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SAVING AND INVESTMENT IN AN OPEN ECONOMY WITH NON-TRADED GOODS*

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We examine a model of a small open economy in which there is free international mobility of financial capital, investment in capital goods and a non-traded good. Such an environment is rich enough to explain several phenomena that are inexplicable in other models. We explain why a high saving country may nonetheless borrow from abroad to finance investment. We suggest an explanation of why saving and investment may be correlated even with no restrictions on trade in assets. We also provide an optimizing model of stages in the balance of payments.

1. INTRODUCTION

Two important but often neglected features of almost all open economies are that they trade investment goods and there are some goods which are non-traded. We explore such an economy in a dynamic model with perfect international mobility of financial capital. In this context we can explain some phenomena that are inexplicable in more barren models.

First, we consider the question: if a country postpones consumption to reach higher future levels of welfare, is it ever optimal for this country to borrow from abroad to expand domestic investment? We find that this may indeed be the case. If planners discount the future by less, then it can be optimal for foreign borrowing to increase in our model. This contradicts the usual presumption, demonstrated in models with simpler structures, that only more impatient countries borrow from abroad (see, for example, Buiter 1981, and Frenkel and Razin 1986). In our model, whether an increase in desired long run per capita consumption leads to current external borrowing or lending depends upon the relative factor intensities of the non-tradeable and tradeable sectors.[1]

The presence of investment goods and non-traded consumables are essential to obtaining this result. Under perfect international mobility of both financial and physical capital, investment and consumption dynamics are related because current domestic demand for the non-tradeable must equal its output, which in turn depends upon the capital stock. We adopt standard Heckscher-Ohlin production assumptions in a small open economy, so that the relative price of consumables (real exchange rate) and the effective rate of interest are constant. This emphasizes that the link between optimal capital accumulation and foreign borrowing arises

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[1] Our results may help to explain the observation made by Sachs (1981) that many developing countries appear to borrow to finance domestic investment.

from the non-tradeability of a consumable rather than from relative price movements.

In a related matter, the presence of a non-traded consumption good can explain the correlation of saving to investment, even under perfect capital mobility (as, for example, in Murphy 1986). Therefore, the empirical findings by Feldstein and Horioka (1980) of such correlations do not necessarily indicate imperfect capital mobility, as they suggest. As aggregate wealth and consumption rise or fall together in convergence to the steady state, the market for the non-traded good must continually clear. In our economy, this equilibrium is maintained through capital stock adjustment, while the returns to physical and financial assets are always identical and constant. Because consumption growth and capital accumulation are tied, saving and investment are correlated.

Next, we ask if the balance of payments for a small developing country can pass through stages when saving is derived from household intertemporal optimization. The stages in the balance of payments theory has a long history and has provoked interest in recent years (see Eaton 1986 for a survey). The theory suggests that an initially capital-scarce country will first acquire debt as it rapidly accumulates capital, then will begin to reduce its foreign liabilities, and may eventually become a net creditor to the rest of the world. Fischer and Frenkel (1972) study the phenomenon in a prominent paper in which saving is not derived from optimizing behavior. However, in standard infinitely-lived representative household models of a small open economy, such stages do not occur as part of an optimal plan: consumption and investment dynamics are too restricted to allow phases in foreign borrowing.[2]

The general plan of this paper is to discuss why simple models give misleading answers to these questions. We show why the presence of investment goods and non-traded goods is important. While we examine a tractable example model which adopts special assumptions, the implications we draw for the issues raised above appear as consequences of these two general features.

Section 2 of this paper lays out the two sector model. The next section solves the model and contains the general discussion of the questions posed above. The final section contains concluding remarks.

2. NON-TRADED GOODS AND INVESTMENT GOODS

The economy of our simple model produces two goods: a non-traded consumption good and a traded good which is a composite good that can be used either for production or consumption.[3] A planner, or given the absence of externalities, a

[2] The standard model of consumer behavior with infinite lifetimes and constant rates of time preference is inadequate for our purposes. First, such a model is inappropriate for comparing dynamics when the rate of impatience changes. Second, such models do not have consumption dynamics that allow for the stages in the balance of payments. In our model there is an endogenous rate of time preference, as in Obstfeld (1981, 1982), which is just one way to enable convergent consumption dynamics.

[3] The generalization to many goods and factors, when possible, would follow as in higher order trade theory (see surveys by Ruffin 1984, and Ethier 1984). Nunes (1983) and Razin (1984) have recently examined international borrowing in a similar framework. However, Nunes assumes a constant rate of

representative consumer maximizes utility over an infinite horizon. There is a freely traded bond. The country is small in the market for traded goods and in international bond markets.

The two goods are produced with a constant returns to scale technology. There are two factors of production, capital and labor, that are freely mobile between industries.

There are perhaps two assumptions we make that are controversial. The implication of the above assumptions that physical capital is freely traded and freely mobile between industries is that there are no lags in investment. When the desired capital stock changes, all the desired new investment or disinvestment can occur instantaneously. It might be more desirable to make some assumptions that caused the capital stock to adjust slowly. For example, investment could be assumed to be irreversible; there could be a cost to new investment; and, there could be a cost to importing physical capital. We do not make these assumptions because, even though they would make the model more realistic, they would complicate the model considerably and have the unfortunate consequence of obfuscating the key economic behavior we want to focus on. Thus, we will look at changes in the desired capital stock. In our model these desired changes will translate into actual changes with no delay, but the reader may wish to think of them in real life as changes in a target capital stock which will be approached over time through investment.[4]

The second controversial assumption involves our modeling of the rate of time preference. It is well known that difficulties arise under the assumption of a constant rate of time preference if the consumers have an infinite horizon and face a given interest rate. Either no steady state can be approached, or consumption expenditures are constant. At least two ways exist in the literature to avoid this problem: either assume a finite horizon, or let the consumer's discount rate vary endogenously. We choose the second approach, and parameterize the rate of time preference as does Uzawa (1968). The assumption of Uzawa that provokes disagreement is that the discount rate is an increasing function of the level of current utility. There is little empirical evidence to support (or refute) this assumption.[5] In this paper, however, none of our major insights depend on this

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time preference equal to the world interest rate and Razin (in his investment model) assumes only two periods. Both models preclude much of the dynamics of interest discussed in this paper.

[4] If the capital stock could not change instantaneously, the dynamic system would be at least third-order. With two "non-jump" variables, there would be a two-dimensional stable manifold, rather than the one-dimensional saddle path. The system would be impossible to study analytically. Furthermore, depending exactly on the form of the cost of adjustment functions, virtually any dynamic behavior could be generated on the stable manifold. However, the economic intuition, which is very simple in our model would be lost. (Nunes 1983 does allow for costs of investment. His model is analytically tractable, however, because his assumption of a constant rate of time preference precludes consumption dynamics, and therefore reduces the dimension of the system.)

[5] There is some evidence to support the Uzawa specification. One of its implications is that there is a stable stationary equilibrium consumption level. (This is indeed the implication that causes the most controversy.) Clower and Johnson (1968), however, find that such a specification has empirical support. An experimental study (as yet unpublished) by Raymond Battalio of Texas A & M University shows that

property. We are interested in how the economy changes when desired saving increases. We generate an increase in saving by allowing a shift down in the rate of time preference. Under almost any conditions, lower time preference should mean higher desired saving—there is nothing special about this. (Thus, the Uzawa specification is convenient for us, but our conclusions do not depend on it in any special way as they might in, for example, Obstfeld 1982. See Svensson and Razin 1982.)

Output of each good can be expressed by the functions:

$$y_T = \gamma f(k_T),$$

$$y_N = (1 - \gamma) g(k_N),$$

where γ is the amount of labor used in the traded goods sector, k refers to the capital-labor ratio in each sector, and the subscripts T and N refer to the traded and non-traded sectors, respectively. (The total labor supply does not grow and is fixed at 1.)

The traded goods price is given and equal to 1, and the price of the non-traded good is p. Under constant returns to scale, cost functions depend only on the factor prices—w, the wage; and r, the internationally given interest rate. Equating prices to costs

$$1 = C_T(w, r),$$

and

$$p = C_N(w, r).$$

From these equations it follows that the wage and the price of non-traded goods are completely determined by the interest rate, and are therefore fixed over time. (Of course, the real exchange rate would change if we were to examine some shock to the system, such as the move from no capital mobility to perfect financial capital mobility studied in Razin 1984.) Furthermore, the capital-labor ratios in each industry are constant, because goods and factor prices are constant and marginal productivities depend only on the k's.

Utility is homothetic, which means that consumption of each good, c, is proportional to total consumption expenditure, z (since p is constant):

$$c_T = \alpha z,$$

and

$$c_N = (1 - \alpha) z/p.$$

Letting k denote the total capital stock, it follows from equilibrium in the market for the non-tradeable and incomplete specialization that

$$z = \eta + \beta k \tag{1}$$

where

$$\eta \equiv p[k_T g(k_N)]/(1 - \alpha)(k_T - k_N),$$

low income (underfed) rats tend to have a lower discount rate than high income (well fed) rats. This is exactly consistent with Uzawa's assumptions.

and $$\beta = -\eta/k_T.$$

We see that consumption expenditures are a linear function of the capital stock. If the traded goods industry is capital intensive, then β is negative. In this case as expenditures fall, the desired (and actual) capital stock must rise. A decrease in expenditure implies a decrease in spending on the non-traded good. Production of the non-traded good must fall. Factors are released to the traded goods sector. However, the non-traded goods sector releases proportionately too much labor. This would lead to potentially a higher marginal productivity of capital in the traded goods sector. The desired capital stock rises.

The reverse relation between expenditure and the capital stock would hold if non-traded goods were capital intensive.

Each consumer maximizes

$$V = \int_0^\infty v(z_t)e^{-\Delta(t)}\,dt. \tag{2}$$

In this expression, v represents the indirect instantaneous utility function. The rate of time preference is not constant, but instead varies over time as the level of expenditure changes:

$$\Delta(t) = \int_0^t \delta(v(z_s))\,ds.$$

Following Uzawa, we assume δ, δ', δ'', and $\delta - \delta' v$ are all positive.[6] The assumption which guarantees that the economy will converge toward a steady-state is $\delta' > 0$. It essentially requires that as felicity, v, increases, the rate of time preference must rise so that saving will fall. If the opposite assumption were made, the rich would get richer and the poor would get poorer and the economy would be unstable.

Each consumer faces the dynamic budget constraint

$$\dot{W} = rW + w - z. \tag{3}$$

Here, W represents total tangible wealth, which is the sum of k, the capital stock, and b, net claims on the rest of the world. Both forms of wealth earn the same rate of return. As explained above, should the net marginal productivity of capital (the gross MPK less the depreciation rate n) exceed the world interest rate, capital goods are immediately imported to the point where the equality is restored.

We also need to impose independently the condition that

$$\lim_{t\to\infty} b_t e^{-rt} \geq 0.$$

[6] Obstfeld (1981) discusses these assumptions. The assumption that $\delta - \delta' v$ is positive ensures that V in steady-state ($= v/\delta$) is increasing in v.

Without such a constraint, with the infinite planning horizon any level of utility could be achieved by borrowing an arbitrary amount at some time and meeting interest payments through further borrowing.

3. THE SOLUTION OF THE MODEL

In this section we will first derive the first-order conditions for the optimization problem. Then we will examine the steady-state. Next we will characterize the dynamics near the steady-state to demonstrate the system is saddle-stable. Finally, we will discuss the evolution of the capital stock and foreign assets as shown in phase diagrams. We will restrict attention to regions where the economy remains incompletely specialized in the production of both goods.[7] We will discuss the questions posed in the introduction with the aid of the phase diagrams.

The Solution. Following Uzawa (1968) and Obstfeld (1981), it is useful to rewrite equation (2) as

$$V = \int_0^\infty [v(z)/\delta(v(z))]e^{-\Delta}\, d\Delta.$$

The Hamiltonian for the optimization problem can then be written as[8]

$$H = (1/\delta(v(z))[v(z) + q(rW + w - z)].$$

The first-order conditions become

$$q = [v'(\delta - \delta' v)]/[\delta + \delta' v' \dot{W}], \tag{4}$$

and

$$\dot{q} = (\delta - r)q. \tag{5}$$

In the steady state, setting $\dot{q} = 0$ in equation (5), the rate of time preference must adjust into equality with the given interest rate: $\delta(v(z)) = r$. Thus the steady state level of expenditure is determined independently from the rest of the system. There is effectively a target level of expenditure. Suppose we consider the effect of a drop in the rate of time preference—a shift down in the δ function. This could be interpreted as a change in preferences on the part of consumers or the planner toward giving more weight to the future. Indeed, in the steady state, expenditures would rise.

With an increase in long-run spending, the steady-state capital stock will rise or fall as β in equation (1) is positive or negative. That is, if the home goods industry is capital intensive the capital stock will rise, and if the home goods industry is labor intensive the capital stock will fall. This is just the Rybczynski theorem in

[7] The dynamics for the general case of this model, including complete specialization in non-traded goods, are examined in Engel and Kletzer (1986).

[8] This transformation is correct as long as the equations of motion for the state variables are time independent, as they are here. (See Obstfeld 1988.)

reverse—to induce expansion of the labor-intensive industry the capital stock must fall, and to induce expansion of the capital-intensive industry the capital stock must rise.

It can also be demonstrated that the steady-state trade deficit must increase when long-run expenditures rise, which in turn implies that claims on foreigners must be higher to generate enough income to support this deficit. The trade deficit is equal to net national product less the level of expenditure. The increase in expenditure contributes to a higher trade deficit. The change in net national product in the long run is of course just the interest rate times the change in the capital stock. If the capital stock falls (i.e., if home goods are labor intensive) then clearly there must be a greater long-run trade deficit. Even in the case in which the capital stock expands (when home goods are capital intensive), the increase in net national product must be less than the increase in expenditure. This follows because gross output must increase more than net output (the difference being depreciation). The output of non-traded goods must go up more than total gross output, since the output of the traded goods sector would actually shrink (again the Rybczynski theorem—an increase in the capital stock causes the labor-intensive industry to contract). But output of non-traded goods, which equals consumption of non-traded goods, goes up less than total expenditure. Hence the long-run trade deficit must rise, and holdings of foreign bonds, b, must expand in the steady state.

To examine the dynamics of the system, logarithmically differentiate equation (4) and equate it to equation (5) to obtain:

$$\delta - r = D\dot{z} - [(\delta'' v'^2 + \delta' v'')\dot{W}\dot{z} - \delta' v' r\dot{W}]/[\delta' v'\dot{W} + \delta], \tag{6}$$

where

$$D \equiv [v''(\delta - \delta' v) - \delta'' v v'^2]/v'(\delta - \delta' v) < 0.$$

Equations (3) and (6) comprise a two equation dynamic system in z and W that characterize the path of the economy. The behavior of the capital stock can be derived from knowing z, since k is just linearly related to z. Total claims on foreigners is given by the difference between W and k.

To examine the stability of the system, we linearize equations (3) and (6) near steady-state to obtain:

$$\begin{bmatrix} \dot{z} \\ \dot{W} \end{bmatrix} = \begin{bmatrix} 0 & \delta\delta' v'/D \\ -1 & r \end{bmatrix} \begin{bmatrix} z - \bar{z} \\ W - \bar{W} \end{bmatrix}.$$

(The overbar above a variable represents its long-run value. There is a unique steady-state.) The determinant of the system equals $\delta\delta' v'/D$, which is negative. The system must have one negative and one positive root, which implies it is saddle stable. The transversality condition gives a sufficient condition for optimality. In this case it may be written:

$$\lim_{\Delta \to \infty} e^{-\Delta} q W_\Delta = 0.$$

Along the path that leads to the steady state, this condition is satisfied, so it is an optimal path. Notice also that if the transversality condition is met that the intertemporal budget constraint is also obeyed.

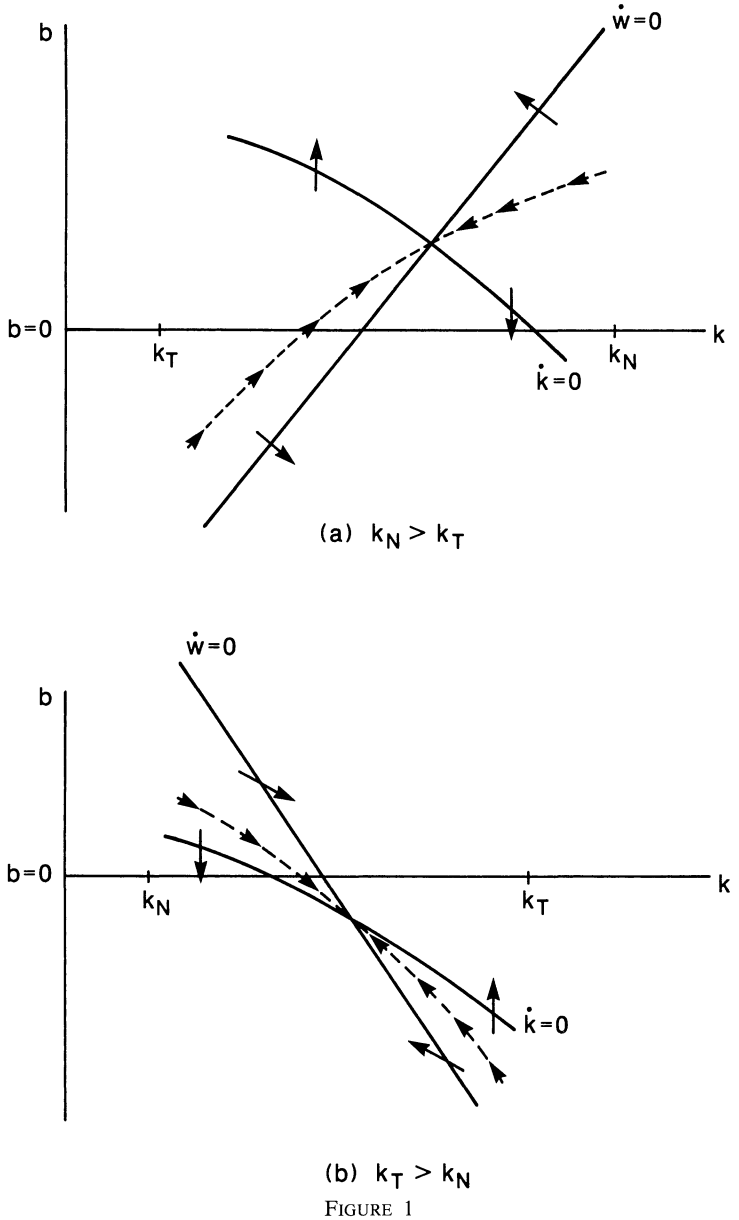


FIGURE 1

It is useful to draw the phase plane in b, k space as in Figure 1 because those are the variables we are most interested in. Near the steady-state the $\dot{z} = 0$ line is not a function of z, so in b, k space it has a slope of -1. The slope of this line cannot be characterized analytically away from the steady state, however it crosses the $\dot{W} = 0$ line only at the steady-state.

In Figure 1a the $\dot{W} = 0$ line slopes upward, which is the case when home goods

are capital intensive. In discussing the steady state above we showed why an increase in the capital stock must be associated with an increase in b in this case. Note that the $\dot{W} = 0$ line is linear everywhere, not just near the steady-state.

In Figure 1b the $\dot{W} = 0$ line slopes downward, which is the case when home goods are labor intensive. Notice that the $\dot{W} = 0$ line cuts the $\dot{z} = 0$ line from above, indicating that at the steady state the $\dot{W} = 0$ line has a slope less than -1. Suppose long-run bond holdings go up one unit. If the long run capital stock fell by exactly one unit then $\dot{W}$ would no longer equal zero. Total wealth would be unaffected by such a switch but expenditures would have to rise, since in this case there is a negative relation between the capital stock and total expenditure. Therefore a one unit increase in bond holdings must be accompanied by a less than one unit drop in k to keep wealth accumulation constant.

The arrows in Figure 1 denote the direction of motion. The dotted line in each case denotes the saddle path. This diagram is drawn assuming incomplete specialization in production of both goods.

The Saving and Borrowing Paradox. Figure 2 demonstrates the dynamic path of the economy in response to a drop in δ—i.e., an increased concern for the future. The economy is initially in steady-state at point a. The change in the rate of time preference has no effect on the $\dot{W} = 0$ line, but as we have already discussed, it leads to an increase in long-run claims on foreigners.

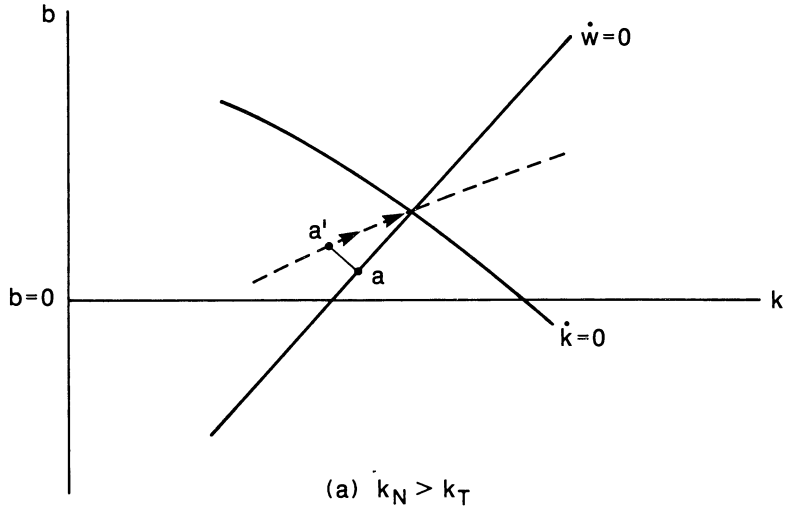
Figure 2a shows the case in which home goods are capital intensive. In the long-run both the capital stock and foreign bond holdings are higher. Initially in response to the drop in the δ function the economy must jump from a to a' to get on the new saddle path. It initially sells some of its capital stock and uses the proceeds to lend abroad. It continues to run a current account surplus, but also accumulates physical capital as it approaches the steady state.

Figure 2b shows the case which is more relevant for the first question posed in the introduction. Here, the long-run capital stock falls when the rate of time preference falls. Initially, however, as the economy moves to the new saddle path (from a to a'), the capital stock is increased. This new investment is financed with borrowing from abroad. Then along the path to the new steady state, the capital stock declines while the country runs a current account surplus.

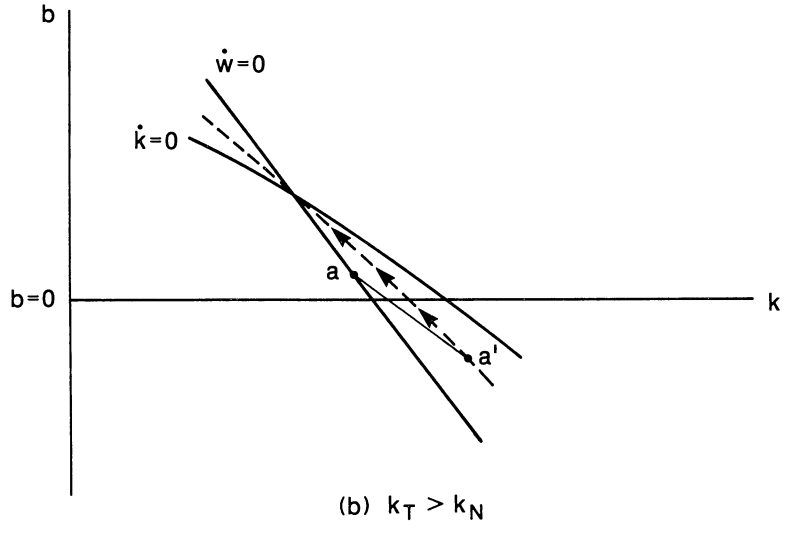
In this case, the initial increase in desired saving is accompanied by an increase in the desired stock of capital. Because of the free mobility of physical capital, all the investment occurs instantaneously. In this initial stage, the discrete increase in the capital stock must be financed through foreign borrowing.

When will a country that decides to postpone consumption also choose to borrow from abroad? It is unlikely that such behavior could arise in a model without investment. Suppose consumption of all goods declines. If all goods are traded, there must immediately be a current account surplus. If there are both home goods and traded goods, production of non-traded goods must fall, which, for a given production possibility frontier, means production of tradeables must rise. If production of traded goods goes up, and consumption of those goods goes down, the country must run a current account surplus and lend abroad.

Even allowing for investment, it will still be the case that higher saving will lead



(a) $k_N > k_T$



(b) $k_T > k_N$

FIGURE 2

necessarily to a current account surplus if all goods are traded. Suppose for a small country that all goods are traded, and there are more factors of production than there are goods. Suppose further that investment can occur, but the total supply of all other factors of production is fixed over time. Let financial capital be mobile, so that the real interest rate is determined exogenously for this small economy. Then the desired total capital stock in this country—indeed, the capital stock in each industry—is fully determined. Investment decisions in no way depend on consump-

tion or saving decisions. Suppose the country wishes to save now to increase its long run income. It would be better off lending abroad rather than investing at home. Adding to the capital stock at home would reduce the marginal productivity of capital below the world interest rate. They could always earn more on foreign bonds.

In such a context it is hard to establish a relation between high saving and a higher target capital stock. Of course high saving countries may turn out to be borrowing to finance investment just because they happen to be capital scarce. A country, for example, that simultaneously removes restrictions on financial capital flows and increases saving might find itself in this position.

In the presence of non-traded goods this reasoning no longer applies. As argued above, if home goods are relatively labor intensive, then reduced consumption of these goods increases the marginal productivity of capital at home and induces domestic investment. It may make sense to borrow from abroad to finance this increased investment.

Note that in this type of model there is an explanation for the correlation between saving and investment found by Feldstein and Horioka (1980). They implicitly consider an environment in which all goods are traded, so that under perfect financial capital mobility there is no necessary relation between saving and investment within a country. (As Obstfeld 1986 points out, or as can be seen immediately from Persson and Svensson 1985, even in this world, saving and investment can be correlated if they react to shocks in the same direction.)

However, in the presence of non-traded goods, this independence of saving and investment breaks down. Production decisions obviously depend on consumption choices for the non-traded goods. As saving rises, suppose consumption of non-tradeables falls. For market equilibrium, production of home goods must fall. However, the factor mix in the non-traded sector need not be the same as in the traded sector. As production in the home goods sector shrinks, factors of production must migrate to find employment. If the non-traded sector is relatively labor-using, then marginal productivity of capital will rise in the economy when home goods production shrinks. This in turn implies the desired capital stock will rise, and there will be a positive relation between saving and investment.[9]

The model described above is a particularly simple example of this. The two factor, two good set-up ensures a constant price of the non-traded good. This makes things easy, since all the decreased demand for home goods is translated into a drop in production of those goods (rather than having the decreased demand being shared between a fall in the relative price of non-tradeables and a drop in their output). Also, the constant price in conjunction with the homotheticity assumption ensures that the fall in home goods demand is simply proportional to the fall in total

[9] Implicit in Frankel (1985) is the notion that non-traded goods might cause the Feldstein–Horioka claim to break down. He might argue that there is no force to determine the own real rate of interest for non-traded goods, because while free financial capital markets can equalize nominal interest rates, they cannot equalize rates of inflation of goods prices. Note however that this argument must be logically separate from the one presented here. In our simple model, the price of home goods relative to traded goods remains fixed, so the real interest rate relative to home goods is the same as r. Nonetheless, there is a relation between saving and investment.

expenditures. The fact that investment goods are traded and capital is mobile between sectors also simplifies things (as discussed above) because it allows adjustment to the desired capital stock to occur immediately.

An intuitive real world explanation would say that low saving, high consumption countries would have to satisfy some of their desired consumption through imports. Therefore, the production structure in these countries will be biased toward non-traded goods. (We are assuming here that there is no particular relation between the level of saving and the desired consumption mix between traded and home goods.) To the extent that home goods tend to be such labor intensive goods as non-traded services, then investment levels in these countries will be lower. So, countries in which saving levels are low will also tend to have low levels of investment.

Murphy (1986) is an example of a model in which there are non-traded goods. (His is a two period model in which there is a traded consumable and a non-traded consumable, and a non-traded investment good.) In his three-good model, investment goods are produced by temporarily drawing capital away from production of consumption goods to make investment goods. It is assumed that one unit of capital devoted toward production of investment today will yield one additional unit of capital tomorrow. Although Murphy does not explicitly consider a change in saving behavior, it is easy to analyze his model in this case. If the non-traded consumption good is the most labor intensive, an increase in consumption leads to a decline in the total capital stock needed to produce the consumption goods. But this frees capital for the production of investment goods. Thus higher consumption is associated with higher investment—the opposite of our result. This occurs because an increase in investment temporarily reduces the capital available for production of other goods, so that higher investment is associated with greater production of labor intensive goods in the short run. In our model investment increases the capital stock, so it increases production of capital intensive goods. Nonetheless, it is the presence of a non-traded good in his model that allows a dependence between saving and investment.

Stages in the Balance of Payments. The interaction between saving and investment in our optimizing model leads to a pattern of foreign borrowing and lending similar to that described in the literature on stages in the balance of payments.[10] Up to five phases in the balance of payments for a developing country's transition to the steady state are suggested in the literature: a) a young debtor-borrower stage in which both the trade balance and current account are in deficit and the country is a net debtor; b) a mature debtor-borrower stage in which the trade balance has turned to surplus but the current account is still in deficit due to debt-service obligations; c) a debtor-repayer stage in which the country is still a net debtor but the current account is in surplus; d) a young creditor-lender stage with both the current account and trade balance in surplus and the country has become a net creditor; e) a mature creditor-lender stage in which the trade balance

[10] See Eaton (1986) for a survey of the field. Fischer and Frenkel (1972) model stages in a non-optimal saving framework.

has turned to deficit but the current account is still in surplus due to interest income from abroad. In the steady-state, a country that has passed through the last two stages will be a net creditor running a trade deficit exactly offsetting its earnings on foreign assets.

The literature has related this time pattern of external balances to growth paths in which investment first exceeds saving then saving overtakes investment. Wealth and per capita consumption rise monotonically throughout. Kindleberger (1968) suggests that the investment motive for foreign borrowing by a growing economy can lead to stages in the balance of payments: "in the early stages of growth when investment opportunities exceed saving, a country may make up the gap with international borrowing. At a later stage as its income and saving rise beyond its investment requirements, it pays back debt and accumulates investments of its own."

An initially capital-poor country can pass through such stages because it is likely to finance rapid capital accumulation through external borrowing. As the marginal productivity of capital falls toward the world rate of interest, the investment motive for borrowing should wane. However, the country will still have a high saving rate if the desired growth rate of per capita consumption is large, so that it will run a trade balance surplus and, eventually, a current account surplus. The country could become a creditor in the long run with a high consumption level supported by earnings from foreign loans.

The optimal wealth accumulation path for a country with a small initial capital stock in our model displays a pattern of external borrowing consistent with stages in the balance of payments. Using the examples depicted in Figure 3 (a and b), the borrowing pattern corresponds to the above sequence of events as follows:

a) Young debtor-borrower—Suppose the country is initially at a point such as x, where its capital stock is below the steady-state level. Bonds are immediately traded for capital, as the country moves from x to point y on the convergent saddle path. Along the saddle path the net marginal productivity of capital is equal to the world interest rate. This phase occurs instantaneously because of our assumption that physical capital is perfectly mobile internationally.[11] If there were costs to adjustment of the capital stock, then this phase would take time.[12]

b) Mature debtor-borrower—In our model, this stage does not appear as the country immediately switches from the young debtor-borrower stage to the debtor-repayer stage in the absence of adjustment costs. The mature debtor-borrower phase could appear with the inclusion of costly adjustment of the capital stock. In such a model, the optimal solution can yield a continuous trade balance over the entire path, starting at point x. (The stages in the balance of payments theory concerns the global dynamics of asset accumulation. Our assumption of perfect international mobility of physical capital allows us to use the saddle-path stability of the model to characterize dynamic phases away from the steady state. Without this assumption, the best we could hope for (given the saving dynamics) is to describe the economy near the steady state—which is

[11] This movement corresponds exactly to that studied in detail by Razin (1984).

[12] See Nunes (1983).

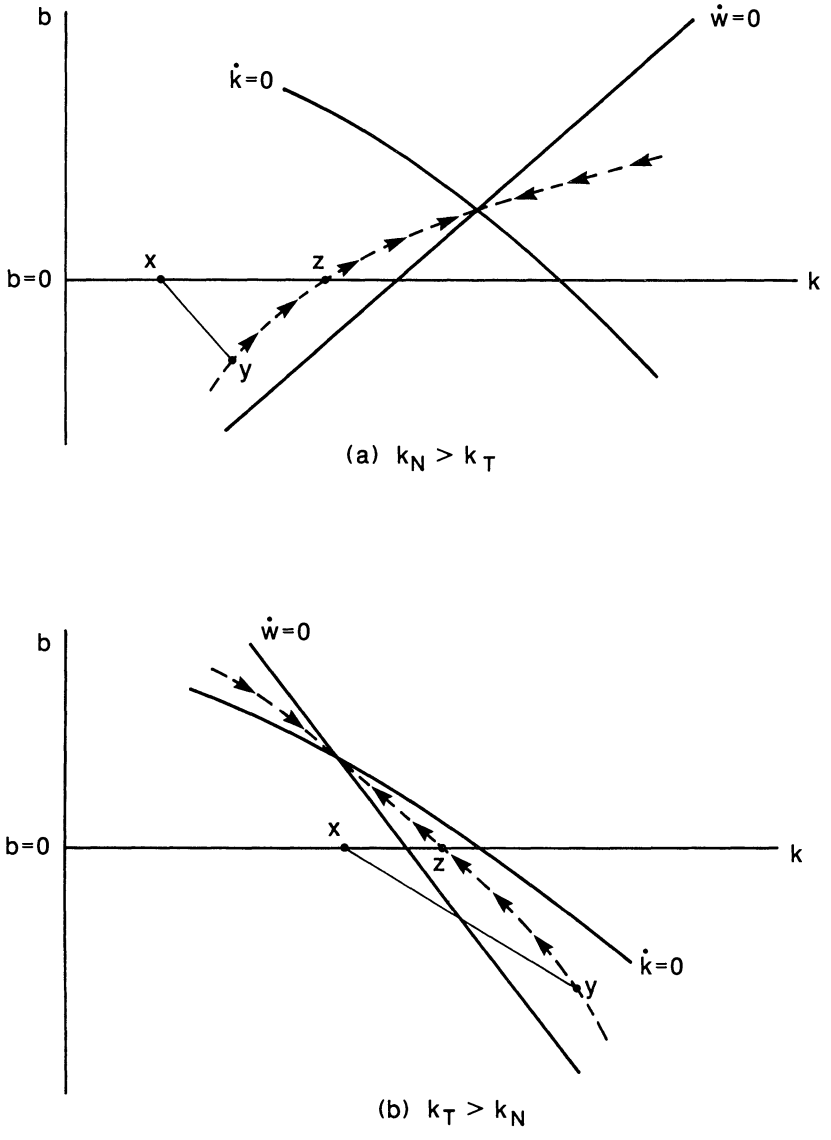


FIGURE 3

inadequate for the study of stages in the balance of payments. So, while this assumption is not a source of stages in the balance of payments, without it the global analysis of borrowing phases would be very difficult or impossible.)

c) Debtor-repayer—As the country moves along the saddle-path from y to z, its external debt declines. Both the current account and trade balance are in surplus, as wealth increases.

d) Young creditor-lender—From point z to the steady state in Figure 3, the country is a creditor. Initially, it is a young creditor-lender because the trade

balance is in surplus. (To see this, note that at point z the current account is in surplus, but the net external position of this country is zero. Therefore the trade balance must be in surplus. Since the trade balance is continuous along the saddle path, it is initially in surplus as the economy moves from point z.)

e) Mature creditor-lender—As the steady state is approached, the trade balance must fall into deficit for the current account balance to converge to zero. In the long run, the current account is balanced, with interest receipts on foreign loans just offsetting a trade deficit.

These phases in foreign borrowing by an initially capital-poor open economy arise in our model as a consequence of the time pattern of optimal investment and saving suggested by the descriptive literature on stages in the balance of payments. In the first phase of the optimal accumulation path, investment dominates saving and the current account is in deficit. Thereafter, wealth and per capita consumption are rising as the steady state is approached, and, in our model, the current account is in surplus.

The current account is in surplus for this country in the last three stages. This requires that saving exceed investment. In the case in which the traded good is capital intensive, this requirement is met since saving is positive (wealth is increasing) but investment is negative after the initial jump up in the capital stock. For the case in which the traded good is labor intensive, saving and investment are both positive in the final three stages. Given our Heckscher-Ohlin production structure, it is the presence of the non-traded good which assures that the current account remains in surplus during these stages. During a period of current account surplus, the country acquires claims on foreigners. In steady state, its interest earnings will be higher, which implies that its steady-state trade balance deficit must be larger. Given the continuity of the trade balance over these stages, it must deteriorate from its position of surplus at point z. As long as neither good is strongly inferior in consumption, then as wealth rises production of the non-tradeable must increase, and consumption of both goods will rise. This insures the necessary decline in the trade balance. So, the current account moves into surplus regardless of the factor intensity of the traded good.

Our model displays the pattern of growth and foreign indebtedness that has been observed for rapidly growing economies because it includes both capital accumulation and consumption dynamics along a path converging to a steady state. Stages in the balance of payments have been shown not to arise in an optimal capital accumulation path for the standard infinitely-lived representative household model of a small open economy in which the discount rate is constant (see Bazdarich 1978, and Nunes 1983). These papers allow for investment, but consumption dynamics are too simple to allow for stages. In these models, either consumption and wealth are constant or change at a constant proportional rate. Stages in which the country increases its net claims on the rest of the world appear in neither the convergent or divergent cases.[13] For example, in the convergent case, wealth remains constant

[13] The models of Bazdarich (1978) and Nunes (1983) are optimizing models in which the capital stock cannot adjust instantaneously: in Bazdarich, capital goods are non-tradeable, and in Nunes, there is a cost to installing investment goods. However, neither model displays the sequence of stages in the balance of

while the capital stock increases monotonically for an initially capital poor country. Since wealth is the sum of capital and foreign bonds, this implies the country must always run a current account deficit in these models.

Because optimal growth models with heterogeneous capital goods are known to display complex dynamics under simple saving assumptions, investment dynamics alone should be able to generate the observed stages in borrowing. If the production structure is rich enough and capital goods are not perfectly mobile internationally, aggregate investment could display cycles of any period (or even be chaotic). However, very different qualitative patterns of investment and borrowing would arise for different specific production functions.[14] It seems unlikely that this is the source for stages in the balance of payments.

Thus, consumption dynamics are important in explaining the stages—but capital accumulation plays an important part too. It is implausible that stages in the balance of payments will occur in an optimal saving model through consumption dynamics alone. In the absence of capital accumulation, per capita consumption must adjust non-monotonically to the steady state to produce the necessary sequence of trade imbalances and foreign borrowing.

Three features make our simple optimal saving model an attractive framework for rationalizing stages in the balance of payments theories. The inclusion of a capital good leads to an initial period in which borrowing from abroad finances rapid investment. Consumption growth along a convergent path and the presence of a non-tradeable consumable lead to the current account and trade balance dynamics described by the historical literature. Because of the non-traded good, these dynamics do not depend qualitatively on the technologies of the two sectors. While other approaches could generate non-monotone foreign asset accumulation with growth, this robustness would not be characteristic of many of them.

4. CONCLUSION

This paper builds a simple framework in which factors are mobile within a country, and capital goods are traded internationally. There is also perfect financial capital mobility. As in other models, a future-oriented shift in time preference leads to reductions in current consumption levels as a means of obtaining higher long-run levels of consumption. In a model in which only consumption goods can be lent or borrowed this implies an increase in lending abroad. However, in our model a fall in current consumption creates a drop in the level of activity in the home goods sector which is accompanied by an increase in domestic production of tradeable goods. In the case in which the amount of capital that can profitably be reallocated from the home goods sector is insufficient (when traded goods production is capital intensive), borrowing to purchase capital goods from abroad will occur.

Because our model has both capital accumulation and consumption dynamics,

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payments. For the case in which convergence to a steady state is optimal, consumption is constant over time and the current account is in deficit for the entire adjustment path of an initially capital-poor country.

[14] This is implied by several recent papers. See, for example, Boldrin and Montrucchio (1986).

we show that the stages in the balance of payments can be traced out in an optimizing framework. A capital scarce country will initially borrow from abroad to finance profitable investment opportunities at home. When the productivity of domestic capital at the margin has been reduced into equality with the return from traded assets, the incentive to borrow to increase the domestic capital stock is eliminated. At that point the country may have a high saving level that will allow it eventually to pay off its debts and increase its wealth. Eventually it could become a net creditor with high per capita consumption.

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REFERENCES

BAZDARICH, M., "Optimal Growth and Stages in the Balance of Payments," *Journal of International Economics* 8 (August 1978), 425–443.

BOLDRIN, M. AND L. MONTRUCCHIO, "On the Indeterminacy of Capital Accumulation Paths," *Journal of Economic Theory* 40 (October 1986), 26–39.

BUITER, W., "Time Preference and International Lending and Borrowing in an Overlapping-Generations Model," *Journal of Political Economy* 89 (August 1981), 769–797.

CLOWER, R. AND M. JOHNSON, "Income, Wealth and the Theory of Consumption," in J. N. Wolfe, ed., *Value, Capital and Growth: Papers in Honor of Sir John Hicks* (Chicago: Aldine, 1968).

EATON, J., "Foreign Public Capital and Economic Development," in H. Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics* (Amsterdam: North-Holland, forthcoming).

ENGEL, C. AND K. KLETZER, "International Borrowing to Finance Investment," Working Paper No. 1865, National Bureau of Economic Research, March 1986.

ETHIER, W., "Higher Dimensional Issues in Trade Theory," in R. Jones and P. Kenen, eds., *Handbook of International Economics* (Amsterdam: North-Holland, 1984).

FELDSTEIN, M. AND C. HORIOKA, "Domestic Saving and International Capital Flows," *Economic Journal* 90 (June 1980), 314–329.

FISCHER, S. AND J. FRENKEL, "Investment, the Two-Sector Model, and Trade in Debt and Capital Goods," *Journal of International Economics* 2 (August 1972), 211–233.

FRANKEL, J., "International Capital Mobility and Crowding out in the U.S. Economy: Imperfect Integration of Financial Markets or of Goods Markets?" Working Paper No. 1773, National Bureau of Economic Research, December 1985.

FRENKEL, J. AND A. RAZIN, "Fiscal Policies in the World Economy," *Journal of Political Economy* 94 (June 1986), 564–594.

KINDLEBERGER, C., *International Economics* (Homewood, IL: Irwin, 1968).

MURPHY, R., "Productivity Shocks, Non-Traded Goods and Optimal Capital Accumulation," *European Economic Review* 30 (1986), 1081–1095.

NUNES, L., "Optimal Capital Accumulation and External Indebtedness in a Two Sector Small Economy Model," University of Chicago, October 1983.

OBSTFELD, M., "Macroeconomic Policy, Exchange-Rate Dynamics, and Optimal Asset Accumulation," *Journal of Political Economy* 89 (December 1981), 1142–1161.

———, "Aggregate Spending and the Terms of Trade: Is There a Laursen-Metzler Effect?" *Quarterly Journal of Economics* 97 (May 1982), 251–270.

———, "Capital Mobility in the World Economy: Theory and Measurement," *Carnegie-Rochester Conference Series on Public Policy* 24 (spring 1986), 55–104.

———, "Exchange-Rate Dynamics and Optimal Asset Accumulation Revisited, Technical Working Paper No. 64, National Bureau of Economic Research, April 1988.

PERSSON, T. AND L. SVENSSON, "Current Account Dynamics and the Terms of Trade: Harberger-Laursen-Metzler Two Generations Later," *Journal of Political Economy* 93 (February 1985), 43–65.

RAZIN, A., "Capital Movements, Intersectoral Resource Shifts and the Trade Balance," *European Economic Review* 26 (1984), 135–152.

RUFFIN, R., "International Factor Movements," in R. Jones and P. Kenen, eds., *Handbook of International Economics* (Amsterdam: North-Holland, 1984).

SACHS, J., "The Current Account and Macroeconomic Adjustment in the 1970s," *Brookings Papers on Economic Activity* 12 (1981), 201–282.

SVENSSON, L. AND A. RAZIN, "The Terms of Trade and the Current Account: The Harberger-Laursen-Metzler Effect," *Journal of Political Economy* 91 (February 1986), 97–125.

UZAWA, H., "Time Preference, the Consumption Function, and Optimum Asset Holdings," in J. N. Wolfe, ed., *Value, Capital and Growth: Papers in Honor of Sir John Hicks* (Chicago: Aldine, 1968).