The Demand for Money in Pakistan

by

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INTRODUCTION

It is the purpose of this paper to present an empirical analysis of the demand function for money in Pakistan. Our empirical investigation is restricted to the period 1951-70. During this period (a) nominal income rose at an average yearly rate of 7.0 per cent; (b) nominal stock of money averaged a yearly increase of 7.9 or 9.7 per cent depending on whether money is defined exclusive or inclusive of time deposits, respectively; (c) the average rise in real income was 4.0 per cent but it fluctuated substantially from one year to another; (d) the yield on long-term government bonds increased about 2.9 per cent per year but the short-term interest rate (call money rate) advanced more than 7.1 per cent; (e) prices were relatively stable and by any measure, averaged a yearly increase of less than 4.0 per cent. To complete this outline we should mention that the institutional setup affecting these economic variables included a wide variety of controls on imports, exports, distribution of commodities, and prices prior to 1958 and somewhat less restrictive policies in the remainder of the period under consideration.

Two alternative theoretical structures form the basis of our empirical research—the modern quantity theory of money and what may be called the "accumulating capital" framework. The former regards the process of substitution between money and non-money assets resulting from changes in the money supply schedule as the central relation to be studied in the macroeconomic context. The latter undermines the existence of substitution effects and views the demand for real cash balances and the demand for physical capital as highly complementary, at least, in the context of underdeveloped economies. A more detailed outline of the two approaches and forms of functions tested in this empirical analysis is presented in the following two sections.

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II. THE DETERMINANTS OF THE DEMAND FOR MONEY: THE SUBSTITUTION HYPOTHESIS

Let r_f be the common rate representing all the yields on financial assets, r_p the yield on physical assets, y real national income (which may be considered to be a welfare proxy for wealth), p* the rate of change of prices ((dp/dt)/p), following Friedman [2] the demand for real balances (m) may then be expressed as:

$$m = f(r_p, r_f, y, p^*) \tag{1}$$

where partial derivatives with respect to p_r, r_f, and p* are negative and the partial derivative with respect to y is positive. In this study it is assumed that there is a co-movement between the yield on financial assets and the yield on physical assets; therefore, r_p need not be included explicitly into the relation. Thus, if r is taken to represent the yields on all money substitutes, equation (1) may be reduced to

$$m = f(r, y, p^*) \tag{2}$$

The tested form of this equation is

$$\ln m = a + b_1 \ln(r) + b_2 \ln(y) + b_3 \ln(p^*) \tag{3}$$

Equation (3) was tested with respect to two price series and two interest rate series for two definitions of money.

In developing economies, the level of industrial activity contains a relatively independent source of variation in the demand for money. Based on Rao and Chaudhry [15] we introduced the index of industrial production (y_1) as an additional relation into equation (3)

$$\ln m = a + b_1 \ln(r) + b_2 \ln(y) + b_3 \ln(y_1) + b_4 \ln(p^*) \tag{3'}$$

and repeated most of our tests.

The use of the index of industrial production in equation (3) needs further elaboration. The level of industrial activity has no special significance in determining the demand for money in developed economies because industrial activity is a function of investment which among other factors is determined by the rate of interest. Therefore, the influence of y_1 is largely taken into account by r and the physical capital need not be considered as an alternative form of assets. Besides the growth of industry is more closely related to the growth of national income in developed economies. None of this is true in developing economies. Most of the investment in such economies is a result of planning in the public sector and expansionary monetary policies. The excess of *ex ante* investment over *ex ante* saving realized through economic planning and expansionary monetary policies explains the growth of industry unexplained by current savings. This last statement is defensible on two grounds: *ex ante* investment is greater than *ex ante* saving at any given rate of return on capital; real resources, not represented by saving out of current income, are often available that may be deployed by the monetary policy to match the excess of *ex*

ante investment.[1] It should be noted here that our main pupose in introducing y_1 as another independent variable is to isolate the effect of r but in a later section of this paper we will also consider implications of the influence of y_1 on the demand for money vis-a-vis the complementarity hypothesis.

No attempt is made here to review the empirical literature.[2] Among others, this study has benefitted from Meltzer [12], Adekunle [1], Gupta [4], and Meisleman [11]. Meltzer [12] is an empirical analysis of long-term relations in determining the demand for money function in the United States. Adekunle [1] presents comparison of the determinants of the demand for money in selected developed and underdeveloped countries. Gupta [4] contradicts two major findings about the Indian economy by Gujarati [3] concerning interest rates and lags in adjustment. Meisleman [11] is a collection of monetary analyses about Chile, Argentina, Japan, Canada, South Korea, and Brazil.

III. THE DETERMINANTS OF THE DEMAND FOR MONEY: THE COMPLEMENTARITY HYPOTHESIS

In developing economies the economic environment is fragmented and financial institutions are underdeveloped. There are few, if any, organized markets for such primary securities as bonds, mortgages, or common stock. Individual economic units issue very few primary securities and most of this issue is acquired by financial institutions rather than directly by final savers. In other words, there is little direct contact between the primary borrower and the ultimate lender. A quite obvious result of this fragmented financial structure is that money broadly defined (currency in circulation+demand deposits+ time deposits) is almost the only financial asset available to wealth holders. In developed economies, on the other hand, there is much wider spectrum of available financial assets, some of which are very close substitutes for money. This difference in financial structures of developed and underdeveloped economies, more particularly the fragmented nature of economic environment in the latter, forms the basis of the complementarity hypothesis developed by McKinnon [10, Pp. 37-67].

If d is the weighted average of nominal interest rates on all classes of deposits, including currency, k the ratio of total investment (changes in the aggregate stock of capital) to real income, and expectations are assumed to be static, then McKinnon's basic hypothesis may be presented as

$$m = g(y, d-p^*, k) \qquad (4)$$

All partial derivatives of (4) are positive. The last two arguments in this equation, d-p* and k, need further explanation. In the financial structure of an underdeveloped economy where creditors know little or nothing about the repayment capability of potential debtors, money is the only financial instrument

[1]For detailed analysis on this point, see Rao and Chaudhry [15, Pp. 13—15] and the literature cited by them. It may be worthwhile to mention two other studies by Imam [7] and Porter [14], partially related to the subject matter of our analysis. The former is an econometric model representing structural relations in the monetary sector of Pakistan. The latter includes a statistical analysis to determine the effect of real income on velocity in Pakistan between 1950 and 1960.

[2]See Laidler [9] for a time-saving review of this literature as well as a bibliography.

which can easily be marketed. This role of money as a means of payment along with its legal designation as the medium of exchange, greatly enhances its value as the instrument of private capital. Money's attractiveness as an instrument of capital depends on the expected changes in prices and the nominal interest rate on deposits.[3] This is represented by d-p* in equation (4) by assuming that actual and expected changes in prices are equal. Increases in d-p* or the real rate of return on money bring about increases in the demand for real balances. The key element in this argument is that d-p* tends to raise investment-savings propensities because of the importance of money as a store of value. This is where complementarity between money and real assets sets in—a feature contrary to the modern quantity theory of money.

The neo-classical monetary theory, one part of which is the modern quantity theory of money, uses r_p—the rate of return on physical assets—instead of k and treats money and physical assets as substitutable forms of wealth holding in a static sense. In developing economies actual rates of return vary greatly, both in the marginal sense as well as in the intra-marginal sense. Therefore, the assumption that there is a single real rate of return which is also the uniform opportunity cost of holding money is a very serious deviation from reality. The use of investment/income ratio implies that exogeneous forces, e.g., "Green Revolution" or a lifting of trade barriers, as well as the effect of d-p* on investment, are taken into consideration in estimating returns to capital. An increase in the investment/income ratio, however brought about, would increase the desired real cash balance holdings: "money is viewed as a conduit through which accumulation takes place—rather than as a competing asset—the demand for money rises paripassu with the productivity of physical capital."[4]

The essential feature of this approach may be summarized as its emphasis on complementarity—the demand for money and the demand for physical capital are seen as highly complementary in the private asset portfolios, in contrast to the modern quantity theory of money where a substitution relation is

[3] In addition to McKinnon, see Handa [5] on this point.

[4] McKinnon [10,p. 60]. Note that total investment rather than private monetized investment is a more appropriate magnitude in obtaining the ratio k. This may be explained by assuming that there is an average rate of return on capital, r, which takes into account all actual rates of return in the economy. Put another way, r is a measure of the variable productivity of capital in all sectors. The k function may now be written as:

$$k = f(r, d\text{-}p^*); \text{ with } \partial f/\partial r > 0 \text{ and } \partial f/\partial(d\text{-}p^*) \gtrless 0.$$

It is obvious that changes in d-p* will affect k almost exclusively through the monetary mechanism of the private sector. It is also obvious that changes in r will affect both monetized private investment and non-monetized investment in the rural sector because r is based on rates of return in all sectors. The relationship between r and public investment needs further elaboration. Consider exogeneous changes that could raise r, such as increasing expenditures on social overheads, lifting of trade barriers, or introducing new technology in one or more sectors of the economy (including a "green revolution" in agriculture). Many of these changes are brought about by government policy and necessarily increase public investment—this has been the case in Pakistan. Thus, simultaneous with a rise in r may be increases in public investment. Furthermore, changes in r are also likely to affect the direction (and perhaps the volume) of public investment. For example, a rise in r may be sufficient to bring private enterpreneurs into a hitherto public industry, thereby making it possible for public investment to be re-directed into another industry. In any case, changes in r involve changes in private monetized investment, non-monetized investment in the rural sector, and public investment.

dominant. Thus, conditions that make m attractive to hold enhance rather than inhibit private incentives to accumulate physical capital.[5]

For the purpose of empirical analysis we converted equation (4) into

$$\ln m = a+b_1\ln(y)+b_2\ln(d-p^*)+b_3\ln(k) \qquad (5)$$

IV. THE DATA

All data used in this study represent July-June fiscal year and are annual averages wherever applicable. Data on national income, money, prices, and indices of industrial production were obtained from Central Statistical Office, 25 *Years of Pakistan in Statistics* [13]. Two definitions of money (both in real terms) used are m_1 = currency outside banks+demand deposits; and m_2 = m_1+time deposits. Consumer prices used in this study depict an average of consumer price indices in Karachi, Narayanganj, Lahore, and Sialkot. These indices are based on the expenditure of industrial workers and consequently, more heavily affected by food prices. Aggregate investment estimates for 1951-59 are by Haq [6, 225-31] and the remainder of the period is covered in 25 *Years of Pakistan in Statistics* [13]. The two series are somewhat inconsistent but alternative sources of investment estimates are even less reliable. Interest rate series are obtained from United Nations, *Statistical Year Book*, 1956, 1960, 1965, and 1971, [19] supplemented and verified by International Monetary Fund, *International Financial Statistics*, January 1955, January 1960, April 1964, September 1969, and September 1971, [8] Deposit rates on six-months to one-year time deposits were estimated from State Bank of Pakistan, *Bulletin* January 1967 and October 1970 [18] and *Banking Statistics of Pakistan*, 1948-61, [17] as weighted averages for 1960-70 and unweighted averages for 1951-59. These are used as proxy for d in this study.

As is obvious from the above description, there are serious shortcomings in the data on investment, deposit rates, and consumer prices. Of course, there is a substitute for consumer prices, namely the implicit national income deflator. Deposit rates and investment estimates are relevant only to the second approach and, to that extent, our results for that approach are less reliable.

V. THE EVIDENCE ON THE SUBSTITUTION HYPOTHESIS

In this section we present an empirical analysis of the modern quantity theory version of the demand for money function with respect to two interest rate series and two price series for two definitions of money. The results with the highest adjusted multiple coefficient of correlation and generally significant regression coefficients, though not necessarily significant t values, are

[5]It is important to note at this juncture that the index of industrial production (y_1) included in the substitution hypothesis to isolate the effect of r, may lend support to the complementarity hypothesis. Increases in y_1 are closely related to increases in real capital. If, therefore, there is a strong positive relation between variations in y_1 and the demand for money, money and physical capital may be regarded as complementary.

reported in Tables I and II. We have singled out specific estimates for discussion in this paper.[6]

Our best estimates for the demand for money function when the yield on long-term government bonds is used as one of its arguments, are[7]

$$\ln m_1 (p_n) = \underset{(4.343)}{-5.854+1.961 \ln y(p_n)} \underset{(-1.759)}{- 1.032 \ln r_g} \qquad 1951—70$$

$$DW = 1.031, R^2 = 0.962 \qquad (6)$$

$$\ln m_2(p_n) = \underset{(5.877)}{-8.362+2.406 \ln y(p_n)} \underset{(-1.716)}{- 0.913 \ln r_g} \qquad 1951—70$$

$$DW = 1.098, R^2 = 0.986 \qquad (7)$$

Equations (6) and (7) show that a very high proportion of the observed variance in money balances is explained by the two arguments of the demand function, real income and interest rates, in both cases. The income elasticity is high and differs substantially depending on the definition of money used. The interest elasticity is also high but it is not substantially different for the two definitions of money. The Durbin-Watson test is inconclusive at the 1 per cent level as well as at the 5 per cent level. Assuming that the residuals are free of autocorrelation, the tests indicate that y is statistically significant at the 1 per cent level (even at the .01 per cent level) for both definitions of money and r_g is significant at the 5 per cent level for $m_1 (p_n)$ but only at the 10 per cent level for $m_2(p_n)$, though it is quite close to being significant at the 5 per cent level.

The economic meaning of this result is that the role of income effects is the primary influence and the tnterest rate is the secondary but strong influence on the demand for money in Pakistan. The interest elasticity indicates a good awareness of the behavior of interest rates and furnishes considerable support for the substitution effect between money and non-money assets. The parameters appear to be statistically significant and their signs are as dictated by the theory.[8]

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[6]Additional notations used include P_n for the implicit national income deflator, p_c for the consumer price index, p_w for the wholesale price index, r_g for the average annual yield on long-term government bonds, and r_m for the call money rate. When p_n, p_c, or p_w are used in parenthesis with y and various definitions of money, it indicates that the nominal value of the variable was deflated by the particular price series to obtain the real value. As before, changes in prices are shown by p^*_n, p^*_c, and p^*_w.

[7] t statistic is given in parenthesis. Adjusted R^2 is reported throughout the paper.

[8]It is interesting to note that the income elasticity in equations (6) and (7), as well as in most other regressions in this study, is significantly above unity indicating support for the hypothesis that there is an inverse relationship between real income and income velocity of money.

TABLE I

The Demand for Money in Pakistan: The Evidence on the Substitution Hypothesis

Period: 1951-70

$$\ln m_1(p_n) = -5.854 + 1.961 \ln y(p_n) - 1.034 \ln r_g \qquad DW = 1.031$$
$$(4.353) \quad (-1.759) \qquad R^2 = 0.962$$

$$\ln m_1(p_n) = -5.617 + 1.902 \ln y(p_n) - 0.978 \ln r_g + 0.0117 \ln p^*_n \qquad DW = 1.061$$
$$(4.269) \quad (-1.697) \quad (0.857) \qquad R^2 = 0.963$$

$$\ln m_1(p_n) = -4.288 + 1.471 \ln y(p_n) - 0.1421 \ln r_m + 0.034 \ln p^*_n \qquad DW = 0.911$$
$$(6.799) \quad (-1.557) \quad (1.573) \qquad R^2 = 0.962$$

$$\ln m_2(p_n) = -8.362 + 2.4061 \ln y(p_n) - 0.9131 \ln r_g \qquad DW = 1.098$$
$$(5.877) \quad (-1.713) \qquad R^2 = 0.986$$

$$\ln m_2(p_n) = -8.174 + 2.3601 \ln y(p_n) - 0.8701 \ln r_g + 0.0131 \ln p^*_n \qquad DW = 1.118$$
$$(5.754) \quad (-1.641) \quad (0.071) \qquad R^2 = 0.985$$

$$\ln m_2(p_n) = -6.812 + 1.943 \ln y(p_n) - 0.111 \ln r_m + 0.027 \ln p^*_n \qquad DW = 0.983$$
$$(9.645) \quad (-1.311) \quad (1.352) \qquad R^2 = 0.984$$

Period: 1958-70

$$\ln m_1(p_w) = -4.471 + 1.2071 \ln y(p_w) - 0.2121 \ln r_g \qquad DW = 1.179$$
$$(3.304) \quad (-0.516) \qquad R^2 = 0.984$$

$$\text{n } m_1(p_w) = -8.113 + 1.5481 \ln y(p_w) - 0.2271 \ln r_m \qquad DW = 0.867$$
$$(11.097) \quad (-4.074) \qquad R^2 = 0.984$$

$$\ln m_2(p_w) = -10.304 + 1.7961 \ln y(p_w) - 0.1911 \ln r_g \qquad DW = 1.180$$
$$(4.895) \quad (-0.465) \qquad R^2 = 0.983$$

$$\ln m_2(p_w) = -12.877 + 2.0461 \ln y(p_w) - 0.1741 \ln r_m \qquad DW = 1.162$$
$$(11.554) \quad (-2.452) \qquad R^2 = 0.99_0$$

Note: m_1 = real money balances exclusive of time deposits; m_2 = real money balances inclusive of time depositis; y = real national income; r_g = yield on long-term government bonds; r_m = call money rate; p_n = implicit national income deflator; p_c = consumer prices; p_w = wholesale prices; p^*_n = rate of change of prices as reflected in the implicit national income deflator.

TABLE II

The Demand for Money in Pakistan: The Evidence on the Substitution Hypothesis

PERIOD: 1951-70

$\ln m_1(p_n) = -1.011 + 0.702 \ln y(p_n) - 0.140 \ln r_m + 0.262 \ln y_t$	(3.693) (−2.841) (5.130)	DW = 1.199 R^2 = 0.983
$\ln m_1(p_n) = -1.464 + 0.791 \ln y(p_n) - 0.168 \ln r_m + 0.247 \ln y_t + 0.018 \ln p^*_n$	(4.025) (−2.856) (4.891) (1.246)	DW = 1.689 R^2 = 0.984
$\ln m_1(p_n) = -0.803 + 0.747 \ln y(p_n) - 0.318 \ln r_g + 0.220 \ln y_t$	(1.256) (−0.532) (2.871)	DW = 1.001 R^2 = 0.967
$\ln m_1(p_n) = -0.833 + 0.753 \ln y(p_n) - 0.319 \ln r_g + 0.217 \ln y_t + 0.003 \ln p^*_n$	(1.378) (0.582) (2.976) (0.147)	DW = 1.011 R^2 = 0.972
$\ln m_1(p_c) = -1.404 + 0.798 \ln y(p_c) - 0.136 \ln r_m + 0.227 \ln y_t$	(4.250) (−2.021) (5.424)	DW = 1.150 R^2 = 0.981
$\ln m_1(p_c) = -1.270 + 0.773 \ln y(p_c) - 0.124 \ln r_m + 0.230 \ln y_t - 0.013 b\, p^*_c$	(4.092) (−1.809) (5.505) (−0.781)	DW = 1.051 R^2 = 0.981
$\ln m_2(p_n) = -4.099 + 1.305 \ln y(p_n) - 0.112 \ln r_m + 0.219 \ln y_t$	(6.581) (−1.899) (4.106)	DW = 1.084 R^2 = 0.991
$\ln m_2(p_n) = -4.444 + 1.373 \ln y(p_n) - 0.122 \ln r_m + 0.207 \ln y_t + 0.014 \ln p^*_n$	(6.647) (−2.152) (3.902) (0.904)	DW = 1.359 R^2 = 0.992
$\ln m_2(p_n) = -4.195 + 1.405 \ln y(p_n) - 0.323 \ln r_g + 0.181 \ln y_t$	(2.658) (−0.608) (2.663)	DW = 0.964 R^2 = 0.987

TABLE II—(cotd.)

$$\ln m_2(p_n) = \underset{}{-4.213} + \underset{(3.022)}{1.4091} \ln y(p_n) - \underset{(-0.693)}{0.3241} \ln r_g + \underset{(2.889)}{0.1801} \ln y_1 + \underset{(0.104)}{0.0021} \ln p^*_n \qquad \begin{matrix} DW = 0.970 \\ R^2 = 0.990 \end{matrix}$$

$$\ln m_2(p_c) = \underset{}{-3.890} + \underset{(6.431)}{1.2451} \ln y(p_c) - \underset{(-1.859)}{0.1281} \ln r_m + \underset{(5.752)}{0.2421} \ln y_1 \qquad \begin{matrix} DW = 1.127 \\ R^2 = 0.990 \end{matrix}$$

$$\ln m_2(p_c) = \underset{}{-3.649} + \underset{(6.556)}{1.2031} \ln y(p_c) - \underset{(-1.611)}{0.1071} \ln r_m + \underset{(6.272)}{0.2591} \ln y_1 - \underset{(-1.471)}{0.0241} \ln p^*_c \qquad \begin{matrix} DW = 0.947 \\ R^2 = 0.991 \end{matrix}$$

Note: m_1 = real money balances exclusive of time deposits; m_2 = real money balances inclusive of time depositis; y = real national income; r_l = yield on long-term government bonds; r_m = call money rate; y_1 = index of industrial production; p^*_n = rate of change of prices as reflected in the implicit national income deflator; p^* = rate of change of prices as reflected in the consumer price index.

The use of r_g in conjunction with the consumer price index instead of the implicit national income deflator causes significant deterioration in our results. The original data yielded relatively poor results and very high autocorrelation. Even after the removal of autocorrelation, there was only marginal improvements in our results. Like the results from the original data the rate of interest and rate of change of consumer prices yielded very poor results. Furthermore, the adjusted coefficient of multiple correlation is lower and the adjusted standard error of estimate is higher, for both definitions of money, as compared with the results by using the national income deflator. These estimates are not shown in tables.

The use of call money rates (r_m) with respect to either of the two price series produced relatively poor results, but p^*_n performed much better than p^*_c. In the case of p^*_n signs of regression coefficients for r_m are correct, but coefficients and their t values are lower than those for r_g (see Table 1). The general nature of the results obtained by using r_m and p_c (not shown in tables) was similar to those obtained by using r_g and p_c with the exception of

$$\ln m_1(p_c) = -10.624 + 1.137 \ln y(p_c) - 0.1051 \ln r_m - 0.0651 \ln p^*_c \quad 1951\text{—}70$$
$$(6.908) \qquad (-0.906) \qquad (-1.497)$$
$$DW = 1.468, \quad R^2 = 0.888 \tag{8}$$

Insofar as the demand for money function with three explanatory variables—income, interest rate, and prices—is concerned, this is the only equation in which we find any evidence of simultaneous negative effect of interest rate and changes in prices on the demand for real balances as suggested by the substitution hypothesis. As is obvious from this equation, this result cannot be considered significant for either of the two hypotheses.

The addition of the index of industrial production (y_I) as an independent variable, when coupled with r_m, brings about an overall improvement in our results for the substitution hypothesis. This is true whether prices used in deflating monetary variables (or as a separate argument in the function) are consumer prices or the implicit national income deflator. The most significant estimates are

$$\ln m_1(p_n) =$$
$$-1.464 + 0.791 \ln y(p_n) - 0.1681 \ln r_m + 0.2471 \ln y_I + 0.0181 \ln p^*_n \quad 1951\text{—}70$$
$$(4.025) \qquad (-2.856) \qquad (4.891) \qquad (1.246)$$
$$DW = 1.689, \quad R^2 = 0.984 \tag{9}$$

$$\ln m_2(p_n) =$$
$$-4.444 + 1.373 \ln y(p_n) - 0.1331 \ln r_m + 0.2071 \ln y_I + 0.0141 \ln p^*_n \quad 1951\text{—}70$$
$$(6.647) \qquad (-2.152) \qquad (3.902) \qquad (0.904)$$
$$DW = 1.359, \quad R^2 = 0.992 \tag{10}$$

The four arguments in equations (9) and (10) explain almost all of the observed variance in real money balances whether money is defined exclusive or inclusive of time deposits. All arguments except p^*_n yield significant regression coefficients. The exclusion of p^*_n as may be seen from Table II leaves the fit of the

regression unaffected. The Durbin Watson test for equation (9) shows the residuals to be free of auto-correlation at the 1 per cent level (almost free at the 2 per cent level) but the test is inconclusive at the 5 per cent level. The test for equation (10) is inconclusive at the 1 per cent as well as at the 5 per cent level. The t-tests indicate that the first three arguments in equations (9) and (10) are significant at the 5 per cent level (y and y_1 at the .5 per cent level).

The implication of all this for the substitution hypothesis is that r_m used as a proxy for the yield on money substitutes appears to be an important variable in explaining variations in the demand for money if the specialized nature of an underdeveloped economy is taken into account. The interest elasticity is significant and indicates a legitimate support for consideration of the role of non-money assets as substitutes for money.

The most disturbing aspect of including the index of industrial production as an independent variable comes from the use of r_g instead of r_m. The fit remains good and regression coefficients are reasonable with correct signs but their t values are not significant indicating a less important role of r_g as an explanatory variable.[9]

VI. THE EVIDENCE ON THE COMPLEMENTARITY HYPOTHESIS

Before we discuss results obtained by the application of equation (5), it is important to note the significance of y_1 for the complementarity hypothesis. Equations (9) and (10), reported above, indicate a strong positive correlation between variations in y_1 and the demand for money, i.e., substantial positive regression coefficients with t values significant at the 1 per cent level. As pointed out elsewhere in this paper, such a relationship is in accord with the complementarity hypothesis because increases in y_1 are closely related to increases in physical capital.

The best estimates from the application of equation (5) are

$$\ln m_1(p_c) = \underset{}{-3.341} + \underset{(8.066)}{0.9391} \ln y(p_c) + \underset{(2.723)}{0.0741} \ln (d\text{-}p^*_c) \underset{(-0.968)}{-0.0341} \ln k \quad 1951\text{-}70$$

$$DW = 1.568, \quad R^2 = 0.905 \qquad (11)$$

$$\ln m_2(p_c) = \underset{}{-14.465} + \underset{(11.120)}{1.4031} \ln y(p_c) + \underset{(2.882)}{0.1111} \ln (d\text{-}p^*_c) + \underset{(0.558)}{0.0291} \ln k \quad 1951\text{-}70$$

$$DW = 1.608, \quad R^2 = 0.941 \qquad (12)$$

Equation (11) indicates that a substantial portion of variations in real money balances is explained by the three arguments but elasticities of $d\text{-}p^*_c$ and k are low. In addition, the regression coefficient of k yields a sign contrary to the theory. One of the major reasons for poor results in equation (11) is that the less inclusive definition of money is not appropriate for a discussion of the

[9] This is quite contrary to the result obtained by Rao and Chaudhry [15], namely, that the role of r_g becomes more significant in determining the demand for money (defined in the broader sense) when y_1 is used as an explanatory argument in the function. The major reason for this difference is to be found in their use of nominal values of income and money as opposed to our use of real or deflated values.

complementarity hypothesis. When money is defined inclusive of time deposits as in equation (12), there are significant improvements in our results. Equation (12) shows that variations of y, d-p*$_c$, and k explain somewhat larger portion of variations in real money balances than before. All three arguments indicate a positive relation to money demand as suggested by the complementarity hypothesis. The Durbin-Watson test implies that serial correlation is rejected at the 2 per cent level, but the test is not conclusive at the 5 per cent level. Assuming on the basis of these results that no serial correlation the t-tests suggest that v and d-p*$_c$ are statistically significant at the 1 per cent level. However, k is insignificant.

These findings provide some evidence to the effect that money and physical assets may be treated as complementary in the context of underdeveloped economies. Due to the data and other problems, these results are less than satisfactory and can hardly be considered conclusive on the domination of the complementary effect as opposed to the substitution effect.

The results obtained by using the implicit national income deflator are somewhat contradictory. The adjusted coefficient of multiple correlation is higher and there is also slight improvement in the performance of y. However, d-p*$_c$ yields an incorrect sign with very low values of regression coefficients. There is no significant improvement in the performance of k. The Durbin-Watson test indicates the presence of significant autocorrelation but the removal of autocorrelation does not bring about any noticeable change in these results. In Table III we have shown many o these reuslts.

VII. CONCLUSION

There is overwhelming evidence in favour of real income as the primary determinant of the demand for money in Pakistan. Unlike Adekunle [1,pp. 36-37] our empirical analysis shows that there is also sufficient evidence to emphasize interest rate effects and, therefore, the role of non-money assets as substitutes for money. However, the rate of change of prices appears to have no significant influence on the demand for real money balances in Pakistan. Various policies pursued by the government and designed to minimize fluctuations in prices are responsible for this result. Among such policies most noteworthy were prior to 1958, extensive controls on trade, commodity distribution, and prices; and throughout the entire period, the use of PL 480 to provide a buffer to maintain low prices.[10]

Passing to the complementarity hypothesis, our empirical analysis presents some evidence to support the view that the demand for money and the demand for physical capital are complementary. The investment/income ratio shows a weak but consistently positive effect on the demand for money. The real rate of return on money indicates a significant positive effect on the demand for money when the consumer price index is used but yields contrary results when the implicit national income deflator is used. The most trustworthy support to the complementarity hypothesis is lent by the significance of the index of industrial production in determining the demand for money.

Given the available data, the evidence in this study supports the domination of the substitution effect as opposed to the complementary effect. Never-

[10]A detailed analysis of various controls and their impact on monetary variables Pakistan is presented by Soligo [16].

TABLE III

The Demand for Money in Pakistan: The Evidence on the Complementarity Hypothesis

$\ln m_1(p_n) = -2.907 + 1.1281 \ln y(p_n) - 0.0261 \ln (d\text{-}p^*_n) + 0.0511 \ln k$	DW	=0.868
(9.601) (—1.085) (0.826)	R^2	=0.952
$\ln m_1(p_c) = -2.486 + 1.0971 \ln y(p_c) + 0.0131 \ln (d\text{-}p^*_c) + 0.0501 \ln k$	DW	=0.593
(9.783) (0.464) (0.964)	R^2	=0.946
$\ln m_1(p_c) = -3.341 + 0.9391 \ln y(p_c) + 0.0741 \ln (d\text{-}p^*_c) - 0.0431 \ln k$	DW	=1.568
(8.066) (2.723) (—0.968)	R^2	=0.905
$\ln m_2(p_n) = -8.294 + 1.6691 \ln y(p_n) - 0.0201 \ln (d\text{-}p^*_n) + 0.0471 \ln k$	DW	=0.949
(16.137) (—0.958) (0.851)	R^2	=0.981
$\ln m_2(p_c) = -7.320 + 1.5961 \ln y(p_c) + 0.0171 \ln (d\text{-}p^*_c) + 0.0881 \ln k$	DW	=0.598
(13.403) (0.564) (1.592)	R^2	=0.971
$\ln m_2(p_c) = -14.465 + 1.4031 \ln y(p_c) + 0.1111 \ln (d\text{-}p^*_c) + 0.0291 \ln k$	DW	=1.608
(11.120) (2.882) (0.558)	R^2	=0.941
Period: 1960-70		
$\ln m_1(p_w) = -3.019 + 1.1381 \ln y(p_w) - 0.0031 \ln (d\text{-}p^*_w) + 0.0291 \ln k$	DW	=1.473
(10.282) (—0.142) (0.452)	R^2	=0.961
$\ln m_2(p_w) = -9.517 + 1.7781 \ln y(p_w) - 0.0211 \ln (d\text{-}p^*_w) + 0.0231 \ln k$	DW	=1.732
(20.575) (—1.446) (0.450)	R^2	=0.990

Note: m_1 = real money balances exclusive of time deposits; m_2 = real money balances inclusive of time deposits; y = real national income; d = average deposit rate on six-month to one-year time deposits; p^*_n = rate of change of prices as reflected in the implicit national income deflator; p^*_c = rate of change of prices as reflected in the consumer price index; p_w = rate of change of prices as reflected in the wholesale price index; k = investment/income ratio.

theless, we must emphasize policy implications of the existence of considerable complementary influence exerted by the real rate of return on money and the investment/income ratio. It is now possible to relate the process of capital formation more directly to changes in the monetary policy. If the rate of change of prices is known or predictable, authorities can set the real rate of return on money at whatever level they believe to be socially desirable. Changes in the deposit rate will directly affect investment-savings propensities, which in turn will affect the rate of economic growth. In view of the potential usefulness of the complementarity hypothesis, there is a definite need for more empirical analyses along these lines.

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APPENDIX

The Demand for Money in Pakistan: The Data

Year	Y (Million Rs.)	M_1 Million Rs.	M_2 Million Rs.	I Million Rs.	y_1 (1960=100)	p_n (1960=100)	p_c (1960=100)	p_w (1960=100)	d	r_g	r_m
1950	—	—	—	—	—	81.28	80.07	—	—	—	—
1951	19427.0	3156.0	3433.0	323.0	23.7	81.68	76.01	—	2.00	2.99	1.43
1952	21073.0	3310.0	3553.0	608.0	29.4	88.69	81.62	—	1.94	2.98	1.41
1953	20372.0	3371.0	3675.0	772.0	37.3	83.28	87.54	—	2.18	3.06	1.82
1954	20387.0	3637.0	4070.0	928.0	48.0	78.38	87.24	—	2.10	3.14	0.93
1955	19697.0	3900.0	4419.0	964.0	61.0	75.55	82.85	—	2.06	3.15	1.48
1956	21139.0	4553.0	5117.0	927.0	73.2	81.28	83.50	—	1.94	3.16	1.75
1957	24839.0	5005.0	5574.0	765.0	78.6	90.18	89.82	95.37	2.25	3.17	2.23
1958	26518.0	5355.0	6055.0	1238.0	84.2	95.57	96.95	95.62	2.50	3.20	1.70
1959	26105.0	5552.0	6305.0	1209.0	92.6	92.87	93.99	93.94	2.37	3.22	1.66
1960	29342.0	5846.0	6792.0	1743.0	100.0	100.00	100.00	100.00	2.37	3.37	2.39
1961	32423.0	5870.0	7098.0	2242.0	118.5	105.23	104.46	102.99	2.78	3.60	3.62
1962	34042.0	6096.0	7603.0	3267.0	138.2	104.07	107.14	105.88	2.75	3.74	3.73
1963	36020.0	6976.0	8911.0	3404.0	158.9	106.51	106.32	104.80	2.85	3.88	3.11
1964	38425.0	7979.0	10411.0	4614.0	180.4	104.82	110.87	104.62	3.16	3.92	3.35
1965	43058.0	8746.0	11974.0	5821.0	200.5	111.45	115.88	112.43	2.91	3.92	4.70
1966	48227.0	9966.0	14005.0	5881.0	212.8	118.50	118.11	117.54	3.51	4.48	5.12
1967	53100.0	10493.0	15633.0	5869.0	235.1	129.55	130.66	133.88	3.59	4.48	5.57
1968	56586.0	10852.0	16785.0	5547.0	252.5	127.69	134.20	128.58	4.08	4.47	6.71
1969	61899.0	12248.0	18449.0	5612.0	271.3	133.65	136.93	137.07	4.95	5.12	5.65
1970	65086.0	13326.0	20440.0	6134.0	300.5	131.84	143.60	140.01	5.05	5.24	5.38

Note: Sources and description of the data are presented elsewhere in the paper; Y = national income (in current prices); I = aggregate net investment (in current prices); M_1 = nominal stock of money exclusive of time deposits; M_2 = nominal stock of money inclusive of time deposits; y_2 = index of industrial production; p_n = implicit national income deflator; p_c = consumer price index; p_w = wholesale price index; d = average deposit rate on six month to one year time deposits; r_g = annual yield on long-term government bonds; r_m = call money rate.