Foreign-Owned Land

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Foreign investment affects land prices as well as domestic capital. A permanent increase in net foreign investment can reduce steady-state welfare if a consequence is higher land values. Other things equal, more crowded countries have higher land prices and lower permanent welfare, but their net foreign indebtedness depends on technology, savings behavior, and the interest rate. Even when the domestic capital stock is not affected, a land tax raises steady-state welfare.

Foreign investment contributes to the productive resources of the capital-importing country. It also affects the value of domestic assets in fixed supply. Most economic analysis, in assuming that assets in the host country are completely reproducible, addresses only the first effect. If some assets in the economy are supplied inelastically, however, the effect of foreign investment on asset values can reverse many standard results on the consequences of foreign investment for welfare, and a number of other comparative static results as well.

This paper develops a life-cycle model of an economy in which three factors, called land, labor, and capital, produce output. Land and capital serve as stores of value as well. The fundamental distinction between them is that capital is reproducible whereas land is in fixed supply.

The distinction between land and capital both as factors of production and as assets appears in David Ricardo (1817) and more explicitly in Henry George (1898). For George, the fundamental difference is that the productive contribution of land, unlike that of labor or capital, does not derive directly or indirectly from human endeavor, its role in production being "passive." George argues that private ownership of land diverts resources away from more productive activities:

> ..."It is seen that private property in land, instead of being necessary to its improvement and use, stands in the way of improvement and use, and entails an enormous waste of productive forces;" [1904, p. x].

In the analysis here, ownership of land, or more specifically private trade in claims on income from land, plays exactly this role by diverting savings away from investment in capital.

Raymond Goldsmith (1985) provides data that give some indication of the quantitative importance of land holdings. Table 1 presents his data on land as a share of tangible assets for twenty countries. These suggest that land can be a nontrivial component of wealth.[1]

One purpose of the analysis here is to consider the consequence of an exogenous increase in the level of foreign investment where land and capital both serve as factors of production and as a store of value. Peter Diamond (1965) and John Kareken and Neil Wallace (1977) address this issue in special cases of the model developed here.[2] The first

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[1]Elsewhere I have explored the implications of changes in the terms of trade and in factor supplies in a three-factor, life-cycle model with portfolio autarky; that is, in the absence of foreign investment (Jonathan Eaton, 1987). Jean Tirole (1985) discusses the implications of fixed factors for asset bubbles. Oded Galor (1986) analyzes migration in an overlapping generations model.

[2]Willem Buiter (1981) extends Diamond's analysis to two countries.

TABLE 1—LAND AS PERCENT OF TANGIBLE ASSETS

Country	Approximate Year					
	1850		1913		1978	
	All Land	Agricultural Land	All Land	Agricultural Land	All Land	Agricultural Land
Australia	–	–	–	–	12.5	–
Belgium	54.5	–	18.7	–	18.1	–
Canada	–	–	–	–	24.3	3.4
Denmark	–	–	26.3	13.3	14.2	2.9
France	56.5	49.9	33.2	25.4	23.4	7.9
Germany	45.8	43.2	26.9	20.2	24.9	12.6
Great Britain	29.9	19.9	22.2	9.9	14.9	2.5
Hungary	–	–	–	–	27.1	16.5
India	35.3	–	53.7	–	25.1	–
Israel	–	–	–	–	18.5	3.3
Italy	47.2	41.8	39.2	33.3	16.8	5.1
Japan	–	–	42.2	29.7	50.7	11.0
Mexico	–	–	–	–	19.3	5.8
Norway	–	–	31.3	22.4	15.8	5.3
Russia/USSR	–	–	61.5	–	22.8	–
South Africa	–	–	28.0	21.1	18.5	8.5
Sweden	–	–	–	–	15.3	2.8
Switzerland	–	–	36.0	21.7	17.2	2.5
United States	41.3	35.8	35.3	19.2	24.9	5.4
Yugoslavia	–	–	–	–	18.5	15.4

Source: Goldsmith (1985, Tables 39 and 40).

analysis excludes land and the second capital. The two yield diametrically opposite conclusions about the implications of foreign investment for welfare, both on impact and in steady state. With no land, foreign capital inflow lowers the welfare of the currently retired but, if the equilibrium is efficient, steady-state welfare rises. With no capital, these results are just reversed. With both factors present the effects, not surprisingly, are ambiguous, but under specific assumptions about technology simple conditions determine their direction. Inserting data from several countries into these conditions suggests no presumption that a reaction in one direction or the other is universally more likely.

A second concern of this analysis is the behavior of a national economy when capital is perfectly mobile, so that the level of foreign investment equates domestic and world rates of return. An exogenous change in the world interest rate has an ambiguous effect on the value of land and on welfare. A fall in this rate can, for example, reduce the steady-state welfare even of a capital importer if it causes land prices to rise, while, on impact, the retired generation benefits from the consequent capital gain on land. An increase in the ratio of labor to land necessarily raises land prices and reduces steady-state welfare, however, while, again, on impact the currently retired benefit from the resulting capital gain.

The third issue that the paper addresses is the effect of a land tax on foreign investment and on national welfare. This analysis extends to an open economy work by Martin Feldstein (1977), Guillermo Calvo et al., (1979) and Christophe Chamley and Brian Wright (1987) who show, in a closed economy, that taxing land raises steady-state welfare. Such a tax raises the capital stock, causing the wage rate to rise and the interest rate to fall.[3] With perfect capital mobility, the domestic capital stock and factor prices are unchanged as a consequence of a land

[3] The effect on the generation first subject to the tax is necessarily negative, however. This result typically extends to the open economy, as I discuss in Section IV.

tax. Nevertheless, a tax on land raises steady-state welfare as long as the value of land remains positive. Thus George's (1904) argument in favor of such a tax extends to an economy facing a given world interest rate, even though the total capital stock is not affected by the tax.

Section I presents the basic assumptions of the analysis. The effect of an exogenous increase in foreign investment is examined in Section II. Section III analyzes the economy under perfect capital mobility, while the issue of the land tax is addressed in Section IV. Section V provides some concluding remarks.

I. The Model

The economy has a constant endowment of land, in an amount T, and a constant labor force L. Investment in the previous period determines the stock of capital in period t, denoted K_t. Aggregate output net of depreciation in period t, Q_t, is a homogeneous, twice-differentiable function of the three inputs,

$$Q_t = G(K_t, L, T). \tag{1}$$

Standard marginal productivity conditions determine the factor rewards w_t for labor, r_t for capital (net of depreciation), and π_t for land. I adopt the normalization $T = 1$.[4]

New investment in capital takes the form of currently produced units of output that are not consumed. National savings is determined by a simple life-cycle optimization. Individuals live two periods. In the first period of life they provide a unit of labor services to earn a wage w. An amount c^y is spent on current consumption with the remainder invested in land and capital. In the second period the individual consumes the value of his assets and the income that they have earned. This amount is denoted c^0. Lifetime utility is $U(c^y, c^0)$.

[4] This specification need not imply that land is homogeneous or that all land is actually used in production. See Eaton (1987).

The price of land is q_t. Denoting the individual's investment in capital as k_t and in land as l_t, budget constraints imply that

$$c_t^y = w_t - k_{t+1} - q_t l_{t+1}. \tag{2}$$

$$c_{t+1}^0 = (1 + r_{t+1})k_{t+1} + (q_{t+1} + \pi_{t+1})l_{t+1}. \tag{3}$$

With perfect foresight, for both land and capital to be held in positive amounts requires that

$$\frac{q_{t+1} + \pi_{t+1}}{q_t} = 1 + r_{t+1}, \tag{4}$$

which implies, with (3), that

$$c_{t+1}^0 = (1 + r_{t+1})(w_t - c_t^y). \tag{5}$$

In the working period the individual's problem is to choose c_t^y to maximize utility, given w_t and r_{t+1}. The utility-maximizing level is denoted by the function $c^y(w_t, r_{t+1})$.

Equilibrium in the markets for land and capital implies that

$$K_{t+1} = Lk_{t+1} + K_{t+1}^f \tag{6}$$

$$1 = Ll_{t+1} + T_{t+1}^f, \tag{7}$$

where K_{t+1}^f and T_{t+1}^f denote net foreign investment in capital and land, respectively. Negative values of these variables imply net ownership of these assets abroad by nationals.

The supply of capital and the price of land q_t evolve according to the two dynamic equations

$$K_{t+1} = L[w_t - c^y(w_t, r_{t+1})] - q_t + F_t \tag{8}$$

$$q_t = \frac{\pi_{t+1} + q_{t+1}}{1 + r_{t+1}}, \tag{9}$$

where F_t denotes net foreign investment in period t.

II. Foreign Investment

This section treats net foreign investment as exogenous, and considers the effect of changes in its amount on the capital stock, the price of land and national welfare, both on steady-state configurations and in the transition from the initial situation to the new steady state.

A. *The Capital Stock and Price of Land*

In a steady state with a constant level of net foreign investment F, the capital stock and price of land are constant values, $\bar{K}$ and $\bar{q}$, respectively, that satisfy[5]

$$\bar{K} = \chi(\bar{K}) - \bar{q} + F \tag{10}$$

$$\bar{q} = \bar{\pi}/\bar{r}, \tag{11}$$

where

$$\chi(\bar{K}) \equiv L[\bar{w} - c^y(\bar{w}, \bar{r})],$$

total savings of workers in steady state, and

$$\bar{w} \equiv G_L(\bar{K}, L, 1)$$

$$\bar{r} \equiv G_K(\bar{K}, L, 1)$$

$$\bar{\pi} \equiv G_T(\bar{K}, L, 1).$$

An increase in total net foreign investment is indicated by an increase in F. Regardless of the form that investment takes, the effects on $\bar{K}$ and $\bar{q}$ are given by

$$\frac{d\bar{K}}{dF} = \frac{1}{\Delta} \tag{12}$$

$$\frac{d\bar{q}}{dF} = \frac{q_K}{\Delta}, \tag{13}$$

[5] Conditions for the existence of a $\bar{K}$ and $\bar{q}$ that satisfy (10) and (11) are provided elsewhere (Eaton, 1987). A condition for the stability of the steady state is given in the Appendix.

where

$$\Delta \equiv 1 - L(1 - c_w^y) w_K + L c_r^y r_K + q_K, \tag{14}$$

$$q_K \equiv \frac{\pi_K - q r_K}{r}. \tag{15}$$

As shown in the Appendix, as long as $1 + L c_r^y r_k \geq 0$ and $c_w^y \leq 1$, the condition $\Delta \geq 0$ is necessary and sufficient for the existence of a unique, stable, nonoscillating convergence path to steady state. This condition states that in the neighborhood of steady state an increase in the capital stock by a particular amount raises investment in capital by a lesser amount.

If this stability condition is satisfied, then an increase in foreign investment raises the steady-state capital stock. The interest rate falls and the return to at least one other factor must rise. If land and capital are complements in production, then the price of land necessarily rises, since $\pi_K > 0$.

An illuminating special case to consider is one in which the aggregate production technology derives from the specific-factors model described by Ronald Jones (1971) and Paul Samuelson (1971). One commodity, a manufactured good, uses only capital and labor in its production. An agricultural good uses only land and labor. Denoting the outputs of the manufactured good and agricultural good as Q^M and Q^A, respectively, and the respective labor inputs as L^M and L^A,

$$Q_t^M = G^M(K_t, L_t^M)$$

$$Q_t^A = G^A(T, L_t^A),$$

where G^M and G^A are homogeneous, twice-differentiable functions. Full employment ensures that $L_t^M + L_t^A = L$.

With the manufactured good serving as numeraire and denoting the relative price of the agricultural good as p_t, the value of output is $Q_t = Q_t^M + p_t Q_t^A$, which is maximized when value of the marginal product of labor is the same in the two sectors. If L_t^{M*} is the value of L_t^M that satisfies this condition then the aggregate production function, which now depends on p_t as well as aggre-

gate factor supplies, is

$$(1') \qquad Q = G(K_t, L_t, T, p_t) = G^M(K_t, L_t^{M*}) + p_t G^A(T, L - L_t^{M*}).$$

In the specific-factors model an increase in foreign investment necessarily *lowers* the return to land. This is because the increase in the capital stock attracts labor to the manufacturing sector.[6] Since the interest rate discounting these returns also falls, the effect on the value of land remains ambiguous. It depends upon the relative labor shares in the two sectors. If the share of labor in manufacturing exceeds its share in agriculture, then the price of land rises. Otherwise it falls. An equivalent condition is that foreign investment raises the price of land if the share of land in domestic wealth, $q/(q+K)$, exceeds the ratio of the labor force in agriculture to total labor. Otherwise foreign investment lowers the price of land.

In the first case the value of land is primarily affected by its role as an asset. Hence it appreciates as a consequence of the lower interest rate. In the second, the value of land is primarily affected by its role as a factor of production complementary with labor. Its value then falls as a consequence of the higher wage.

To demonstrate these results, observe that in the specific-factors model, $\pi_K = -w_K(L - L_M)$ and $r_K K + w_K L_M = 0$. Hence

$$q_K = \frac{\pi w_K}{wr}\left[\frac{wL_M}{rK} - \frac{w(L-L_M)}{\pi}\right],$$

which is positive or negative as

$$\frac{wL_M}{rK} \gtrless \frac{w(L-L_M)}{\pi},$$

or, rearranging, as

$$\frac{q}{K+q} \gtrless \frac{L-L^M}{L}.$$

Thus there is no presumption that a permanent increase in foreign investment raises the price of land as it does in Kareken and Wallace's (1977) model. If agriculture is labor-intensive relative to manufacturing, the price falls.[7]

B. *Foreign Investment and Welfare*

The implications of a permanent increase in the level of foreign investment for the welfare of current and future generations can be very different. In the absence of a fixed factor, the case of Diamond's analysis, an increase in foreign investment necessarily lowers the welfare of the generation that enters retirement when the increase in foreign investment first occurs. It lowers the rate of return on that generation's savings while not contributing to their wage income in earlier years. Foreign investment can consequently not provide a Pareto improvement. If the steady state is efficient, so that the interest rate exceeds the population growth rate, later generations benefit. The positive effect of the increase in the wage more than offsets the negative effect of the lower return on savings. (In an inefficient equilibrium this is not the case: an increase in foreign investment lowers welfare of subsequent generations as well. It can then be Pareto worsening.)

[6] This result generalizes to technologies in which both sectors employ all three factors as long as land is the factor used most in agriculture and capital the factor used most in manufacturing. See Roy Ruffin (1984).

[7] Except for Hungary and Yugoslavia, in the most recent period for which Goldsmith provides data, agricultural land constitutes less than half of total wealth in land, as indicated in Table 1. The specific-factors model apparently does not apply. For Yugoslavia, however, nonagricultural land is insignificant, so that here the specific-factors model could have some relevance. The fraction of the labor force in agriculture in this country in 1978 was 33 percent, substantially in excess of the share of land in wealth (World Bank, 1980). If the specific-factors model is appropriate, then foreign investment acts to *lower* the price of land in this country.

A fixed asset eliminates the possibility that the steady state is inefficient, since the return on that asset must at least equal the population growth rate. It can then never be the case that an anticipated increase in foreign investment is Pareto worsening. It either raises steady-state welfare or it raises the welfare of the retiring generation upon announcement. It can even do both. When the increase in foreign investment is unanticipated, however, then the effect on the contemporaneous retired nationals depends, among other things, on how ownership of domestic land and capital is divided between nationals and foreigners.

I first consider the implications of foreign investment for the steady state. For one thing, this is the relevant criterion for comparing two parallel economies that have different, permanent levels of foreign investment. I discuss the transitional effects of an increase in foreign investment in this section, Part C.

Differentiating utility, U, evaluated at steady state, with respect to F gives, using the first-order condition for utility maximization,

$$(16)\qquad \frac{dU}{dF} = \frac{\partial U}{\partial c_0}\left[r_K(w - c^y) + (1+r)w_K\right]\Delta^{-1}.$$

Incorporating the relationship

$$w - c^y = \frac{q + K - F}{L},$$

the Euler condition (that $\pi_K = -w_K L - r_K K$), and equation (15), this expression can be shown to have the sign of

$$(17)\qquad r(w_K L - q_K) - r_K F,$$

if there is no national investment abroad.

The last term in this expression is positive. As in G. D. A. MacDougall's (1958) analysis of foreign investment, an exogenous increase in foreign investment acts to raise welfare by lowering the return on existing foreign-owned assets.

The first term can have either sign. The availability of land with a nonnegative yield as a store of value ensures that the steady state is efficient, that is, that $r \geq 0$. Consequently foreign investment raises steady-state welfare if it raises the real wage ($w_K > 0$) and lowers the price of land ($q_K < 0$). In Diamond's (1965) model with no land, w_K is necessarily positive, so that the outcome depends upon whether the initial equilibrium is efficient or inefficient. In Kareken and Wallace's (1977) model with no capital, $w_K = 0$ while $q_K < 0$, so that foreign investment reduces welfare in steady state.

Because of the generally ambiguous permanent welfare effect of foreign investment some special cases merit discussion: (*i*) If labor and capital are substitutes in production ($w_K \leq 0$), then necessarily $\pi_K \geq 0$, so that $q_K \geq 0$. Foreign investment necessarily *lowers* welfare in steady state if initially $F = 0$. (*ii*) If the aggregate production function is Cobb-Douglas, so that

$$Q_t = K_t^{\alpha} L^{\beta} \qquad \alpha + \beta < 1$$

then

$$q = \frac{1 - \alpha - \beta}{\alpha} K$$

and

$$w_K L - q_K = \alpha\beta K^{\alpha-1} L^{\beta} - \frac{1 - \alpha - \beta}{\alpha}$$

$$= r\beta - \frac{1 - \alpha - \beta}{\alpha}.$$

Foreign investment acts to raise steady-state welfare if the interest rate is initially high and the share of land ($1 - \alpha - \beta$) is small relative to that of capital (α).[8] (*iii*) In the

[8]Edward Denison (1974) estimates the shares of earnings in the nonresidential business sector of the United States by input in 1968 as follows: Labor = 79.94, nonresidential structures and equipment and inventories = 16.02, and land = 4.04. Under a Cobb-Douglas assumption the expression is positive or negative depending upon whether $r \gtrless 5$ percent. If a period

specific-factors model expression (17) has the sign of

$$\frac{(1+r)K}{L^M} - \frac{K+q-F}{L}.$$

A sufficient condition for foreign investment to raise steady-state welfare is that the capital-labor ratio in manufacturing exceed wealth per worker or, equivalently, that the ratio of the labor force in agriculture to total labor exceed the share of land in *national* wealth.

C. *Dynamic Adjustment*

The discussion so far has compared the effect of different levels of foreign investment across steady states. The dynamics of a transition from one steady state to another can be analyzed by manipulation of equations (A3) and (A4) in the Appendix. Once the change in foreign investment has occurred, the capital stock and price of land, and consequently factor prices, begin to move monotonically toward their new steady-state values.

If the change is anticipated then the land price begins to move toward its new steady-state value prior to the actual increase in foreign ownership. If the steady-state price of land falls, then the capital stock begins to rise before the increased foreign investment occurs. As the price begins to fall in anticipation, more national savings is diverted toward capital investment. If the steady-state land price rises, however, then there is a period of capital *decumulation* before the increase in foreign investment. Once the investment takes place, this process is reversed as the capital stock moves to exceed its initial steady-state level.

The older generation when the increase in foreign investment is first anticipated experiences a capital gain or loss on its land holdings depending upon whether the ultimate effect is to raise or to lower the steady-state land price. Since an increase in the steady-state price of land is *necessary* for foreign investment to lower steady-state welfare, anticipated foreign investment is never Pareto worsening.

What happens, on impact, in the case of an unanticipated increase in foreign investment depends on the initial distribution of assets between nationals and foreigners. If the land price rises and nationals hold relatively more land than capital, then the current welfare effect, from a national perspective, is more likely to be positive.

To summarize, in the one-asset Diamond (1965) model, foreign investment results in a capital deepening that raises the wage and lowers the interest rate. In that analysis, the retired generation when the investment occurs experiences a loss in welfare, but if the interest rate exceeds the growth rate then the long-run effect on welfare is positive. These results extend to an economy with land if there is no positive effect on the price of land. In this case current wealth holders experience a capital loss when foreign investment is first anticipated. Subsequent generations benefit from the higher wage.

If the price of land rises, then any wage increase may *not* compensate for the fall in the interest rate in determining the overall effect on steady-state welfare. But in this case current wealth holders benefit from a capital gain when foreign investment is first expected.

III. Perfect Capital Mobility

Section II considered the effect of an increase in foreign investment, treating this amount as exogenous. I now assume that investors have investment opportunities elsewhere in the world that yield a real return r^*. The country considered here is small in the sense that it does not affect this rate. In a perfect foresight equilibrium the level of foreign investment will ensure a capital stock that satisfies

$$r^* = G_K(K^*, L, 1), \tag{18}$$

is taken to be anything more than five years, then the corresponding annual interest rate is near zero, suggesting that the effect in the United States is very likely to be positive.

so that

$$(19)\quad F_t = K^* + q^* - L\left[w_{t-1} - c^y(w_{t-1}, r^*)\right],$$

where

$$q^* = \frac{G_T(K^*, L, 1)}{r^*}.$$

A. *The World Interest Rate*

The effect of a permanent decline in the world interest rate is qualitatively the same as that of a permanent increase in exogenous net foreign investment. Hence, even a capital importer can experience a drop in steady-state welfare as a consequence of a lower interest rate. In contrast, this result cannot happen in Diamond's (1965) model when the steady state is efficient since this result requires that the lower interest rate raise the price of land.

If anticipated, the announcement of the lower rate benefits the contemporaneous retired generation if it appreciates land values. Hence the effect can never be Pareto worsening.[9]

When the decline in the world interest rate is unanticipated, if it causes the price of land to rise then the effect on the currently retired generation of nationals depends on how claims on land and capital are distributed between nationals and foreigners. If nationals own relatively more land, then improvement in their welfare is more likely.

When the decline in the world interest rate causes a drop in the price of land, in which case an improvement in steady-state welfare is assured, a decline in the welfare of the currently retired upon announcement is inevitable. This is true regardless of whether the change is anticipated in advance or a surprise on impact, and regardless of the distribution of claims.

B. *The Land-Labor Ratio*

Since savings behavior and foreign investment determine the capital stock, only land and labor are primitive endowments. Homogeneity of the production function implies that only the *ratio* of labor to land matters in determining factor rewards, individual welfare, and the amount of foreign investment per unit of land.

An increase in the labor force will raise or lower the total capital stock depending upon whether capital and labor are complements or substitutes in production ($G_{KL} \gtrless 0$). What happens to the capital-labor ratio depends upon the sign of $-G_{KT}$. Unless capital and land are substitutes, the capital-labor ratio falls when the labor force rises. More crowded countries have a lower capital stock per worker.

Whatever the effect on the capital stock, an increase in the labor-land ratio raises the return to land, and hence its price, and lowers the real wage ($w_L \leq 0$ and $\pi_L \geq 0$).[10] Steady-state welfare always falls, but when the increase in the labor force is first anticipated landowners experience a capital gain.[11]

Whether more crowded countries export or import capital is ambiguous. Differentiating expression (19), with w_{t-1} assuming its steady-state value, gives

$$(20)\quad \frac{dF}{dL} = \frac{dK^*}{dL} + \frac{\pi_L}{r^*} - (w - c^y) - (1 - c^y_w) w_L L.$$

[9] Note that factor prices and the domestic capital stock, and consequently the price of land, now assume their new steady-state values immediately upon any anticipated change in exogenous variables. From equation (19) the level of foreign investment therefore achieves its new steady-state value after one period.

[10] These results follow from the relationships $w_L = G_{LL} + G_{LK}(dK^*/dL)$; $\pi_L = G_{TL} + G_{TK}(dK^*/dL)$; $(dK^*/dL) = -(G_{KL}/G_{KK})$; the Euler conditions, and the condition that the principal minors of the matrix of second derivatives of the production function alternate in sign. See Samuelson (1947, p. 62).

[11] If there is one sector of the economy that employs only capital and labor, as in the specific-factors model, then factor rewards, the price of land and welfare are all unaffected by an increase in the labor force. This sector expands to employ the increase in the labor force at the initial capital-labor ratio.

Unless labor and capital are strongly substitutable ($G_{KL} \ll 0$), *domestic* wealth rises, both because the capital stock is likely to rise and because the value of land rises. The effect on *national* wealth is ambiguous. There are more workers saving, but since the wage is lower each saves less.[12]

C. *Relative Commodity Prices*

The model can also be used to consider the effect of a change in a relative commodity price on foreign investment. In the specific-factors model, for example, an increase in the relative price of the agricultural commodity raises the value of land but reduces the equilibrium level of the capital stock.[13] The net effect on domestic wealth in steady state is given by the sign of the expression

$$\frac{\pi}{\sigma w(L - L_M)} - \frac{r^*K^*}{wL^M},$$

where σ is the elasticity of substitution between land and labor in agriculture. If this elasticity is low or if the labor share in agriculture is relatively low then an increase in the price of the agricultural commodity has little effect on the allocation of labor. Its primary effect is to raise land values. This attracts foreign capital. At the opposite extremes, if σ is large and agriculture labor-intensive, then the major effect is to reduce the equilibrium capital stock, which acts to lower foreign investment.

IV. The Consequence of a Tax on Land with International Capital Mobility

In contrast to what is implied by a static model of tax incidence, that a tax on land is neutral in its effects on resource allocation, in a closed economy, overlapping generations context such a tax, by reducing the price of land, increases savings available for capital investment.[14] The steady-state supply of capital and wage rise and the interest rate falls. Steady-state welfare rises.

With capital mobility, a tax on land has no effect on factor prices or on the domestic stock of capital. These are governed by the world interest rate. Nevertheless, the tax does have real effects. It lowers the value of foreign investment and, as in a closed economy, it raises steady-state welfare.

A. *The Land Tax and Foreign Investment*

Consider a tax in amount τ that is collected on all domestic land each period. Foreign investment continues to imply a domestic capital stock that equates the world interest rate to the domestic marginal product of capital. Since factor supplies are unchanged and marginal productivity conditions continue to determine factor rewards, the wage and the return to land are unaffected.

[12] With a Cobb-Douglas technology and isoelastic marginal utility of consumption, the effect of an increase in the labor force on the level of foreign investment has the sign of the expression $(1-\beta)-\beta(1-\sigma)r^*$, where σ is the share of wage income consumed and β the labor share in production. Of two countries with the same technologies and preferences, the more crowded one will import capital if the labor share, the interest rate, and the savings propensity are small. Otherwise such a country will export capital. In the specific-factors model, since factor rewards do not change, national wealth rises in proportion to the labor force while domestic wealth rises by the increase in the labor force times the capital-labor ratio in manufacturing. Whether foreign investment rises or falls depends upon whether the capital-labor ratio in manufacturing is larger or smaller than national wealth per worker or, equivalently, if the share of land in national wealth is smaller or larger than the ratio of the labor force in agriculture to total labor.

[13] I assume that capital is an output solely of the manufacturing sector, which involves some loss of generality. A more complete analysis would introduce a price index for investment. Examination of the polar opposite case, an agricultural investment good, yielded very similar conclusions, however.

[14] The effect is similar to the "Tobin effect" of inflation on the capital stock: higher anticipated inflation channels savings out of cash balances into capital investment (James Tobin, 1965). Chamley and Wright (1987) emphasize the quantitatively trivial potential for inflation to affect the capital stock in contrast with the potential effect of a land tax.

The tax does affect the *price* of land, however. Equation (4) must be changed to

$$(21)\qquad \frac{q_{t+1}+\pi_{t+1}-\tau}{q_t}=1+r_{t+1}.$$

If retirees receive a share λ of the tax revenue and workers the rest, then the equation of motion for the capital stock in a perfect foresight equilibrium is

$$(22)\quad K_{t+1}=L\Bigg\{w_t-c^y\Bigg[w_t+\tau\Big(1-\frac{\lambda r^*}{1+r^*}\Big)\Big/L,r^*\Bigg]\Bigg\}+(1-\lambda)\tau-q_t+F_t,$$

which, in steady state, implies that

$$(23)\quad F=K^*+\frac{\pi-\tau}{r^*}-(1-\lambda)\tau-L\Bigg\{w-c^y\Bigg[w+\tau\Big(1-\frac{\lambda r^*}{1+r^*}\Big)\Big/L,r^*\Bigg]\Bigg\},$$

where K^* satisfies

$$G_K(K^*,L,1)=r^*.$$

The effect of an increase in τ on F is unambiguously negative regardless of λ. A land tax reduces foreign investment. Whatever the level of the tax, foreign investment falls more when more of the revenue is distributed to current workers (the lower λ).

B. *The Land Tax and Welfare*

However the tax revenue is distributed, the land tax does not affect the steady-state wage rate or rate of return on savings. But each individual receives, in addition to his wage income, redistributed tax proceeds with value $\tau[1-\lambda r^*/(1+r^*)]$. Consequently, a tax on land raises steady-state welfare regardless of how the revenue is distributed between generations.

Steady-state welfare rises as τ rises. The potential welfare gain is not, of course, unlimited. If land can remain unowned then when $\tau>\bar{\pi}$ no land is owned and no tax is collected; $\bar{\pi}$ consequently imposes an upper bound on τ.[15]

While Feldstein (1977) and Chamley and Wright (1987) demonstrate that a land tax raises *steady-state* welfare in a closed economy, they also show that such a tax does not constitute a Pareto improvement. This is likely to be the case here as well. If the tax is announced in advance of its imposition, or if the tax revenue is distributed to workers at the time the tax is announced, retirees owning land experience a capital loss for which they receive no compensation. Their welfare drops because of the tax. If, however, the tax is imposed immediately upon its announcement *and* retirees are given the tax revenue, then the potential for a Pareto-improving land tax, from a national perspective, emerges.

This outcome requires that some foreign investment take the form of claims on land. Let T_0^f denote the initial amount of foreign land owned by foreigners. A sudden land tax creates an immediate capital loss for retirees in total amount $(1-T_0^f)\tau/r^*$. If $1-T_0^f>r^*$, of course, then this magnitude exceeds tax revenue, τ. Even if retired landowners are given the tax revenue, it does not compensate them for their capital loss. They are net losers. If $1-T_0^f<r^*$, however, tax receipts exceed the capital loss to nationals, and retirees are net beneficiaries of a land tax. Since steady-state welfare rises as a consequence of the tax, and the new steady state is achieved in one period, the tax yields, from a *national* perspective, a Pareto improvement. The loss on the part of foreign

[15] If landowners *must* sell their land, then a negative price of land must be admitted. The upper bound on τ in this case is determined by the wealth of landowners at the period in which the tax is initially imposed.

landowners is, of course, the source of the gain to the initial retirees.

In summary, while a land tax raises steady-state welfare, it typically harms the retired generation at the time it is announced. For a national Pareto improvement to emerge requires that: (*i*) the tax is not anticipated, (*ii*) tax revenue is distributed to retirees, *and* (*iii*) the share of nationally owned domestic land is less than the world interest rate.

V. Conclusion

Capital and land serve both as factors of production and as stores of value. The primary distinction between capital and land is that the supply of the first is determined by household savings and foreign investment. Nature determines the supply of land. Models of international trade and investment have typically incorporated land and capital only in their roles as factors of production, not as competing assets in household portfolios. Once a role for land as an asset is recognized, standard results on the implications of international investment can change significantly. This paper has examined the effects of international investment when land is both a factor of production and an asset in fixed supply.

Even though results, in general, are ambiguous, the direction of the effects of changes in relevant exogenous variables can be inferred from the underlying technology. Analysis of aggregate production relationships has typically not distinguished between reproducible and nonreproducible factors of production, however, so that the empirically relevant effects are difficult to ascertain. Examination of the meager data that are available suggests that, in different countries, different answers may emerge to questions about the consequences of foreign capital for welfare and land prices, and about the implications of interest rate, terms-of-trade, and resource supply changes for welfare, the price of land, and the direction of foreign investment. Much more data and analysis are needed before any answers can be provided with reasonable confidence.

Appendix

Equations (8) and (9) in the text may be linearized around $\bar{K}$ and $\bar{q}$ as follows:

$$(A1)\qquad x_{t+1} = L(1-c_w^y)w_K x_t - Lc_r^y r_K x_{t+1} - y_t$$

$$(A2)\qquad y_t = \left[\frac{\pi_K}{1+r} - \frac{\bar{q}}{1+r}r_K\right]x_{t+1} + \frac{1}{1+r}y_{t+1},$$

where $x_t \equiv K_t - \bar{K}$ and $y_t \equiv q_t - \bar{q}$.

These equations constitute a second-order system of linear homogeneous difference equations. Their solution has the form

$$(A3)\qquad x_t = A_1(\rho_1)^t + A_2(\rho_2)^t$$

$$(A4)\qquad y_t = \frac{\rho_1 - \Gamma_{11}}{\Gamma_{12}}A_1(\rho_1)^t + \frac{\rho_2 - \Gamma_{11}}{\Gamma_{12}}A_2(\rho_2)^t,$$

where ρ_1 and ρ_2 are roots of the equation

$$\rho^2 - (\Gamma_{11} + \Gamma_{22})\rho + \Gamma_{11}(1+r) = 0,$$

where

$$\Gamma_{11} \equiv \frac{L(1-c_w^y)w_K}{1+Lc_r^y r_K}$$

$$\Gamma_{12} \equiv \frac{-1}{1+Lc_r^y r_K}$$

$$\Gamma_{21} \equiv -(\pi_K - \bar{q}r_K)\Gamma_{11}$$

$$\Gamma_{22} \equiv 1 + r + \Gamma_{12}\Gamma_{21}/\Gamma_{11},$$

and with ρ_1 and ρ_2 defined so that $\rho_1 \leq \rho_2$. The scalars A_1 and A_2 are determined by boundary conditions.

At any period t the capital stock K_t, and hence x_t, are predetermined. The price of land q_t, and hence y_t, are determined by asset market equilibrium each period. At period $t=0$, A_1 must therefore satisfy the condition $A_1 = x_0 - A_2$.

A necessary and sufficient condition for the existence of a unique stable nonoscillating convergence path to steady state is that $0 \le \rho_1 < 1 \le \rho_2$.

If $\rho_1 < 0$ the system oscillates. The conditions $\Gamma_{11} > 0$ and $\Gamma_{11} + \Gamma_{22} > 0$ preclude oscillation. These conditions in turn are guaranteed by the two conditions

$$(A5) \qquad 1 \ge c_w^y,$$

which states that the marginal propensity to save is nonnegative, and

$$(A6) \qquad 1 + Lc_r^y r_K > 0,$$

which requires that an increase in the interest rate not have a highly negative effect on savings.

If $\rho_1 \ge 0$ and $\rho_2 < 1$ then for *any* value of A_2 equations (A3) and (A4) converge to steady state while if $\rho_1 \ge 1$ no path converges. A unique convergence path therefore requires that $0 \le \rho_1 < 1 \le \rho_2$ and $A_2 = 0$.

If (A5) and (A6) are satisfied, then a necessary and sufficient condition for a unique stable nonoscillating convergence path is that $\Delta \ge 0$, where Δ is defined in equation (14).

To verify that $\Delta \ge 0$ is necessary and sufficient define the function

$$\Lambda(\rho) \equiv \rho^2 - (\Gamma_{11} + \Gamma_{22})\rho + \Gamma_{11}(1+r).$$

Since $\Lambda(\rho) = 0$ defines ρ_1 and ρ_2, for $\rho \in (\rho_1, \rho_2)$, $\Lambda(\rho) < 0$. If $\rho_1 < 1 \le \rho_2$, then $\Lambda(1) \le 0$. Since

$$\Lambda(1) = \frac{r\Delta}{-(1 + Lc_r^y r_K)},$$

along with (A6), $\Delta \ge 0$ implies and is implied by $\Lambda(1) \le 0$.

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