The Demand for High-Powered Money

By James R. Lothian*

The resurgence of the quantity theory in the past two decades has brought with it a renewal of an often-debated question—how to define money. Though the answers that have been given vary widely, most economists, with little hesitation, would probably settle on a monetary total similar to M_1 or M_2 in the United States as "the" definition of money.

What this paper shows, however, is that the choice is not nearly so simple. Empirical analysis is often circumscribed by lack of data on many of the variables theory suggests can affect the demand for money, such as the interest rates paid on various categories of deposits and the quality or "moneyness" of those deposits. Under some circumstances the omission of these variables can have a serious effect on the stability of conventional deposit-inclusive definitions of money, causing them to be highly imperfect indicators of the effects of money on the overall economy.

The solution that I propose in these situations is to return to a narrower definition of money, high-powered money alone. The rationale is that since high-powered money is of relatively constant quality over time and space, such specification errors are likely to be less important for high-powered money than for deposit-inclusive totals. The demand for high-powered money should be more stable than the demand for other monetary aggregates.

Since differences in deposit quality and deposit interest rates are likely to be particularly great across countries, I test this proposition by analyzing the demand functions for high-powered money and for various other monetary assets estimated across an international time-section sample spanning forty countries in the postwar period. On the whole the results support my hypothesis. I find that high-powered money is unambiguously the most stable total across the countries in my sample, even when it is judged on the basis of the constant velocity model and the other totals are judged on the basis of a more sophisticated model of money demand. Moreover, I find evidence of several sorts that the factors which a priori could be expected to produce this result have actually been operable.

I. Theoretical Considerations

A. *Money Demand Functions*

To be able to make a judgment about which monetary total is most stable in demand, and hence which is the most useful definition of money, we first have to decide which variables we will assume to be the most important determinants of demand and which we will assume to have only a negligible impact and will ignore in the statistical analysis.[1] In discussing the

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[1] Milton Friedman and Anna Schwartz (1970) provide a strong statement of the position that choosing a definition of money is primarily an empirical issue. They argue further that stability in demand is an appropriate criterion for deciding between alternative definitions of money. A related criterion for defining money has been advocated by V. Karuppan Chetty, who has attempted to estimate directly the substitution relationships between various monetary totals.

factors affecting the stability of high-powered money relative to deposit-inclusive definitions of money and in the subsequent statistical analysis, I assume a simple and widely used money demand function that is derivable from the modern quantity theory and has the form:

$$m = f(y_p, r) \tag{1}$$

where m is the desired ratio of money to income, y_p is permanent real income, and r is "the" nominal rate of interest.

As a first approximation for statistical purposes, I also use a more restrictive formulation based upon the constant velocity model of the earlier quantity theory,

$$m = k \tag{2}$$

where k—the Cambridge k—is a constant.

Before we actually use these demand functions to evaluate competing definitions of money empirically, I want to discuss in detail some of the other omitted influences on money demand and their likely effects on the various monetary totals. But first, let us briefly outline a more general approach to the demand for money that relaxes some of the restrictive assumptions implicit in equation (1).

A model of money demand like Benjamine Klein's (1970, 1974), which is similar to the formulations used by Edgar Feige (1964) and by Morris Perlman and is in the spirit of the new approaches to consumer theory developed by Gary Becker and Kelvin Lancaster (1966, 1971), is a particularly useful starting point. In his model Klein makes explicit the distinction between the services individuals receive from money and the real stock of money that they hold, and he assumes that the services are what provide utility to money holders. Then by specifying an individual's demand and production functions for monetary services he derives an individual's (stock) demand function for money that we can express as

$$m = g(y_p, P_M, \beta_M) \tag{3}$$

where P_M is the price of the monetary services from the marginal unit of money, equal to the difference between r and the rate of interest paid on money r_M, and β is an index of the quality of money, a term from the individual's production function for monetary services.[2]

B. *Conventional Definitions of Money*

The estimation of an equation based on (1) rather than on the more complete formulation (3) can lead to several types of specification error when money is defined conventionally to include deposits.[3] Let us consider the effect of omitting r_M first.

Since r_M is likely to move together with the overall level of interest rates, the coefficient in the auxiliary regression of r_M on r will be positive, which means that the coefficient of r in the regression based on (1) will be biased downwards in absolute value. But if the correlation between r and r_M is high, this type of specification error may have only a small effect on the stability of the demand for conventionally defined money.

Both across countries and within some countries over time this is unlikely to be the case. With no interest paid on currency, r_M will be equal to the product of r_D, the rate paid on deposits, and D/M, the ratio of deposits to money. If the interest rate paid on deposits is competitive (in the sense of reflecting a zero marginal profit), it in turn will equal $r_l(1-R/D)$,

[2] Equation (3) is derivable from a demand function for monetary services of the form $S^d = D(R, y_p)$ and from a production function for monetary services of the form $S = \beta_M(M/P)$, where S represents monetary services; M/P is the real stock of money; β_M is a variable coefficient of production; R is the rental price of a unit of monetary services, equal to P_M/β_M; and the superscript d signifies quantity demanded.

[3] See Henri Theil, pp. 504–56, for a discussion of specification analysis. Note that to simplify the discussion throughout, I am only considering one alternative definition of money, the sum of currency and total commercial bank deposits.

where r_I is the interest earned on bank assets and R/D is the ratio of bank reserves to deposits.[4] Hence, even if movements in r and r_I are closely related, differences in R/D due to differences in reserve requirements or in other factors affecting banks' preferences for reserves relative to deposits will be reflected in differences in r_D. The existence of ceilings on either r_I or directly on r_D, which cannot be evaded costlessly, will also reduce the correlation of r and r_M.

What may be an even more serious problem empirically than unaccounted differences in own interest rates on money are differences in the quality of money. These differences can stem from differences in the degree of financial development of different countries or from the method used by banks to circumvent regulatory constraints on the interest they pay on deposits and earn on their assets. This second source of problems would be relevant both across countries that have differing regulations and within countries having high and variable rates of inflation along with regulations.

We can categorize these quality differences under a number of headings, each of which has slightly different implications. One assumption is that quality differences, or differences in the services offered in connection with money, are exactly equivalent to implicit interest payments on deposits. In this case their omission produces the same results as omission of explicit interest payments.

Another assumption is that quality differences are of a factor-augmenting form, involving differences in the β_m of equation (3). In this case their impact is more difficult to assess, since an increase in β_M has both a negative production and a positive price effect on the derived demand for money, with the net outcome ambiguous. If the net effect is positive this type of quality difference will cause a downward bias in the income coefficient in regression counterparts of (1), since countries that are more financially sophisticated are also likely to be on the whole more developed. It may also cause a downward bias (in absolute value) in the interest rate coefficient if deposit rate ceilings are the rule, since in countries with high rates of inflation banks will make more attempts to circumvent regulations.

When circumvention of interest ceilings provides the impetus, another form of what we have termed "quality changes" may take place. Banks may introduce a new liability that is unregulated as a substitute for the regulated deposits. In some instances, such as with Eurodollar deposits at foreign branches of American banks, these new liabilities may be close substitutes with existing deposits and, in principle, simply could be added to these totals to preserve their homogeneity. In actuality, however, this is unlikely to be an option, since the success of introducing new unregulated liabilities as substitutes for existing deposits depends upon their going unnoticed by the authorities. Hence, to the extent that this is the method of circumvention, the interest coefficient will be biased upwards in absolute value. Countries with high rates of inflation will have recorded deposit totals that are lower than the true totals that include the new goods.

A fourth and perhaps most realistic assumption is that quality differences affect not only the monetary service stream received from deposits, but also their substitutability with other assets. That is, we can view deposits as supplying more than one type of service, bond-type services in addition to monetary services. Some types of regulations and some patterns of finan-

[4] This formulation is discussed in Klein (1970, 1974). As he points out, even where entry into banking is regulated, competitive interest rates could still exist if competition is allowed in the provision of nonprice services which are viewed by individuals as equivalent to explicit interest payments.

cial development may lead to a change in the mix of these services. For instance, to circumvent ceilings on deposit rates, banks may offer relatively more bond-type services in connection with deposits, thus increasing their substitutability with bonds and decreasing their substitutability with currency. The end result would be to decrease the stability of the demand for money defined to include deposits.

C. *High-Powered Money*

All of these factors—changes in own interest rates and the various types of quality changes—have direct effects on deposits but not on currency held by the public, making currency a potentially attractive alternative to broader definitions of money.[5] However, if we use currency alone as the definition of money rather than, say, the sum of currency and total commercial bank deposits or M_2, a consistent accounting practice would be to redefine the currency component of M_2 to include all of high-powered money.[6]

The use of high-powered money as the definition of money can also be viewed from a different perspective. When no interest is paid on either the deposits of commercial banks with the monetary authorities or on currency and hence on vault cash, reserve holdings of commercial banks set an upper limit on the extent to which interest can be paid on deposits. Reserves are in effect the portion of deposits which always yield only monetary services and no interest. The remainder of deposits, equal to the difference between deposits and reserves, is the portion of deposits which, at least potentially, yields interest. A holder of deposits is thus a participant in a tie-in sale, receiving these two components of deposits. The similarities in service flows between the reserve portion of deposits and currency held by the nonbank public and between the excess of deposits over reserves and other interest-bearing assets, such as bonds, may mean that the reserve portion of deposits is a close substitute with currency held by the nonbank public, while the remainder of deposits is a close substitute for the other interest-bearing assets.[7]

The analogy between this approach and Lancaster's is readily perceivable. In the simple case with which we are dealing, we can distinguish three assets and two characteristics: the former are currency, deposits, and bonds; the latter are moneyness (common to currency and deposits) and bondness (common to bonds and deposits). In this formulation, Lancaster's model explains several phenomena relevant to our discussion. In particular, it provides a rationalization for the proposition that changes in the mix of characteristics of deposits towards relatively more bondness make deposits and bonds closer substitutes, since in Lancaster's model "... closeness of substitution [is] an intrinsic effect, depending on objective characteristics of goods ..." (1967, p. 67). Hence it explains why such changes will increase the stability of high-powered money relative to money defined to include deposits. As we approach the polar case in which the only part of deposits that yield monetary services is the high-powered money por-

[5] See Friedman and Schwartz (1970, pp. 142–46), for a similar argument.

[6] When deposits of commercial banks are included in the definition of money, vault cash of commercial banks and other high-powered money reserves of commercial banks are excluded to avoid double-counting. However, if commercial bank deposits were excluded a consistent procedure would be to redefine currency held by the public to include the total monetary liabilities of the monetary authorities, or high-powered money. One way to view this is that the public is now expanded to include commercial banks just as the public can be considered to include nonbank financial intermediaries when money is defined as the total of currency and commercial bank deposits.

[7] While this may not hold as a general proposition it will be more nearly the case when variations in deposit quality affect the meaning of deposits to holders, as I explain below using Lancaster's framework.

tion, progressively smaller increases in the cost of holding deposits will lead to progressively larger decreases in deposit holdings. And in the polar case itself, deposits will be a linear combination of the characteristics of the other two goods and any increase in the cost of holding deposits will cause them to be technologically inefficient (in consumption) and hence cease to exist.[8]

II. Empirical Results

A. *The Data and Empirical Model*

To compare the stability of the demand for high-powered money with that of other monetary totals across countries, I have used analysis of variance techniques and their multiple regression analogues. The data used span 40 countries over the period 1952 to 1966. For each country, I have fifteen yearly observations for real per capita net national product (in 1958 dollars), for the rate of increase of the cost of living index, and for four monetary totals: high-powered money, currency held by the public, deposits, and the sum of currency and deposits, which I refer to as M_4 throughout. Deposits are defined broadly to include all private deposits at bank-type financial intermediaries, and high-powered money is defined as the total monetary liabilities of the monetary authorities. It therefore includes total currency outstanding along with bank and, where they exist, other private deposits at the central bank. For 22 of the countries I also have yearly figures for long-term bond yields.[9] Separate analysis is carried out for this 22-country sub-sample.

The regressions are based on the two simple general demand functions presented above and take the following form in the covariance analyses:

$$(4) \quad log\,(M/Y)_{it} = \alpha_i + \delta_t + \beta_1\, log\,(y/L)_{it} + \beta_2 r_{it} + \epsilon_{it}$$

where i denotes the country, t denotes the time period, M/Y is the number of weeks of income held as the particular asset, y is real income, L is population, r is the rate of interest, α_i, δ_t, β_1, and β_2 are parameters to be estimated, and ϵ_{it} is the error term assumed spherical normal.[10] This formulation assumes that: (a) actual and desired money balances are equal; (b) the demand function is homogeneous of degree one in population and of degree zero in prices; (c) the income elasticity is constant; (d) the semilogarithmic interest rate slope term is constant; and (e) measured income is a close approximation for permanent income. The first four assumptions are standard in much money demand analysis. The last assumption is an empirical expedient that may be imperfect within countries over time but appears reasonable

[8] In this case (which is the case of the tie-in sale) the demand for high-powered money will be unaffected by individual's choices of deposits versus currency and will depend only on their choice of characteristics. This becomes less true as deposits become more efficient, that is, as the production possibilities curve becomes more concave.

[9] The income total for almost all countries was net national product in current prices, taken from the United Nations' (*U.N.*) *Yearbook of National Account Statistics, 1969*. Publications of the *U.N.* principally issues of the *Demographic Yearbook*, provided midyear estimates of population. The bulk of the data for the four monetary totals, the data on interest rates, and the cost of living indices (1958=100), used to convert the income figures to constant prices and to compute yearly rates of change of prices, came from the 1966–67 and 1967–68 supplements to the International Monetary Fund's (*IMF*) *International Financial Statistics*, together with various monthly issues of that publication. Exchange rates for 1958, adjusted for changes in purchasing power parity and used to convert real per capita income to dollars, came from the *U.N. Yearbook of National Account Statistics, 1963*, Table 3B. I initially used only a broad definition of deposits because of difficulties in constructing a series for demand deposits at commercial banks, the most important of which was that for some years for some countries separate demand deposit data were not available from the *IMF*. As reported in the conclusion, later work with a demand deposit series obtained in part from other sources alters none of my results.

[10] The corresponding regression for an analysis of variance imposes the constraint that $\beta_1=\beta_2=0$.

TABLE 1—ANALYSES OF VARIANCE AND COVARIANCE[a]

Mean Squares for:	Degrees of Freedom	Variable[b] log (H/Y)	log (C/Y)	log (D/Y)	log (M_4/Y)
40-Country Sample					
Analysis of Variance					
Countries	39	1.364	2.156	8.512	5.430
Years	14	.031	.136	.546	.179
Remainder	546	.015	.009	.029	.016
Analysis of Covariance					
Countries	39	1.239	2.086	3.011	2.235
Years	14	.018	.016	.069	.016
Remainder	545	.015	.009	.028	.015
22-Country Sample					
Analysis of Variance					
Countries	21	.801	1.892	6.369	3.777
Years	14	.059	.073	.099	.028
Remainder	294	.011	.009	.015	.008
Analysis of Covariance					
Countries	21	.760	1.828	1.178	.878
Years	14	.012	.002	.009	.004
Remainder	293	.011	.008	.012	.007

[a] The International Monetary Fund (*IMF*) was the main source of monetary data and the United Nations (*U.N.*) the main source of income data.

[b] High-powered money, currency, broadly defined deposits, and the sum of currency and broadly defined deposits are represented by H, C, D, and M_4, respectively, and nominal income by Y.

across countries, where differences in transitory income seem to be a relatively small proportion of differences in measured income. The next to last assumption, unlike the logarithmic formulation that is also sometimes used, implies a finite demand for money at a zero rate of interest, and is justifiable if there are some increasing marginal costs of holding money.

B. *Stability of Alternative Totals*

Analyses of variance and of covariance of the monetary totals are presented in Table 1 to provide evidence on the relative stability of each of the four totals over time and across countries under both specifications of the demand for money function. The mean squares for countries and years of the analyses of variance are measures of the absolute variation in the fraction of income held in the form of each asset (or in velocity) across countries and over time, while those in the analyses of covariance are measures of the variations in asset holdings across countries and over time after allowance is made for the effects of the independent variables, real per capita income in the full sample, and both real per capita income and the rate of interest in the subsample. Tests of significance of these mean squares are therefore tests for significant departures from the respective models of the demand for money.[11]

[11] The mean square for countries is the regression sum of squares due to the dummy variables used to allow the α_i to differ, the mean square for years is the regression sum of squares due to the dummy variables used to allow the δ_t to differ, and the remainder sum of squares is the sum of squared errors from the regression. A test of the null hypothesis that the α_i are all equal is a test

The results of both types of analyses strongly support the view that narrower totals in general and high-powered money in particular are more homogeneous across countries. In the analyses of variance for the full sample, the country mean square for high-powered money is less than two-thirds that of currency and less than one-third of the other two assets. In the subsample, it is at the most one-half of the mean square of the other three assets. In the analyses of covariance, high-powered money, too, is the least variable across countries in both samples. What is particularly surprising when these results and the analyses of variance results are compared is the minute reductions in the mean square for high-powered money across countries (1.36 to 1.24 in the full sample and .80 to .76 in the subsample) and the lower unadjusted mean square for high-powered money than the adjusted mean squares for either deposits or M_4 (1.36 versus 3.01 and 2.24 in the full sample and .80 versus 1.18 and .88 in the subsample).

Over time the results are more mixed, and appear somewhat different from those obtained across countries. In the analyses of variance, high-powered money proves least variable in the full sample and M_4 in the small sample, while in the analyses of covariance, currency and M_4 prove equally less variable in the full sample and currency proves least variable in the small sample. However, in both sets of covariance analyses, with the exception of deposits in the full sample, these mean squares for years are insignificant at the .05 level.[12]

for no significant variation across countries; a test of the null hypothesis that the δ_j are all equal is a test for no significant variation over time. Rejection of the alternative hypotheses that in each instance they are unequal implies that velocity can be taken as constant and equal to its geometric mean.

[12] All of the mean squares in the analyses of variance, with the exception of the mean square for years for high-powered in the full sample (which is barely significant at .05), are highly significant. Those for countries in the analyses of covariance remain so.

C. *Estimated Demand Functions*

Summary statistics and coefficients of the independent variables for the regressions underlying the covariance analysis—pooled regressions with individual intercepts for countries and years—together with the results of five other types of regressions are presented in Tables 2 and 3. These results permit comparison with the findings of other demand for money studies and also help illuminate the differences between the cross-country and within-country stabilities of different totals.

The implied income elasticities and the interest rate coefficients are for the most part highly significant and agree closely with estimates obtained in previous money demand studies.[13] The pooled regressions with single intercepts, the pooled regressions with individual yearly intercepts, and the country-mean regressions, all capture primarily cross-country relationships.[14] In these regressions the income elasticities of demand for real balances range from close to 1.0 for currency to close to 1.5 for deposits. The interest elasticities (evaluated at the mean of the interest rate, .054) all indicate an inelastic response of asset holdings to changes in interest rates and range from less than −.10 for high-powered money to a little over −.40 for money.

[13] For example, see the time-series studies by Klein, Allan Meltzer, Friedman and Schwartz (forthcoming), A. A. Walters, and the cross-state studies by Feige and Arthur Gandolfi. Note that my estimates of income elasticities (of real cash balances held in the form of each asset) equal one plus the income coefficient. Hence an income coefficient significantly different from minus one implies an income elasticity significantly different from zero. Correspondingly, a coefficient of determination close to zero implies no additional gain in explanatory power from relaxing the assumption of unit income elasticity (or from including interest rates).

[14] Both the yearly intercepts and the averaging inherent in the country-mean regressions dictate this. The primarily cross-country nature of the regressions with single intercepts is peculiar to these data. Such regressions treat within-country and cross-country variation the same, and the latter is a predominant portion of the total variation in holdings.

TABLE 2—SUMMARY STATISTICS FOR REGRESSIONS FOR THE 40-COUNTRY SAMPLE[a]

Dependent Variable	Coefficients of[b] log (y/L)	Coefficients of[b] g_p	R^2	Standard Error	Coefficients of[b] log (y/L)	R^2	Standard Error
Pooled: Intercepts for Years					**Pooled: Intercepts for Countries**		
log (H/Y)	.090 (.013)		.08	.310	−.117 (.033)	.02	.122
log (C/Y)	.070 (.016)		.03	.384	−.374 (.026)	.28	.094
log (D/Y)	.497 (.019)		.62	.477	.745 (.046)	.32	.170
log (M_4/Y)	.455 (.016)		.57	.404	.455 (.033)	.25	.122
Pooled: Single Intercept					**Pooled: Intercepts for Countries and Years**		
log (H/Y)	.085 (.012)		.07	.309	.009 (.053)	.00	.122
log (C/Y)	.062 (.016)		.02	.385	−.217 (.041)	.05	.093
log (D/Y)	.601 (.019)		.62	.473	.417 (.074)	.05	.167
log (M_4/Y)	.456 (.016)		.57	.400	.332 (.050)	.06	.122
Country Means					**Pooled: Error Component for Countries**		
log (H/Y)	.086 (.048)	−.214 (.574)	.05	.295	.090 (.012)	.09	.274
log (C/Y)	.049 (.060)	−1.164 (.720)	.05	.370	.072 (.015)	.04	.355
log (D/Y)	.586 (.063)	−.587 (.892)	.63	.457	.599 (.018)	.65	.427
log (M_4/Y)	.438 (.062)	−.871 (.760)	.58	.390	.456 (.016)	.59	.368

[a] The *IMF* was the main source of monetary and price data and the *U.N.* of income and exchange rate data.

[b] Real per capita income in 1958 dollars is represented by y/L and the average rate of change of the cost of living index by g_p. Standard errors of the coefficients are beneath them in parentheses.

The pooled regressions with individual country constants and the pooled regressions with individual yearly and country constants both seem to capture primarily time-series relations. They yield estimated elasticities fairly similar to those from the three types of cross-country regressions. The only substantial differences are in the interest elasticities of deposits and money and the income elasticities of high-powered money and currency, all of which are lower in the pooled regressions with individual country constants than in the cross-country regressions.

The standard errors of these regressions provide information similar to though not fully independent of the results of the covariance analyses. Again, high-powered money is the most stable total across countries. Within countries currency appears somewhat more stable than alternative totals, though again the differences among them are slight.

A problem with the within-country comparisons, however, is that for none of the assets are the individual within-country regressions statistically homogeneous.[15] The implication is that from the standpoint of the time-series relations there are

[15] The F-ratio to test jointly the homogeneity of both slopes and intercepts in the regressions for the individual countries, showed significant differences at less than the .001 level for all assets in both samples. Tests of individual yearly regressions revealed the opposite—no significant differences at the .10 level.

TABLE 3—SUMMARY STATISTICS FOR REGRESSIONS FOR THE 22-COUNTRY SAMPLE[a]

Dependent Variable	Coefficients of[b] log (y/L)	Coefficients of[b] r	R^2	Standard Error	Coefficients of[b] log (y/L)	Coefficients of[b] r	R^2	Standard Error
Pooled: Intercepts for Years					**Pooled: Intercepts for Countries**			
log (H/Y)	.044	−1.143	.04	.248	−.206	−3.254	.17	.107
	(.013)	(.734)			(.044)	(.805)		
log (C/Y)	−.016	−3.795	.04	.361	−.336	−3.468	.36	.089
	(.019)	(1.068)			(.037)	(.671)		
log (D/Y)	.523	−8.065	.80	.301	.577	−2.199	.35	.110
	(.016)	(.889)			(.046)	(.828)		
log (M_4/Y)	.379	−7.891	.75	.255	.354	−2.731	.26	.081
	(.013)	(.756)			(.034)	(.614)		
Pooled: Single Intercept					**Pooled: Intercepts for Countries and Years**			
log (H/Y)	.039	−1.745	.05	.248	−.007	−1.769	.01	.106
	(.013)	(.710)			(.073)	(.923)		
log (C/Y)	−.020	−4.214	.05	.355	−.331	−3.488	.13	.090
	(.018)	(1.018)			(.062)	(.784)		
log (D/Y)	.527	−7.568	.79	.297	.495	−2.993	.17	.110
	(.015)	(.851)			(.075)	(.957)		
log (M_4/Y)	.381	−7.568	.75	.251	.296	−3.280	.16	.082
	(.013)	(.721)			(.056)	(.712)		
Country Means					**Pooled: Error Component for Countries**			
log (H/Y)	.045	−1.069	.00	.236	.045	−1.038	.05	.213
	(.048)	(2.900)			(.012)	(.696)		
log (C/Y)	−.014	−3.897	.00	.366	−.014	−4.015	.04	.328
	(.074)	(4.400)			(.018)	(1.072)		
log (D/Y)	.524	−8.747	.82	.291	.524	−8.746	.82	.263
	(.059)	(3.577)			(.014)	(.857)		
log (M_4/Y)	.380	−8.523	.77	.251	.380	−8.543	.23	.226
	(.051)	(4.318)			(.012)	(.739)		

[a] The *IMF* was the main source of monetary, price, and interest rate data and the *U.N.* of income and exchange rate data.

[b] Real per capita income in 1958 dollars is represented by y/L and the rate of interest by r. Standard errors of the coefficients are beneath them in parentheses.

some important omitted variables that differ in their impact from one country to the next. An alternative way of dealing with the time-series relations therefore may be in order. One solution is to use an error component model, such as that proposed by Pietro Balestra and Marc Nerlove, which views the error term in the model as being made up of two parts: a cross-country error and a remainder. When this technique is used we get another set of time-series estimates which are also presented in Tables 2 and 3. What they show is, as in the cross-section regressions, the clear superiority of high-powered money. In both samples the standard errors of estimate for the regressions for high-powered are lower than those for the regressions for the other assets.

One reason for the differences between the relative stabilities of different totals across countries and within countries uncovered in some of the regressions is brought out by examination of the interest rate coefficients. In the regressions in which high-powered money is most stable, its sensitivity to interest rates is much lower than that of deposits and M_4. This is precisely what one would expect if there were specification bias in the deposit and money regressions, caused by either the existence of close substitutes for deposits introduced to circumvent interest rate ceilings, or by a greater degree of substitutability of deposits for bonds than of the high-powered money portion of deposits for bonds.

What may be more important sources of differences between the two sets of results are differences between cross-country and within-country variations in deposit quality. One might plausibly expect the former to be considerably greater since differences in the degree of financial development across countries are probably much greater than those that are likely to exist within countries over the relatively short time span covered by the sample. Omitting this variable, therefore, would decrease the stability of M_4 relative to narrower totals across countries and have little effect within countries.

This second explanation, moreover, is given credence by several additional types of evidence. In the analyses of variance and of covariance, variations in holdings of deposits and of M_4, both absolutely and relative to high-powered money, were much lower in the small sample that is the more homogeneous of the two with respect to degree of financial development. Regressions run with country means and incorporating the ratio of banking offices to population as an index of deposit quality also support this hypothesis.[16] Hence, differing degrees of financial sophistication seem to account for at least part of the difference between the performance of M_4 and high-powered money across countries and, therefore, may also account for part of the differences between the cross-country and the time-series results.

III. Summary and Conclusions

The central theoretical proposition of this paper is that substantial variations in the cost of holding deposits relative to the costs of holding currency and other assets and in the quality or "moneyness" of deposits, such as exist across countries and within some countries having high and varying rates of inflation and ceilings on deposit rates, will substantially reduce the stability of the demand for money defined conventionally to include deposits while having only a minor effect on the stability of the demand for money defined more narrowly as high-powered money alone. In these circumstances high-powered money may therefore be a more useful definition of money than deposit-inclusive monetary totals.

The empirical evidence I have presented in the main supports this proposition. I have found that across countries high-powered money is the most stable of the four totals I have examined even when it is judged on the basis of the simple constant

[16] The data and their sources are described in my dissertation. The regression for the country means of deposits for 34 countries in the full sample for which data were available was

$$\log(D/Y) = .413 + \underset{(.093)}{.345}\log(y/L) + \underset{(563.3)}{1637.8}B/L - \underset{(.776)}{1.260}g_p$$

$R^2 = .74; \quad SE = .382$

and for the 22 countries in the small sample was

$$\log(D/Y) = .484 + \underset{(.076)}{.425}\log(y/L) + \underset{(492.7)}{945.0}B/L - \underset{(3.347)}{9.174}r$$

$R^2 = .85; \quad SE = .274$

where B/L is the deposit quality variable and where standard errors are beneath the coefficients in parentheses. Higher income coefficients were obtained in similar regressions that omitted B/L (.528 and .524, respectively), which is what one would expect if an increase in deposit quality caused by increased financial development has a positive effect on the demand for deposits and if more financially developed economies are also more developed on the whole. In the above regressions B/L was significant in both instances at the .05 level which it never was when I used high-powered money as the dependent variable.

velocity model and the other totals are judged on the basis of a more sophisticated model of money demand. Moreover, this greater stability of high-powered money appears directly attributable to the factors which theory suggests will have an important destabilizing influence on the demand for deposits. Specification analysis of various types of regressions, the observed differences in the stability of M_4 relative to high-powered money in the two samples, and the results of regressions which use a proxy for the quality of deposits as an independent variable all tend to confirm the importance of variations in deposit quality. The one major piece of evidence which does not support the hypothesis is that high-powered money is if anything less stable than either currency or M_4 within countries. But as already mentioned, this finding is consistent with the other evidence if, as appears reasonable, variations in deposit quality are on average of only minor importance within countries.

Moreover, this greater cross-country stability of narrower totals in general and high-powered money in particular is not just a statistical quirk peculiar to these data. Analysis of other studies indicates that this result still holds when other assets, specifically M_1 and its deposit component, are considered and other samples are used.[17] As an additional check, I compiled an M_1 series for my group of countries. The regressions I ran for both the 40 countries and the 22 countries also indicate that high-powered money is more stable than either M_1 or the deposit component of M_1.[18]

My findings also provide evidence of several sorts bearing on the overall stability of money demand. They show that given the variations in factors which could plausibly be expected to affect the demand for money across countries, it is reasonably stable. Estimates of international variations in money holdings are not radically greater than the intranational estimates.[19] In addition, even though these international variations are both significant and substantial, it is clear that even so simple an hypothesis as constant velocity has considerable merit. For example, from knowledge of high-powered money and of its average velocity, one can account for an overwhelming proportion of the variance in the level of nominal income or in its rate of change— over 95 percent of the variance of the level in 1958 and over 90 percent of the variance of its average annual rate of change. In addition, my estimates of money demand functions on the whole accord fairly well with esti-

[17] Estimates of coefficients of variation of velocity derived from regressions similar to mine contained in studies by Hannan Ezekial and Joseph Adekunle, by Morris Perlman, and by Henry Wallich show that currency is more stable than broader totals (either M_4 or both M_1 and M_4, depending upon the study) and that holdings of both broader totals are more variable than high-powered money is in my full sample. Additional comparisons which I have made with an extended and otherwise revised version of Perlman's data and which I report in my dissertation show high-powered money to be the most stable total.

[18] The regression for the country means of M_1 holdings for the 40-country sample was

$$\log (M_1/Y) = \underset{}{.840} + \underset{(.056)}{.259} \log (y/L) - \underset{(.411)}{.276} g_n$$

$R^2 = .39; \quad SE = .345$

and for the 22-country sample was

$$\log (M_1/Y) = 1.337 + \underset{(.056)}{.233} \log (y/L) - \underset{(3.338)}{3.912} r$$

$R^2 = .50; \quad SE = .278$

where standard errors of the coefficients are beneath them in parentheses. We can compare the standard errors of estimate of these regressions of .345 and .278 with the standard errors of estimate for similar regressions for high-powered money of .295 and .236, respectively.

[19] Friedman and Schwartz (forthcoming) report coefficients of variation of the levels of velocity of M_2 in the United States of .32, and in the United Kingdom of .18 over the years 1880–1968. Estimates for the velocity of total adjusted commercial bank deposits from cross-state data, made available by Gandolfi, range from .17 in 1929 to .20 in 1933.

mates others have obtained from long-term studies of the United States and the United Kingdom and from cross-section studies of the United States.[20] Given the substantial independence of my data from theirs, this close agreement of results provides a strong corroboration of their results. Conversely, it casts considerable doubt on estimates from postwar time-series for those two countries which in general conflict greatly with both long-term time-series and cross-section estimates.[21]

An obvious implication of my findings is that for international studies in which the stability of the demand for money is a key assumption, such as in monetarist models of the balance of payments or of exchange rates, the use of high-powered money as the definition of money may prove extremely fruitful. In studies of that type it also has the added advantage of eliminating the need for separate relationships to explain the conventional money multiplier and conventional money demand. For countries having no income data or data of dubious accuracy there are also direct applications for these findings. By extension they also may prove useful in time-series studies of economic conditions in countries experiencing rapid inflation or substantial changes in their financial structure.

My results also have implications for monetary policy. Since inflation coupled with regulation of banking tends to reduce the homogeneity of deposits, conventional definitions of money may become highly imperfect indicators for monetary policy in such situations. On the one hand, my findings suggest that policy should be such that supply and demand are not made more interdependent. And on the other, they suggest that, having made them so, the monetary authorities should look for a more homogeneous total as an indicator and not deduce from the instability in demand of a nonhomogeneous total that monetary aggregates play only a weak role in the economy.[22]

Perhaps the most interesting implications of these results are for the definition of money. Most of the current debate over how to define money has centered upon whether to include various types of time and savings deposits in the definition of money. My results suggest that the focus of current debate has been too narrow, that the range of plausible alternative definitions of money and the factors influencing the selection of one of these alternatives are both broader than is commonly realized. They indicate that an earlier definition of money as high-powered money alone may be a useful alternative to these conventional definitions of money. And because the differences in the performance of high-powered money and deposit-inclusive definitions of money across countries can be attributed to variations in deposit quality, these results also indicate the importance of asset quality in deciding upon a definition of money.

[20] In addition to the studies cited in fnn. 13 and 17, see the cross-country study by James Hanson and Robert Vogel.

[21] Estimates of income elasticities obtained from the studies referred to in the previous footnote tend to fall in the range of 1.0 to 1.3. Estimates obtained with postwar data (see Stephen Goldfeld) are usually considerably below 1.0.

[22] The United Kingdom currently provides an instructive example. Changes in the regulations surrounding banking appear to be a major cause of the marked divergences over the past several years in the growth rates of the two published deposit-inclusive definitions of money. These changes have undoubtedly decreased the homogeneity of both totals and thus have drastically increased the difficulties in assessing British policy.

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