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A MODEL OF INTERNATIONAL TRADE AND FINANCE

Laurence Weiss

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A MODEL OF INTERNATIONAL TRADE AND FINANCE*

by

Laurence Weiss

The justification for a distinct theory of international capital asset price formation and portfolio composition rests upon a systematic relationship between asset returns and changes in the relative prices of consumption goods of investors of different countries.¹ Otherwise, the theory would be a simple extension of the single country model by modifying the original choice set to include foreign assets. On purely theoretical grounds, the relevant price index might vary among heterogeneous investors within a country as well as among investors of different countries. To explain observed asset holdings it is necessary to make identifying restrictions on the sources of exogenous uncertainty which influence aggregate returns and relative price changes.

In this paper an equilibrium model of international trade, payments and financial asset flows is presented. The model lays no claim to gen-

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¹For example, Solnik's (1975) international capital asset pricing model, it is assumed that residents of each country consume a different good and domestic bonds are risk free for residents of the country. This relationship was assumed a priori, without reference to the underlying structure which might give rise to it.

erality; it has several special features which may prove useful to explain observed relationships. The basic characteristics of the model are the specification of consumer tastes, money demand, production technology and the sources of exogenous uncertainty. The latter are taken to be revisions of expectations concerning the future productivity of capital, what Keynes called "the state of long term expectations." It will be shown that international trade and capital flows, variations in relative prices and exchange rates, and the return to alternative capital assets may all be explained as arising from unexpected changes in the state of long term expectations in one country relative to those in its trading partner. The model assumes a particular structure of international trade which enlarge opportunities for intertemporal exchange. There is no trade in physical capital goods, nor in some collection of domestically consumed goods. Potential exports are perfect consumption substitutes for potential importables, so that any time merchandise trade flows in one direction only in return for financial assets.

An important factor in explaining asset holdings is shown to be the time horizon of investors' prospective consumption streams. For those investors with relatively longer economic horizons, foreign assets will be held as a risk avoidance strategy, while myopic investors will find domestic assets to provide for more nearly certain consumption.

The paper is organized as follows: Section I describes the non-monetary (Walrasian) model in the hope of integrating financial equilibrium relationships with international trade theory. This section examines the theoretical justification for asset preferences to depend upon both the country of residence and the relevant time horizon of investors. Section II introduces money in a somewhat ad hoc, but conventional manner, by postulating plausible money demand functions. This is analyzed both under the

assumptions of country specific money with an endogenous (flexible) exchange rate, and under the assumption of world money, equivalent to a regime of fixed exchange rates. Section III contains some interpretations of the results and the testable implications of the model.

Section I. The Model

There are two symmetric countries, and three periods. There exist three distinct consumption commodities in periods two and three; a good which is traded internationally and is consumed by residents of either country (T) and two other goods which are non-traded, the quantity of which in the home country is denoted by N, and in the foreign country by N'. The second period permits the production of country specific capital goods (I₂ and I'₂ respectively), which are not physically traded internationally.

In the home country the ordinal preferences of each agent may be described by a Cobb-Douglas utility function

$$(1) \quad U = \log N_2 + \log T_2 + \log N_3 + \log T_3$$

(subscripts refer to time periods).

The aggregate production opportunities in the home country are described by the following relationship:

$$(2) \quad N_2^2 + T_2^2 + I_2^2 = K_2^2$$

$$(3) \quad K_3 = I_2$$

$$(4) \quad N_3^2 + T_3^2 = \bar{x}K_3^2$$

where \tilde{x} is an index of productivity of period 3 capital specific to the home country, a random variable which is realized costlessly and publicly prior to period 2 trade. Thus \tilde{x} is an indication of the profitability of investment, corresponding to the state of long term expectations. Note that the aggregate production opportunities for the four domestically produced consumables, given by

$$(5) \quad N_2^2 + T_2^2 + \frac{1}{\tilde{x}}N_3^2 + \frac{1}{\tilde{x}}T_3^2 = K_2^2$$

is homogeneous of degree one, so that factor payments, which accrue exclusively to the holders of period 2 capital, exhaust the value of output. The tastes and production opportunities in the foreign country are identical. The index of productivity of period 3 foreign capital will be denoted by x' . All expectations of period 3 prices are held with certainty during period 2 trade. The revelation of state of expectations is the only source of uncertainty in the model.²

The only economic activity which occurs in the first period is trade in claims to the capital stock. Assume that initial endowments of capital are symmetric between the two countries, and that there is an aggregate capital stock of one unit in each country. Expectations of x and x' are taken to be homogeneous and symmetric so that the relative price of the two kinds of capital is one. The outcome of period one trade may be denoted by α ($0 \leq \alpha \leq 1$), the fraction of the capital stock in each country which is owned by residents.³ The particular α which emerges will

²The model does not consider the possibility of exchange controls or other uncertain government policies which may explain a relative preference for domestic assets.

³The possibility of short sales is not considered. I have not been able to find conditions that make this constraint binding.

be shown to depend upon attitudes towards risk as expressed by monotonic transformations of the specified ordinal preference ranking, and the relevant time horizon of investors.

Given a particular value of α , the equilibrium may be determined as a function of x and x' . The equilibrium is assumed competitive and is characterized by relative prices of the six economically distinct final goods. Normalizing the price of second period traded goods at one, the five relative price relations are:⁴

⁴In the home country firms seek to

$$\text{Maximize } P_{N_2} N_2 + T_2 + P_{N_3} N_3 + P_{T_3} T_3$$

$$\text{Subject to } N_2^2 + T_2^2 + \frac{1}{x} N_3^2 + \frac{1}{x} T_3^2 = K_2^2$$

to which the optimal solution is

$$N_2^S = \frac{P_{N_2}}{r}, \quad T_2^S = \frac{1}{r}, \quad T_3^S = \frac{xP_{T_3}}{r}, \quad N_3^S = \frac{xP_{N_3}}{r}$$

where r equals the shadow price on a unit of domestic capital.

Letting $W = \alpha r + (1-\alpha)r'$ be the income accruing to domestic residents, and W' be the income to foreigners, demand for the non-traded goods is given by $N_2^D = (W/4P_{N_2})$ and $N_3^D = (W/4P_{N_3})$ so that $P_{N_2} = (rW/4)^{1/2}$ and $P_{N_3} = (rW/4x)^{1/2}$.

The world demand for traded goods is given by

$$T_2^D + T_2^{D'} = \frac{r+r'}{4}, \quad T_3^D + T_3^{D'} = \frac{r+r'}{4P_{T_3}}$$

which must equal world supply

$$T_2^S + T_2^{S'} = \frac{1}{r} + \frac{1}{r'}, \quad T_3^S + T_3^{S'} = xP_{T_3} \left(\frac{1}{r} + \frac{1}{r'} \right),$$

yielding the equilibrium price relationships $rr' = 4$ and $P_{T_3} = ((r+r')/(xr'+rx'))$.

$$P_{N_2} = \frac{1}{2}(\alpha r^2 + 4(1-\alpha))^{1/2}, \quad P_{N'_2} = \frac{1}{2}(\alpha r'^2 + 4(1-\alpha))^{1/2},$$

$$P_{N_3} = \frac{1}{2}((\alpha r^2 + 4(1-\alpha))/x)^{1/2}, \quad P_{N'_3} = \frac{1}{2}((\alpha r'^2 + 4(1-\alpha))/x')^{1/2},$$

$$P_{T_2} = ((r+r')/(xr' + x'r))^{1/2}$$

where r and r' are the aggregate returns to capital at home and abroad. For the home country this number (in units of T_2) is given by

$$(6) \quad r^2 = \left(\frac{3-2\alpha}{2-\alpha} \right) \left(1 - \frac{x}{x'} \right) + \left[\left(\frac{3-2\alpha}{2-\alpha} \right)^2 \left(\frac{x}{x'} - 1 \right)^2 + 16 \frac{x}{x'} \right]^{1/2}.$$

For the foreign country x and x' are interchanged.

It will prove useful to approximate the value of r by its first order expansion about $x = x' = 1$. This is given by

$$(7) \quad r^2 \cong 4 + \frac{1}{(2-\alpha)}(dx - dx')$$

or

$$(7') \quad r \cong 2 + \frac{1}{4(2-\alpha)}(dx - dx').$$

Qualitatively, the equilibrium may be described in the following manner. A rise in productivity of investment in one country increases both the value of that country's capital stock (equal to current period GNP) and the fraction of resources used for investment, with an opposite and equal effect in its trading partner. In order to acquire capital in the now more productive country, residents of the now less productive country will be net exporters of current period consumables. This will raise the price of period 2 non-tradeables in the importing country relative to traded

goods, and lower the relative price of non-tradables in the exporting country. This is equivalent to saying that price of a representative basket of consumables in the importing country rises relative to the price of the equivalent basket of period 2 consumables in the exporting country. Thus each country's capital stock maintains a more constant purchasing power over a typical second period basket of domestic consumption than would claims to foreign capital.

More precisely, the second period price of non-traded home goods in terms of traded goods is given by the first order approximation

$$(8) \quad P_{N_2} \cong 1 + \frac{\alpha}{8(2-\alpha)}(dx - dx')$$

which rises with domestic productivity so long as some capital is domestically owned ($\alpha > 0$). The balance of trade for the home country in period two is the difference between production of tradables and consumption of tradables, given by

$$(9) \quad T_2^S - T_2^D = \frac{1}{r} - \frac{\alpha r + (1-\alpha)r'}{4}$$

which is approximately equal to $-(\alpha/4(2-\alpha))(dx - dx')$. A rise in relative productivity implies a deficit in the second period current account and, necessarily in this Walrasian non-monetary equilibrium a surplus on the capital account.

Thus the competitive equilibrium (the determination of all prices and quantities for each realization of x and x') is completely described by the share of capital domestically owned and the ordinal preferences of each agent. However, to predict the value of α which emerges from first

period maximizing behavior requires knowledge of attitudes towards risk as represented by the von Neumann-Morgenstern (cardinal) utility function, and the relevant⁵ price index for each investor.

If investors, whether through lack of foresight or in contemplation of mortality, are concerned only with period 2 consumption, the relevant domestic price index would be $P_{T_2}^{1/2} P_{N_2}^{1/2}$. Thus the ratio of the price index for consumers in the home country to consumers in the foreign country would be $P_{T_2}^{1/2} P_{N_2}^{1/2} / P_{T_2}'^{1/2} P_{N_2}'^{1/2}$ which has a first order approximation of $1 + [\alpha/4(2-\alpha)](dx - dx')$. Consumers of goods in the country with bullish expectations require more wealth (evaluated in units of T_2 , the numeraire) to achieve the same utility as consumers in the bearish country.

However, this relationship is reversed if agents have two period time horizons. The increased productivity of period 3 capital raises the supply of period 3 non-traded consumption goods and thus their relative price. The ratio of period 3 consumption goods prices between the two countries is $P_{N_3} P_{T_3} / P_{N_3}' P_{T_3}'$ which has a first order approximation of $1 - [(3\alpha+8)/4(2-\alpha)](dx - dx')$, which declines with a relative increase in home country capital productivity. The relevant price index for agents who contemplate consumption in both periods is, for the stated ordinal preferences, the geometric mean of each period's price index. The ratio of this index between the home and foreign country fall with an increase in relative productivity:

⁵The price index depends only upon ordinal preferences.

$$(10) \quad \frac{P_{N_2}^{1/4} P_{T_2}^{1/4} P_{N_3}^{1/4} P_{T_3}^{1/4}}{P_{N_2}'^{1/4} P_{T_2}'^{1/4} P_{N_3}'^{1/4} P_{T_3}'^{1/4}} = \left[\frac{\alpha r^2 + 4(1-\alpha)}{\alpha r'^2 + 4(1-\alpha)} \right]^{1/4} \left[\frac{x'}{x} \right]^{1/8}$$

$$\cong 1 - \frac{1-\alpha}{8(2-\alpha)}(dx - dx') .$$

Ordinal utility may be described as an increasing function of nominal wealth deflated by the correct price index. To characterize how agents trade utility across states requires knowledge of cardinal preferences, unique up to a positive linear transformation. For example, it is well known that if the cardinal utility function is additive in the logarithms of the quantities consumed, that the indirect utility function is

$$(11) \quad \log W - \log \prod_i P_i^{\alpha_i}$$

where W = nominal wealth, α_i = fraction of income spent upon good i , P_i = price of the i^{th} good. In this case the indirect utility function is separable in income and prices, and each investor would seek to maximize the expected logarithm of nominal wealth, independent of his particular price index. Because of the assumed symmetry of the initial situation, the outcome of period 1 trading would be that $\alpha = 1/2$, so that each investor would have an identical portfolio with half of his wealth invested at home and half invested in foreign assets.⁶

⁶The problem of each agent in period one may be defined as selecting that such that maximizes

$$E[\log \alpha r + (1-\alpha)r' - \log \prod_i P_i^{\alpha_i}]$$

the necessary first order condition for this problem is

Suppose, however that cardinal utility is expressed by

$$(12) \quad U(X) = F\left(\sum_i \alpha_i \log x_i\right), \quad F' > 0$$

then the indirect utility function is

$$(13) \quad V(W, P) = F\left(\log W - \log \prod_i P_i^{\alpha_i}\right)$$

and the marginal utility of wealth is given by

$$(14) \quad \frac{\partial V}{\partial W} = \frac{1}{W} F'\left(\log W - \log \prod_i P_i^{\alpha_i}\right).$$

A rise in the price indice will raise the marginal utility of nominal wealth if

$$(15) \quad \frac{\partial^2 V}{\partial W \partial \left(\prod_i P_i^{\alpha_i}\right)} = - \frac{1}{W \left(\prod_i P_i^{\alpha_i}\right)} F''\left(\log W - \log \prod_i P_i^{\alpha_i}\right)$$

is positive, which occurs if $F'' < 0$, or when investors are more risk averse than the logarithm.⁷

$$E\left[\frac{r - r'}{\alpha r + (1-\alpha)r'}\right] = 0$$

which at $\alpha = 1/2$ equals $E\left[(r - r')/\left(\frac{1}{2}r + \frac{1}{2}r'\right)\right]$, which by symmetry equals 0, establishing that $\alpha = 1/2$ is the unique equilibrium.

⁷An agent with a utility function $U(\cdot)$ is said to be more risk averse than an agent with a utility function $V(\cdot)$ if and only if there exist a concave, increasing function $F(\cdot)$ such that $U = F(V(\cdot))$.

In the present analysis, this implies that, if agents have two period consumption horizons, domestic assets will comprise the dominant share of each portfolio ($\alpha > 1/2$) when investors are less risk averse than the logarithm, and favor foreign assets in the opposite case.⁸ If, however, investors are concerned only with the utility of period two consumption, the qualitative results of equilibrium portfolio composition are reversed, with domestic assets affording relatively safer consumption streams. In this way investors guarantee for themselves high nominal returns when the marginal utility of wealth, for any fixed level of nominal wealth is relatively high.

⁸The necessary first order conditions for a competitive equilibrium is that in the home country

$$\frac{\partial EU}{\partial \alpha} = E \left[\frac{r - r'}{W} F'(\log W - \log \prod_i P_i^\alpha) \right] = 0$$

and in the foreign country

$$\frac{\partial EU'}{\partial \alpha} = E \left[\frac{r' - r}{W'} F'(\log W' - \log \prod_i P_i^{\alpha'}) \right] = 0$$

which at $\alpha = 1/2$ implies that

$$\frac{\partial EU}{\partial \alpha} + \frac{\partial EU'}{\partial \alpha} = E \left[\left(\frac{r - r'}{\frac{1}{2}r + \frac{1}{2}r'} \right) (F'(\log W - \log \prod_i P_i^\alpha) - F'(\log W - \log \prod_i P_i^{\alpha'})) \right].$$

The first term in the expression is increasing in (x/x') . It has been demonstrated that $\log \prod_i P_i^{\alpha} - \log \prod_i P_i^{\alpha'}$ is decreasing in x/x' so that if F' is increasing ($F'' > 0$) the term in the second parentheses $[F'(\log(\frac{1}{2}r + \frac{1}{2}r')) - \log \prod_i P_i^{\alpha}] - F'(\log(\frac{1}{2}r + \frac{1}{2}r')) - \log \prod_i P_i^{\alpha'}$ is increasing in (x/x') , and decreasing if $F'' < 0$. Thus the expression is positive, negative, 0, as F'' is positive, negative, 0. This implies that the sum of expected utility will increase with an increase in α at $\alpha = 1/2$ if $F'' > 0$, which by symmetry implies that both agents' expected utility will increase.

Section II. An Ad Hoc Monetary Model

In this section money is added to the model with the hope of integrating the determinants of exchange rate movements, inflation and balance of payments phenomenon with the real sector of the economy. This will be done first under the assumption that the relative price of currencies is endogenous, corresponding to a case of national currencies and freely floating exchange rates. This extension will be assumed to have no effect upon the Walrasian equilibrium previously described. Its purpose is to try to show why domestic currency might be relatively safer in terms of domestic consumption than foreign currency, or equivalently why exchange rate flexibility is a partial substitute for money price flexibility. The analysis then considers a world of fixed exchange rates, which is modeled by assuming that there is world money. In this case foreign trade and capital accumulation may be financed by running down real cash balances which may affect relative prices.

In both situations, the approach taken is consistent with what has been called "the monetary approach to the balance of payments."⁹ This views the determinant of the exchange rate under flexible exchange rates, and the balance of payments under fixed rates, to be the relative demands for real money balances in the two countries. The supplies of nominal monies are fixed; the model does not analyze the affects of either anticipated or un-anticipated changes in money supply.

⁹This analysis of exchange rate determination may be found in Hahn (1959), Dornbusch (1973), Frenkel and Rodriguez (1976) and Kouri and Porter (1975).

A. Flexible Exchange Rates

The ratio of final period real money balances between the two countries is assumed to be influenced primarily by the division of real output. Thus

$$(16) \quad \frac{\left(\frac{M}{P}\right)_3^D}{\left(\frac{M}{P'}\right)_3^D} = 1 + K_1 \left(\frac{Y_3}{Y'_3} - 1 \right), \quad K_1 > 0$$

where Y_3/Y'_3 is the ratio of third period production in the home country relative to its trading partner. The justification for this money demand function is that money is basically used to facilitate domestic transactions, the value of which are proportional to the value of production. Since both countries have access to the same international capital market, the influence of interest rates on relative money demand is neglected. P and P' are the domestic and foreign money price indexes of the same basket of world consumption. The exchange rate, defined as e units of foreign currency per unit of domestic may be defined equal to P'/P , so that variations in the exchange rate equilibrates the relative demands for real money balances.

The ratio of third period production between the two countries

$$(17) \quad \frac{P_{N_3} N_3 + P_{T_3} T_3^S}{P_{N'_3} N'_3 + P_{T'_3} T'_3^S} = \frac{\frac{4-\alpha}{4} r + \frac{\alpha-2}{r}}{\frac{4-\alpha}{4} r' + \frac{\alpha-2}{r'}} \\ \approx 1 + \frac{3-\alpha}{4(2-\alpha)} (dx - dx') .$$

The nominal supply of each type of national currency is taken to be one unit. Initial money endowments are exclusively in the domestic currency,

and there is no forward market in currency. Money market equilibrium implies that

$$(18) \quad e_3 \equiv \frac{\frac{1}{P_3}}{\left[\frac{1}{P_3}\right]^r} = 1 + k_1 \left[\frac{3-\alpha}{4(2-\alpha)} (dx - dx') \right] .$$

An increase in domestic productivity ($dx > 0$) can be seen to induce higher real domestic income, the need for relatively greater real cash balances, and an appreciation of the exchange rate.

Second period money demand is modified to the extent that inflationary expectations differ between the two countries. Suppose that

$$(19) \quad \frac{\left[\frac{M}{P_2}\right]^D}{\left[\frac{M'}{P_2}\right]^D} = 1 + k_2 \left[\frac{Y_2}{Y_2'} - 1 \right] - k_2 \left[\frac{\pi}{\pi'} - 1 \right]^{\text{expected}}$$

where $\pi = (P_3/P_2)^{\text{expected}}$, $\pi' = (P_3'/P_2')^{\text{expected}}$, equal to one plus the expected inflation rate. The demand for real balances increases with real income, and decreases with expected inflation. Since π/π' equals e_2/e_3 , the term $(\pi/\pi') - 1$ will be approximated by its first order expansion, $e_2 - e_3$. Substituting the ratio of relative real second period real income between the two countries

$$(20) \quad \frac{r}{r'} \equiv 2 + \frac{1}{4(2-\alpha)} (dx - dx')$$

and assuming that agents have correct ("rational") point expectations of future inflation rates, second period equilibrium in the money market implies

$$(21) \quad e_2 \equiv \frac{\frac{1}{P_2}}{\left(\frac{1}{P_2}\right)^*} = 1 + k_1 \left(\frac{1 + (2-\alpha) \frac{k_2}{1+k_2}}{4(2-\alpha)} (dx - dx') \right)$$

and

$$(22) \quad (e_2 - e_3) = \frac{-1}{4(1+k_2)} (dx - dx') .$$

The exchange rate movement in the second period is greater than could be explained solely by changes in current period real income. The excess represents anticipation of future differential inflation and exchange rate movements. The relative discrepancy in period 3 production is $(3-\alpha)$ times as great as the percentage disparity in period 2 production. This is because all investors seek to acquire capital in the country with the higher productivity. The movement in the real value of each currency will be qualitatively similar to the movement in the relative price of that country's non-traded good. Each national currency will maintain a more constant period 2 purchasing power over a representative domestic consumption bundle than would foreign currency.¹⁰ This does not arise from the failure of prices to instantaneously reach their market clearing values, but as the solution to an admittedly simplified and somewhat ad hoc general equilibrium system.

Flexibility of exchange rates serve to lessen the burden of adjustment in relative prices borne by changes in money prices, since the relative price of non-traded goods and the value of domestic currency are affected

¹⁰This theoretical conclusion has received empirical support. Kouri and de Macedo (1978) report that domestic currency will dominate the portfolios of minimum variance real purchasing power in the case of Germany, U.K. and the U.S., but not for France or Japan.

similarly by revisions in the long term state. It would be possible for the domestic money price of non-traded goods to be invariant to changes in the expected productivity of capital, leaving the burden of adjustment in relative prices to the exchange rate and the money price of traded goods.

The theory presented is an explicit alternative to the purchasing power parity theory of exchange rate determination. Those shocks which cause an increase in the relative value of one country's currency also raise the equilibrium value of that country's non-traded good, and hence the price of all consumables. Hence, the purchasing power of an appreciating currency over a basket of domestic consumption will be less than the purchasing power of a depreciating currency over its domestic counterpart. Over time, however, the relative price of consumables will fall in the appreciating country because of superior productivity, and the once overvalued currency will appear undervalued by the purchasing power criterion.

B. Fixed Exchange Rates

Under fixed exchange rates, a country can finance the acquisition of capital or goods by running down real cash balances. The transfer of real resources effected by exporting money can affect relative prices.

Let Z be the size of the transfer of real resources to the home country financed by exporting money. Positive Z implies a balance of payments deficit for the home country. This will be spent like any other income, which will alter relative prices and factor rewards. The return to domestic capital will increase by $Z/4-2\alpha$ ¹¹ and the aggregate return

¹¹Because of the particular pattern of trade, a transfer will not affect nominal demand for tradables. In the home (receiving) country the demand for non-tradables becomes $N_2^D = (Y+Z)/4P_{N_2}$ and $N_3^D = (Y+Z)/4P_{N_3}$. Market

to foreign capital will decrease by the same amount.

Suppose that the relative demand for money in each country in the third period is dependent upon the ratio of the value of aggregate production.

$$(23) \quad \frac{\left(\frac{M}{P}\right)_3^D}{\left(\frac{M}{P}\right)_3^D} = 1 + k_1 \left[\frac{Y_3}{Y_3'} - 1 \right] = k_1 \left[\frac{P_{T_3} T_3^S + P_{N_3} N_3}{P_{T_3} T_3^{S'} + P_{N_3} N_3'} - 1 \right]$$

which equals¹²

clearing implies that

$$r^2 = \left[\frac{rY}{2} + 1 + \frac{Z}{2} + \frac{r^2 + 4}{r^2 \left(\frac{x'}{x} \right) + 4} \right]$$

which, after some manipulation becomes

$$r^2 = \left[\frac{3-2\alpha}{2-\alpha} \left(1 - \frac{x}{x'} \right) + \frac{Z}{2-\alpha} + \left[\left(\frac{3-2\alpha}{2-\alpha} \left(\frac{x}{x'} - 1 \right) - \frac{2}{4-2\alpha} \right)^2 + 16 \frac{x}{x'} - \frac{4Z}{2-\alpha} \frac{x}{x'} \right]^{1/2} \right]$$

so that

$$\left. \frac{\partial r^2}{\partial Z} \right|_{\substack{T=0 \\ \frac{x}{x'}=1}} = \frac{1}{2-\alpha} - \frac{4}{2\sqrt{16}} = \frac{1}{2(2-\alpha)} .$$

¹²Third period production in the home country is equal to $P_{N_3} N_3 + P_{T_3} T_3^S$

which is equal to $(4-\alpha/4)r + (\alpha-2/r) + Z/4$. The first order approximation at $Z = 0$, $r = 2$ is given by

$$1 + \frac{3-\alpha}{2} dr + \frac{1}{4} dZ$$

where $dr = [1/4(2-\alpha)](dx - dx') + [1/2(2-\alpha)]dZ$ so that third period production is

$$1 + \frac{3-\alpha}{8(2-\alpha)}(dx - dx') + \left[\frac{5-2\alpha}{4(2-\alpha)} dZ \right] .$$

$$(24) \quad 1 + k_1 \left[\left(\frac{3-\alpha}{4(2-\alpha)} \right) (dx - dx') + \left(\frac{5-2\alpha}{2(2-\alpha)} \right) Z \right] .$$

Since the exchange rate is assumed to be fixed, the demand and supply of money between the two countries is equilibrated by a flow of $Z\%$ of the value of currency from the home to the foreign country. Equilibrium implies that

$$(25) \quad \frac{1-Z}{1+Z} = \frac{\left(\frac{M}{P} \right)_3^D}{\left(\frac{M}{P} \right)_3^D}$$

or¹³

$$Z = - \left[\frac{3-\alpha}{26-12\alpha} \right] (dx - dx') .$$

Thus the flow of real resources from the country with high productivity to the other country, reduces the decline in income for any size exogenous shock. In each country, there will be less variability of the return to capital than under flexible exchange rates, since the transfer of real resources is opposite in sign from the random disturbance and accrues partly to the holders of capital.

It would be erroneous, however, to conclude that monetary integration achieves something that could not be duplicated through private channels. If a market for forward delivery of currency existed, then the private economy could duplicate the transfer of resources effected by fixed exchange rates

For the foreign country, the change in production is of opposite sign and of the same magnitude, so that the percentage discrepancy is doubled, yielding expression (23) in the text.

¹³ Approximating expression (24) by $1-2Z$.

by agreeing to deliver forward a fixed quantity of domestic currency in return for foreign currency at a specified price. In this way each agent insures himself against a decline in the value of his own portfolio induced by the relative decline in the productivity of investment in his home country.

Conclusion

This paper has set forth a model of international trade and capital flows in which asset preferences depend upon investors' relevant consumption sets. These differ across investors of different countries because some consumption goods are not traded internationally. Within a country, the relevant consumption sets might vary among agents with different consumption time horizons.

The principal result is that bullish expectations in one country raise not only the proportion of resources devoted to capital formation, but the return to existing capital and the relative price of non-traded goods in this country. Over time, the greater productivity of domestic capital will increase the supply of non-traded goods and make them cheaper relative to their foreign counterparts.

Although the treatment of money in the model is not wholly satisfactory,¹⁴ the explicit characterization of sources of aggregate uncertainty may help to explain the co-movements between exchange rates and relative price changes. The model confirms a widely held proposition among international trade theorists that internal price stability may be inconsistent

¹⁴ A more complete analysis would integrate money holdings with claims to private capital as a way of intermediating intertemporal exchange.

with exchange rate stability. Those shocks which cause an appreciation in the value of domestic country also raise the relative price of non-traded goods. Thus part of the adjustment in relative prices is borne by exchange rate movements, leaving a smaller burden of adjustment in the domestic money price of non-traded goods. If, because of factors not included in the model downward price adjustments are accompanied by low rates of utilization,¹⁵ flexible exchange rates may avoid undesirable fluctuations in aggregate income which would occur under fixed rates.

The model also illustrates the types of private portfolio adjustments which could be expected to accompany a switch from fixed to flexible exchange rates. The use of the forward market to hedge against unexpected changes in exchange rates is well known. However, because the return to domestic capital moves in the same direction as the external value of domestic currency, the model predicts that ownership in claims to foreign capital can substitute, at least partially, for hedging in the forward market in foreign exchange. In this way the private economy will share those risks which were implicitly borne by agreeing to accept each other's currency at a fixed exchange rate. Private international financial relationships can substitute for international monetary cooperation.

Perhaps the most important feature of the model is its emphasis upon the role of expectations of the profitability of new investment for determination of exchange rates and investment flows. This view leads to the conclusion that exchange rate movements will be of the same direction as

¹⁵One factor which could explain aggregate fluctuations in aggregate output is the limited information transmitted by observation of money price signals. This idea was suggested by Lucas (1972).

domestic capital values. Thus the model stands in contrast to previous monetarist approaches to the balance of payments which have primarily examined the responses to unanticipated changes in the supply of nominal balances (Frankel and Rodriguez, 1976). Such monetary shocks could be expected to cause divergent movements between the external value of domestic currency and the money price of claims to real capital assets.

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