MARKET-ORIENTED CENTRAL BANKING

By: Vicente B. Valdepeñas, Jr.[*]

For effective monetary management in competitive economies, market-oriented central banking relies on financial markets rather than discretionary controls in adjusting overall liquidity to stabilize prices. Behind this reliance on money markets, however, is a stable long-run relationship between money and output as well as the interest rate. In an illustrative estimation of the demand for money in the Philippines covering the period 1950-1991, using the framework of an error-correction model, such a stable relationship is found after testing the relevant time series for trend and mean stationarity. It is inferred from this that monetary programming on the basis of open market operations becomes a meaningful endeavor.

The Job of Market-Oriented Central Banking

Central banking as a human endeavor performs two key functions for the community. It is responsible for the formulation of monetary policy to stabilize prices. In addition, it also handles the supervision of financial institutions to ensure a sound and predictable financial and payments system so that trade and investment can go on most productively.

For effective monetary policy to happen, it is necessary that prices of goods and services reflect their scarcity value. This is possible when competitive conditions prevail in the markets for goods and services, on both sides of the market or economic transaction, supply and demand, seller and buyer. However, this is

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not possible when either costs of inputs are subsidized or prices of outputs are controlled. Prices are market — determined only to the extent that they are free from intervention on both the input and output sides of economic transactions.

A community's financial system is sound and stable whenever all the financial institutions participating in it have adequate capital cover in relation to their deposit and long-term liabilities, as well as in relation to the intrinsic and contingent riskiness of their earning assets. This implies that any financial intermediation between funds-surplus and funds-deficit institution and areas, between savers and investors, between creditors and borrowers proceeds on the market basis.

Lending and borrowing on market basis ensures that the cost of funds reflects their scarcity value in a given financial market and that their price, in the form of interest rates charged by lenders on the borrowers of these funds, matches their market cost and the transaction costs in the course of lending the funds. This implies that interest rates earned by lenders of funds are positive. Otherwise, somebody is subsidizing someone on either side of the financial market which eventually shows up in non-performing accounts or a drying up of the deposit or funding base of creditors. As this process snowballs, it eventually leads to a collapse in the process of financial intermediation altogether. Going by the experience of modern nations, governments at the end of the day pick up the entire bill for the effort to rehabilitate a financial system run down by such a collapse.

The necessity for positive or real rates of interest is the basis for the existential interface between the monetary policy which is formulated by central banks on the one hand, and the supervision they exercise, on the other hand, over financial institutions to keep them in a sound and stable operating condition for trade and investment to happen efficiently and predictably. Effective market-oriented central banking is the outcome of monetary policy which succeeds in keeping overall prices low and a sound and stable financial system which operates at positive market rates of interest across the whole range of financial intermediation in the community.

VICENTE B. VALDEPEÑAS, JR.

Development Context of Central Banking

People or their communities generally expect their governments and their central banks to provide the necessary and appropriate conditions for jobs, investment and growth, stable prices, and more equity in the distribution of incomes and wealth to happen within their foreseeable lifetimes. Given a population level and its growth rate, every year can expect an increase in labor force, however working age is defined whether it is at 12 or 14 or 16 years old. Today's government must grow jobs for people born 16 years ago. And depending on the retirement age whether this be defined as 55 or 65 years old, it must try to keep all of them on the job over the next 50 or 40 years ahead if it is to continue to have their confidence as well as their support.

How much does it cost at today's prices to grow a job in the farm, in the factory, in the bank? How much will it cost to keep a job in the farm, the factory or the bank over the next 50 or 40 years ahead? While they want so many things for themselves and for their government to provide or at least help them supply in private-sector dominated systems, people or their communities do not have all the resources in men, money, materials and machinery it takes to make available to them all these public services at the same time.

Facing the reality of resource constraints, people or their communities have to decide which public services they can afford to have in the next 12 months, the next 5 years or the next 10 years. This implies that people or their communities need to order their needs according to some priority: which public services they need at present, and which ones they can afford to have in another 12 months or over the next 5 or 10 years.

It also implies, however, that some institutions, whether markets or public agencies, must do the homework of organizing the priorities for the supply of public services to people or their communities. Which group of people will be provided first? Which part of the country will get first priority? Who will do the provisioning of these services, at what cost, and where will the resources in men, money, materials and machinery come from? How long will it take to get the provisioning done for a feeder road

or a key highway, a local or international airport or harbor, a fibre-optic telecommunications network, a 1000MW power-generating system, low-cost or middle-income housing, primary or specialized medical care, high school or research university, local or national security force?

Development Financing

The financing program for development projects takes into account what is affordable within the government tax-expenditure budget, the current and prospective mobilization of domestic resources by the country's financial system, realistic access to external financing, as well as the objectives of maintaining both internal and external balance throughout a defined time span. Public policies on the national budget, credit and international payments must be internally consistent. Consistency check is performed between goals/targets and the financing package to ensure internally consistent programs of action within this time span. Adjustments are made every 12 or 18 months on financial objectives to ensure both balance of payments and price stability.

How Fast to Grow?

One approximation of how fast a community could grow is to look at its output as the product of output per hour, average hours worked, employment as percent of labor force, working-age population as percent of labor force and working-age population however this is defined, 12/14/16 years old. An analysis of the annual growth rate in these five variables every 10 years suggests the extent by which real GNP/GDP could grow every year over the defined period. Replicate this analysis for key sectors in the national eonomy to approximate the sectoral growth in agricluture, industry and services, with adjustments made for intersectoral transitions as development shifts towards more processing industries.

The Way to Grow in Market-oriented Nations

People consume or spend on goods and services as their incomes

will allow. Accordingly, low levels of income lead to low levels of consumption. Businessmen invest in new facilities of production in response to consumer spending, so that investment spending depends on consumer spending. Investment spending is financed out of internal funds of the business or out of external funds which have been made available to it through one form of borrowing or another. So that a nation which is short of domestic resources to invest can access either direct foreign investment or foreign debt.

New investment spending leads to more jobs, more productivity and more incomes. Often, with new investment comes new or better technology which raises labor productivity and incomes. Direct foreign investment, on the other hand, brings with it more effective management of inputs or resources into outputs at the same time that it generally exports large parts of its output. This makes for a more effective use of the available productive capacity to the extent that only the most efficient producers can stand the competition in the world market. The international marketplace eventually levels every producer to the highest productivity it can raise by dint of his own initiatives, imagination and stamina.

Higher productivity and incomes lead to more savings as well as to more consumer spending. This is because as average incomes increase, people's ability to save goes up at the same time that they can afford higher levels of consumption. Business responds to these higher levels of consumption by expanding productive capacity once more. This incremental investment spending is made possible with the rising levels in domestic resources. By such a process, growth soon becomes sustainable and may well hold up for long periods of time afterwards. Central banks assist in the effective mobilization of these domestic resources to support further growth.

Central Banking Interface with Growth and Development

Central bank exercise of monetary policy in market-oriented nations generally goes by a program of action. In its determination, such a program includes its objective, targets including intermediate and operating targets, and the instruments by which these targets are deemed achievable. Chart 1 which follows illustrates such a program of monetary management.

Chart 1 - Market-Oriented Central Banking
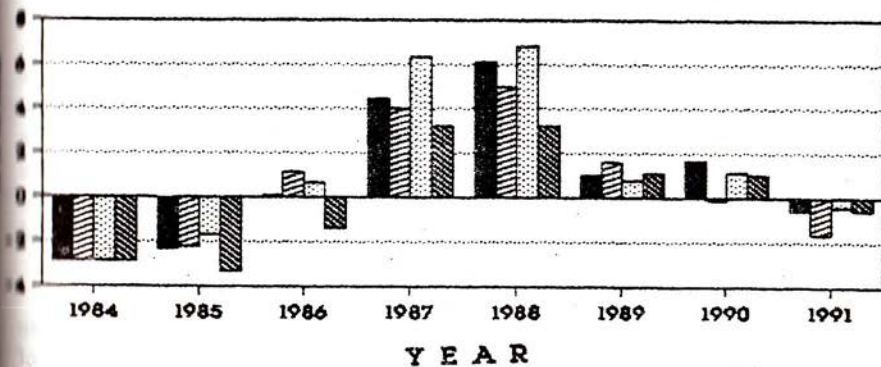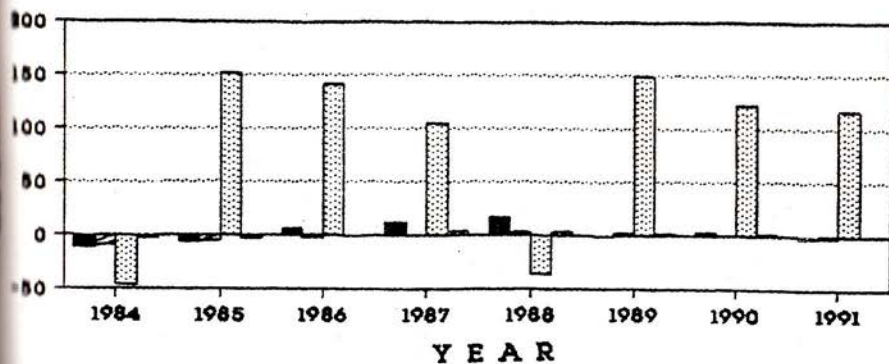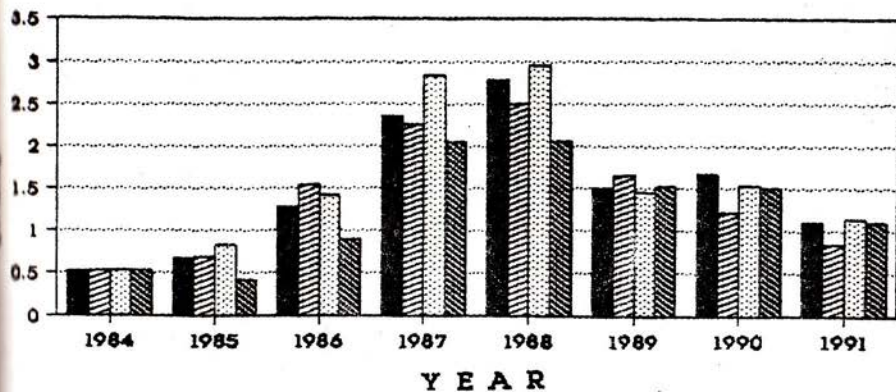
| Coco+Cacao | Coco+Coffee |
| Coco+Pineapple | Coconut alone |

The objective is to have in the financial system the approriate money and credit levels as well as the interest rate which together are consistent with the delivery of a public welfare or development package on jobs, output and prices. The targets are bank liquidity and money market rates. Because these are not directly within the control of central banks in the market economy, the need for intermediate targets within their influence and management becomes apparent. The intermediate targets generally include some monetary aggregate or long-term interest rate.

The monetary aggregate, whether M1 (currency and checkable deposits) or M2 (M1 plus savings and time deposits), should have a relatively stable relationship with the level of real income, overall prices and interest rates, as in a good estimate of the demand for money. Whichever monetary aggregate is adopted for monetary targeting, its annual growth rate should reflect the requirements of forecast output or GDP growth rate, a target inflation rate and some incremental monetization of the national economy during the year.

Depending on the economy's interdependence with the rest of the world market, an appropriate operating target in the exercise of monetary policy may either be the interbank lending rate or the exchange rate. In the face of international capital movements, central banks often find it worth their while to keep their options open in exercising some influence over both.

Among the instruments applied by central banks in their exercise of monetary management are treasury bill auctions, reserve requirements, rediscount facilities, repurchase agreements and reverse repurchases, secondary trading in government securities, government deposits operations, central bank bills, special deposits with the central bank, and foreign exchange operations. Where markets for these are not too well developed, it remains the job of central banks to assist in their orderly and progressive growth and development within the financial system.

Depending on bank liquidity, money and credit either ease or tighten which affects both the availability and the cost of credit. In response, corresponding adjustments are made by households and businesses on their respective levels of consumer

and investment spending, as well as in the international capital flows and the exchange rate. Depending on the overall direction of these adjustments, a nation experiences growth or recession, inflation or deflation, deficit or surplus in its balance of payments with the rest of the world economy. Thus, at the end of the day, it is these macroeconomic adjustments which market-oriented central banking tries to nurture so that sustainable growth and development can proceed predictably throughout the world economy.

The People's Demand for Money

Often, in practice, central banks zero in on managing the money supply as a first approximation at effective monetary management to keep overall prices down. They do this for several reasons. One is the obvious reason that frequently they have the physical control over the banknote-printing facilities as a matter of public responsibility. Another reason is the great lesson from the world's history of hyperinflation which in every case has been preceded by mindless printing of money. However, the more sensible reason is their realization that people want money for what it buys them in goods and services which comprise their necessities as well as amenities in their daily quest for a better standard of living. This is known as the community's transactions demand for money.

Behind the central bank's mind for the money supply is often an unexpressed though very real compulsion to adjust its availability in the hands of the public in some proportion to their need for it to spend, to do business and get on with the daily requirements of living. Underlying this presumed proportionality is a fundamental stability in the public demand for money. Thus, as a matter of daily operating procedure, those in the national community who are responsible for sound monetary management have to bother about its money demand.

One may well ask what figures into the community's demand for money, especially in the context of economies built around the ideas of individual initiatives, enterprise, and markets. As already mentioned previously, people want money for what it buys. This implies that as their capacity to buy increases, which normally happens when their incomes are rising, their demand for money

likewise goes up. In addition, however, they may also want money for what it can earn them in the way of interest income. In this case, they face the option of doing less consuming of goods and services and getting more of their money into government bonds and securities which pay them a positive rate of interest. Moreover, as overall prices rise, people are likely to unload any unnecessary money balances as their purchasing power erodes with the inflation. In this case, there would be little point in people holding on to money balances whose real value is dwindling by the day in the face of inflation. In brief, then, people's demand for money increases with the real income or spending that they do; decreases with rising positive interest rates in borrower's papers whether these are issued by a government or by a commercial enterprise of good standing in the national community; and, shrinks as the inflation rate grows.

Modelling the Demand for Money

In what follows, the process of estimating a money demand is illustrated to describe the foregoing perceptions and behavior of people about money balances, i.e., to model their demand for money. Because of the author's experience in monetary management as member of the Monetary Board of the Central Bank of the Philippines in 1983-1986, the money demand which is estimated uses Philippine economic and monetary data. To keep this illustrative case clearly in mind, it is necessary to map out a modeling strategy. The first step is to define the economic and monetary data which are available on an annual frequency for the period 1950-1991, and to describe their time-series properties. This is necessary to avoid the pitfalls of spurious relationships that might be embedded in the time series (Granger and Newbold, 1986). Depending on their time-series characterization, one can proceed to specify an appropriate model of the people's demand for money which matches the time-series characterization in the data. The next stage is the actual estimation of such a model. At the final stage, an evaluation of this model is performed, whether it reasonably fits the data in general and, in particular, whether the relationship so fitted among the relevant time series represents a stable money demand which could form a working basis for the exercise of effective monetary management.

It is necessary, at this point, to recall the way Philippine law understands the money supply. For the period under consideration, viz. 1950-1991, and going by Republic Act No. 265 of 1948 which chartered into existence the Central Bank of the Philippines as amended by Presidential Decree No. 72, the money supply includes currency in circulation and peso deposits subject to check. Since 1949, the Central Bank has been collecting time series data on the money supply as understood in these laws (Central Bank of the Philippines, 1972, p.2). In comparison to international practice, this idea of money supply corresponds to either the MO of the Bank of England or the M1 monetary aggregate of the United States Federal Reserve System. Because of its availability on a consistent basis since 1949, the annual time series of the Central Bank of the Philippines on money supply as interpreted in its law is adopted in the following estimate of money balances.

The choice of an appropriate interest rate to include in the subsequent estimation of the demand for money in the Philippines for the period 1950-1991 again depends on what time series data are available on a consistent basis since 1949. Clearly, such an interest rate should reflect market conditions as much as possible if it is to serve as a signal to people whether to load up on money balances or unload them in response to the prospect of earning incremental income out of interest-bearing debt instruments which they could buy instead of keeping the money balances. Once more, the Central Bank of the Philippines since 1949 and through 1969 has been collecting data on the interest rates paid by the national and local governments as well as by government corporations on their respective internal debts (Central Bank of the Philippines, 1978, p. 258). From 1950 through 1954, all of the debt incurred by government corporations was guaranteed by the national government; in the period 1955-1960 as much as 92% and in 1961-1969, as much as 70% of their debt was guaranteed by the government. Accordingly, for the period 1950-1969, a weighted average of the interest rates paid by government authorities is estimated to represent the effective interest rate. During this time, the interest rate on government securities ranged from 0% to 10%, with as much as half of the government debt in 1950-1954, more than one-fourth in 1955-1960, more than one-sixth in 1961-1966 and about one-tenth in 1967-1969 paying no interest at all. For the period 1970-1991, a weighted average of the Treasury Bill rates for all maturities is estimated as the effective market rate of interest (SEACEN Centre, 1991-93).

As mentioned earlier, people's demand for money rises with their real income or spending. This suggests that the time series which is intended to capture this increasing capability for transactions mimics as closely as possible the personal spending undertaken by the people. Once again, a practical consideration in this regard is the availability of suitable data on a consistent basis for the period 1950-1991.[1] In this regard, while real GNP or GDP has been frequently adopted in the conventional literature to measure real income or spending ever since it was initially suggested by Milton Friedman (1956), more recent work such as that of N. Gregory Mankiw and Lawrence H. Summers (1986) have demonstrated that personal consumption expenditure is more aptly suited as the scale variable rather than GNP, which includes among others business fixed investment and inventory changes that do not raise cash balances by as much as consumer spending does.

Perhaps, a somewhat more salient point to make in this connection is the need to match whichever scale variable is eventually adopted with an appropriate price deflator for nominal money blances. It often happens that on the left-hand side, nominal GNP or GDP is deflated by the impicit price deflator of the national income accounts. Because these two price indexes are constructed differently,[2] the mismatch could lead to misleading estimates of the money demand equation with the appropriate price deflator. In this way, it will become apparent which economic aggregate serves best as the scale variable.

Characterization of Time Series Properties

Because the information on money supply, real spending and interest rate constitutes sets of discrete data ordered in time

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[1] Time series on the GNP, personal consumption expenditure, personal disposable income including their corresponding implicit price deflators (1972=100) are from the *Philippine Statistical Yearbook*, 1981-1991.

[2] Time series on the Consumer Price Index (CPI) for the Philippines with 1978 as the base year is constructed by the National Statistics Office (NSO), Republic of the Philippines.

with each observation amounting to a single realization from an underlying data generation process, they represent stochastic processes which may or may not be stationary. This is because effective monetary management implies the ability to control key factors behind price increases. This in turn presupposes a certain stability and predictability in the basic structure of the stochastic process. Such stability and predictability, on the other hand, are ensured by the stationarity of the relevant time series.[3] With stationarity, the time series are independent of time and are characterized by constant mean, variance and covariance.[4] As these stationary properties are established, they also assist in the identification of the appropriate model to fit (Granger and Newbold, 1986, pp. 79-81). Given these time series properties, the relationship between money supply on the one hand, and real income and interest rate, on the other hand, can be described as stable and predictable for purposes of policy control as in the exercise of monetary policy. To formally establish their stationarity, the time series on money, real income and interest rate require testing them individually for a unit root and together in a linear combination, for cointegration as suggested by Engle and Granger (1987).

Proceeding accordingly, a first approximation to the stationarity or nonstationarity of the relevant time series in question is its corresponding autocorrelation function which essentially contains all the information available in the corresponding autocovariance function.[5] However, as the autocovariance coefficients are sensitive to the unit of measurement adopted for a particular time series while those of the autocorrelation function are not, the latter is used in initially testing for stationarity. In an autocorrelation function, which depends simply on a time lag, stationarity is detected when as its coefficient is positive the outocorrelation function sharply declines and as its coefficient turns negative it oscillates within generally narrower amplitudes over an increasing number of lags,

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[3] See Judge, Hill, Griffiths, Lutkepohl and Lee (1988, pp. 676-679).

[4] See Pindyck and Rubinfeld (1991), *Econometric Models and Economic Forecasts*, Third Edition, Chapter 15, especially pp. 443-456.

[5] See G.S. Maddala (1992, pp. 527-528).

suggesting in the process that the error term does not depend on time.[6] A visual check on this condition is the *correlogram*[7] which plots the autocorrelation function as a function of time lags.

In detecting stationarity in the data set by visual inspection, the autocorrelation functions for every relevant time series are estimated for the original time series itself expressed in logarithm, then for its first difference, and finally on the residuals when the original time series is regressed against itself with one time lag. As indicated in the following correlogram (Chart 2), in the case of money supply as defined above, within less than a third of the original time series from 1950 through 1991, there is a sharp drop in the autocorrelations, which withering process is made even more visible as the first difference of the original time series is taken and is well confirmed in the rapid dissipation of the autocorrelations of the residuals as one regresses the original time series for money supply against itself with a time lag.[8] Similar rounds of autocorrelations are estimated for interest rate on government securities, real final expenditures (GNP), real consumer spending, real personal disposable income, the implicit price deflators for GNP and personal consumption expenditure, and the consumer price index. The corresponding correlograms (Charts 3-9) emerging out of these iterations show the same general pattern: a fairly swift decay in the autocorrelations as the number of lags increases. This characterizes the correlogram for a stationary stochastic process.[9]

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[6] See Jan Kmenta (1986, pp. 300-302).

[7] G.S. Maddala (1992, p. 285), suggests that the correlogram of a time series be inspected prior to applying the unit root test to the series.

[8] The time series and their corresponding first differences as well as residuals are labeled as follows: *LM* is money supply, *DLM* is its first difference and *LMRES* its lagged residuals; *R* is interest rate, *DR* its first difference and *RIRES* its lagged residuals; *LGY* is real final expenditures, *DLGY* its first difference and *LGYRES* its lagged residuals; *LC* is real consumer spending, *DLC* its first difference and *LCRES* its lagged residuals; *LPY* is real personal disposable income, *DLPY* its first difference and *LPYRES* its lagged residuals; *LP* is implicit price deflator for *GNP*, *DLP* its first difference and *LPRES* its lagged residuals; *LPC* is implicit price deflator for personal consumption expenditure, *DLPC* its first difference and *LPCRES* its lagged residuals; *LCP* is consumer price index, *DLCP* its first difference and *LCPRES* its lagged residuals.
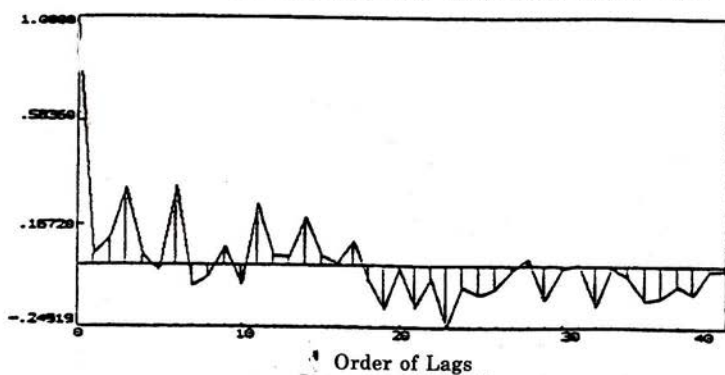
[9] See Harvey (1990, p. 30).

Chart 2

Autocorrelation function of LM, sample from 1960-1991

Order of Lags
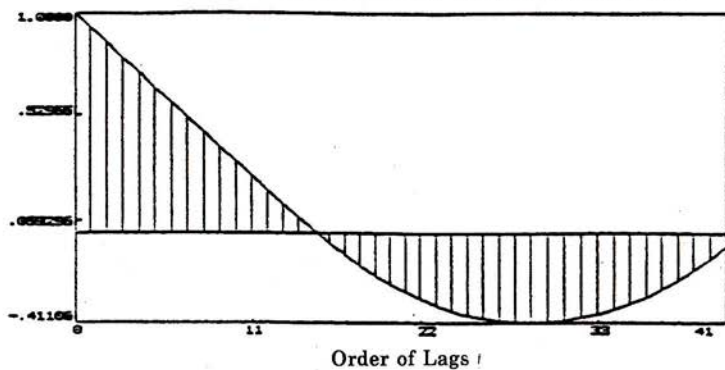
Autocorrelation function of DLM, sample from 1961 to 1991

Order of Lags

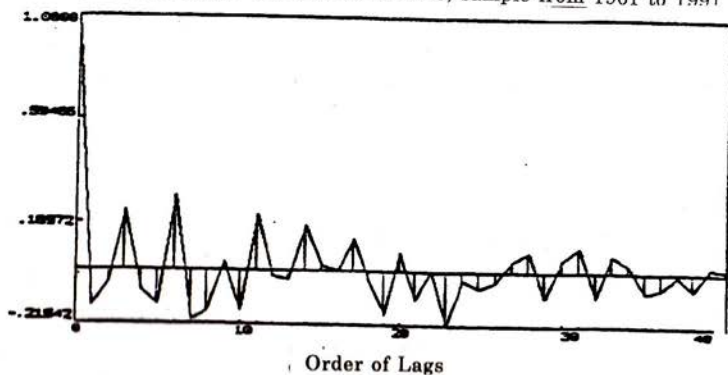Autocorrelation function of LMRES, sample from 1961 to 1991
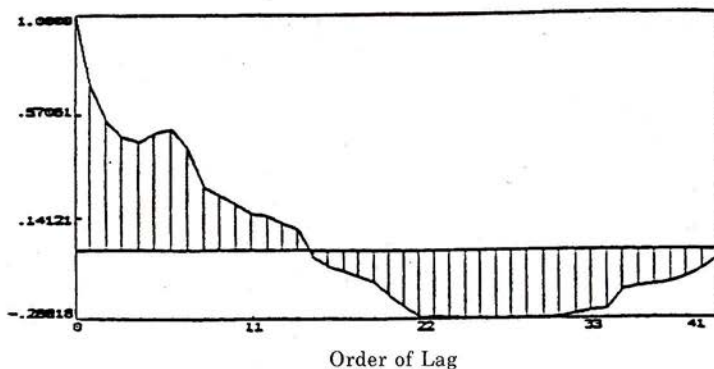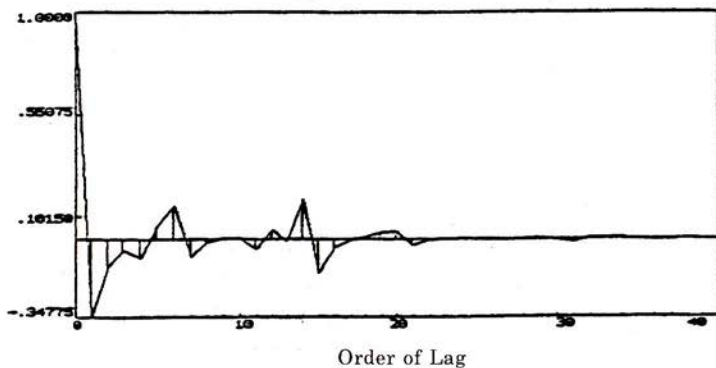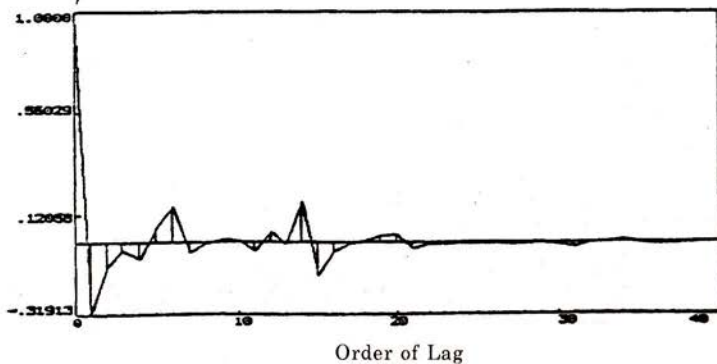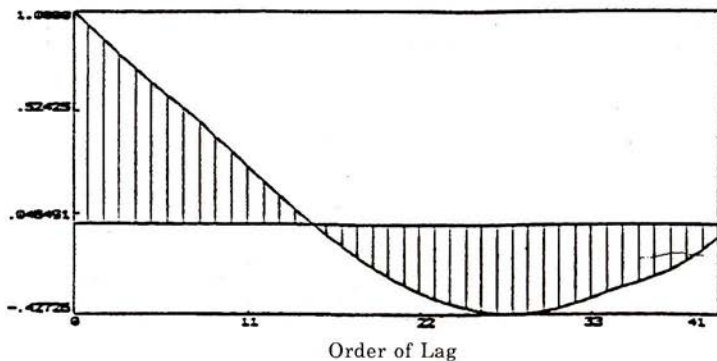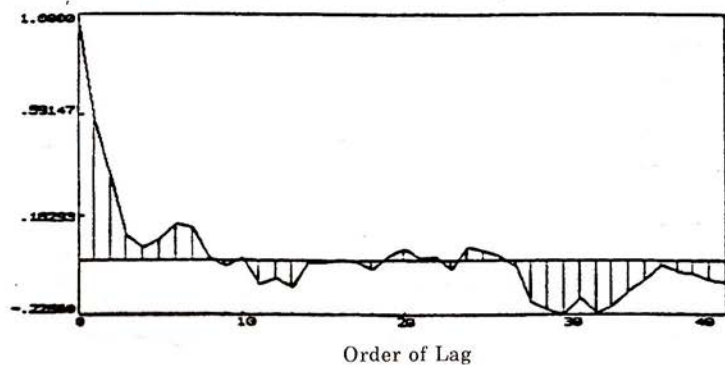

Order of Lags

Chart 3

Autocorrelation function of R, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DR, sample from 1961 to 1991

Order of Lag

Autocorrelation function of RIRES, sample from 1961 to 1991
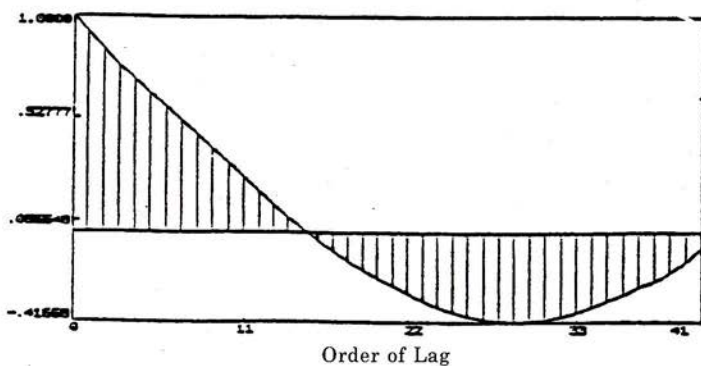

Order of Lag

Chart 4

Autocorrelation function of LGY, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DLGY, sample from 1961 to 1991

Order of Lag
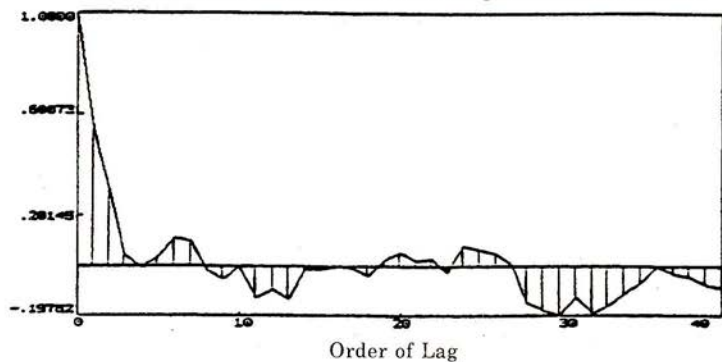
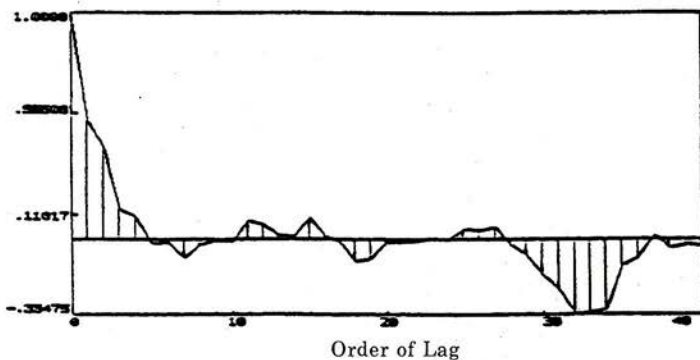Autocorrelation function of LGYRES, sample from 1961 to 1991

Order of Lag

Chart 5

Autocorrelation function of LC, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DLC, sample from 1961 to 1991

Order of Lag
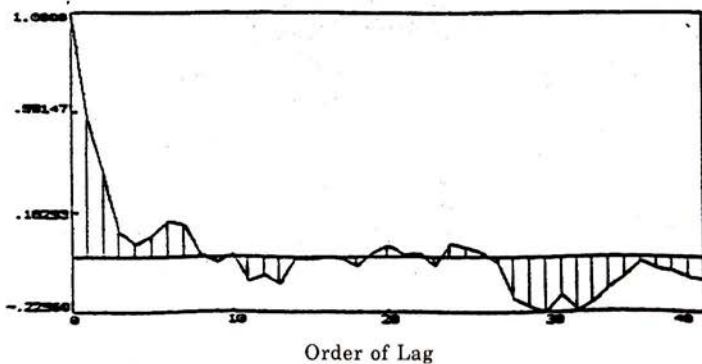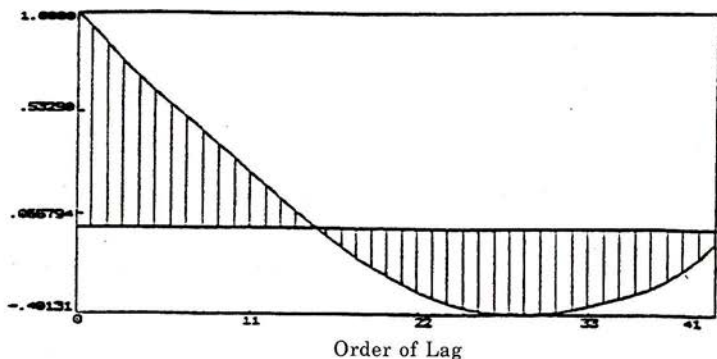
Autocorrelation function of LCRES, sample from 1961 to 1991

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Chart 6

Autocorrelation function of LPY, sample from 1960-1991

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Autocorrelation function of DLPY, sample from 1961 to 1991

Order of Lag
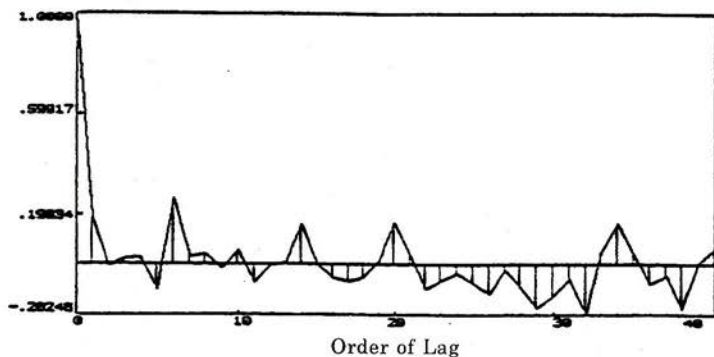
Autocorrelation function of LPYRES, sample from 1961 to 1991

Order of Lag

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Chart 7

Autocorrelation function of LP, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DLP, sample from 1961 to 1991

Order of Lag

Autocorrelation function of LPRES, sample from 1961 to 1991

Order of Lag

Chart 8

Autocorrelation function of LPC, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DLPC, sample from 1961 to 1991

Order of Lag

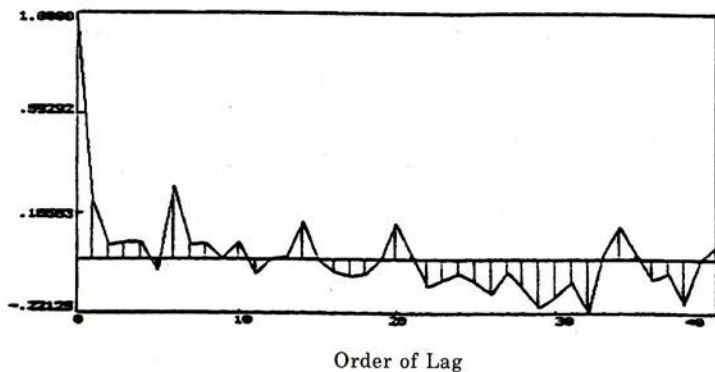Autocorrelation function of LPCRES, sample from 1961 to 1991
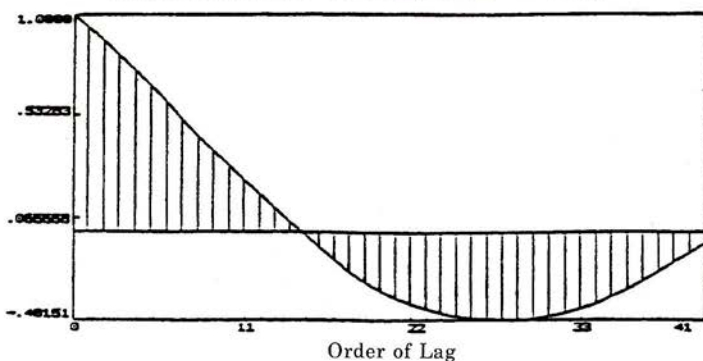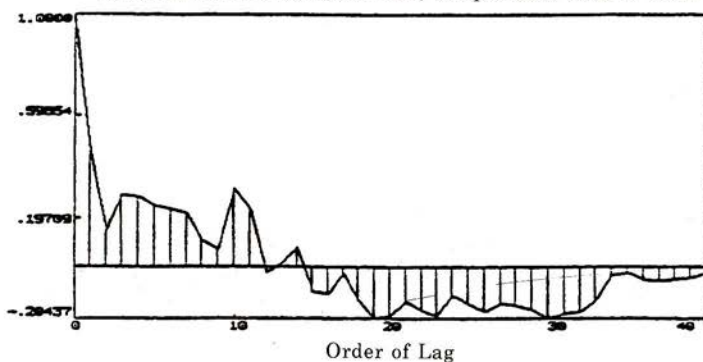

Order of Lag

Chart 9

Autocorrelation function of LCP, sample from 1960 to 1991

Order of Lag

Autocorrelation function of DLCP, sample from 1961 to 1991

Order of Lag

Autocorrelation function of LCPRES, sample from 1961 to 1991

Order of Lag
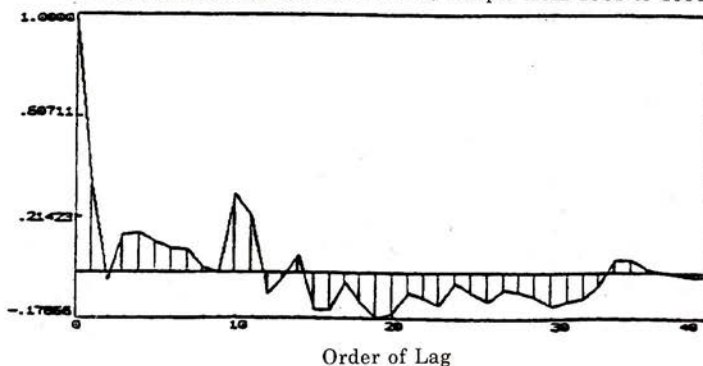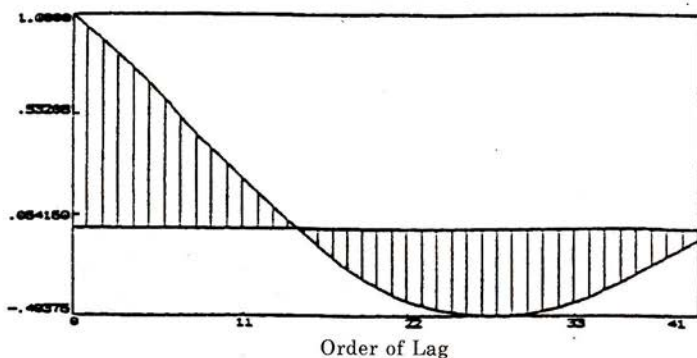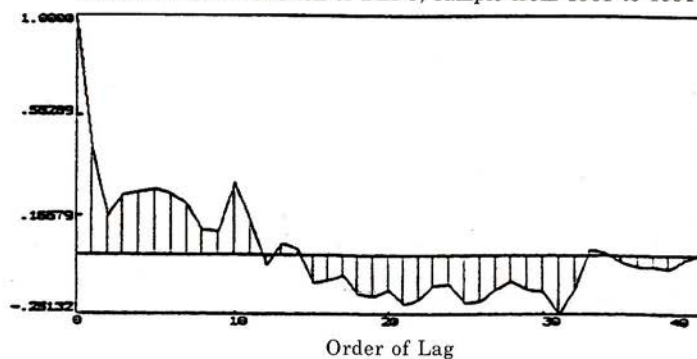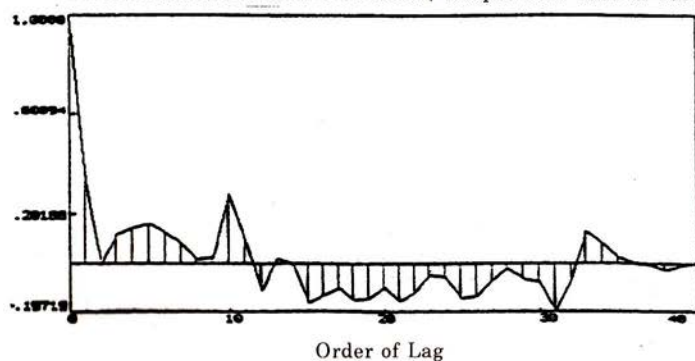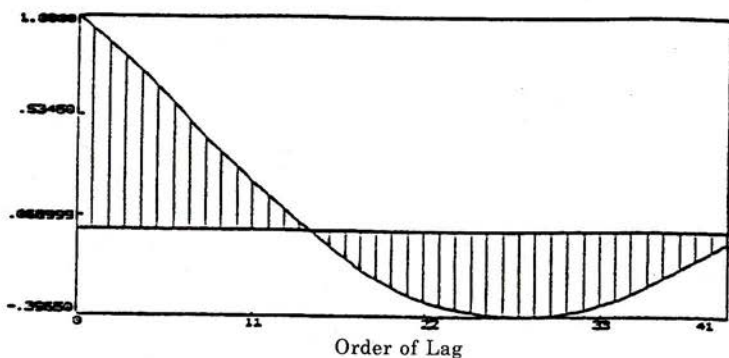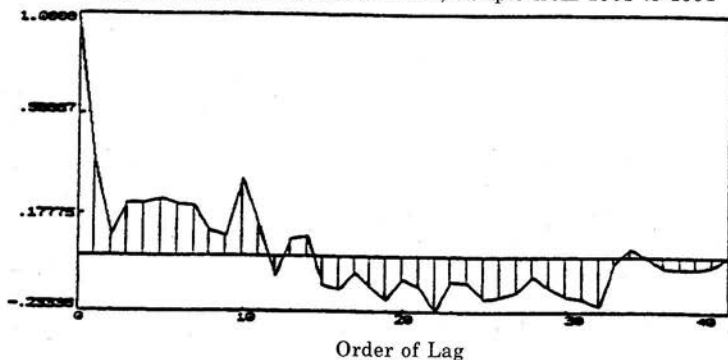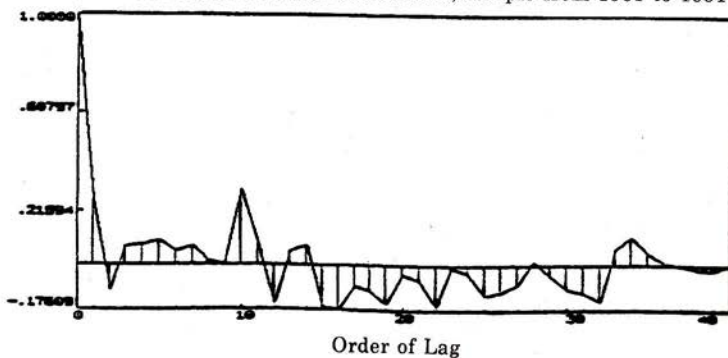
However, as suggested above, a somewhat more formal test for stationarity in a given time series is represented in the statistical test for unit root and cointegration. For purposes of this test, the relevant time series are transformed into their logarithms prior to their estimation for unit root and cointegration. As mentioned earlier, one of the conditions for stationarity in a given time series is a constant mean, which is negated when a stochastic trend is embedded in the time series. As suggested by Wayne A. Fuller (1976,pp. 366-382), testing for a unit root in a time series amounts to detecting therein a stochastic trend. In this regard, the Augmented Dickey-Fuller[10] (ADF) regression is applied for every relevant time series as in the following form:

$$X_t = a_o + a_1 T + a_2 X_{t-1} + \Sigma_{t=1}^{m} b_i \Delta X_{t-1} + \varepsilon_t$$

in which T denotes a time trend while ε_t are considered to be identically as well as independently distributed random variables, and m depends on the number of observations as well as the character of any serial correlation embedded in ε_t. This is essentially a t test which is meant to reject the hypothesis that the relevant time series is a random walk[11] in order to establish its stationarity. Thus, it must yield a negative value which stands up to a significant test statistic. Table 1 reports the ADF statistic for the eight time series and their differences as will as alternative measures of real cash balances depending on the price deflator that is adopted.

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[10] See David A. Dickey and Wayne A. Fuller (1979, 1991).

[11] The residuals of a random walk wander about signifying non-stationarity of a time series.

Table 1 - Time Series Properties of the Variables
Test for Unit Roots

Variables		ADF Statistic	
Integrated of Order	I(0)	I(1)	I(2)
LM	-1.8388	-5.6202*	
LGY	-0.7123	-3.0101	-3.5216*
LC	-2.2718	-3.0811	-5.3715*
LPY	-1.8982	-5.2106*	
R	-4.3744*	-6.5195*	
LP	-2.2478	-5.2232*	
LPC	-2.5458	-5.0686*	
LCP	-2.3250	-5.2351*	
MDG	-2.4880	-5.7684*	
MDP	-2.4383	-5.9478*	
MDC	-2.4663	-5.7954*	

*Significant at the 5 percent level.
LM, log of money supply
LGY, log of real final expenditures (GNP)
LG, log of real personal consumption expenditure
LPY, lof of real personal disposable income
R, interest rate on government securities
LP, log of implicit price deflator for GNP
LPC, log of implicit price deflator for personal consumption expenditure
LCP, log of consumer price index
MDG, real money with LP as price deflator for LM
MDP, real money with LPC as price deflator for LM
MDC, real money witkh LCP as price deflator for LM

Table 1 above tests the different time series whether they represent stationary or intergrated processes. When the residuals of a time series are stationary, it is said to be integrated of order zero, that is *I (0)* (Maddala, 1992). If these residuals become stationary after differencing the time series once, it is said to be integrated of order I, that is *I (1)*. If they require further differencing to achieve stationarity, the time series is said to be integrated of order 2, that is *I (2)*; and, so forth. It is apparent from Table 1 that there is a unit root in virtually all the relevant time series insofar as their individual levels go, except in the case of the interest rate for government securities. After one differencing, however, most of them appear to be stationary, with the exception

of real GNP and real personal consumption expenditure both of which require an additional differencing to become stationary. This suggests that both real GNP and real consumer spending seem unsuitable as scale variables in estimating a money demand function within a cointegrated framework which requires that all the relevant variables on both sides of the equation are integrated to the same order. Otherwise, no sensible relationship is likely to emerge out of any effort to fit them in a regression analysis.

While the foregoing tabulation tests for trend stationarity amongst the time series and has identified which of them belong to the same set for purposes of cointegration, it is necessary to further test them for mean stationarity. This is because in a number of more recent work,[12] reservations have been expressed on the low power of unit root tests which going by the usual classical way of testing hypotheses tends to accept the null hypothesis unless there is strong evidence against it. Precisely to address this problem, Denis Kwiatkowski et al. (1992, pp. 159-178) have provided a method of testing the null hypothesis of mean (μ) stationarity against the alternative of a unit root. The Kwiatkowski test statistic, labeled as $\bar{n}_\mu$ is formulated as follows:

$$\bar{n}_\mu = n_\mu/s^2(\ell) = T^{-2}\Sigma S_t^2/s^2(\ell)$$

where $S_t = \Sigma_{i=1}^t \varepsilon_i$ t= 1,2...T (sample size); $e_t = Y_t - \bar{Y}$, the residual from regression y on an intercept only; $s^2(\ell)$ = consistent estimator of the long-run variance, with ℓ being the lag truncation parameter. Thus, S_t represents the partial sum process of the residuals e. If the statistic $\bar{n}_\mu$ which has a non-standard distribution is large, the null hypothesis of mean stationarity is rejected. Kwiatkowski et al. also provide the critical values for $\bar{n}_\mu$.

In the following implementation of the above Kwiatkowski test for mean stationarity, K-test for short, only those time series which had already been found by the previous ADF statistic to be trend-stationary will be included in the analysis. Because of the

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[12] See, for example, DeJong, Nankervis, Savin and Whitman (1992, pp. 423-433).

modest size of the sample on hand, i.e. 1950-1991, the analysis is limited to testing for level-stationarity. Table 2 reports the outcome of applying the K-test on the relevant time series. This configuration of results confirms that virtually all the relevant variables which earlier had tested trend-stationary on the strength of the ADF statistic are likewise mean-stationary going by the K-test statistic, with the exception of the interest rate for government securities whose level previously tested trend-stationary by the ADF statistic. However, the mixed outcome for interest rate on government securities is explained by a prolonged regime of financial repression from 1950 through 1971 as described earlier, followed by a market regime since 1972 which became progressively volatile the second half of the 1980s.

Table 2 - Time Series Properties of the Variables-Kwiatkowski Test for Mean Stationarity

Variables	Kwiatkowski Test Statistic*
LM	.018
LPY	.007
R	1.420
LP	.016
LPC	.018
LCP	.019
MDG	.024
MDP	.025
MDC	.027

*Critical Value at the 5 percent Critical Level is 0.463.
See Kwiatkowski et al., op.cit., Table 1, p. 166.
LM, log of money supply
LPY, log of real personal disposable income
R, interest rate on government securities
LP, log of implicit price deflator for GNOP
LPC, log of implicit price deflator for personal consumption expenditure
LCP, log of consumer price index
MDG, real money with LP as price deflator for LM
MDP, real money with LPC as price deflator for LM
MDC, real money with LCP as price deflator for LM

Specification of the Money Demand Model

Having established the time series properties of the relevant variables, the stage is now set for the specification of the money demand model. Given the characterization of these variables as described in Tables 1 and 2 above and the fact that the annual interest rate on government securities is expressed as a percent of face value, it becomes appropriate to specifiy the demand for money generally in a semi-logarithm linear form as follows:

$$(1) \qquad \ln(M/P)_t = \alpha + \beta \ln Y_t - \gamma R_t + v_t$$

where M is nominal money supply; P, the price level; y, real income; R, interest rate on government securities; and v_t, the error term. The variables, M, P and y are expressed in natural logarithm. Equation (1) describes the relationship over time between the people's demand for real cash balances on the one hand and on the other, the level of economic activity they do and the opportunity cost of holding on to these money balances to the extent that this is adequately reflected in the going market rate of interest. The inclusion of the error term in the equation suggests that at any one point in time the people's current holdings of money balances may deviate from their average holdings over the long haul.

This also implies that the modelling effort should capture the dynamics of such short-run adjustments in the people's holding of cash balances. That is, the current movements in people's holdings of money balances reflect as much the prevailing conditions in overall economic activity and the money market as their accommodation to similar conditions over previous periods of time. To the extent that is so, the corresponding analytical framework which might well match the time series data is an error correction model (ECM) (Maddala, 1992, pp. 590-592). Moreover, in the estimation if the error term turns out to be stationary, then Equation (1) amounts to a stable and predictable representation of the long-run relationship which holds up the possibility of its use for effective monetary policy and management.

Estimation of the Money Demand Model

In estimating the above money demand model, the nominal value of money supply is deflated by the implicit price deflator for personal consumption expenditure to obtain real money balances. As both Tables 1 and 2 indicate, any of the above price deflators could be used as all of them have tested both trend- and mean-stationary. However, the choice of this price deflator is guided by the fact that it is a more comprehensive measure of price movements over long periods of time than the consumer price index; while the implicit price deflator for GNP might have been more appropriate to use for a monetary aggregate which goes beyond currency in circulation and checkable deposits. Again on the evidence from Tables 1 and 2 above for its stationarity, the appropriate scale variable for economic activity is personal disposable income which is likewise deflated by the implicit price deflator for personal consumption expenditure. Although the evidence for its stationarity as shown in Table 1 and 2 above is somewhat mixed, the interest rate on government securities is used nonetheless as a measure of the opportunity cost for holding money balances in the following estimation of money demand. By the ADF test, it is trend stationary both in its level and more so, in its first difference.

As already suggested in the foregoing, in the estimation which follows it is appropriate to capture both the long-run and short-run tendencies behind the people's demand for money. This implies that the regression analysis should include on the right hand side of the equation lagged values of the relevant variables. Thus, the estimation essentially captures a dynamic specification[13] of the relationship between the people's money balances and their level of activity as well as the cost to them of keeping cash balances instead of investing them in earning assets.

From Table 1 above, while the ADF statistic shows the interest rate on government securities to be trend-stationary in its level,

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[13] Banerjee, Dolado, Hendry and Smith (1986, pp. 253-277), make the case that for small samples, in particular, dynamic modelling tends to yield better results.

the comparable evidence for the levels of the money supply, real personal disposable income and the implicit price deflator for personal consumption expenditure indicates that they are first-order homogeneous non-stationary or random walks. However, in their first differences, they are all found to be integrated of order one. Thus, they could be cointegrated depending on whether the residuals from a linear combination of these variables as in a co-integrating regression are found to be stationary. In practice, the test for stationarity in these residuals consists in testing that they are not stationary, i.e., the absence of co-integration among the variables. Once more, in this test, the ADF statistic will be evaluated as before against certain critical values at a given level of significance.

Proceeding accordingly, real money balances are regressed against real income and the interest rate on government securities in their first differences as well as in levels of relevant variables lagged one period of time.[14] The outcome of this co-integrating regression is reported in Table 3 below. Going by the ADF statistic in its residuals, it represents a stable and predictable relationship, with real money demand positively related to real income and inversely so with the interest rate on government securities. The short-run elasticity of money demand in response to a rise in income is greater than unity, and reflects the fact that through a good part of this period up to 1971 holding cash balances represented a sensible way of keeping one's wealth in the face of the financial repression in the money market. However, the long-run income elasticity is 0.75 or less than unity.[15] The parameter estimates, after applying the Newey-West adjustments on the variance-covariance matrix for heteroscedasticity and autocorrelation, have small standard errors and thus appear consistent, yielding in the process fairly significant t-ratios. While

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[14] Including lagged level values of the relevant variables helps toward a better estimation of the long-run parameters. See Maddala (1992, pp. 588-589) and Cuthbertson, Hall and Taylor, (1992, pp. 98-128).

[15] The long-term income elasticity of the money demand is given by the estimated coefficient on Y_{t-1} divided by the estimated coefficient on $(M/P)_{t-1}$. Moreover, as they have opposite signs, they add up to -0.05 or close to zero.

it apparently explains just two-fifths of the variation in real money demand over this period in part because money demand supply is here limited to currency in circulation and checkable deposits, the standard error of the regression is arguably small. The DW statistic does not indicate serial correlation and thus the dynamics in the equation are non-systematic which amount to a white noise.[16]

A more visual confirmation of the stability of the above relationship is shown in the autocorrelation function of the residuals of the foregoing ECM regression as imaged in the following Chart 10. There it is seen that the ECM residuals peter out rather quickly

Table 3 - Dynamic Modeling of Money Demand
Philippines 1950-1991

Error Correction Model in Semi-Log Specification Estimated by Ordinary Least Squares

Co-integrating Regression: $\Delta(M/P)_t$	=	-.95	+	$1.89\Delta y_t$	−	$.005\Delta R_t$
Newey-West Adjusted Standard Error		(.24)		(.39)		(.001)
T-Ratio		-3.91		4.75		-4.69
		-.20		$(M/P)_{t-1}$	+	$.15y_{t-1}$
		(.07)				(.04)
		-2.82				3.64

| $R^2 = .40$	SER = .0827	DW = 2.32	ADF $(\bar{u}_t)$ = -5.95*

*Significant at the 5 percent level.
Δ is first-difference operator. M is money supply comprising currency in circulation and checkable deposits. P is implicit price deflator for personal consumption expenditure, y is real personal disposable income. R is interest rate on government securities. SER is standard error of the regression. DW is Durbin-Watson statistic. Newey-West adjusted standard errors use Parzen weights with truncation lag = 13, see Whitney K. Newey and Kenneth D. West, A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance matrix, *Econometrica*, Vol. 55 (May 1987), pp. 703-708.

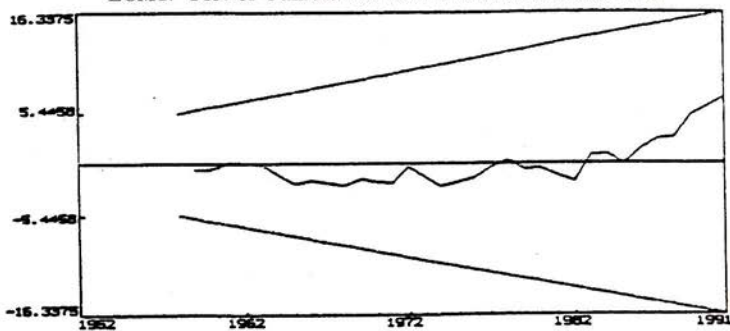
[16] See Harvey, (1990, pp. 23-24).

Chart 10

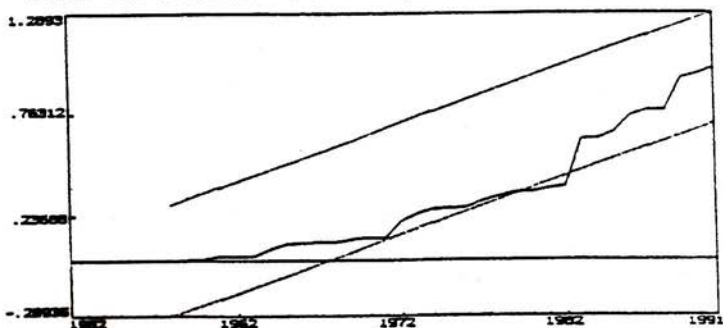Autocorrelation function of ECM1RES, sample from 1962 to 1991

Order of Lags
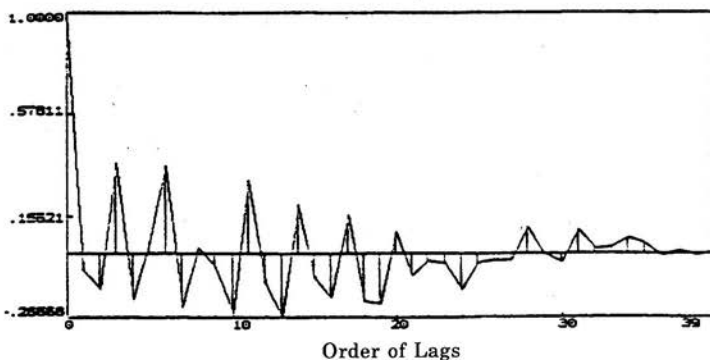
ECM1: Plot of Cumulative Sum of Recursive Residuals

The straight lines represent bounds at 5% significance level

ECM1: Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

as the order of time lags increases. Graphically a more convincing evidence of the stability of the parameters estimated in the above ECM regression is the plot of the cumulative sum of its recursive residuals, which do not breach the critical bounds at the 5 percent significance level. A similar plot of the cumulative sum of squares of these residuals, which represents a tougher test of parameter stability, is likewise persuasive of the stability and predictability of of the money demand relationship as depicted in Table 3 above.

Conclusion

At the beginning of this paper, the point was made that the effectiveness of monetary management in a market system is premised on a real relationship between the people's demand for real cash balances and the level of economic activity which they wish to do as well as the opportunity cost of keeping the money balances rather than investing them in an alternative asset for a positive rate of return. To the extent that this relationship prevails, there is meaning to efforts at central banking with the aim of stabilizing prices at a low level, say at 2 to 3 percent annual inflation rate.

Behind the whole effort at the foregoing estimation of money demand in the Philippines over the period 1950-1991 is the need to clearly establish the premises around which monetary management in the national community could be pursued under a program for monetary stability. The transition from monetary stability to incremental investment which generates more jobs and nurtures more economic growth is a matter of historical record even in contemporary South East Asia. It is a lesson which is not easy to learn. Neither is it easy to keep once it has been learned.

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