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A Survey of Recent Empirical Money Demand Studies

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This paper surveys a selected number of studies that evaluated the demand for money using the error-correction model approach in the 1990s across a range of industrial and developing countries. It briefly presents issues relevant to modeling and estimating the demand for money; and synthesizes information concerning variables, data period and frequency, unit root and cointegration techniques, stability tests, and findings in a tabular form. In addition, it presents estimated long-run income elasticity and elasticities or semi-elasticities for opportunity cost and other variables in a comparable framework. It aims to provide a reference tool for future research on demand for money in various countries. [JEL E41]

Demand for money plays a major role in macroeconomic analysis, especially in selecting appropriate monetary policy actions. Consequently, a steady stream of theoretical and empirical research has been carried out worldwide over the past several decades. The interest has, however, heightened in recent years, triggered primarily by the concern among central banks and researchers on the impact of the movement toward flexible exchange rate regime, globalization of capital markets, ongoing domestic financial liberalization and innovation, advancement in time series econometrics, and country-specific issues.

The extensive literature underscores two major points relevant to modeling and estimating the demand for money: variable selection and representation, and

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framework chosen. Failure to provide due consideration to these issues has tended to yield poor results. For the former, proper specification of opportunity cost variables happens to be the most important factor in getting meaningful results. Regarding the latter, the chosen system should be free of theoretical and estimation problems, and should perform well in empirical testing. The error-correction models (ECMs) have shown to meet these criteria.

This paper surveys a selected number of papers that applied the ECM approach to analyze the demand for money (of various definitions) during the 1990s in several industrial and developing countries.[1] The objective is to extract relevant information from these studies and provide it in a readily useable and comparable framework. In specific, the paper presents details concerning the techniques followed, variables chosen, periods and frequency selected, and major findings. In addition, it summarizes the long-run income elasticities, interest-rate semi-elasticities (or elasticities), and the coefficients of other relevant variables. It is hoped that the materials presented in this paper provide some reference points concerning the behavior of money demand in various countries, which in turn will help the policy makers in designing appropriate monetary policy actions and the researchers in carrying out further research.[2]

The paper is organized as follows: Section I briefly specifies the general framework that usually underlies the empirical formulation in estimating the demand for money. Section II carries out relevant discussion regarding the variables and estimation techniques, and summarizes information concerning various studies including the findings and estimated coefficients. Finally, Section III presents the conclusions.

I. General Framework

There is a diverse spectrum of money demand theories emphasizing the transactions, speculative, precautionary or utility considerations.[3] These theories implicitly address a broad range of hypotheses. One significant aspect, however, is that they share common important elements (variables) among almost all of them. In general, they bring forth relationship between the quantity of money demanded and a set of few important economic variables linking money to the real sector of the economy (see Judd and Scadding, 1982, p. 993). What sets apart among these theories is that although they consider similar variables to explain the demand for money, they frequently differ in the specific role assigned to each. Consequently one consensus that emerges from the literature is that the empirical work is motivated by a blend of theories.

The general specification begins with the following functional relationship for the long-term demand for money:

[1]This paper is based on Sriram (1999b, 1999c, and 2000). There have been other survey papers (for example, Judd and Scadding, 1982; Goldfeld and Sichel, 1990; Boughton, 1992; Laidler, 1993); but none of them focused exclusively on ECMs and covering a wide range of both industrial and developing countries.

[2]Refer to Ericsson (1998) for general issues concerning the empirical modeling of money demand.

[3]See, Laidler (1993) and Sriram (1999c), among others, for a survey of these approaches.

$$\frac{M}{P} = f(S, OC) \tag{1}$$

where the demand for real balances M/P is a function of the chosen scale variable (S) to represent the economic activity and the opportunity cost of holding money (OC). M stands for the selected monetary aggregate in nominal term and P for the price. Like in theoretical models, the empirical models generally specify the money demand as a function of real balances (see Laidler, 1993).[4]

II. Discussion on Variables and Estimation Techniques

Given the above general framework, this section provides a brief overview of issues concerning selection and representation of variables, modeling, and estimation. Sriram (1999c) presents detailed account of these issues, including relevant references justifying various approaches undertaken by the researchers. The literature shows that money demand has been estimated for various aggregates, their components, or certain combination of these components. As definitions of money differ across countries (see Boughton, 1992, and Kumah, 1989), measures considered, including divisia aggregates, also varied across studies. Scale variable is used in the estimation as a measure of transactions relating to the economic activity. It is usually represented by variables expressing income, expenditure, or wealth concept (although a host of other variables is discussed in the literature). The price variable is selected to follow closely the chosen scale variable, although consumer price index is the most commonly used measure.

One of the most important aspects of modeling the demand for money is the selection of appropriate opportunity cost variables. The literature has shown that studies which paid inadequate attention on this matter produced poor results. There are two major ingredients: (i) own-rate and (ii) alternative return on money. The former happens to be very important, especially if the financial innovation has been taking place in an economy (see Ericsson, 1998). The latter involves yields on domestic financial and real assets for a closed economy, and additionally on foreign assets for an open economy. A number of instruments are available to represent the yields on domestic financial assets. The yield on real assets is usually proxied by the expected inflation. And, on foreign assets by foreign interest rate or some form of exchange rate variable. Prior to selecting appropriate opportunity cost variables, careful attention should be paid on evaluating macroeconomic situation and developments in the financial system (including institutional details and the regulatory environment), and degree of openness of the economy.

The economic theory provides some guidance in reference to the relationship between demand for money and its arguments. As the scale variable represents the transactions or wealth effects, it is positively related to the demand for money. The

[4]Using the real money balance as the dependent variable will also mean that price homogeneity is explicitly imposed into the model. Additionally, there are less severe econometric problems associated with using real rather than nominal balances as the dependent variable (see Boughton, 1981, and Johansen, 1992b). And, majority of the empirical work does find evidence for the demand being for *real* balances.

own-rate is expected to be positively related as higher the return on money, less the incentive to hold assets alternative for money. Conversely, higher the returns on alternative assets, lower the incentive to hold money, and hence, the coefficients of alternative returns expected to be negative. The expected inflation generally affects the demand for money negatively as agents prefer to hold real assets as hedges during the periods of rising inflation. The foreign interest rates are expected to exert negative influence as increase in foreign interest rates potentially induce the domestic residents to increase their holdings of foreign assets which will be financed by drawing down domestic money holdings. Similarly, the expected exchange depreciation will also have a negative relationship. An increase in expected depreciation implies that the expected returns from holding foreign money increases, and hence, agents would substitute the domestic currency for foreign currency.[5]

The economic theory does not provide any rationale as to the correct mathematical form of the money demand function. There is consensus, however, that the log-linear version is the most appropriate functional form (see Zarembka, 1968). While money and scale variables typically enter in logarithms, interest rate variables appear either in levels or in logarithms. Consequently, estimates of the coefficient for the scale variable directly provides the measure of income elasticity, and those of interest rates show either elasticities or semi-elasticities depending on the way they are introduced in the formulation.

The partial adjustment framework was extremely popular in the 1970s. However, it was shown to suffer from specification problem and highly restrictive dynamics (see, for example, Cooley and LeRoy, 1981; Goodfriend, 1985; Hendry, 1979 and 1985; Hendry and Mizon, 1978). To counter these problems, two major solutions were proposed—modifying the theoretical base and improving the dynamic structure. The former led to buffer-stock models (BSMs), which were built upon the theory of precautionary demand for money (see, for example, Laidler, 1984; Cuthbertson and Taylor, 1987; Milbourne, 1988), and the latter to ECMs.[6] The BSMs also ran into criticism, especially in their relevance in the empirical estimation (see Milbourne, 1988). Meanwhile, ECMs seem to be promising. An important aspect of these models is that the data characteristics are thoroughly examined before selecting the appropriate estimation techniques. Furthermore, lag structures are selected based on the data generating process of the economic variables and not on *a priori* based on the economic theory or naive dynamic theory.

The ECM is shown to contain information on both the short- and long-run properties of the model with disequilibrium as a process of adjustment to the long-run equilibrium. Granger (1983 and 1986) has demonstrated that the concept of stable long-run equilibrium is the statistical equivalence of cointegration. When cointegration holds and if there is any shock that causes disequilibrium, there exists a well-defined short-term dynamic adjustment process such as the error-

[5]Refer to Jusoh (1987) and Tan (1997) for reasons to expect positive relationship for expected inflation and expected exchange rate depreciation with the demand for real money respectively.

[6]In fact, Hendry, Pagan, and Sargan (1984) showed that PAMs and BSMs form the special cases of ECMs.

correction mechanism that will push back the system toward the long-run equilibrium. In fact, cointegration does imply the existence of a dynamic error-correction form relating to variables in question (see Engle and Granger, 1987). The major advantage of the error-correction modeling is that the economic theory is allowed to specify the long-run equilibrium while the short-run dynamics be defined from the data.

The earlier ECMs on money demand tended to be based on the single equation cointegrating relationship between money and the chosen scale variables as developed by Engle and Granger (1987). However, further research suggested that multivariate cointegrating vectors encompassing a broader number of variables provided a fuller characterization of the long-run determinants of demand. The specification of such multiple cointegrating vectors between nonstationary variables primarily employs the procedures developed by Johansen (1988) and Johansen and Juselius (1990) which make the original Engle-Granger framework a special case. However, as can be seen from Table 1, a number of other measures available to conduct the cointegration analysis.[7]

Table 1 also presents details relevant to modeling and estimating the demand for money from various studies. In specific, it summarizes information for a cross-section of developing and industrial countries, on monetary aggregates (nominal or real), scale variable(s), and the opportunity cost and other variables included; data period and frequency chosen; unit root, cointegration, and stability tests applied; nature of various time series (such as the order of integration and whether seasonally adjusted or not). It also presents the findings. The presentation of information will enable the researchers to draw some insights into the justification of selecting diverse set of variables and approaches across various countries.

Table 2 summarizes the long-run income elasticities and the semi-elasticities or elasticities of opportunity cost and other variables from those studies listed in Table 1. As the short-run dynamics can be potentially complicated, the table concentrates only on the long-run results. In order to promote comparability, the results are shown only for those studies which reported the long-term relationship (existence of cointegration). If more than one cointegration relationship is found, results are reported only for the preferred cointegration vector(s) as identified by the author(s), which not only meet a battery of statistical tests but also economically make sense with correct signs of the variables and meaningful size of coefficients.

Figures 1–3 show the distribution of income elasticities for real money as presented in Table 2 for components of narrow money, narrow money, and broad money respectively. The relevant descriptive statistics is shown in Table 3. It is clear from the table, the medians for all three groups are closer to one than to 0.5 thereby indicating that money does not play the role of transaction measure alone. There is no clear guidance from the theory or empirical studies regarding the acceptable magnitude on elasticities or semi-elasticities of the opportunity cost variables. The most relevant information will be the signs of the coefficients—positive for own-rate and negative for alternative return on money and expected

[7]Refer to Sriram (1999c) for a longer list of studies that applied the ECM framework to analyze the demand for money in the past two decades.

Table 1. Summary of Demand for Money Studies Involving Cointegration/Error-Correction Modeling in Selected Industrial and Developing Countries

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Industrial countries											
Australia											
Lim (1993)	1977:4-1990:2 Quarterly 1976:8-1990:6 Monthly	Real currency;[1] real bank deposits;[1] real nonbank deposits[1] [GDPD-based]	Real GDP[1]	90-day bank bill rate; 2- and 5-year T-bond rate	Inflation rate (GDPD-based); structural dummy	ADF; P (1987)	90-day bank bill rate is I(0); others are I(1)	PH (1990) "fully modified" "regression"; JJ (1990); PO (1990)	...	Yes	Cointegrating relationships exist for both monthly and quarterly models for each money variable (without the 90-day bank bill rate); ECM shows some evidence for the significance of the 90-day bank bill rate in influencing the short-run of the monetary aggregates.
Canada											
Haug and Lucas (1996)	1953:1-1990:4 1968:1-1990:4 Quarterly	ln (real M1);[1] ln (real M2);[1] ln (real M2+)[1] [IGDPD-based]	ln (real GDP) [IGDPD-based]	ln (91-day T-bill rate); ln (10-year T-bond rate)	...	DF	I(1)	AEG; DOLS; JJ (1990); PO (1990)	Hansen (1992)	No	Results vary depending on the cointegration tests selected and the combination of money and interest rates; however, stable long-term relationship is found among real M1, real GDP, and the 91-day T-bill rate.
Germany											
Deutsche Bundesbank (1995)	1970:1-1994:4 Quarterly	Log (M3/ GNPD) [M3 is adjusted for statistical breaks]	Log (real GNP) [GNPD-based]	Yield on domestic bearer debt securities outstanding (r); r-it[2]	Seasonal dummies	ADF	I(1)	EG (1987)	...	Yes	Cointegrating relationship exits among money, interest rate r, and real GNP. The EC term is calculated as the avg. of previous four quarters, and has the negative coefficient which is significant.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Greece											
Ericsson and Sharma (1998)	1976:2-1994:4 Quarterly	ln (M3/CPI)	ln (GDP at factor cost in constant 1970 prices)	Net return on TD; interest rate spreads for repos and deposits;[3] LIBOR	DEPR using NEER; inflation rate; seasonal and structural dummies	ADF	I(1)	EG (1987); J (1988); J (1991a); J (1992a); J (1992b)	Chow	Yes [General to Specific Approach]	Cointegrating relationship among money, scale variable, inflation rate, and domestic interest rates and the spreads; stable ECM.
Italy											
Muscatelli and Papi (1990)	1963:1-1987:4 Quarterly	Log (M2/ GDPD)[1]	Log (real GDP)[1]	R = alternative return on M2 minus own-rate[4]	Variables to express learning curves after the introduction of BOTs and CCTs[5]	ADF; PO (1990); PP (1988)	I(1)	EG (1987)	Chow	Yes [General to Specific Approach]	Cointegration relationship can be obtained only after the addition of learning curve variables. Demand for M2 is significantly affected by the introduction of new financial instruments.
Japan											
Arize and Shwiff (1993)	1973:1-1988:4 Quarterly	ln (real M2)[1]	ln (real GNP);[1] ln (real wealth)[1]	ln (1+R)[6]	ln (real XR);[1] inflation rate;[1] ln (IGNPD)[1]	DF; ADF; PP (1988)	I(1)	AEG	Ashley (1984); Chow; CUSUM; CUSUMSQ	Yes	Cointegrating relationship among real GNP, real wealth, and real XR; stable ECM throughout the sample period.
New Zealand											
Orden and Fisher (1993)	1965:2-1989:4 1965:2-1984:2 Quarterly	Log (M3)	Log (real GDP)	Annual rate on S-T trading bank loans	Log (GDPD)	DF	I(1)	J (1988); JJ (1990)	...	No	Cointegration without interest rate for the sub sample; and with interest rate for full sample.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Norway											
Bårdsen (1992)	1967:3-1989:4 Quarterly	ln (NM)	ln (real GDE)	Interest rate on DD and TD; yield on long-term private bond; 3-month euro-krone rate	ln (GDED)	not explicitly shown	I(1) except for 3-month euro-krone rate (which may be stationary around a trend)	J (1988); JJ (1990)	Chow	Yes	At least two and possibly up to five cointegration vectors exist; money is endogenously determined by prices, real expenditure, and interest rates.
Switzerland											
Chowdhury (1995)	1973:2-1991:4 Quarterly	Log (real B) Log (real M1)	Log (real GDP)	S-T (3-month TDR on Euro deposits in Swiss francs); L-T (return on federal bonds)	NEER; London clearing banks rate	ADF; KPSS (1992); PP (1988)	I(1)	J (1988); JJ (1990)	Chow	No	Demonstrates the importance of including variables expressing foreign influence in an open economy; without adding exchange rate no cointegration is found.
United Kingdom											
Drake and Chrystal (1994)	1976:2-1990:3 Quarterly	ln (M1d); ln (M2d); ln (M3d) where d stands for divisia aggregates	ln (real GDP)	Benchmark rate of interest; own rates of interest on M2d and M3d	ln (GDPD); inflation [GDPD-; based]; implicit divisia rental price or user cost indices for M1d, M2d, and M3d; dummy variable	DF; ADF; PP (1988)	I(1) except for implicit divisia rental price or user cost indices for M2d and M3d which are I(0)	J (1988); JJ (1990)	Chow; CUSUM; CUSUMSQ	Yes [General to Specific Approach]	Company sector money demand; cointegrating relationship exists for all monetary aggregates. ECMs indicate that the speed of adjustment of the EC term is faster for M1d than for M2d and M3d.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
United States											
Miller (1991)	1959:1-1987:4 Quarterly	ln (adjusted B); ln (M1); ln (M1A); ln (M2); ln (M3)	ln (real GNP)	ln (4-6 month CPR); ln (dividend-price ratio)	ln (IPD)	DF; ADF	I(1)	EG; AEG	...	Yes	Cointegration relationship exists among M2, real GNP, IPD, and the CPR. ECM for M2 suggests valid and significant error-correction term.
Baba, Hendry, and Starr (1992)	1960:3-1988:3 Quarterly	ln (M1/ IGNPD)[1]	ln (real GNP)[1]	Yields on 20-year T-bond and on one-month T-bill	Learning adjusted yield on instruments in M2 and other checkable rate in M1; measure of volatility on long bond; credit control dummy	J (1988)	I(1)	J (1988); JJ (1990)	Chow	Yes [General to Specific Approach]	Stable cointegrating demand function for real M1 (with the arguments which include inflation, real income, long-term bond yield and risk, T-bill interest rate, and learning curve weighted yields on newly introduced instruments in M1 and non-transactions M2).
McNown and Wallace (1992)	1973:2-1988:4 Quarterly	Log (real M1); Log (real M2)	Log (real GNP)	Nominal T-bill rate	Log (NEER)	ADF	I(1)	J (1988); JJ (1990)	...	No	Cointegrating relationship for M1 (but not for M2) with real GNP and T-bill rate. Adding NEER to the M2 equation establishes the cointegrating relationship.
Mehra (1993)	1953:1-1991:2 Quarterly	ln (M2/IGNPD)	ln (real GNP)	ln (R-RM2)[7]	...	ADF	Interest rate is I(0); others I(1)	OLS; IVT	Chow	Yes [OLS and IVT]	Example of a model that estimates both the long- and short-run coefficients in one step. Cointegrating relationship for real M2 and real GNP; money demand function is stable throughout the sample period.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Developing countries											
Argentina											
Choudhry (1995)	1935:1-1962:4 1946:1-1962:4 Quarterly	ln (M1/WPI); ln (M2/WPI)	ln (real NNI)	...	Inflation rate [WPI-based]	ADF	I(1)	J (1988); JJ (1990)	...	Yes	Cointegration relationship exists among real money (M1 and M2), real NNI, and the inflation rate. ECM finds relationship between real money and inflation.
Bolivia											
Asilis, Honohan, and McNelis (1993)	1980:9-1988:12 Monthly	ln (B/CPI); ln (M1/CPI); ln (M2/CPI)	...	...	Expected inflation; inflation uncertainty	ADF	I(1)	J (1988); JJ (1990)	...	Yes	The null hypothesis of at least one cointegrating vector is not rejected. ECM contains time-varying EC term, estimated by Kalman filtering technique.
Cameroon											
Fielding (1994)	1976:1-1987:2 Quarterly	ln (BM/CPI)	ln (real GDP adjusted for terms of trade)	ln (1+CBDR)	ln (1+π); mavarπ; quarterly dummy variables[8]	DF; Hylleberg and others (1990)	I(1)	JJ (1990)	Chow [for ECM]	Yes	Three cointegrating relationships among real BM, real GDP, inflation, interest rate and mavarπ. ECM passes diagnostic tests; EC term has a nearly unit coefficient.
China											
Hafer and Kutan (1994)	1952-88 Annual	Log (currency); Log (currency plus SD)	Log (NI/RPI); Log (NI/NID)	Log (one-year interest rate on SD)		DF	I(1)	J (1988); JJ (1990)	...	...	Cointegrating relationship exists only when NID (and not RPI) is used as a price variable; currency plus SD is the preferred measure of the monetary aggregate.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Tseng and others (1994)	1983:1-1988:4 1989:1-1993:4 1983:1-1993:4 Quarterly	ln (CC/RPI);[1] ln (M1/RPI);[1] ln (M2/RPI)[1]	ln (real NI)[1]	Real interest rate for the M1 and M2 equations for 1989:1-1993:4[9]	Quarterly inflation rate (RPI-based) [for 1983:1-1988:4]	ADF	I(1)	EG; J (1988); JJ (1990)	Chow	Yes	All monetary aggregates are sensitive to inflation although its impact drops during the 1989:1-1993:4 subperiod. Interest rates exert significant influence on M1 and M2 in the 1989:1-1993:4 subperiod.
Côte d'Ivoire											
Fielding (1994)	1974:3-1987:4 Quarterly	ln (BM/CPI)	ln (real GDP adjusted for terms of trade)	ln (1+CBDR)	ln (1+π); mavarπ; quarterly dummy variables[8]	DF; Hylleberg and others (1990)	I(1)	JJ (1990)	Chow	Yes	At least two cointegrating vectors among real money, real GDP, inflation, interest rate, and mavarπ. The error-correction coefficient is calculated from the residuals of the first two cointegrating vectors. Very slow adjustment to long-run equilibrium.
India											
Moosa (1992)	1972:1-1990:4 Quarterly	Log (CC/CPI); Log (NM/CPI); Log (BM (NM plus QM)/CPI)	Log (IO)	Log (MMR; rate offered in Bombay interbank market)	...	DF; ADF	I(1)	EG; AEG; CRDW; J (1988); JJ (1990)	...	Yes	Cointegration relationship exists for real money (except for BM using AEG) with IO and MMR. More stable relationship for CC and NM than for BM. ECMs show better results for CC and NM than for BM.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Indonesia											
Price and Insukindro (1994)	1969:1-1987:4 Quarterly	ln (real CHP); ln (real DD)	ln (real GDP)	Rate of return on TD and on SD; LIBOR	Dummy variable for 1983 [for ECM]	DF; ADF	I(1)	EG; J (1988)	Chow; Salkever (1976) dummy approach [for ECM]	Yes	EG: weak evidence of cointegration relationship for currency; J (1988) finds up to 2 cointegrating vectors for both money equations. ECM does not find LIBOR being an important variable.
Dekle and Pradhan (1997)	1974-95 Annual	Log (NM); Log (BM); Log (real NM); Log (real BM)	Log (real GDP)	TDR [for NM]; MMR-TDR weighted by the share of QM in BM;	Log (CPI)	ADF	I(1) except for Log (CPI) which is I(0)	J (1988); JJ (1990)	...	No	No cointegrating relationship for any definition of money.
Iran											
Bahmani-Oskooee (1996)	1959-90 Annual	Log (M1/GDPD); Log (M2/GDPD)	Log (GDP in 1980 prices)		Inflation; Log (official XR); Log (black market XR)	ADF; Perron (1989)	I(1)	J (1988); JJ (1990)	...	No	The most suitable model is the one that applies the black market XR with real GDP and inflation to explain demand for real M2.
Kenya											
Adam (1992) among	1973:1-1989:2	Log (M0/CPI);	Log (GNY/	ln (1+r) where	Expected DEPR	DF;	I(1)	J (1988);	...	Yes	Two cointegrating vectors
	Quarterly	Log (M1/CPI); Log (M2/CPI); Log (M3/CPI); Log (M3d/CPI) where M3d is divisia M3	CPI) where GNY is GNP adjusted for changes in terms of trade	r = quarterly yield on T-bill	using parallel market XR; inflation; seasonal dummies	ADF; CRDW		JJ (1990)			5 variables for each monetary aggregate. ECMs validate the cointegrating relationships.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Fielding (1994)	1975:2-1989:2 Quarterly	ln (BM/CPI)	ln (real GDP adjusted for terms of trade)	ln (1+T-bill rate)	ln (1+π); ln (1+DEPR) using parallel market XR; mavarπ; mavarr; quarterly dummy variables[8]	DF; Hylleberg and others (1990)	I(0) for ln (1+DEPR); I(1) for others	JJ (1990)	Chow [for ECM]	Yes	Three cointegrating relationships among real money, real GDP, inflation, interest rate, mavarr, and mavarπ. The EC term is calculated based on the residuals from the first two cointegrating vectors. S-T elasticities are smaller than those of long run.
Korea											
Arize (1994) (both	1973:1-1990:1 Quarterly	ln (M1/CPI); ln (M2/CPI)	ln (real GDP)	CBR; interest rate on loans and TD on NCB; weighed avg. of S-T interest rates in 9 industrial countries; uncovered interest rate differential in favor of foreign country	Expected rate of inflation; EER; standard deviation of the change in the log of the EER; dummy variable to measure the change in circumstances	ADF; Hylleberg and others (1990); Osborn (1990); Hasza and Fuller (1982); Perron (1988)	I(1)	EY (1987); J (1988); JJ (1990)	Chow	Yes	Two to three cointegrating vectors among real money M1 and M2), real income, interest rate, and foreign exchange rate risk and return. Well-specified ECM.
Lebanon											
Eken and others (1995)	1964-93 Annual	Log (B/CPI); Log (M1/CPI); Log FCD$;[10] Log (M2LL /CPI);[10]	Log (real GDP); Log (U.S. dollar-denominated GDP)	...	Log (CPI); Log (U.S. CPI); expected inflation; war year dummy	PP (1988)	I(1)	EG (1987); PO (1990)	...	...	Cointegrating relationship exits between various definitions of money and with real GDP, prices, and domestic inflation.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Malaysia											
Sriram (1999a)	1973:8-1995:12 Monthly	ln (M2/CPI)	ln (IIP)	CBTD3M; discount rate on 3-month T-bills	Expected inflation; nominal XR; seasonal and structural dummies	DF; ADF	ln (IIP) and expected inflation are I(0); others are I(1)	J (1988); JJ (1990)	Chow	Yes [General to specific Approach]	Cointegration relationship exists between real M2 and its determinants under both the closed- and open-economy framework; fairly stable ECMs under both situations.
Mexico											
Khamis and Leone (1999)	1983:1-1997:6 Monthly	ln (CC/CPI)	ln (real private consumption expenditure)	60-day TDR	Inflation	ADF	I (1)	J (1988); JJ (1990)	Chow	Yes	Cointegration relationship among real CC, scale variable, and 60-day TDR; stable ECM.
Morocco											
Hoffman and Tahiri (1994)	1959:1-1988:2 Quarterly	Log (M1); Log (M2)	Log (GDP/ CPI); Log (GNP/ CPI)	Swiss S-T interest rate; interest rate on TD	Log (CPI); seasonal dummies	ADF; KPSS (1992)	I(1) possibly about a deterministic trend; KPSS test fails to reject the null of stationary for Swiss S-T interest rate adjusted for TDR	J (1988); J (1991b); JJ (1990); OLS; DOLS	Hansen and Johansen (1993)	No	Single cointegrating vector among measures of nominal money, prices, real income, and Swiss S-T interest rate.
Nigeria											
Fielding (1994)	1976:1-1989:2 Quarterly	ln (BM/CPI)	ln (real GDP adjusted for terms of trade)	ln (1+T-bill rate)	ln (1+π); ln (1+DEPR) using parallel market XR; mavarπ;[8] seasonal dummies	DF; Hylleberg and others (1990)	I(0) for ln (1+DEPR); I(1) for others	JJ (1990)	Chow [for ECM]	Yes	One cointegrating relationship among real money, real GDP, inflation, interest rate and mavarπ.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Teriba (1997)	1960-94 Annual 1962:1-1995:2 for M1; and 1962:1-1992:4 for M2 Quarterly	Log (COB); Log (M1); Log (M2)	Log (real DA)	Log (interest rate for 12-month TD); Log (interest rate for 3-month TD)	Log (DAD); Log (LTBR in Nigeria/LTBR in the United States)	DF	I(1) except for Log M1 (I(2)) and for parallel market XR (I(0))	EG; AEG	...	Yes	Cointegration relationship exists among the monetary aggregates, DA, DAD, and interest rates. Foreign opportunity cost variable has influence on M1 equation only.
Pakistan											
Arize (1994)	1973:1-1990:1 Quarterly	ln (M1/CPI); ln (M2/CPI)	ln (real GDP) [WPI-based]	CMR; Govt. bond yield; weighted avg. of S-T interest rates in 9 industrial countries; uncovered interest rate differential in favor of foreign country	Expected rate of inflation; EER; standard deviation of the change in the log of the EER; dummy variable to measure the change in circumstances	ADF; Hylleberg and others (1990); Osborn (1990); Hasza and Fuller (1982); Perron (1988)	I(1)	EY (1987); J (1988); JJ (1990)	Chow	Yes	Two to three cointegrating vectors exist among real money (both M1 and M2), real GDP, interest rate, and foreign exchange rate risk and return. Well-specified ECM.
Hossain (1994)	1951-91 1972-91 Annual	Log (M1/CPI); Log (M2/CPI)	ln (real GDP)	ln (yield on Govt. bonds); ln (market call rate of interest)	Expected inflation	DF; ADF	Expected inflation is I(0); others I(1)	EG; AEG; CRDW; J (1988); JJ (1990)	...	No	EG, AEG, and CRDW tests show conflicting results. But JJ (1990) test finds 2 cointegrating vectors among money, real GDP, and call rate of interest for 1972-91 and one for 1953-91. M1 is found to be more stable than M2.

Table 1. *(continued)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Singapore											
Arize (1994)	1973:1-1990:1 Quarterly	ln (M1/CPI); ln (M2/CPI)	ln (real GDP) [WPI-based]	CMR; 3-month FDR; weighed avg. of S-T interest rates in 9 industrial countries; uncovered interest rate differential in favor of foreign country	Expected rate of inflation; EER; standard deviation of the change in the log of the EER; dummy variable to measure the change in circumstances	ADF; Hylleberg and others (1990); Osborn (1990); Hasza and Fuller (1982); Perron (1988)	I(1) except for expected rate of inflation which is I(0)	EY (1987); J (1988); JJ (1990)	Chow	Yes	2-3 cointegrating vectors among real money (both M1 and M2), real GDP, interest rate, and foreign exchange rate risk and return. Well-specified ECM.
Dekle and Pradhan (1997)	1975-95 Annual	Log (NM); Log (BM); Log (real NM); Log (real BM)	Log (real GDP)	TDR [for NM]; MMR-TDR weighted by the share QM in BM; LIBOR	Log (CPI); expected depreciation rate	ADF	I(1)	J (1988); JJ (1990)	...	No	Cointegrating relationships for nominal NM and BM.
Thailand											
Dekle and Pradhan (1997)	1978-95 Annual	Log (NM); Log (BM); Log (real NM); Log (real BM)	Log (real GDP)	TDR [for NM]; MMR-TDR weighted by the share of QM in BM;	Log (CPI)	ADF	I(1)	J (1988); JJ (1990)	...	No	Cointegrating relationship for nominal NM only.

Table 1. *(concluded)*

Country/ Author(s)	Sample Period/ Frequency	Monetary Aggregate(s)	Determinants: Scale variable(s)	Determinants: Interest rate(s)	Determinants: Other(s)	Unit Root Test(s)	Order of Integration	Cointegration Technique(s)/ Test(s)	Stability Test(s)	Error-Correction Model (ECM)	Findings
Tunisia											
Treichel (1997)	1963-95 Annual 1990-95 Monthly	ln (M2/CPI); ln (M4/CPI)	ln (real GDP)	Monthly yield on T-bill; rediscount rate; MMR	Inflation rate; seasonal dummies	ADF	I(1) except for inflation rate which is I(0)	AEG; J (1988); JJ (1990)	Recursive Chow [for ECM]	Yes	Stable long-term relationship among real money, real GDP, and the monthly yield on T-bill. Stable ECM.

Note: The following abbreviations are used:
Monetary aggregates: B = base money; BM = broad money; CHP = currency held by public; CC = currency in circulation; COB = currency outside banks; DD = demand deposits; NM = narrow money; QM = quasi-money; SD = savings deposits; and TD = time deposits.
Scale variable: DA = domestic absorption; GDE = gross domestic expenditure; GDP = gross domestic product; GNP = gross national product; IIP = index of industrial production; IO = industrial output; NI = national income; and NNI = net national income.
Interest rate: CMR = call money rate; CBDR = Central Bank discount rate; CPR = commercial paper rate; CBR = corporate bond rate; FDR = fixed deposit rate; LIBOR = London interbank offered rate; LTBR = Long-term borrowing rate; MMR = money market rate; CBTD3M = Three-month deposit rates at commercial banks; TDR = time deposit rate; T-bill = Treasury bill; and T-bond = Treasury bond.
Exchange rate: DEPR = depreciation; XR = exchange rate; EER = effective exchange rate; and NEER = nominal effective exchange rate.
Prices: CPI = consumer price index; RPI = retail price index; and WPI = wholesale price index.
Deflators: DAD = domestic absorption deflator; GDED = gross domestic expenditure deflator; GDPD = gross domestic product deflator; GNPD = gross national product deflator; IGDPD = implicit GDP deflator; IGNPD = implicit GNP deflator; IPD = implicit price deflator; and NID = national income deflator.
Unit root tests: ADF = augmented Dickey-Fuller; CRDW = cointegration regression Durbin-Watson; DF = Dickey-Fuller; J (1988) = Johansen (1988); KPSS = Kwiatkowski, Phillips, Schmidt, and Shin (1992); P (1987) = Phillips (1987); PO (1990) = Phillips and Ouliaris (1990); and PP (1988) = Phillips and Perron (1988).
Cointegration tests: AEG = augmented Engle and Granger; CRDW = Cointegration regression Durbin-Watson; DOLS = dynamic ordinary least squares of Stock and Watson (1993); EG = Engle and Granger; EY = Engle and Yoo (1987); IVT = instrumental variable technique; J (n) = Johansen (n) where n stands for 1988, 1991a, 1991b, 1992a, 1992b respectively; JJ (1990) = Johansen and Juselius (1990); OLS = ordinary least squares; PH = Phillips and Hansen (1990); and PO (1990) = Phillips and Ouliaris (1990).
General: avg. = average; CB = corporate bonds; EC = error-correction; Govt. = Government; NCB = nationwide commercial banks; L-T = long-term; and S-T = short-term.

[1]Seasonally adjusted.
[2]Where "it" stands for time deposit rate of deposits between DM 100,000 and DM 1 million.
[3]Spreads between yield on T-bill and net return on time deposits and between yield on T-bill and net return on repurchase agreements respectively.
[4]Own-rate is interest rate on bank deposits, net of taxes; and alternative return is yield on longer-term government debt.
[5]BOT stands for Buoni Ordinari del Tesoro and CCT for Certificati di Credito del Tesoro.
[6]R is defined as the three-month average Gensaki rate minus the average return on holding broad money defined as weighted average of the interest rate on three-month certificates of deposit and the guideline three-month deposit rate.
[7]R = own rate of return for M2 (weighted average of explicit interest rates paid on the components of M2) minus RM2 (four-six month CPR).
[8]mavarπ is annual moving average of changes in inflation calculated as $|\Delta \ln(1+p)|_t$ and mavarr is for interest rates.
[9]Defined as one-year time deposit rate minus the rate of inflation.
[10]FCD$ and M2LL stand for U.S. dollar-denominated deposits and Lebanese pound component of M2 respectively.

Table 2. Coefficients of Long-Run Demand for Money Estimated Under ECM Framework in Selected Countries[1]

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Opportunity Cost (Semi-Elasticity)[2]: Other
Industrial countries										
Canada										
Haug and Lucas (1996)	1953:1–1990:4 Quarterly	DOLS	*m1*	0.420				–0.033*		
Germany										
Deutsche Bundesbank (1995)	1970:1–1994:4 Quarterly	EG (1987)	*m3*	1.400				–1.220		
Greece										
Ericsson and Sharma (1998)	1976:2–1994:4 Quarterly	J (1988); JJ (1990)	*m3*	1.220		7.650 & 7.020	–10.090		–3.380	
Italy										
Muscatelli and Papi (1990)	1963:1–1987:4 Quarterly	EG (1987)	*m2*	1.367			–2.082			–0.352[5]
Japan										
Arize and Shwiff (1993)	1973:1–1988:4 Quarterly	AEG	*m2*	0.641 & 0.378[6]						0.094*[7]
New Zealand										
Orden and Fisher (1993)	1965:2–1989:4 Quarterly	J (1988); JJ (1990)	*M3* *M3*	0.410 0.630	1.130 1.020			–0.014 –0.001		

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Other
Norway										
Bårdsen (1992)	1967:3–1989:4 Quarterly	J (1988); JJ (1990)	*NM*	1.374	0.810	6.553	–1.544 & –0.995			–0.097[8]
Switzerland										
Chowdhury (1995)	1973:2–1991:4 Quarterly	J (1988); JJ (1990)	*b*	0.940			–0.260			0.363 & –0.140[9]
			m1	0.887			–0.310			0.344 & –0.098[9]
			b	0.952			–0.110			0.391 & –0.102[10]
			m1	0.900			–0.080			0.308 & –0.052[10]
United Kingdom										
Drake and Chrystal (1994)	1976:2–1990:3 Quarterly	J (1988); JJ (1990)	*M1d*	3.223	1.041					–4.346[11]
			M1d	3.372	0.815				–0.032	–4.829[11]
			M2d	2.560	1.208	0.775	–0.707		–3.765	
			M3d	2.576	1.190	1.087	–0.769		–4.187	
United States										
Miller (1991)	1959:1–1987:4 Quarterly	EG (1987)	*M2*	1.204	0.952			–0.092*		
Baba, Hendry, and Starr (1992)	1960:3–1988:3 Quarterly	J (1988)	*m1*	0.510				–6.640	–5.510	–3.960 & 3.720[12]
McNown and Wallace (1992)	1973:2–1988:4 Quarterly	J (1988); JJ (1990)	*m1*	0.987				–2.828		
			m1	1.001				–9.600		
			m2	1.131				–1.745		0.133*[7]
			m2	1.128				–1.747		0.131*[7]

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Opportunity Cost (Semi-Elasticity)[2]: Other
Developing countries										
Argentina										
Choudhry (1995)	1935:1–1962:4 Quarterly	J (1988); JJ (1990)	*m1*	1.970					–0.025	
			m2	1.680					–0.033	
	1946:1–1962:4 Quarterly		*m1*	1.910					–0.034	
			m2	3.450					–0.041	
Cameroon										
Fielding (1994)	1977:1–1987:2 Quarterly	JJ (1990)	*m2*	1.490				–8.910*	–1.310*	–8.100[13]
China										
Tseng and others (1994)	1983:1–1988:4 Quarterly	EG (1987)	*cc*	1.900					–1.230	
			m1	1.530					–1.510	
			m2	1.810					–2.210	
	1989:1–1993:4 Quarterly		*m1*	1.480			–0.030		–0.940	
			m2	1.580		–0.050			–1.540	
Côte d'Ivoire										
Fielding (1994)	1975:3–1987:4 Quarterly	JJ (1990)	*bm*	1.580				–3.040*	2.430*	–1.630[13]

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Opportunity Cost (Semi-Elasticity)[2]: Other
India										
Moosa (1992)	1972:1–1990:4 Quarterly	EG (1987)	*cc*	0.874				–0.109*		
			nm	0.785				–0.032*		
			bm	1.471				–0.172*		
		J (1988)	*cc*	0.986				–0.258*		
		JJ (1990)	*nm*	0.797				–0.277*		
			bm	1.573				–0.861*		
Indonesia										
Price and Insukindro (1994)	1969:1–1987:4 Quarterly	EG (1987)	*chp*	0.880				–1.500		–2.100[8]
			dd	1.300				–1.900		–1.000[8]
		J (1988); JJ (1990)	*chp*	0.710				–4.400		–3.300[8]
			dd	1.100				–8.400		–9.100[8]
Iran										
Bahmani–Oskooee (1996)	1959–90 Annual	J (1988); JJ (1990)	*m2*	1.390					–1.370	0.250*[7]
			m2	1.330					–1.610	0.020*[7]
Kenya										
Adam (1992)	1973:1–1989:2 Quarterly	J (1988); JJ (1990)	*m0*	1.010					–6.150	
			m1	0.890		0.520*			–5.460	–0.160[14]
			m2	0.840		2.250*			–6.730	–0.110[14]
			m3	1.100		18.140*			–6.190	–0.090[14]
			m3d	0.840					–5.510	–0.070[14]

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Other
Korea										
Arize (1994)	1973:1–1990:1 Quarterly	EY(1987)	*m1*	0.500				–0.027		–0.007 & –0.016[15]
			m2	0.950					–1.220	–0.003 & –0.080[15]
		J (1988); JJ (1990)	*m1*	0.570				–0.034		–0.008 & –0.02[15]
			m2	1.160					–9.150	–0.017 & –0.090[15]
Lebanon										
Eken and others (1995)	1964–93 Annual	EG (1987) PO (1990)	*b*	0.790					–1.200	
			m1	1.120					–1.470	
			m2ll	0.960					–1.310	
Malaysia										
Sriram (1999a)	1973:8–1995:12 Monthly	J (1988);	*m2*	1.036		4.884	–5.391		–4.745	
		JJ (1990)	*m2*	1.130		2.510	–1.834		–4.891	–0.581[7]
Mexico										
Khamis and Leone (1999)	1983:1–1997:6 Monthly	J (1988); JJ (1990)	*cc*	0.450			–9.730			

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Opportunity Cost (Semi-Elasticity)[2]: Alternative Return	Opportunity Cost (Semi-Elasticity)[2]: Interest Rate[4]	Opportunity Cost (Semi-Elasticity)[2]: Inflation	Other
Morocco										
Hoffman and Tahiri (1994)	1959:1–1988:2 Quarterly	OLS	*M1*	1.080 1.120	1.330 1.290		–0.050 –0.050			–0.020[8] –0.030[8]
			M2	1.100 1.140	1.120 1.090					–0.010[16] –0.020[16]
		DOLS	*M1*	1.180 1.200	1.080 1.050		–0.025 –0.020			–0.040[8] –0.040[8]
			M2	1.210 1.230	1.900 0.900					–0.030[16] –0.040[16]
		J (1991b)	*M1*	1.120 1.100	0.940 0.970					–0.060[8] –0.060[8]
			M2	1.180 1.170	0.860 0.870					–0.040[16] –0.040[16]
Nigeria										
Fielding (1994)	1977:1–1987:2 Quarterly	JJ (1990)	*bm*	0.720				1.180*	–1.420*	–4.430[13]
Teriba (1997)	1960–94 Annual	EG (1987)	*COB* *M1* *M2*	1.325 1.525 1.317	1.057 1.051 0.626	2.683* 2.859* 2.122*	–2.854* –2.819* –2.209*			–0.314*[16]
	1962:1–1995:2 Quarterly	EG (1987)	*M1*	1.607	0.843	0.663*				–0.286*[16]
	1962:1–1992:4 Quarterly	EG (1987)	*M2*	1.146	0.269	0.943*	–0.592*			

Table 2. *(continued)*

Study	Period/ Frequency	Method	Money[3]	Elasticity: Real Income	Elasticity: Price Level	Opportunity Cost (Semi-Elasticity)[2]: Own-Rate	Alternative Return	Interest Rate[4]	Inflation	Other
Pakistan										
Arize (1994)	1973:1–1990:1 Quarterly	EY(1987)	*m1*	0.930					–1.130	–0.030[14]
			m2	0.990				0.003	–1.270	–0.023[14]
		J (1988); JJ (1990)	*m1*	1.030					–5.480	–0.040[14]
			m2	0.770				0.038	–7.880	–0.008[14]
Hossain (1994)	1972–91 Annual	J (1988); JJ (1990)	*m1*	0.860				–0.540*		
			m2	1.070				–0.050*		
Singapore										
Arize (1994)	1973:1–1990:1 Quarterly	EY(1987)	*m1*	0.720				–0.330		–1.790[17]
			m2	1.080				–0.030		–1.980[17]
		J (1988); JJ (1990)	*m1*	0.710				–0.110		–1.780[17]
			m2	1.120				–0.030		–1.830[17]
Dekle and Pradhan (1997)	1975–95 Annual	J (1988); JJ (1990)	*NM*	0.620	1.620					–0.017[18]
Thailand										
Dekle and Pradhan (1997)	1978–95 Annual	J (1988); JJ (1990)	*NM*	1.130	0.670			–0.009		
Tunisia										
Treichel (1997)	1990:1–1995:12 Monthly	J (1988); JJ (1990); AEG	*m2*	0.130			–0.020			
			m4	1.070			–0.030			
	1963–95 Annual		*m2*	0.800			–0.008			

Table 2. *(concluded)*

[1]Refer to Table 1 for corresponding expansion on abbreviations used in this table.
[2]Semi–elasticities except for those market by *, which refer to elasticities.
[3]Variables in nominal term are shown in upper case letters and in real term in lower case; and all variables are in italics to show that they are expressed in logarithmic term.
[4]Where own–rate or alternative return is not explicitly stated; also refers to the net interest rate measure.
[5]Financial innovation variable.
[6]Elasticities of those variables expressing the income and wealth concepts respectively.
[7]Exchange rate measure.
[8]A measure of foreign interest rate.
[9]Short–term interest rate for alternative return, and the other category includes both NEER and a measure of foreign interest rate.
[10]Long–term interest rate for alternative return, and the other category includes both NEER and a measure of foreign interest rate.
[11]Implicit divisia rental price or user cost index.
[12]Financial innovation variable and volatility measure for yield on long bond.
[13]Measure of price variability.
[14]Exchange rate depreciation.
[15]Foreign exchange risk and a measure of foreign interest rate respectively.
[16]Spread between local and foreign interest rates.
[17]Foreign exchange risk.
[18]Variable expressing foreign influence.

Figure 1. Frequency Distribution of Estimated Income Elasticities for Components of Narrow Money

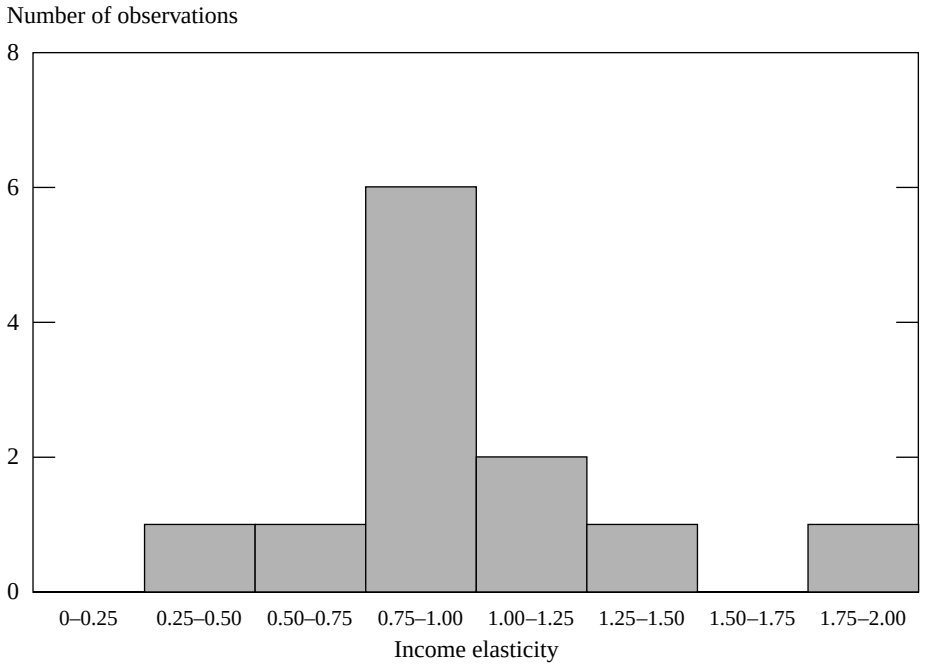

Figure 2. Frequency Distribution of Estimated Income Elasticities for Components for Narrow Money

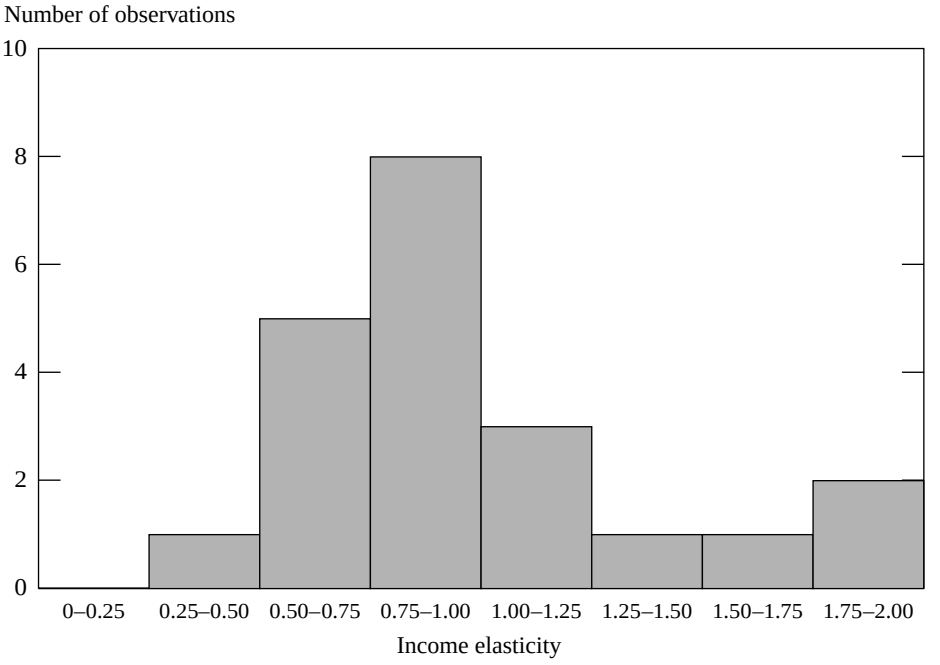

Figure 3. Frequency Distribution of Estimated Income Elasticities for Components for Broad Money

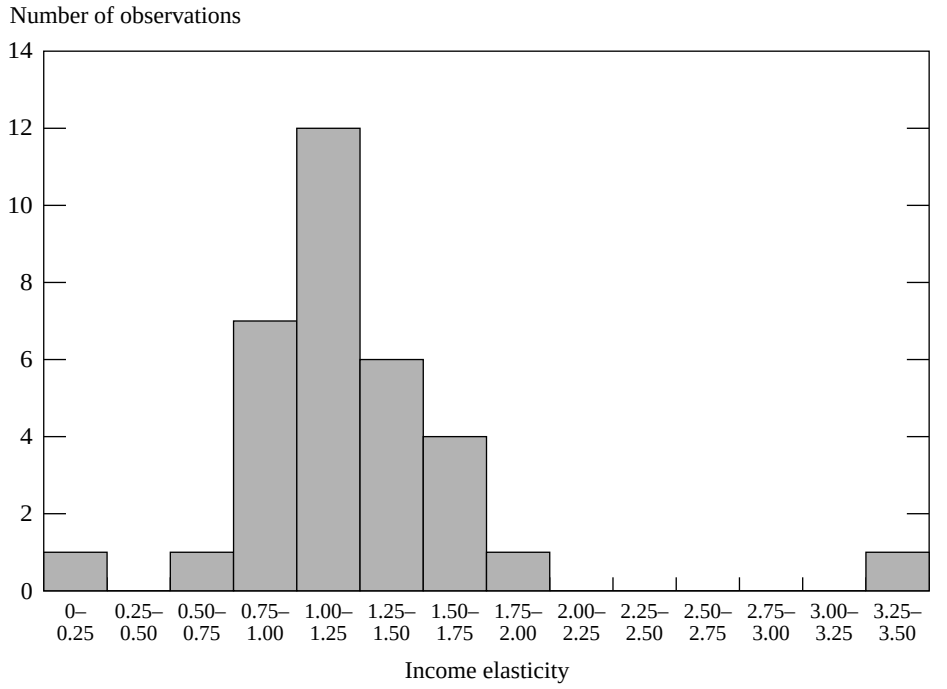

Table 3. Descriptive Statistics for Income Elasticities

	Number of Observations	Mean	Median
Components of narrow money	12	0.99	0.95
Narrow money	21	0.98	0.89
Broad money	33	1.22	1.13

Source: Table 2.

inflation. As can be seen from Tables 1 and 2, there are a number of other variables considered to tackle the country-specific issues; in addition, the open-economy type models also employ the foreign opportunity cost variables.

III. Conclusion

The study has made an attempt to survey a number of papers that applied the error-correction models to analyzed the demand for money in a number of industrial and developing countries. The major contribution of this paper is that it has summarized the major features of these papers and presents relevant information in a comparable framework to promote easy understanding of the approaches followed, variables included, and coefficients derived. The information presented

thus will enable the researchers to compare their own results and approaches with what were undertaken previously in a wide range of countries. Alternatively, it will help identify important factors to be considered before modeling and estimating money demand in other countries exhibiting similar or different economic characteristics. In short, it will provide a starting point to conduct the money demand research using the error-correction approach.

REFERENCES

Adam, Christopher S., 1992, "On the Dynamic Specification of Money Demand in Kenya," *Journal of African Economies*, Vol. 1 (August), pp. 233–70.

Arize, Augustine C., 1994, "A Re-Examination of the Demand for Money in Small Developing Economies," *Applied Economics*, Vol. 26 (March), pp. 217–28.

———, and Steven S. Shwiff, 1993, "Cointegration, Real Exchange Rate and Modelling the Demand for Broad Money in Japan," *Applied Economics*, Vol. 25 (June), pp. 717–26.

Ashley, Richard, 1984, "A Simple Test for Regression Parameter Instability," *Economic Inquiry*, Vol. 22 (April), pp. 253–68.

Asilis, Carlos M., Patrick Honohan, and Paul D. McNelis, 1993, "Money Demand During Hyperinflation and Stabilization: Bolivia, 1980–1988," *Economic Inquiry*, Vol. 31 (April), pp. 262–73.

Baba, Yoshihisa, David F. Hendry, and Ross M. Starr, 1992, "The Demand for M1 in the U.S.A., 1960–1988," *Review of Economic Studies*, Vol. 59 (January), pp. 25–61.

Bahmani-Oskooee, Mohsen, 1996, "The Black Market Exchange Rate and Demand for Money in Iran," *Journal of Macroeconomics*, Vol. 18 (Winter), pp. 171–76.

Bårdsen, Gunnar, 1992, "Dynamic Modelling and the Demand for Narrow Money in Norway," *Journal of Policy Modeling*, Vol. 14 (June), pp. 363–93.

Boughton, James M., 1981, "Recent Instability of the Demand for Money: An International Perspective," *Southern Economic Journal*, Vol. 47 (January), pp. 579–97.

———, 1992, "International Comparisons of Money Demand," *Open Economies Review*, Vol. 3, No. 3, pp. 323–43.

Choudhry, Taufiq, 1995, "Long-Run Money Demand Function in Argentina During 1935–1962: Evidence from Cointegration and Error Correction Models," *Applied Economics*, Vol. 27 (August), pp. 661–67.

Chowdhury, Abdur R., 1995, "The Demand for Money in a Small Open Economy: The Case of Switzerland," *Open Economies Review*, Vol. 6 (April), pp. 131–44.

Cooley, Thomas F., and Stephen F. LeRoy, 1981, "Identification and Estimation of Money Demand," *American Economic Review*, Vol. 71 (December), pp. 825–44.

Cuthbertson, Keith, and Mark P. Taylor, 1987, "Buffer-Stock Money: An Appraisal," in *The Operation and Regulation of Financial Markets*, ed. by Charles A.E. Goodhart, David A. Currie, and David T. Llewellyn (London: The Macmillan Press Ltd.).

Dekle, Robert, and Mahmood Pradhan, 1997, "Financial Liberalization and Money Demand in ASEAN Countries: Implications for Monetary Policy," IMF Working Paper 97/36 (Washington: International Monetary Fund).

Deutsche Bundesbank, 1995, "Demand for Money and Currency Substitution in Europe," *Monthly Report*, Vol. 47 (January), pp. 33–49.

Drake, Leigh, and K. Alec Chrystal, 1994, "Company-Sector Money Demand: New Evidence on the Existence of a Stable Long-Run Relationship for the United Kingdom," *Journal of Money, Credit, and Banking*, Vol. 26 (August, Part 1), pp. 479–94.

Eken, Sena, Paul Cashin, S. Nuri Erbas, Jose Martelino, and Adnan Mazarei, 1995, *Economic Dislocation and Recovery in Lebanon*, IMF Occasional Paper No. 120 (Washington: International Monetary Fund).

Engle, Robert F., and C.W.J. Granger, 1987, "Co-Integration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, Vol. 55 (March), pp. 251–76.

Engle, Robert F., and Byung Sam Yoo, 1987, "Forecasting and Testing in Co-Integrated Systems," *Journal of Econometrics*, Vol. 35 (May), pp. 143–59.

Ericsson, Neil R., 1998, "Empirical Modeling of Money Demand," *Empirical Economics*, Vol. 23, No. 3, pp. 295–315.

Ericsson, Neil R., and Sunil Sharma, 1998, "Broad Money Demand and Financial Liberalization in Greece," *Empirical Economics*, Vol. 23, No. 3, pp. 417–36.

Fielding, David, 1994, "Money Demand in Four African Countries," *Journal of Economic Studies*, Vol. 21, No. 2, pp. 3–37.

Goldfeld, Stephen M., and Daniel E. Sichel, 1990, "The Demand for Money," in *Handbook of Monetary Economics, Volume I*, ed. by Benjamin M. Friedman and Frank H. Hahn (New York: North-Holland), pp. 300–56.

Goodfriend, Marvin, 1985, "Reinterpreting Money Demand Regressions," Carnegie-Rochester Conference Series on Public Policy, Vol. 22, pp. 207–42.

Granger, C.W.J., 1983, "Cointegrated Variables and Error Correction Models," Discussion Paper No. 83-13, Department of Economics (San Diego: University of California at San Diego).

———, 1986, "Developments in the Study of Cointegrated Economic Variables," *Oxford Bulletin of Economics and Statistics*, Vol. 48 (August), pp. 213–28.

Hafer, R.W., and A.M. Kutan, 1994, "Economic Reforms and Long-Run Money Demand in China: Implications for Monetary Policy," *Southern Economic Journal*, Vol. 60 (April), pp. 936–45.

Hansen, Bruce E., 1992, "Tests for Parameter Instability in Regressions with I(1) Processes," *Journal of Business & Economic Statistics*, Vol. 10 (July), pp. 321–35.

Hansen, Henrik, and Søren Johansen, 1993, "Recursive Estimation in Cointegrated VAR-Models," Institute of Economics Discussion Papers No. 92 (Copenhagen: University of Copenhagen).

Hasza, D., and W. Fuller, 1982, "Testing for Nonstationary Parameter Specifications in Seasonal Time Series Model," *The Annals of Statistics*, Vol. 19, pp. 1209–16.

Haug, Alfred A., and Robert F. Lucas, 1996, "Long-Term Money Demand in Canada: In Search of Stability," *The Review of Economics and Statistics*, Vol. 78 (May), pp. 345–48.

Hendry, David F., 1979, "Predictive Failure and Econometric Modelling in Macroeconomics: The Transactions Demand for Money," in *Economic Modelling: Current Issues and Problems in Macroeconomic Modelling in the UK and the US*, ed. by Paul Ormerod (London: Heinemann Education Books), pp. 217–42.

———, 1985, "Monetary Economic Myth and Econometric Reality," *Oxford Review of Economic Policy*, Vol. 1 (Spring), pp. 72–84.

———, and G. Mizon, 1978, "Serial Correlation as a Convenient Simplification, Not a Nuisance: A Comment on a Study of the Demand by the Bank of England," *The Economic Journal* (September), pp. 549–63.

Hendry, David F., Adrian R. Pagan, and J. Denis Sargan, 1984, "Dynamic Specification," Chapter 18 in *Handbook of Econometrics, Vol. 1*, ed. by Zvi Griliches and Michael D. Intriligator (New York: North-Holland, 2nd ed.), pp. 1023–1100.

Hoffman, Dennis L., and Chakib Tahiri, 1994, "Money Demand in Morocco: Estimating Long-Run Elasticities for a Developing Country," *Oxford Bulletin of Economics and Statistics*, Vol. 56 (August), pp. 305–24.

Hossain, Akhtar, 1994, "The Search for a Stable Money Demand Function for Pakistan: An Application of the Method of Cointegration," *Pakistan Development Review*, Vol. 33 (Winter), pp. 969–81.

Hylleberg, S., R.F. Engle, C.W.J. Granger, and B.S. Yoo, 1990, "Seasonal Integration and Cointegration," *Journal of Econometrics*, Vol. 44 (April–May), pp. 215–38.

Johansen, Søren, 1988, "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, Vol. 12 (June–September), pp. 231–54.

———, 1991a, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, Vol. 59 (November), pp. 1551–80.

———, 1991b, "The Role of the Constant Term in Cointegration Analysis of Nonstationary Variables," Working Paper, Institute of Mathematical Statistics (Copenhagen: University of Copenhagen, July).

———, 1992a, "Cointegration in Partial Systems and the Efficiency of Single-Equation Analysis," *Journal of Econometrics*, Vol. 52 (June), pp. 389–402.

———, 1992b, "Testing Weak Exogeneity and the Order of Cointegration in UK Money Demand Data," *Journal of Policy Modeling*, Vol. 14 (June), pp. 313–34.

———, and Katarina Juselius, 1990, "Maximum Likelihood Estimation and Inference on Cointegration, With Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, Vol. 52 (May), pp. 169–210.

Judd, John P., and John L. Scadding, 1982, "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, Vol. 20 (September), pp. 993–1023.

Jusoh, Mansor, 1987, "Inflationary Expectations and the Demand for Money in Moderate Inflation: Malaysian Evidence," *Jurnal Ekonomi Malaysia*, Vol. 15 (June), pp. 3–14.

Khamis, May Y., and Alfredo M. Leone, 1999, "Can Currency Demand Be Stable Under a Financial Crisis? The Case of Mexico," IMF Working Paper 99/53 (Washington: International Monetary Fund).

Kumah, Emmanuel O., 1989, "Monetary Concepts and Definitions," IMF Working Paper 89/92 (Washington: International Monetary Fund).

Kwiatkowski, Denis, Peter C.B. Phillips, Peter Schmidt, and Yongcheol Shin, 1992, "Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure Are We That Economic Time Series Have a Unit Root?" *Journal of Econometrics*, Vol. 54 (October–December), pp. 159–78.

Laidler, David E.W., 1984, "The 'Buffer Stock' Notion in Monetary Economics," *The Economic Journal: The Journal of the Royal Economic Society*, Vol. 94 (Supplement), pp. 17–34.

———, 1993, *The Demand for Money: Theories, Evidence, and Problems* (New York: HarperCollins College Publishers, 4th ed.).

Lim, G.C., 1993, "The Demand for the Components of Broad Money: Error-Correction and Generalised Asset Adjustment Systems," *Applied Economics*, Vol. 25 (August), pp. 995–1004.

McNown, Robert, and Myles S. Wallace, 1992, "Cointegration Tests of a Long-Run Relation Between Money Demand and the Effective Exchange Rate," *Journal of International Money and Finance*, Vol. 11 (February), pp. 107–14.

Mehra, Yash P., 1993, "The Stability of the M2 Demand Function: Evidence from an Error-Correction Model," *Journal of Money, Credit, and Banking*, Vol. 25, Part 1 (August), pp. 455–60.

Milbourne, Ross, 1988, "Disequilibrium Buffer Stock Models: A Survey," *Journal of Economic Surveys*, Vol. 2, No. 3, pp. 187–208.

Miller, Stephen M., 1991, "Monetary Dynamics: An Application of Cointegration and Error-Correction Modeling," *Journal of Money, Credit, and Banking*, Vol. 23 (May), pp. 139–54.

Moosa, Imad A., 1992, "The Demand for Money in India: A Cointegration Approach," *Indian Economic Journal*, Vol. 40 (July–September), pp. 101–15.

Muscatelli, Vito A., and Luca Papi, 1990, "Cointegration, Financial Innovation, and Modelling the Demand for Money in Italy," *Manchester School of Economic and Social Studies*, Vol. 58 (September), pp. 242–59.

Orden, David, and Lance A. Fisher, 1993, "Financial Deregulation and the Dynamics of Money, Prices, and Output in New Zealand and Australia," *Journal of Money, Credit, and Banking*, Vol. 25 (May), pp. 273–92.

Osborn, Denise R., 1990, "A Survey of Seasonality in UK Macroeconomic Variables," *International Journal of Forecasting*, Vol. 6 (October), pp. 327–36.

Perron, Pierre, 1988, "Trends and Random Walks in Macroeconomics Time Series: Further Evidence from a New Approach," *Journal of Economic Dynamics and Control* (June–September), pp. 297–332.

———, 1989, "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis," *Econometrica*, Vol. 57 (November), pp. 1361–1401.

Phillips, Peter C.B., 1987, "Time Series Regression with a Unit Root," *Econometrica*, Vol. 55 (March), pp. 277–301.

———, and Bruce E. Hansen, 1990, "Statistical Inference in Instrumental Variables Regression with I(1) Processes," *Review of Economic Studies*, Vol. 57 (January), pp. 99–125.

Phillips, Peter C.B., and S. Ouliaris, 1990, "Asymptotic Properties of Residual Based Tests for Cointegration," *Econometrica*, Vol. 58 (January), pp. 165–93.

Phillips, Peter C.B., and Pierre Perron, 1988, "Testing for a Unit Root in Time Series Regression," *Biometrika*, Vol. 75 (June), pp. 335–46.

Price, Simon, and Insukindro, 1994, "The Demand for Indonesian Narrow Money: Long-Run Equilibrium, Error Correction and Forward-Looking Behaviour," *Journal of International Trade and Economic Development*, Vol. 3 (July), pp. 147–63.

Salkever, David S., 1976, "The Use of Dummy Variables to Compute Predictions, Prediction Errors and Confidence Intervals," *Journal of Econometrics*, Vol. 4 (November), pp. 393–97.

Sriram, Subramanian S., 1999a, "Demand for M2 in an Emerging-Market Economy: An Error-Correction Model for Malaysia," IMF Working Paper 99/173 (Washington: International Monetary Fund).

———, 1999b, "Demand for M2 in Malaysia" (Ph.D. dissertation; Washington: George Washington University).

———, 1999c, "Survey of Literature on Demand for Money: Theoretical and Empirical Work with Special Reference to Error-Correction Models," IMF Working Paper 99/64 (Washington: International Monetary Fund).

———, 2000, *The Demand for Money in Malaysia: A Study of M2* (Bangalore, India: Southern Economist).

Stock, James H., and Mark W. Watson, 1993, "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems," *Econometrica*, Vol. 61 (July), pp. 783–820.

Tan, Eu Chye, 1997, "Money Demand Amid Financial Sector Developments in Malaysia," *Applied Economics*, Vol. 29 (September), pp. 1201–15.

Teriba, Ayodele Olalekan, 1997, "Demand for Money in Nigeria: New Evidence from Annual (1960–94) and Quarterly (1962I–1995II) Data," IMF Seminar Series No. 1997-25a, July 1 (Washington: International Monetary Fund).

Treichel, Volker, 1997, "Broad Money Demand and Monetary Policy in Tunisia," IMF Working Paper 97/22 (Washington: International Monetary Fund).

Tseng, Wanda, and Robert Corker, 1991, *Financial Liberalization, Money Demand, and Monetary Policy in Asian Countries*, IMF Occasional Paper No. 84 (Washington: International Monetary Fund).

Tseng, Wanda, Hoe Ee Khor, Kalpana Kochhar, Dubravko Mihaljek, and David Burton, 1994, *Economic Reforms in China: A New Phase*, IMF Occasional Paper No. 114 (Washington: International Monetary Fund).

Zarembka, Paul, 1968, "Functional Form in the Demand for Money," *Journal of American Statistical Association*, Vol. 63 (June), pp. 502–11.