DM/85/63

INTERNATIONAL MONETARY FUND

Central Banking Department

Interest Rates, Saving and Investment in Developing Countries: A Re-examination of the McKinnon-Shaw Hypotheses

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October 7, 1985

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*I am indebted to Messrs. Galbis, Leite and Sundararajan for many valuable comments on an earlier draft of this paper. I am solely responsible for any remaining errors.

I. Introduction

Until the early 1970s the economic literature on saving and investment was mainly geared toward advanced countries, with the common presumption that the same analysis applied to developing countries. According to this analysis, the relationship between savings and interest rates could be ambiguous in light of the opposing influences of the income and substitution effects, but the relationship between investment and interest rates was unambiguous. Low interest rates would promote investment spending and economic growth in developed and developing countries alike, in accordance with the Keynesian and neoclassical theories. Although the empirical evidence on the interest sensitivity of investment was mixed, economic policymakers in developing countries frequently adopted low interest rate policies as a way of promoting economic growth. 1/ McKinnon and Shaw were the first to seriously challenge this conventional wisdom.

McKinnon (1973) analyzed an economy with very limited external finance possibilities for the vast majority of investors. He argued that, because of the lumpiness of physical capital, savers may find it convenient to accumulate funds in monetary assets until they have enough resources to invest in higher-yielding physical assets. In McKinnon's words, deposits may serve as a "conduit" for capital formation, making deposits and capital complementary assets. 2/ The availability of deposits with positive real rates of return may thus encourage both savings and capital accumulation.

Shaw (1973) also stressed the importance of positive real deposit rates as an inducement to save in financially repressed economies but, unlike McKinnon, he emphasized external rather than internal financing possibilities as the effective constraint on capital formation. Focusing

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1/ A detailed discussion of various rationales for a low interest rate policy is given in Shaw (1973, pp. 92-112). For a survey of empirical studies on investment behavior in advanced countries, see Jorgenson (1971). Empirical studies on the interest sensitivity of savings and investment in LDCs were much more scarce until the early 1970s, partly as a result of data limitations. For discussions of the relevant literature, see Mikesell and Zinser (1973), and Leff (1975).

2/ Even though McKinnon describes an extreme case of financial repression with no possibilities of external finance, his argument is intuitively appealing under much more general circumstances. For example, in the U.S. economy, with its highly sophisticated financial system, housing investment is subject to similar considerations. External financing is typically available for only a fraction of the price of a house and some savers may need a few years to accumulate sufficient funds for a downpayment. For these savers, high money market rates may encourage accumulation of liquid assets for the purpose of buying a house. Even if higher rates do not generate more saving, they may increase investment by making more expensive houses affordable.

on the role of deposits as a source of funds for financial intermediaries, Shaw argued that high deposit rates may stimulate investment spending by allowing the supply of credit to expand in line with the financing needs of the productive sectors of the economy.

Although much theoretical and empirical work has been aimed at criticizing, testing or elaborating on the McKinnon-Shaw propositions in the last ten years, there remains today some misunderstanding or confusion over their interpretation. 1/ This confusion is due mainly to a neglect of the intertemporal nature of McKinnon's complementarity hypothesis and to the common presumption that this hypothesis is inconsistent with Shaw's debt-intermediation view. 2/

The purpose of this paper is to sharpen our understanding of these two hypotheses, using an analytical model that allows explicit treatment of their intertemporal aspects. The model underscores the lag in the effect of interest rates on investment, saving and asset-holding decisions and shows that the McKinnon-Shaw theses are mutually compatible. With regard to the existing empirical work, the model implies that it has failed to test adequately the validity of these two theses, partly due to misspecification of the appropriate lag structure. Based on this model the paper provides suggestions on how to specify aggregate investment, saving, and money demand functions in developing countries, so as to do more justice to the complexity of saving-investment decisions.

The paper is organized as follows. Section II develops a three-period life-cycle model of consumption and saving behavior. This model allows us to study the effects of deposit rate changes under various circumstances, including the McKinnon case of pure self-finance and the case of part debt-finance. The model is extended in Section III, with an informal derivation of some testable implications for aggregate economic behavior. Section IV gives a critical review of related empirical studies, and Section V contains some concluding remarks along with suggestions for further research.

1/ Gupta (1984, p. 3), for example, argues that "neither McKinnon nor anyone else has offered any rationale for [the assertion] that private saving (investment) is sensitive to the real return on holding money." But this assertion is at the center of McKinnon's argument and questioning it indicates failure to understand it. Van Wijnbergen (1983b, p. 433), in a similar vein, refers to McKinnon's analysis as eloquent but occasionally vague. For more specific references to misunderstandings of McKinnon's complementarity hypothesis, see footnote 1, page 19.

2/ Fry (1982a), for example, asserts that complementarity is incompatible with the debt intermediation view. Gupta (1984) also refers to the two hypotheses as competing theories, although he makes an attempt to integrate them into one empirical model.

II. A Microeconomic Model of Saving-Investment Behavior

In this section we develop a three-period life-cycle model of consumption with no bequests, which differs from the conventional Fisherian model in that it allows for more than one asset, with different rates of return. This feature is important for our purposes, because it makes possible the study of the complementarity hypothesis, which involves accumulation of saving first in the form of deposits and later in the form of physical capital. In the case of certainty about all rates of return, we derive the complementarity relationship under pure self-finance and show that the introduction of borrowing possibilities need not alter the nature of this relationship. For the case of pure self-finance, we also show that when capital is a risky asset and deposits are a safe asset, the complementarity relationship may break down.

We start by considering a consumer who expects to live three periods and has a utility function that depends on consumption in each one of these periods. The consumer earns income only in the first two periods and saves part of it for consumption in the third period. Savings can be invested in deposits with financial institutions or physical capital. The consumer can finance some of his asset holdings with loans in the first two periods, and repays all his loans, liquidates all his assets, and consumes all his wealth in the third period, as there are no bequests.

When capital markets function smoothly, the consumer's asset holdings will reflect his rate of time preference, the rates of return on the various assets and liabilities, and, if these returns are uncertain, his attitude toward risk. In a financially repressed economy, 1/ however, the consumer may be constrained to borrow less than he wishes to, and, at the limit, he may have to finance his acquisition of all goods and assets with his own resources. Also, in the absence of a well developed equity market, physical capital may be much less divisible an asset than in more sophisticated economies. This lumpiness, together with borrowing constraints, may make it necessary for investors to accumulate savings over some time in the form of deposits, before investing in physical capital. 2/ It is precisely in this capacity that McKinnon (1973) argues that deposits serve as a "conduit" for capital accumulation.

In order to determine the nature of the complementarity between deposits and physical capital we set up the consumer's optimization problem formally. The consumer maximizes:

1/ Financial repression is defined to entail artificially low deposit and loan rates that give rise to excess demand for loans and to nonprice credit rationing [McKinnon (1973, Ch. 7) and Shaw (1973, Ch. 4)].

2/ This pattern of savings accumulation is by no means peculiar to financially repressed economies. Self-financing may be optimal even in economies with highly developed capital markets, when borrowing rates are sufficiently high.

(1) $u = u(C_1, C_2, C_3)$ 1/

subject to the constraints:

(2) $Y_1 - C_1 - S_1 = 0$

(3) $Y_2 - C_2 - S_2 = 0$

(4) $S_1 + L_1 - K_1 - D_1 = 0$

(5) $S_2 + L_2 + K_1(1+r_K) + D_1(1+r_d) - L_1(1+r_L) - K_2 - D_2 = 0$

(6) $K_2(1+r_K) + D_2(1+r_d) - L_2(1+r_L) - C_3 = 0$

(7) $K_1(K_1 - K_{min}) > 0$

(8) $K_2(K_2 - K_{min}) > 0$

(9) $L_1 < \bar{L}_1$

(10) $L_2 < \bar{L}_2$

where

C_i = Spending in the beginning of the i^{th} period on goods that are consumed during the period, $i = 1, 2, 3$

D_i = Funds deposited with banks in the beginning of the i^{th} period, $i = 1, 2$

K_i = Physical capital purchased in the beginning of the i^{th} period, $i = 1, 2$

K_{min} = Minimum possible investment in physical capital

L_i = Borrowing in the beginning of the i^{th} period that is repayable in the beginning of the $i+1^{th}$ period, $i = 1, 2$

1/ In principle, C_3 may be a random variable if there is uncertainty with respect to interest rates. Constraints (5) and (6) can then be interpreted to hold for expected values. The cases with and without risk will be considered separately in the following analysis.

$\bar{L}_i$ = Maximum amount of borrowing possible in the i^{th} period, $i = 1, 2$

r_d = Rate of return on bank deposits

r_k = Rate of return on physical capital

r_L = Rate of return on loans

S_i = Savings in the i^{th} period, $i = 1, 2$

Y_i = Noninterest income, received in the beginning of the i^{th} period, $i = 1, 2$

and $r_d < r_L$.

We assume that the marginal utility of C_i is positive, decreasing in C_i and independent of C_j for $i = 1, 2, 3$ and $j \neq i$. We also assume that the rate of return on deposits is lower than the loan rate, which implies that the consumer will never choose to borrow and hold deposits at the same time. Constraints (2) and (3) simply state that income in each period must be allocated between consumption and savings. Equations (4) and (5) are the financing constraints which require that first-period assets be financed out of borrowings and current savings, and second-period assets out of previously accumulated wealth plus new savings and borrowings. In the third period there is no current income and all consumption is financed by the liquidation of second-period investments as is indicated by (6). Finally, inequalities (7) and (8) reflect the lumpiness of physical capital and inequalities (9) and (10) are the borrowing constraints which are likely to be effective in financially repressed economies. If the consumer's desired investment in physical capital falls short of the required minimum, K_{min}, then he can hold either more capital than he wishes to ($K_i = K_{min}$), or none at all ($K_i = 0$). Of course, if the minimum capital requirement is not binding ($K_i > K_{min}$), then (7) and (8) are inconsequential. Since our purpose is to highlight the "conduit" role of deposits it is useful to assume that desired savings and borrowing possibilities are insufficient to make investment in capital positive in the first period, while in the second period enough resources have been accumulated to make (8) ineffective. More specifically, we have

(11) $K_1 = 0$

(12) $K_2 > K_{min}$

Equations (4) and (11) imply that

(13) $L_1 = 0$

and (14) $D_1 = S_1$.

In other words, all investment in physical capital takes place in the second period while all first-period savings are placed in deposits. Thus, deposits can be viewed as a temporary abode of funds which facilitates the accumulation of resources necessary to satisfy the minimum capital requirement.

It is already clear at this point that the "conduit" role of deposits and their possible complementarity with physical capital result from the intertemporal nature of the process of capital accumulation. Deposits and capital in the second period (D_2 and K_2) may thus be perfect substitutes, while first-period deposits and second-period capital (D_1 and K_2) are complementary. In order to derive these relationships more explicitly we consider separate cases depending on the riskiness of physical capital, and on the existence of borrowing possibilities. 1/

1. The case of certainty

In this case investors are, or act as if they were, certain about the rates of return that they will realize on all assets and liabilities. We distinguish two cases depending on the availability of borrowing possibilities.

a. The model with pure self-finance 2/

A saver-investor may be confined to self-finance, either because he has no access to external funds ($\overline{L}_2 = 0$) or because loan rates are too high for borrowing to be worthwhile ($r_k < r_L$). As was pointed out above, our assumption that the minimum capital requirement cannot be met in the first period implies that all first-period savings are placed in deposits. In the second period, however, there is a choice between deposits and capital. If both assets are riskless, then the investor will choose to hold only the one with the higher rate of return. 3/ In this formulation, therefore, the two assets are perfect substitutes in the second

1/ The detailed solution of the model and the derivation of the results presented in Sections II.1 and II.2 are available from the author upon request.

2/ This case is perhaps the most appropriate one for illustrating the nature of complementarity between deposits and capital described by McKinnon, who assumes that "all economic units are confined to self-finance, with no useful distinction to be made between savers (households) and investors (firms)... These firm-households do not borrow from, or lend to, each other." [McKinnon (1973, p. 56)]

3/ In addition to riskiness, divisibility, and the rate of return, there are other characteristics, such as taxability, liquidity, and transactions costs, that may make one asset dominate the other in consumers' preferences. In our model we abstract from taxes, and liquidity is not very important since the investor knows with certainty when he will be selling his assets. Thus, the rates of return, which can be defined to be net of transactions and other related costs, ultimately determine which asset will be held.

period and the lower-yielding asset will not be demanded at all. If there is to be any investment at all in physical capital, we must have

(15) $r_d < r_k$

Obviously, if (15) holds, the investor will prefer to hold only physical capital in his portfolio in both the first and second periods. The minimum capital requirement, however, forces him to accumulate savings in the form of deposits in the first period in order to be able to take advantage of the higher profitability of capital in the second period. Thus, the only function of deposits is that of a "conduit" for capital accumulation.

Solving the consumer's optimization problem we obtain:

$$(16) \qquad \frac{\partial u/\partial C_1}{\partial u/\partial C_2} = 1 + r_d$$

$$(17) \qquad \frac{\partial u/\partial C_2}{\partial u/\partial C_3} = 1 + r_k$$

$$(18) \qquad \frac{\partial u/\partial C_1}{\partial u/\partial C_3} = (1 + r_d)(1 + r_k)$$

Conditions (16), (17), and (18) simply require that the marginal rate of substitution between consumption in any two periods equal the relevant discount rate. The deposit rate gives us the rate at which first-period consumption can be exchanged for second-period consumption, as all savings are originally accumulated in deposits. In the second period, the minimum capital requirement is no longer binding, and the exchange rate between second- and third-period consumption is determined by the higher rate of return on capital.

Looking at the effects of interest rates on consumption, savings, and asset demands, we note that our model differs from the simple Fisherian framework in two important ways. First, we allow for two different assets with distinct rates of return. This makes it possible, at least in principle, for the two rates to affect each variable in different directions. Second, in our model saving takes place in both the first and second periods. In addition to the ambiguities that are typically associated with income and substitution effects of changes in interest rates, this raises the possibility of offsetting changes in saving in the two periods.

More specifically, the only unambiguous effects of changes in the deposit rate are those on second-period demand for capital and second-period saving. We have

(19) $dK_2/dr_d > 0$ and $dS_2/dr_d < 0$.

In other words, a rise in the deposit rate discourages second-period saving and encourages capital formation.

The positive relationship between demand for capital (K_2) and the rate of return on deposits (r_d) is a direct result of the "conduit" role of deposits. This relationship is unambiguous because, in this version of our model, deposits can never be viewed as a competing asset for capital and are used exclusively as a temporary abode for savings. Thus, a rise in r_d raises the quantity of funds available for investment in the second period without leading to a substitution away from capital and into deposits. 1/ Similarly, second-period saving (S_2) is inversely related to r_d as a result of this mode of accumulating wealth, first in the form of deposits and then in the form of capital. In general, there are income and substitution effects of interest rate changes on saving which make the net effect ambiguous. In our case, however, a change in r_d can have no substitution effect on S_2 since all wealth is held in physical capital in the second period. The income effect, then, obviously dominates and a higher r_d increases second-period wealth and thereby second-period consumption.

The other effects of r_d and r_k on consumption, savings, and demand for capital are subject to the usual qualifications with respect to the relative magnitude of the income and substitution effects. Three cases can be distinguished:

(a) The substitution effect dominates. We have:

(20) $dS_1/dr_d > 0$, $dS_1/dr_k > 0$, $dS_2/dr_k > 0$ and $dK_2/dr_k > 0$.

(b) The substitution effect dominates for r_d but not for r_k. We now have:

(21) $dS_1/dr_d > 0$, $dS_1/dr_k < 0$, $dS_2/dr_k < 0$ and $dK_2/dr_k < 0$ and

(c) The income effect dominates. In this case we have:

(22) $dS_1/dr_d < 0$, $dS_1/dr_k < 0$, $dS_2/dr_k < 0$ and $dK_2/dr_k < 0$.

1/ The implicit assumption here is that r_d does not rise enough to overtake r_k. If $r_d > r_k$, then our model implies that all wealth is shifted into deposits and that investment in physical capital falls to zero; this is one of the points made by Khatkhate (1980).

In case (a) both interest rates have positive effects on first-period saving, and r_k has a positive effect on savings and on demand for capital in the second period. Case (b) is slightly more interesting, as first-period saving is positively related to r_d but negatively related to r_k. This is because the substitution effect is stronger in the first period for r_d than it is for r_k. A rise in r_d, on the one hand, stimulates a relatively larger amount of saving in the first period because it changes the rates of substitution between both first- and second-period consumption $(1 + r_d)$ and first- and third-period consumption $[(1 + r_d)(1 + r_k)]$. A rise in r_k, on the other hand, leaves the terms of trade between first- and second-period consumption unchanged and has a weaker overall substitution effect on first-period consumption and saving. Finally, in case (c) the income effect dominates for both interest rates in both periods. The apparent paradox in this case is that even though a rise in r_d discourages saving in both the first and second periods, it still stimulates demand for capital (K_2) as (19) always holds. Since in our model all investment is self-financed, a question arises as to the availability of resources for K_2 to rise. K_2 is financed with second-period savings and first-period savings that have been placed in deposits. We have:

$$(23) \qquad K_2 = S_1(1 + r_d) + S_2 \; .$$

This implies that a change in r_d affects K_2 not only through changes in savings but also through changes in interest income from first-period saving. We have:

$$(24) \qquad \frac{dK_2}{dr_d} = \frac{dS_1}{dr_d}(1 + r_d) + \frac{dS_2}{dr_d} + S_1 \; .$$

Thus, even if S_1 and S_2 are inversely related to r_d, the effect on interest earned on S_1 allows a positive relationship between K_2 and r_d. With regard to consumption, (19) and (22) imply that a rise in r_d raises C_1 and C_2. Our assumption of diminishing marginal utility implies that it is optimal for C_3 to share some of the gains of the increase in r_d. But C_3 can rise only if K_2 rises since, with $D_2 = 0$, (6) becomes

$$(25) \qquad C_3 = K_2(1 + r_k) \; .$$

Hence, a rise in r_d leads to a higher K_2 irrespective of its effects on saving.

Looking at the properties of the asset-demand functions, recall that all first-period savings are placed in deposits. Since demand for deposits is identical to savings in the first period, the properties of the deposit-demand function can be obtained from (20)-(22). It follows that dD_1/dr_k may be positive or negative while dK_2/dr_d is always positive.

These results confirm McKinnon's complementarity hypothesis. It should be emphasized, however, that this is a peculiar sort of complementarity as it refers to assets that are held at different points in time.

Our results imply that demand for capital may be positively associated with deposit rates even if saving responds negatively to these rates. Higher deposit rates increase the wealth of prospective investors, and thereby the amount of resources available for future investment. This wealth effect may be especially important in countries with less developed capital markets, where the nonexistence of alternative financial assets may force savers to hold deposits for some time, even if the real deposit rate is negative. The compound wealth effect of deposit rates is likely to be substantial, and a change in the authorities' policy stance from negative to positive real rates may increase resources available for self-financed investment dramatically.

To illustrate the importance of this type of wealth effect it is useful to consider a real-world example. We choose two countries, one that followed a positive real rate policy and one with negative rates during the period 1978-1981. The actual figures are: 1/

	Real Deposit Rate	
	Country 'A'	Country 'B'
	(In per cent)	
1978-1979	3.7	-25.3
1979-1980	5.4	-13.8
1980-1981	12.1	-27.9

We consider two savers that deposited 100 local currency units each, in bank accounts in countries 'A' and 'B', respectively, in 1978. By 1981 these deposits would be worth 122.5 units in 1978 prices in Country 'A' but only 46.4 units in Country 'B'. The depositor in the high interest rate country would have almost three times the wealth he would have had if he had lived in the low interest rate country. In light of the magnitude of this wealth effect, the theoretical possibility

1/ The figures are taken from "Interest Rate Policies in Developing Countries," IMF, Occasional Paper 22 (October 1983, p. 4).

that higher deposit rates will stimulate investment in physical capital even if they do not generate more saving seems quite plausible. 1/

b. The model with external finance

In this case we assume that the investor is able to obtain one-period loans not exceeding $\bar{L}_1$ and $\bar{L}_2$, in the first and second periods, respectively. 2/ We still assume that, in the first period, the investor does not have sufficient resources to satisfy the minimum capital requirement; this implies that there is no borrowing in that period, as the loan rate exceeds the deposit rate. We also assume that the rate of return on capital is higher than the loan rate. We have

$$r_d < r_L < r_k .$$

In the absence of risk, this interest rate structure induces the investor to borrow as much as he can in the second period, in order to increase his holdings of physical capital. We have

(26) $L_1 = 0$

(27) $D_2 = 0$

and (28) $L_2 = \bar{L}_2$.

Finally, we assume that the loan rate exceeds the deposit rate by a fixed margin, α, which covers the cost of financial intermediation.

(29) $r_L = r_d + \alpha$.

1/ Our partial equilibrium framework is not well-suited for a rigorous treatment of this issue. The other side of negative real deposit rates may be artificially cheap credit. The net effect of interest rate changes on capital formation, then, depends on how this subsidized credit is utilized. If borrowers use subsidized credit for investment spending exclusively, then low rates need not hamper capital formation. If, on the other hand, credit finances consumer expenditures or capital flight, higher rates may be expected to promote domestic investment. Such general equilibrium considerations are outside the scope of this paper. Some of these issues are discussed informally in Section III.

2/ An alternative way of modeling the borrowing constraint would be to assume a maximum debt-equity ratio. Although this might seem more plausible than a nominal ceiling on borrowing capacity, the latter has been chosen because it makes the algebra much more tractable.

This implies that changes in deposit rates are always reflected in equal changes in loan rates.

A rise in the deposit rate now increases interest income from first-period savings, but also raises the cost of borrowing in the second period. In addition to the substitution effect, which encourages first-period saving, we may now have a negative income effect that encourages saving in both periods. However, the sign of the income effect depends on the relative importance of loans as a source of financing, and, as in the case of pure self-finance, the effects of changes in interest rates on savings are ambiguous when the income effect is positive.

The availability of external financing does not affect our results with respect to demand for physical capital, which continues to be positively related to the deposit rate, even when loans account for a large share of its financing. This is because of the assumption that actual borrowing is not affected by interest rate changes when there is excess demand for loans. As long as the rate of return on capital exceeds the loan rate, the investor wishes to borrow as much as he can and is restricted to the maximum amount of loans available to him ($\bar{L}_2$). Of course, if the interest rate rises sufficiently for the loan rate to exceed the rate of return on capital, then borrowing is no longer worthwhile, and this case degenerates to that of pure self-finance.

A relaxation of the borrowing constraint, through an increase in $\bar{L}_2$, also stimulates demand for capital in this version of the model. The increase in $\bar{L}_2$, however, encourages consumption and discourages saving in the first two periods. Increased borrowing possibilities are viewed as a windfall gain, as long as borrowed funds can be invested profitably. This gain is realized in the third period, when all assets and liabilities are liquidated, and induces the investor to increase consumption in the first and second periods, in order to allocate his increased wealth evenly.

The availability of external financing possibilities allows us to highlight some of the distinctions between the various channels through which interest rates affect savings and investment. McKinnon's complementarity hypothesis, on the one hand, emphasizes the role of deposits in encouraging self-financed investment. A rise in the deposit rate stimulates demand for capital by making savings accumulation more rewarding, and by increasing the amount of internally financed investment. Shaw's debt-intermediation view, on the other hand, focuses on the role of deposit accumulation in expanding the lending potential of financial intermediaries. Higher deposit rates encourage the inflow of deposits in banks, which in turn can increase lending, thereby stimulating externally financed investment. Although the Shaw and McKinnon theses emphasize different aspects of the process of accumulation of financial assets and liabilities, it is clear from our discussion that they should be viewed as complementary rather than competing theories. A more systematic attempt to integrate these two theories is postponed until Section III below.

2. The case of uncertainty 1/

In general, the returns to capital and other assets may be associated with a great deal of uncertainty. If deposits are considered safer than capital, the two assets will not be perfect substitutes. A risk-averse investor may choose to hold both capital and deposits if the expected rate of return on capital is higher than the deposit rate.

We can extend the model of the previous section to account for risky investments by allowing the rate of return on capital to be a random variable. We assume that the deposit and loan rates are known with certainty, which again implies that the investor will never wish to borrow and hold deposits at the same time. If the minimum capital requirement can be met only in the second period, the investor will place all his savings in deposits in the first period, and, in the second period, he may choose to hold a diversified portfolio of deposits and capital, or to hold all his wealth in capital. The possibility of portfolio diversification is especially interesting for our purposes as it allows deposits and physical capital to be complements in the first period, but substitutes in the second period. We can determine the effects of changes in interest rates, for this case, by solving the consumer's optimization problem.

The marginal rate of substitution between C_1 and C_2 is the same as in the certainty model since all first-period savings are still held in deposits. The rate of substitution between C_2 and C_3, however, can vary depending on the relative size of deposit and capital holdings in the second period. It attains its minimum $(1 + r_d)$ when no capital is held $(K_2 = 0)$ and its maximum $(1 + r_k)$ when no deposits are held $(D_2 = 0)$. Finally, the rate at which expected third-period consumption can be traded for a reduction in its riskiness is smaller the greater the margin between r_k and r_d. This is because a reduction in riskiness can only be attained by shifting from capital to the safe asset. Given any fall in C_3, the larger the gap $r_k - r_d$, the smaller the corresponding fall in K_2 and the smaller the accompanying risk reduction.

In this formulation of the consumer's maximization problem deposits and capital need not be complements. In particular, it can be shown that under some conditions we may have:

$$(30) \qquad \frac{dK_2}{dr_d} < 0, \quad \frac{dC_1}{dr_d} < 0, \quad \frac{dD_1}{dr_d} > 0, \quad \frac{dC_2}{dr_d} < 0, \quad \frac{dD_2}{dr_d} > 0,$$

and

1/ The model in this section is based on Tobin (1958).

$$(31) \qquad \frac{dK_2}{dr_k} > 0, \quad \frac{dC_1}{dr_k} > 0, \quad \frac{dD_1}{dr_k} < 0, \quad \frac{dC_2}{dr_k} > 0, \quad \frac{dD_2}{dr_k} < 0 .$$

A rise in the deposit rate now affects K_2 not only through the "conduit" effect but also through the competing asset effect. Thus, a rise in r_d may stimulate savings and demand for deposits in both periods, but it may also induce a shift from capital to deposits in the second period that offsets the savings effect. Notice that again it is possible for savings to be positively related to r_d but negatively related to r_k. A rise in r_d induces the investor to shift some of his funds from K_2 to D_2, which implies a lower but more certain level of consumption (C_3) in the third period, with the fall in C_3 moderated through inreases in saving in the first two periods. A rise in r_k, however, has the reverse effect. Shifts from D_2 to K_2 raise expected consumption (C_3) and its variance in the third period, and allow the individual to spread his increased consumption evenly, by decreasing saving in the first two periods.

The model of this section can be generalized to take account of inflationary uncertainty which is endemic in many less developed countries. So far, we have assumed that deposits are a safe asset and that only capital is associated with risk, drawing no distinction between nominal and real rates of interest. In practice, even if the nominal deposit rate is known with certainty, the variability in the rate of inflation may account for large fluctuations in real rates. In such situations both deposits and physical capital may be viewed as risky assets, and inflation hedges, such as precious metals or real estate, may play the role of safe assets. 1/ Interest rate policy may then have a much more powerful effect on the public's asset composition as the authorities may raise real deposit rates to consistently positive levels, thereby decreasing the riskiness of deposits. In time, deposits may replace inflation hedges in investors' portfolios as the highest-yielding safe asset and this may further stimulate current savings and the process of financial deepening.

III. Extension and Macro-Implications of the Model

The foregoing analysis has highlighted the differing roles of deposits in the various stages of the process of wealth accumulation. Deposits with financial institutions may be an investor's only outlet for savings while he accumulates funds for the purchase of higher-yielding assets. The investor may later shift his position vis-a-vis the financial system from one of net creditor to that of net debtor

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1/ Vogel and Buser (1976) allow for three risky assets. Their one-period model, however, cannot adequately account for the "conduit" role of deposits.

or he may choose to keep some deposits as the safe asset, along with higher-yielding, riskier assets in a diversified portfolio.

At any point in time, some investors are at an early stage of the process of wealth accumulation while others are at a later stage. In order to explain aggregate economic behavior, we must take into account both types of investors as well as the possible interactions between them. In our previous discussion we assumed that each individual borrower had access to a fixed amount of loans. From the point of view of the economy as a whole, however, aggregate credit flows are bound to be related to aggregate deposit flows. Accordingly, interest rate policy will influence capital formation by affecting not only the returns to internally financed investment but also the availability of external financing. The former effect is the focus of the analysis in McKinnon (1973), while the latter is emphasized by Shaw (1973).

In this section we attempt to integrate these two approaches and to determine their implications for aggregate economic behavior. We distinguish between past, current and expected future changes in interest rates in order to account for the intertemporal nature of McKinnon's complementarity hypothesis, and stipulate a positive relationship between the aggregate levels of deposits and loans, in accordance with Shaw's debt-intermediation view. We consider in turn the effects of interest rates on saving, investment and demand for money.

1. Saving

The aggregate saving function will reflect the behavior of the different types of depositors and borrowers described in Section II. Therefore, the saving function implied by our model can be written as:

$$(32) \qquad S^t = f(r_d^t, r_k^t, L^t, r_d^{t-1}, r_k^{t+1})$$

where

S^t = Flow of saving in period t

L^t = Stock supply of loans in period t

r_k^{t+1} = Expected rate of return on capital in period t+1

r_d^{t-1} = Rate of return on deposits in period t-1

In addition to current interest rates and the current supply of loans, both past and expected future rates enter the savings function. Past deposit rates affect the level of currently available internal funds and thereby current savings, while expected future rates of return on capital affect the expected return of current deposits that are to be placed in capital in the future. The presence of income and substitution effects results in the familiar ambiguities with respect to the effects of changes in current and expected future interest rates on saving. Changes in past rates, however, can have only income effects in the current period, and, as a result, only negative effects on current saving. Finally, increases in the supply of loans will encourage current consumption and will discourage current saving according to our model. We have:

$$(33) \qquad \frac{\partial S^t}{\partial r_k^{t+1}} \gtreqless 0$$

$$(34) \qquad \frac{\partial S^t}{\partial r_d^t} \gtreqless 0$$

$$(35) \qquad \frac{\partial S^t}{\partial r_d^{t-1}} < 0$$

$$(34) \qquad \frac{\partial S^t}{\partial L^t} < 0$$

We assume a positive relationship between the stock of deposits and the supply of loans, i.e.,

$$(37) \qquad 0 < \partial L^t/\partial D^t < 1$$

where D^t = Stock of deposits in period t.

A deposit rate change that raises demand for deposits will thus lead to an increase in loan supply. In long-run equilibrium, we can expect interest rates to stabilize so that

$$(38) \qquad r_d^t = r_d^{t-1} = r_d$$

The ultimate effect of a permanent deposit rate change on saving can then be obtained from:

$$(39) \qquad \frac{dS_t}{dr_d} = \frac{\partial S_t}{\partial r_d^t} + \frac{\partial S_t}{\partial r_d^{t-1}} + \frac{\partial S_t}{\partial L_t}\frac{\partial L_t}{\partial D_t}\frac{\partial D_t}{\partial r_d}$$

It follows that, in general, the long-run impact of deposit rate changes on saving is ambiguous. Even if a higher rate stimulates current saving, (39) implies that this effect will be dampened over time, under the influence of the income effects of past interest rate increases and loan supply increases.

2. Investment

Aggregating the demands for capital by the various types of asset holders described in the previous section we obtain:

$$(40) \qquad K^t = g(r_k^t, r_d^t, L^t, r_d^{t-1})$$

According to our model, aggregate demand for capital is positively related to past deposit rates, but may be negatively related to the current deposit rate. This is because, from the point of view of current holders of capital, deposits may have served as a conduit for capital accumulation in the past, but currently may be a substitute for the riskier physical assets. Of course, for those savers that are still accumulating all their funds in deposits, with the ultimate purpose of investing in capital in the future, demand for capital will also be positively associated with the deposit rate. However, it is future demand for capital that will be affected by changes in current deposit rates. Thus, we may have:

$$(41) \qquad \partial K^t/\partial r_d^t < 0$$

$$(42) \qquad \partial K^t/\partial r_d^{t-1} > 0$$

Our model also implies a positive relationship between demand for capital and loan supply, and we assume that the aggregate demand for capital is positively related to its own rate of return. We have:

$$(43) \qquad \partial K^t/\partial L^t > 0$$

$$(44) \qquad \partial K^t/\partial r_k^t > 0$$

This framework, which gives us a theory of the determination of the stock demand for capital, can be easily extended to account for the flow of investment spending. Assuming that the marginal productivity (R) and the supply (K_o) of capital are fixed in the short run, we can interpret r_k^t as the rate of return that wealth owners require in order to be induced to hold a quantity of capital exactly equal to K_o. Financial sector developments can then stimulate investment spending by increasing demand for capital and thereby lowering its required rate of return relative to its marginal productivity. 1/

1/ For more detailed discussions on this type of investment theory, see Tobin and Brainard (1968), Tobin (1969), and Tobin and Brainard (1977).

In order to determine the long-run effect of changes in deposit rates on capital formation, we consider both direct and indirect interest rate effects on the demand for capital. The former reflect the substitutability or complementarity between deposits and capital, while the latter capture the impact of interest rates through their effect on financial deepening. We have:

$$(45) \qquad \frac{dK_t}{dr_d} = \frac{\partial K_t}{\partial r_d^t} + \frac{\partial K_t}{\partial r_d^{t-1}} + \frac{\partial K_t}{\partial L_t}\,\frac{\partial L_t}{\partial D_t}\,\frac{\partial D_t}{\partial r_d^t}$$

Assuming that (37), (41) and (42) hold and that

$$(46) \qquad \partial D_t/\partial r_d^t + \partial K_t/\partial r_d^t > 0$$

we find that

$$(47) \qquad \frac{\partial K_t}{\partial L_t}\,\frac{\partial L_t}{\partial D_t} > -\,\frac{\partial K_t/\partial r_d^t}{\partial D_t/\partial r_d^t}$$

is a necessary and sufficient condition for dK_t/dr_d to be positive in the short run, and a sufficient condition for dK_t/dr_d to be positive in the long run. Inequality (47) ensures that the financial deepening effect of deposit rate increases on demand for capital more than offsets the effect of substitutions of deposits for capital. From (45) and (47) we draw the following conclusions:

(1) A rise in r_d will discourage capital formation in the short run if loans finance a relatively large increase in current consumption, or if loans fail to increase in line with deposits. The latter may happen if, for whatever reason, financial intermediaries use some of their new deposits to acquire assets other than loans (e.g., cash reserves or foreign assets). 1/

(2) In the longer run, capital formation will be positively related to the deposit rate if the "conduit" role of deposits dominates the substitute-asset role. A deposit rate increase thus may discourage investment immediately, but encourage it in the long term. The time it takes for an interest rate change to have its full impact will be longer the longer the period over which self-financed investors accumulate their savings in deposit form.

1/ The possibility that financial deepening may be associated with a decrease in investment spending in the short run has been extensively discussed by Tobin and Brainard (1963) and, more recently, by Van Wijnbergen (1983b).

(3) McKinnon's complementarity hypothesis addresses inherently intertemporal aspects of the process of capital accumulation and has very little to say about the short run. 1/ Shaw's debt-intermediation view, however, has some short-run implications as asset substitutions in favor of deposits may occur in a relatively short period of time. Our approach shows that the McKinnon-Shaw theses are mutually compatible, and can be integrated into one framework.

3. Demand for money 2/

Assuming that money consists mainly of deposits with financial intermediaries we can draw our model's implications for the money demand function. Deposits are held either as a safe asset in conjunction with riskier assets, or as a temporary abode of funds that are to be used for the acquisition of higher-yielding assets in the future. In their former capacity, deposits are a substitute for capital, but in their latter one they are complementary to capital. If all investors follow the same pattern of asset accumulation over their planning horizons, then the relationship between deposits and capital is a function not only of relative rates of return but also of temporal considerations. Current deposits may thus be a substitute for current capital, but complementary to future capital.

Accordingly, demand for money may be negatively related to the current rate of return on capital, but positively related to its expected future rate of return. The current supply of loans does not enter the money demand function as depositors and borrowers are distinct groups at any one point in time. Money demand, however, is

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1/ These aspects of McKinnon's model have been subject to some misunderstanding. Vogel and Buser (1976, p. 36), for example, write "Money and capital cannot be complements when they are the only two assets held in the portfolio and when the constraint on total assets is fixed. Thus, it is not surprising that the complementarity hypothesis has been overlooked in growth models where money is grafted onto the economy as the second of only two assets. However, the consideration of additional classes of assets introduces the possibility of limited complementarity. For McKinnon and Shaw, the additional assets considered are stores of goods or finished inventories labeled as inflation hedges." As was shown above, temporal considerations may account for complementarity between money and capital in the absence of any other assets. Similarly, Van Wijnbergen's (1983b) criticism of McKinnon (1973) is based on a one-period portfolio balance model, which is unsuited for capturing the intertemporal complementarity that is at the core of McKinnon's argument.

2/ The balance sheet constraint that we can obtain by aggregating equation (5) over all individual savers implies that the aggregate demand for money can be determined as a residual once the aggregate savings and demand for capital functions have been determined. The balance sheet constraint can also be used to determine the interrelationships among the partials of the savings and asset demand functions.

negatively related to the expected future loan supply, as a rise in this supply lowers the need for current accumulation of internal funds. Thus, we may have:

(48) $D^t = h(r_d^t, r_k^t, r_k^{t+1}, L^{t+1})$

(49) $\partial D^t/\partial r_k^t < 0$

(50) $\partial D^t/\partial r_k^{t+1} > 0$

(51) $\partial D^t/\partial L^{t+1} < 0$

The foregoing discussion highlights three important aspects of the saving-investment process in financially repressed economies. First, interest rates affect individual asset holders' decisions with a complex lag structure. For example, an investor's demand for capital may be positively related to past deposit rates, but negatively related to current rates; similarly, his demand for money may be negatively related to the current rate of return on capital, but positively related to its expected future rate of return. Second, at the aggregate level, external financing possibilities are closely related to savings flows, and as a result are also affected by interest rates. Investment spending may thus be affected by deposit rates both directly, through the competing or complementary asset effect, and indirectly through the flow of loans. Finally, our analysis suggests that, in the presence of financial constraints, saving and investment decisions are intimately related, and can be viewed as different stages of the same process. Accordingly, any theory of saving behavior in financially repressed economies should take into account the investment motive. 1/

IV. A Critique of the Empirical Literature on the McKinnon-Shaw Models

Although a number of empirical studies have been aimed at assessing the validity of the McKinnon-Shaw propositions during the last ten years, the evidence still appears to be inconclusive. The low quality of the existing data on household behavior in less developed countries obviously constitutes a serious limitation in this regard. 2/ Equally important, however, is the soundness of the economic theory that underlies the specification of the estimated equations. In this section

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1/ This point has been emphasized by Leff (1975, pp. 848-49).

2/ For a discussion of some of these problems regarding savings functions, see Mikesell and Zinser (1973, pp. 1-3).

we critically review the econometric evidence on the McKinnon-Shaw propositions in light of our theoretical framework. Suggestions for future empirical research are presented in the following section.

A general criticism of all the empirical studies on the complementarity hypothesis is that they completely disregard the profitability of investment, although it may provide the central motive for saving and holding money in many developing countries. The problems associated with obtaining data on the rate of return on capital are well understood. 1/ Nevertheless, the omission of this variable from the estimated equations blurs the interrelationships between the saving, investing, and money-holding decisions, and possibly generates biased estimates. Focusing exclusively on the rates of return on deposits and loans may distort the view of the relative importance of financial and real sector developments. This problem may be most acute in cross-sectional studies, as there may be large cross-country variations in the rate of return on capital.

A second general shortcoming of this literature is that it disregards the intertemporal aspects of the saving-investment process. This may be due to the nature of the original presentations of the McKinnon-Shaw arguments, which were based on growth models. No time subscripts are needed in discussions of steady state equilibria, but in real time the complementarity hypothesis involves an intrinsically dynamic relationship: the accumulation of current savings in deposits, intended to finance future investment. Again, data limitations may account for researchers' aversion to specifications with long lags. The resulting estimates, however, cannot possibly capture the intricacies of the complementarity relationship.

Notwithstanding these shortcomings, the empirical evidence on the McKinnon-Shaw theses is worthy of a more detailed examination. Support for McKinnon's complementarity hypothesis has been provided in a series of related papers by Akhtar (1974), Abe, Fry et al (1975 and 1977) and Vogel and Buser (1976). These papers found a strong positive relationship between the investment/income (or savings/income) ratio and real money holdings as well as a positive relationship between the savings ratio and the real deposit rate in several Asian and Latin American countries. These relationships were interpreted as evidence in favor of the complementarity hypothesis.

One general problem with these studies is their apparent disregard of the balance sheet identity that relates saving and investment flows to financial asset holdings. An alternative interpretation of the above findings could be that they reflect this balance-sheet identity rather than any complementarity relationship. A more direct test of complementarity would focus on cross-interest rate elasticities of

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1/ For a survey of the theoretical and empirical issues relating to the measurement of the rate of return on capital in developing countries, see Leff (1975).

demand for financial and real assets. In such a spirit, Qureshi (1981) corroborated the earlier findings on the interest sensitivity of saving in Pakistan, but also found that direct investment in real assets was positively related to the real deposit rate. This apparent linkage between the demands for real and financial assets was perhaps the strongest evidence of the above studies in favor of the complementarity hypothesis.

In a more recent study, Gupta (1984) critically reviewed some of the above, as well as many other, empirical studies on the complementarity hypothesis, and then developed and estimated his own simultaneous equations model. Gupta criticized the existing empirical literature for, among other things, not following the theoretical literature closely enough and adopting too high a level of aggregation. Unlike previous attempts to test the McKinnon-Shaw hypotheses, his model distinguished between low-, medium- and high-inflation countries as well as between interest-bearing and noninterest-bearing financial assets. Based on the estimated interest elasticities of private investment, Gupta concluded that although the complementarity relationship is not a pervasive phenomenon, it appears to be relevant for countries with high rates of inflation. 1/

Gupta's work constitutes one of the more systematic attempts to test for the McKinnon-Shaw propositions, but like all previous studies, it undertakes to test these propositions without properly accounting for the lag structure implicit in the complementarity relationship. Although each one of Gupta's savings and asset demand functions includes a lagged dependent variable as a regressor, the investment equation includes only current financial savings and the current interest rate as explanatory variables. A more appropriate specification would seek to relate current investment to past financial savings and past rates of return on financial assets, in accordance with the theoretical model of the previous section.

Intertemporal considerations are perhaps less important for tests of Shaw's debt-intermediation view. According to this view, high interest rates encourage accumulation of deposits, which are a source of funds for financial institutions and for credit-financed investment. In a repressed economy, with excess demand for credit, investment spending is constrained by the availability of financing. From an econometric point of view, it thus seems legitimate to consider credit flows exogenous to expenditure decisions. Wai and Wong (1979), Fry (1980), Leff and Sato (1980) and Blejer and Khan (1984) have all estimated investment functions with some measure of credit supply as an independent variable, using data from many less developed countries. The estimates of the credit coefficients turned out to be positive and statistically significant in most cases, lending support to the debt-intermediation hypothesis.

1/ According to Gupta's classification, the group of high-inflation countries included Argentina, Bolivia, Colombia, Korea, Peru and Uruguay (Gupta (1984, p. 146)).

Although the differences between the theoretical models of McKinnon and Shaw are well defined, in practice it is very difficult to determine which model has greater empirical relevance. A rise in deposit rates may stimulate investment by both encouraging more self-financing and by raising the demand for money and thereby the availability of external funds. Fry (1978) attempted to disentangle these two channels of transmission of deposit rate policy by estimating different versions of the money demand function on data from ten Asian countries. His results were contrary to the findings of his earlier study on Pakistan 1/ and led him to conclude that "McKinnon loses and Shaw wins their disagreement over the transmission mechanism."

A closer look at this paper gives a good example of how disregarding the intertemporal character of the complementarity hypothesis may give rise to misinterpretation of the empirical evidence. Fry (1978, p. 470) started with McKinnon's specification of the money demand function:

$$(52) \qquad (M/P)^d = f(Y/P,\ I/Y,\ d-i^*)$$

where M/P is the real money stock, Y/P real GNP, I/Y the ratio of gross investment to GDP, d-i* the real deposit rate of interest, and where complementarity implies:

$$(53) \qquad \frac{\partial(M/P)}{\partial(I/Y)} > 0.$$

He estimated (52) and found a negative and statistically significant coefficient for I/Y, which led him to reject the complementarity hypothesis.

One serious problem of this, and most other tests of the McKinnon-Shaw theses is that they interpret (52) and (53) as relationships between current variables, even though these relationships were originally intended to describe steady-state, long-run equilibrium conditions. The "conduit" effect refers to current savings temporarily accumulated in the form of money but ultimately intended to finance future investment. It follows that current money demand is positively related to intended future investment rather than to current investment. Only in a steady state is it warranted to disregard this distinction between current and future investment. In the short run, current investment may be quite volatile, and in McKinnon's world of self-finance, it is likely to be associated with decumulation of previously accumulated deposits. Accordingly, the complementarity hypothesis implies a negative relationship between current money demand and current investment. Viewed in this light, Fry's results appear to be consistent with this

1/ Abe, Fry et al. (1975).

The McKinnon-Shaw propositions on the benefits of financial liberalization have recently come under attack in a series of papers by Van Wijnbergen (1982, 1983a, 1983b, 1983c, 1984) and Buffie (1984). The thrust of this criticism is that arguments in favor of higher deposit rates have disregarded the importance of the unofficial loan market (curb market), which sometimes supplies a large share of loanable funds in less developed economies. If the reserve requirement on deposits with banks is sufficiently high and if deposits are a closer substitute for curb loans than for currency or unproductive inflation hedges, then a deposit rate increase may result in a net decline of loanable funds in the short run. Running simulations with his econometric model of the Korean economy, Van Wijnbergen (1984) found that an increase in the time deposit rate discourages investment in the short run, while an increase in the bank loan rate increases the total supply of loans to the business sector and thereby investment spending. These results, however, imply that a coordinated increase in deposit and loan rates need not have any contractionary short-run effects, even in the presence of an active curb market. Moreover, if curb market loans are mostly used to finance consumption, financial liberalization may stimulate investment by channeling a larger share of loanable funds into the banking system. 1/

V. Conclusions and Suggestions for Further Research

The McKinnon-Shaw models emphasize different aspects of the effects of interest rate liberalization in a financially repressed economy. McKinnon (1973) focuses on the linkage between internally financed investment and the deposit rate, while Shaw (1973) highlights the importance of financial deepening and external financing. The two approaches complement each other as most projects are financed partly with own funds and partly with borrowings. This paper has illustrated how we can integrate these two views without altering their basic conclusions.

In the context of a life-cycle model of consumption, the financing constraint applies over each individual's planning horizon, which comprises several periods. The possibilities of substitution between current and future consumption and between different assets allow for a great variety of saving-investment patterns. In particular, when physical capital is lumpy, deposits may serve as a "conduit" for its accumulation, and high deposit rates may stimulate investment even if they do not encourage saving. Negative real deposit rates may thus constitute a tax on saver-investors that decreases the amount of internally

1/ According to Tun Wai (1957), the demand for loans in the unorganized money markets of less developed countries originates mainly from the agricultural sector, where a large share of debt finances current consumption. However, this description of unorganized money markets does not apply to the Korean curb market.

generated resources available for investment. 1/ The other side of this tax, of course, is the corresponding subsidy to borrowers that have access to artificially cheap credit. The net effect of interest rate changes on aggregate investment then depends on the fraction of total investment that is financed by credit. 2/

The complementarity relationship between deposits and physical capital is intertemporal, with current deposits intended to finance future investment. This implies that even if higher deposit rates discourage investment in the short run they may encourage it in the long run. Instantaneous portfolio shifts into deposits may have an immediate negative effect on investment while the increase in the rate of accumulation of internal funds will result in increased investment only gradually. The latter response may be extremely sluggish in the presence of inflationary uncertainty. If the government is not unequivocally committed to a policy of positive real deposit rates, the risk associated with accumulating savings in deposit form may outweigh any short-run interest rate advantage. Investors then know that unanticipated inflation may reduce the real value of nominally denominated assets very rapidly, before they get a chance to switch to inflation hedges. 3/ Thus, a high interest rate policy will have its full effect only after enough time has elapsed to eliminate any credibility problems. This time may be longer the longer the public's experience with negative real rates and inflationary uncertainty.

The findings of this paper underscore the need for both further theoretical and empirical research on the McKinnon-Shaw propositions. The theoretical model of Section II is adequate for demonstrating some of the implications of the complementarity hypothesis, but it is clearly too simple to give a realistic account of saving behavior in repressed economies. Variables such as the demographic characteristics of the population, which are crucial determinants of aggregate saving behavior, can only be accounted for in a much more general multi-period framework. Such a framework would also allow a more rigorous treatment of the complementarity hypothesis. For example, the number of years required for a saver to accumulate enough funds to satisfy the minimum capital

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1/ In advanced countries, interest rate increases may be associated with a negative wealth effect for holders of bonds and stocks. Deposits, however, are not subject to such risk of capital loss. Unlike more illiquid assets they have a fixed current nominal worth which can be fully realized upon withdrawal.

2/ For a systematic analysis of how the effects of interest rates on investment depend on firms' debt-equity ratios, see Sundararajan (1985).

3/ Such experiences were all too common in the hyperinflations that preceded and followed World War II in several European countries. It is not surprising that after seeing the value of paper assets reduced to practically nothing on various occasions, many Europeans are still reluctant to hold large sums of financial assets and have a special affinity for traditional inflation hedges such as gold.

requirement may be an important determinant of his propensity to save. The larger this number, the longer the horizon over which the saver will have to anticipate the rate of return on capital, and the lower the rewards from saving. It would be a useful exercise to extend our model and derive its implications for life-cycle saving decisions under alternative assumptions about utility function parameters, the structure of interest rates and the demographic composition of the population. 1/

Our theoretical model has suggested that interest rates affect expenditure-saving decisions through a complex and, possibly, very long lag. Moreover, in the presence of inflationary uncertainty, the ex ante current real deposit rate may be a function of ex post past rates, further complicating this lag structure. Statistical tests of the complementarity hypothesis are thus likely to require long interest rate series, which may be unavailable for many less developed countries. In view of the serious data limitations, it is perhaps most desirable to try to estimate reduced-form saving and investment equations rather than attempt to determine the precise mechanism of transmission of interest rate changes.

More generally, time series savings equations are unlikely to yield reliable coefficient estimates. Even for the U.S. economy, with its advanced statistical collection methods, aggregate data have failed to provide conclusive evidence on the interest sensitivity of savings. 2/ Auerbach and Kotlikoff (1981) have shown that, even with a "clean" data set generated from simulations of a theoretical life-cycle model, regression equations yield highly unstable estimates of the consumption function. One promising approach for future studies of investment and saving behavior may be to conduct simulations of theoretical models, based on microeconomic data. 3/ Such models may be better suited to account for the complex interrelationships between saving, asset-holding and investment decisions.

1/ For examples of such exercises, see Tobin and Dolde (1971) and Summers (1981).

2/ See, for example, Weber (1970), Howrey and Hymans (1978), Boskin (1978), and Gylfason (1981).

3/ For a description of some of the pitfalls in the statistical estimation of aggregate consumption functions, see Summers (1984).

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