries (New Zealand, Canada, the United Kingdom, and Sweden); one is to compare each country's economic performance after target adoption with its performance prior to adoption; another approach is to use a "control group" strategy, in which various aspects of economic performance in an inflation targeting country are compared with the developments in a non-targeting country, which is broadly similar. Economic performance includes evidence from sacrifice

ratios,[31] inflation forecasts from estimated Phillips curves, surveys of expectations, and interest-rate differentials. According to the results of empirical study, the four OECD countries with inflation targeting have seen inflation levels and inflation expectations fall below and remain below, compared with those before adoption. The comparison of the adopting countries' inflation record with that of the "control" countries (Australia and Italy) underscores the favorable effect of inflation targeting on inflation expectations.[32] They argue that the adoption of inflation targeting as the framework for monetary policy appears to have been a success, on the whole.

4.1.4 Some Caveats

Inflation targeting is a forward-looking monetary policy framework, in which the central bank forecasts future inflation and take pre-emptive measures against inflation pressure. The success of inflation targeting depends on: (1) whether the central bank can forecast future inflation accurately; (2) if the central bank has effective channels of monetary transmission mechanism; and (3) whether the central bank has effective policy instruments to influence policy objectives directly or indirectly (Hahm et al., 2000).

To enhance the ability to get inflation forecast, the central bank need to develop a technique to estimate inflation pressure and expected inflation through econometric models etc. The central bank also needs to build a system to monitor inflation pressures, to reduce inflation forecast error, through information variables associated with inflation such as interest rates, exchange rates, monetary aggregates, asset prices, and so on.

Without understanding the monetary transmission mechanism, the central bank cannot cope with inflation pressure, so that it is

31. Sacrifice ratios are measures of the loss of output or employment that an economy must sustain in order to achieve a reduction in inflation. A sacrifice ratio is usually calculated as the number of years of reduced growth in output or in increased unemployment that a country must accept in order to achieve a one-percentage-point reduction in the inflation rate.

32. Australia is classified as the control group, as the sample period is before 1994, when Australia joined among inflation targeting countries.

necessary to check which channel has relative effectiveness. In developing countries such as SEACEN countries, it would not be easy to analyze the interest rate channels, since financial markets are not well developed. Balanced development of financial markets is an important factor in that it would improve the effectiveness of monetary policy by connecting money market and capital market as well as by providing effective policy instruments.

4.2 Exchange Rate Targeting

Another alternative is exchange rate targeting under the fixed and flexible exchange rate regime. The targeting under the fixed rate system is to fix the exchange rate of the currency to that of a large, low-inflation country.[33] With the fixed exchange rate regime, the domestic inflation rate would approach that of the anchoring country.[34] The fixed exchange rate has the advantage of simplicity and clarity, which makes the public understand easily.

Meanwhile, keeping the fixed exchange rate system has several disadvantages. First, it forces the central bank to sacrifice its ability to use monetary policy for stabilization purposes. When the domestic business cycle is in recession, excess supply of money is useful to raise output. The expansionary monetary policy leads to decline in interest rate, providing depreciation pressure on exchange rate. To keep the fixed exchange rate, the central bank will respond to the depreciation pressure by selling foreign assets for domestic money, which removes the effect of the initial excess supply of money. Second, there is always a possibility of a speculative attack on the pegged currency. As the aftermath of German reunification, members of the ERM experienced the currency crisis. Since then

33. A strong form of exchange rate pegging is the currency board, in which the monetary authority announces both a fixed exchange rate with a particular foreign currency and its willingness to trade the foreign and domestic currencies in unlimited amounts. To keep the commitment credible, the authorities must maintain high levels of foreign reserves. Another form is a crawling peg, in which the exchange rate is allowed to depreciate at a fixed rate, resulting in higher domestic rate of inflation than that of the larger (anchoring) country.

34. For this expression, there is an assumption that movements in the real exchange rate are not too large.

followed the currency crisis of Mexico in 1994 and the speculative attacks on East Asian currencies in 1997.

Another type of exchange rate targeting is undertaken under the flexible exchange rate regime. Singapore is the country to take exchange rate targeting as a nominal anchor for monetary policy. This country is classified as a country of adopting a managed floating exchange rate system according to International Financial Statistics (IFS) of IMF. Since the Monetary Authority of Singapore (MAS) was established in 1971, Singapore chose to maintain its peg to the Pound Sterling, then switching its parity to the US Dollar in 1972, and allowed its currency to float in 1973. In the process of overcoming the first and second oil shocks, the MAS shifted the focus of its monetary policy to emphasize managing the exchange rate as its principal policy instrument, instead of targeting money supply or interest rates.

There are reasons why the MAS took the exchange rate targeting in implementing the monetary policy (Wong, 1999). First, Singapore has to import even the most basic of its daily requirements and to export to pay for them, due to the small size of the country and lack of natural resources. Imports comprise 60% of exports and 54% of final expenditure. External demand accounts for some 70% of total demand. In this situation, the exchange rate influences the overall inflation through import inflation and the exchange rate impact on total demand. Thus, the exchange rate is not used to boost the economy, since the initial depreciation of exchange rate is offset by the increase in the real exchange rate due to inflationary pressures. Second, as an international financial center, the economy is open to capital flows, so domestic interest rates are determined by the uncovered interest parity condition, that is, by foreign interest rates and expectations of exchange rate changes. This open economy makes Singapore give up control over domestic interests and money supply. Under the situation of this small open economy, the stability of exchange rate is important and monetary policy is synonymous with exchange rate policy.

Under the exchange rate targeting, Singapore has enjoyed high economic growth and low inflation, although for tactical reasons,

the MAS does not disclose its exchange rate policy path nor the currency composition of the trade-weighted basket. Between1981 and 1998, the real GDP growth recorded 7.6% per year on average with CPI inflation of 2.2% per year on average, which compares with an average CPI inflation of over 6.7% per year for all OECD countries.

4.3 Interest Rate Targeting

Interest rate targeting may become another alternative to monetary targeting. Judging from criteria for choosing an intermediate target, nominal interest rates are not only available quickly but they are also measured precisely and are rarely revised. In addition, the central bank can set nominal interest rates easily through open market operations. In this sense, interest rates seem suitable for the intermediate targets. However, this corresponds to nominal interest rates. Friedman and monetarists argue that the real interest rate is the rate relevant for determining the level of investment, which is the interest rate adjusted for expected inflation ($i_r = i_n - \pi^e$). There is no direct way to measure expected inflation and the central bank does not have control over expected inflation, interest rate target has also the measurability and controllability problem (Mishkin, 1992).

With respect to interest rate targeting, Wicksell (1965) thinks that pegging the interest rate might lead to instability of the inflation rate—a conjecture that also emerges from adaptive-expectations models. Rational expectations theory shows the possibility that, unless there is some additional nominal anchor, an interest rate policy may lead to indeterminacy of the price level or the inflation rate (Sargent and Wallace, 1975; McCallum, 1986). Unlike the results of these papers, Calvo and Végh (1990) shows that the indeterminacy problem does not arise in a model of a small open economy under predetermined exchange rates. The interest rate targeting received more concern, as institutional changes and financial innovation have distorted the signals conveyed by the monetary aggregates since the 1980s. Academic research on the nominal interest targeting as well as the real interest rate targeting is still being undertaken.

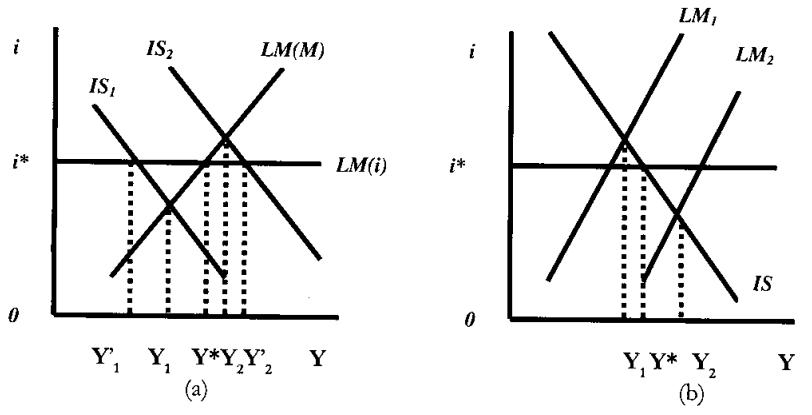
The interest rate targeting as an alternative to monetary targeting has the following advantage and disadvantage through the IS-LM curve.[35] In Figure 4-1, the IS curve shows combinations of the interest rate and output at which the goods market is in equilibrium. The LM curve shows combinations of the interest rate and output at which the money market is in equilibrium. The LM curve labeled LM(M) is the LM curve that exists when the central bank fixes the money supply under the monetary targeting. The LM curve labeled LM(i) describes money market equilibrium when the central bank fixes the interest rate under the interest rate targeting. LM(i) is horizontal at the chosen level of the interest rate, i^*. Here, the aim of the central bank is to have the target income, Y^*.

Figure 4-1(a) describes the case that the IS curve shifts, while the LM curve is stable. When the LM curve is LM(M) in the monetary targeting, the output level will be either Y_1 or Y_2, depending on where the IS curve turns out to be. In the case of the interest rate targeting, the corresponding levels of output are Y_1' or Y_2', which is located farther from the desired level of output, Y^*. Thus, the monetary targeting leads to more stable output behavior.

In Figure 4-1(b), the LM curve is shifting because of shifts in the demand for money, while the IS curve is stable. In the case of the monetary targeting, output will be at either Y_1 or Y_2, if the money stock is held constant. In the interest rate targeting, output will be at the target level Y^*, if the interest rate is held constant. Thus, the central bank should target the interest rate if the demand for money function is unstable.

35. The analysis is presented in Dornbusch (1990) based on Poole (1970).

Figure 4-1
Money and Interest Rate Targets



Among the SEACEN countries, Malaysia shifted its focus from monetary targeting to interest rate targeting towards the mid-1990s, while Malaysia, nevertheless, still monitors very closely monetary aggregates, credit growth and other economic and monetary indicators. There are four main factors to precipitate this target shift (refer to BNM, 1999). First, the liberalization of interest rates since 1978, led to a more market oriented interest rate determination process. Second, financial deregulation and liberalization measures undertaken during the decade had enhanced the role of interest rate in monetary transmission mechanism. Third, there was a notable shift in the financing pattern of the economy since the mid-1980s from an interest-inelastic market (government securities market) to a more interest-sensitive market (bank credit and capital market). Finally, BNM has maintained positive real interest rates of return on deposits.

4.4 Nominal GDP Targeting

Central banks could target the growth rate of nominal GDP as an alternative to monetary targeting (refer to Taylor, 1985; Hall and Mankiw, 1994). The advantage of the nominal GDP targeting is that it puts some weight on both output and prices in the policy-making

process. With a nominal GDP target, a decrease in projected real output growth would imply an increase in the inflation target.

However, this targeting also has some limitations. First, under a nominal GDP target, the government has to make public its estimate of potential real GDP growth, which is not an easy concept for the public to understand. The data on capital stock that is needed to estimate potential GDP is not compiled on the regular basis in most of the developing countries. Second, nominal GDP data are compiled quarterly and are less accurate than data on interest rates, inflation rate, and monetary aggregates. It also takes time to compile nominal GDP data so that the data cannot provide fast information when the data on nominal GDP are off track from the target. Third, the central bank has little direct control over nominal GDP data. These points constrain the usefulness of nominal GDP targeting, despite its advantages.

CHAPTER 5

Concluding Remarks

Since the 1970s, monetary targeting has been used as a main framework for implementing monetary policy. Financial innovation or liberalization made a rapid progress from the 1980s, and the selected SEACEN countries could not be exempted from this trend. In addition, the selected SEACEN countries experienced the economic and financial crisis directly or indirectly during the last three years. The empirical study was undertaken at this point of time to find out whether monetary targeting is viable or not. The main findings from the empirical study are as follows.

First, in the estimation of money demand function in six countries, only the Philippines has stable money demand functions for two monetary aggregates: in both the long-run and the short-run money demand function, coefficients are statistically significant with the same signs as theoretical prediction. In the other five countries, the cointegration relation does not exist in the long-run money demand function. In the short-run money demand functions, coefficients are not significant in four cases out of twelve, even for the period excluding the Asian crisis. These poor results are attributable, in part, to financial liberalization, since these SEACEN countries undertook financial liberalization including interest rate deregulation during the estimation period (after the mid-1980s or 1990s). The estimation of each money demand was undertaken by the two-stage Engle-Granger methodology. To confirm the good results of the Philippines, Vector Error Correction Model (VECM) was again used to check existence of the cointegration relation as in Appendix B, which also corroborates the results of the two-stage method.

Second, the graphical findings on velocity of money are consistent with the results of the cointegration test. In six countries, velocity of money is not stable on the whole and shows a downward trend, which is consistent with income elasticity greater than one in money demand functions of most countries.

Third, in the variance decomposition of VAR model, money's contribution to real income and the price level is not satisfactory, downgrading the usefulness of monetary targeting.

The main reason for the poor results of monetary targeting is partly attributable to financial liberalization and innovations, which would reduce the effectiveness of monetary policy. When monetary targeting is not workable, what the central bank could do is to choose the other targeting framework from alternatives such as inflation targeting, interest rate targeting, exchange rate targeting, and nominal GDP targeting. Among these options, the right to choose is up to each central bank or monetary authority. Among six countries in the paper, four countries (Indonesia, Korea, Philippines, and Thailand) recently adopted inflation targeting or are in transition process by using two targets (monetary aggregate and inflation); Malaysia is taking interest rate targeting; Taiwan is still maintaining monetary targeting. Besides choosing one among the alternatives, the central bank might take a "just-do-it" approach of the United States (Bernanke et al., 1999), in which the United States has maintained a coherent strategy, without explicit nominal anchor, by monitoring carefully for signs of future inflation, coupled with periodic preemptive strikes against the threat of inflation. Through this approach, the United States has achieved excellent macroeconomic performance, that is, sustainable growth and low inflation.

The adoption of a good alternative does not guarantee achievement of price stability. It must be emphasized that there is no panacea for monetary policy. For the successful achievement of the final objective through a well-chosen targeting, the central bank must also find the effective transmission mechanism of monetary policy as well as effective policy instruments to influence policy objectives. Furthermore, monetary policy must be undertaken by the central bank with credibility to enhance the effectiveness. To obtain credibility, the central bank must be independent of the government and demonstrate that it has the means and the will to reduce inflation. There are the exemplary cases of Germany and Switzerland; they have been coping well with business cycles under monetary targeting, although they also experienced financial liberalizations and innovations.

[Appendix A] Monetary Policy Frameworks of SEACEN Countries

Countries	Central Banks/ Monetary Authorities	MONETARY POLICY IMPLEMENTATION			
		Goals	Targets	Main Instruments	Signals
Indonesia	Bank Indonesia	To achieve and maintain the stability of the rupiah value. BI is responsible for prescribing and implementing monetary policy to regulate and to safeguard the smooth running of the payment system and to regulate and supervise banks	Base money and its components, net international reserves and domestic assets	Weekly and monthly auctions of SBIs, daily rupiah intervention and repo facility	
Korea	The Bank of Korea	Price stability	M3 is the intermediate target	OMO, rediscount and reserve requirement	
Malaysia	Bank Negara Malaysia	Price stability and stability in domestic money and foreign exchange markets	Guided by monetary aggregates and level of interest rates	OMO, interest rates, statutory reserve requirement	3-month intervention rate
Mongolia	The Bank of Mongolia	Maintain domestic price stability and strengthening financial sector restructuring policy	Operating target: Reserve Money (RM) Intermediate target: M2	Central Bank Bills (CBB), unified interest rate policy, reserve requirements, refinancing credits, credit ceilings	
Myanmar	Central Bank of Myanmar	Ensure adequate expansion of money supply to support a growing economy at reasonable stable prices and promote domestic savings		Reserve requirements, interest rate policy and OMO to a certain extent	
Nepal	Nepal Rastra Bank	Price stability and external payments sustainability	Intermediate target: M1	OMO, bank rate, and reserve requirements	Weekly movements in interest rates in short-term bills market and reserve money posititon of the Central Bank
Philippines	Bangko Sentral ng Pilipinas	Price stability complementing economic growth, stability and convertibility of the Philippine peso	Intermediate target: M3 Operating target: RM (or BM)	OMO; re-discount window, reserve requirements and forex purchases/ sales	91-Treasury bill rate, BSP's lending and borrowing rates

[Appendix A]-Continuation

		MONETARY POLICY IMPLEMENTATION			
Countries	**Central Banks/ Monetary Authorities**	**Goals**	**Targets**	**Main Instruments**	**Signals**
Singapore	Monetary Authority of Singapore	Price stability	Exchange rate	Foreign exchange intervention; and money market operations through forex swaps, inter-bank lending/ borrowing, repos of government securities	Outlook for inflation and economic growth
Sri Lanka	Central Bank of Sri Lanka	Sustainable output growth, price stability and viable external balance	Intermediate targets: M2, NDA, and REER Operating target: Monetary base	OMO, statutory reserve requirements, and moral suasion	
ROC, Taipei	The Central Bank of China, Taipei	Financial stability, sound banking operations, stable exchange rate and fostering economic development	Intermediate target: M2 Operating target: Monetary base	OMO, rediscount rates, reserve requirements, forex operations, forex swaps, and accommodation to banks	
Thailand	Bank of Thailand	Price and financial stability, and sustainable economic recovery	Intermediate target: Monetary base and M2A Operating targets: Short-term repurchase rate and reserve money	Bond repurchase market, forex swaps, loan window and liquid asset requirement	Bank rate and bond repurchase rate

Source: Guide to SEACENBANK Watch 2000

Note: 1) The table was written as of the end of 1999.
2) Four countries (Indonesia, Korea, Philippines and Thailand) adopted inflation targeting and announce the annual inflation target.

[Appendix B]
Cointegration Tests for The Philippines Using Vector Error Correction

1. Cointegration Test for RM1

Estimation period: 1987. Q1 ~ 1999. Q3
Lag number in VAR: 1
Eigenvalues in descending order: 0.3207; 0.1941; 0.0045

A. Test Statistics

Null	Max	95% C.V.	Trace	95% C.V.
P = 0	19.33	21.0	30.35*	29.7
P ≤ 1	10.79	14.1	11.01	15.4
P ≤ 2	0.22	3.8	0.22	3.8

B. Standardized Beta Eigenvectors

LRM1	LRGDP	LINT
1.0000	-1.8915	1.8073
-0.43272	1.0000	0.11425
-21.154	27.399	1.0000

C. Summary

The analysis of vector error correction here is based on Johansen (1988). Two statistics were used to check whether the cointegration relationship exist or not; one is "*trace statistic*" and the other is "*maximum eigenvalue statistic.*" The null hypothesis of zero cointegrating vector is re-

jected by trace statistic at the 5 percent significance level, which means that there exists one cointegrating relationship. The stadardized cointegrating vector in the first row has the same signs as theoretical prediction. The result obtained by vector error correction supports that of single equation method by Engle and Granger.

2. Cointegration Test for RM3

Estimation period: 1987. Q1 ~ 1999. Q3
Lag number in VAR: 1
Eigenvalues in descending order: 0.3605; 0.2582; 0.0030

A. Test Statistics

Null	Max	95% C.V.	Trace	95% C.V.
P = 0	22.35*	21.0	37.44*	29.7
P ≤ 1	14.93*	14.1	15.08	15.4
P ≤ 2	0.15	3.8	0.15	3.8

B. Standardized Beta Eigenvectors

LRM1	LRGDP	LINT
1.0000	-2.6662	1.4256
-0.2614	1.0000	1.2537
-1.0713	1.0581	1.0000

C. Summary

The null hypothesis of zero cointegrating vector is rejected by two statistics (maximum eigenvalue statistic and

trace statistic) at the 5 percent significance level. The null hypothesis of one cointegrating vector is also rejected by maximum eigenvalue statistic at the 5 percent significance level, which leads to the possibility of the existence of two cointegrating vectors. However, the standardized cointegrating vector in the second row has not the same signs as theoretical prediction. Thus, the standardized cointegrating vector in the first row is interpreted as the cointegrating vector consistent with theoretical prediction. The result obtained by vector error correction supports that of single equation method by Engle and Granger.

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