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A NORTH-SOUTH MODEL OF TAXATION AND CAPITAL FLOWS

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ABSTRACT

This paper presents a simple two-country model of the role of taxation in capital flows between developed countries ("The North") and developing countries ("The South"). The Southern country is assumed to be unable to enforce a tax on its residents' foreign-source income, and the Northern country chooses not to impose a withholding tax on portfolio income earned in its country.

The world equilibrium in the model is characterized by excessive (by the standard of global efficiency and Southern welfare) flows of capital across borders, and insufficient investment located in the South. National income of the South could, under certain conditions, be improved if the North would impose a withholding tax on portfolio income that leaves the country, even though the South sacrifices tax revenue to the North. A Southern tax on foreign-source income may dominate this, depending on the resource cost of enforcing such a tax.

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1. INTRODUCTION

Tax systems may exert a powerful influence on the location of investment and the extent of cross-border capital flows. This influence is likely to be particularly strong for flows between developed (Northern) and developing (Southern) countries, due to fundamental asymmetries in their tax technologies and financial structures. Although there has been much speculation on the role of taxation in capital flight, indebtedness, and related problems, there has been little formal analysis of that role.

This paper presents a simple two-country model of the role of taxation in capital flows. I call it a "North-South" model because the two countries are assumed to differ in ways that characterize developed and developing countries, respectively. In particular, the Southern country is assumed to be different from the Northern country in three critical ways.

First, the Southern country cannot enforce a tax on its residents' foreign-source income. For example, as noted by McLure (1987), most Latin American countries do not attempt to tax foreign-source income, and for those that do success is likely to be difficult for administrative reasons.

Second, the financial structure of the Southern country is insufficiently developed so that there are real resource costs to Northern investment in the South. These costs cannot be effectively circumvented by Southerners' borrowing from the North to invest in domestic capital.

Finally, it is assumed that only Northerners have access to certain technologies which can be applied profitably in the South. It is further assumed that the Northern possessors of this technology choose to exploit it by undertaking direct investment in the South, rather than through alternative means such as licensing the technology.

Given these assumptions the world equilibrium is characterized by excessive (by the standard of global efficiency and Southern welfare) flows of wealth across borders, and insufficient investment located in the South. National welfare of the South could, under certain conditions, be improved if the North would impose a withholding tax on portfolio income that leaves the country, even though it thereby sacrifices tax revenue to the Northern country. A tax on foreign-source income may dominate this, depending on the resource costs of enforcing such a tax.

2. THE ANALYTICAL MODEL

2.1 Basic Assumptions

I assume that there is a resource cost that must be borne for any Southern investment owned or financed by a Northern resident. This cost includes the expense of monitoring the firm or borrower and collecting information from afar. In practice the cost per unit of investment in practice probably varies inversely with the scale of the investment, as there are likely to be fixed cost elements to monitoring and information gathering. It also varies inversely with how developed the financial system is in the Southern country. For many investments, such as purchases of stock sold in a highly developed stock market, this cost will be small.[1] For others, such as ownership of a Mom and Pop grocery store, the cost will likely exceed the expected gross return on the investment.

I represent the cost of monitoring and collecting information per dollar of investment as $c[\max(W^L_{NS},0) - \min(W_{SN},0)]$, where W^L_{NS} is the Northern portfolio investment in the South and W_{SN} is Southern portfolio investment in the North. Only North-to-South investments have monitoring costs, so that only positive values of W^L_{NS} and negative values of W_{SN} (Southern borrowing from the North) affect the value of c. Here the possible investments are ranked from lowest cost to highest cost, so that $c'(W^L_{NS})$, the marginal resource cost of Northern portfolio investment in the South, is non-decreasing and is assumed to be positive whenever W^L_{NS} is positive. The value of

[1]This cost may be zero for some investments. For expositional convenience, I assume that there is some positive cost for any Northern investment in the South, unless it is a direct investment.

$c'(W_{SN})$ is zero when W_{SN} is positive and increases with increasing negative values of W_{SN}.[2]

It is also assumed that some Northerners have exclusive access to certain technologies that can be profitably applied in the Southern country. This advantage could be exploited by exporting products that embody the knowledge or by licensing the technology to Southern firms. I assume instead that, for reasons not addressed here, the Northern owner of the technology retains direct control over it by operating a branch or subsidiary. To simplify the model, I further assume that the parent firm wholly owns the subsidiary. To simplify the exposition, I refer to the Northern direct investment as the high-tech (H) sector, and the remaining Southern economy, in which Northerners may make portfolio investments, as the low-tech sector (L).

2.2 Notation

I use the following notation:

K_S^h: capital invested in hth sector located in South h = H,L

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[2]The assumption that cross-border wealtholdings are subject to increasing monitoring costs places a limit on the tax arbitrage profits that would otherwise be unbounded due to the differential taxation of investments. As Slemrod (1988) elaborates, whenever the relative rate of tax on investments is different for different investors, some investor will find one investment to dominate another in terms of after-tax return. In a riskless world, this opens the possibility of unlimited tax arbitrage profits by holding a short position in the lower-yielding asset and a long position in the higher-yielding asset. This failure of equilibrium can be eliminated by putting arbitrary restrictions on short holdings, as in Slemrod (1988), or by introducing an increasing cost to extreme portfolio positions. The model of this paper appeals to increasing monitoring costs of cross-border holdings. An alternative modelling strategy is to introduce risk aversion and residence-specific risk. In this case, arbitrage profits would be limited by investors' aversion to portfolios which are insufficiently diversified among the capital of various countries. In essence, an increasing risk premium would replace the increasing monitoring costs as the limit on cross-border holdings. The analytical disadvantage of this modelling strategy is that, in the presence of risk, taxation takes an insurance dimension which is difficult to disentangle from its revenue-raising function. An alternative approach is to assume that foreign investment is subject to a risk of expropriation by the host country which increases (because its attractiveness increases) with the total volume of foreign investment.

W^h_{iS}: wealth of ith investor invested in hth sector in South $h = H,L$ $i = S,N$

K_N: capital invested in North

W_{iN}: wealth of ith investor invested in North

$\bar{W}_i$: wealth of the ith investor $i = S,N$

f: high-tech production function

g: low-tech production function

r_N: pre-tax rate of return earned on capital located in the North

The identity relationships that link the wealth and capital stock variables are summarized in Figure 1.

FIGURE 1

Wealth

$\bar{W}_N$		$\bar{W}_S$			
"		"			
W_{NN}	+	W_{SN}	=	K_N	
+					Capital Stocks
W^H_{NS}			=	K^H_S	
+		+			
W^L_{NS}	+	W^L_{SS}	=	K^L_S	

By assumption, Southerners do not own high-tech capital in their country, so that W^H_{SS} is zero.

2.3 The Tax System

I make the following assumptions about the Northern tax system:

1. The capital income of Northerners is taxed at rate t.

2. Northern investors in the South are offered a modified foreign tax credit for taxes paid to the Southern government. Effectively, the Northern government imposes a repatriation tax on Southern investments equal to $\max[\gamma(t - u), 0]$, where u is the Southern tax rate and γ lies between zero and one. Note that the repatriation tax applies only if t exceeds u; if it does not, no repatriation tax is due. The total effective tax on a Northerner's investment in the South is thus $(1-\gamma)\, u + \gamma \max(u,t)$. Compare this to a regular foreign tax credit system, where the repatriation tax is equal to t - u when t exceeds u, and is zero otherwise; the effective tax in this case is $\max(u,t)$. This modified tax credit system is meant to represent the fact that some Northern countries apply a regular foreign tax credit and others operate on an exemption system, so that no repatriation tax is due and the effective tax on Northerners is simply u.[3]

3. The Northern government imposes no tax on Southern wealthowners' investments in Northern assets. This assumption reflects the absence of withholding tax on interest payments in the United States, Japan, and the United Kingdom--and the low rate of withholding tax on dividend payments. In the United States, foreign-owned businesses are subject to U.S. corporate tax, but we have ruled out by assumption direct investment by Southerners in the North.

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[3]It also accounts for Northern investors in excess credit positions.

I make the following assumptions about the Southern tax system:

1. The Southern government is unable to enforce any tax on the capital income earned abroad by its residents.
2. The Southern government cannot impose differential tax rates on capital within its borders depending on ownership.

Let t_{ij} and u_{ij} be the tax rates imposed by the Northern and Southern governments, respectively, on income owned by residents of country i located in country j. Then the assumptions made above about the tax systems require that

(i) $t_{NS} = t_{NN} \equiv t$

(ii) $t_{SN} = 0$

(iii) $u_{SN} = 0$

(iv) $u_{SS} = u_{NS} \equiv u$

2.4 Investor Equilibrium

The Southern resident has two investment opportunities--Southern low-tech capital (W^L_{SS}) and Northern capital, W_{SN}. In equilibrium, it must be that:

$$(1)\quad g'(W^L_{NS} + W^L_{SS})(1 - u) = r_N + c'(W_{SN}).$$

$$W^L_{NS} + W_{SN} = \bar{W}_S$$

The Northern investor has three investment opportunities--Southern high-tech capital (W^H_{NS}), Southern low-tech capital (W^L_{NS}), and Northern capital (W_{NN}). This investment equilibrium is characterized by two conditions as follows:

(2a) $(g'(W_{NS}^{L} + W_{SS}^{L}) - c'(W_{NS}^{L}))(1 - v) = r_N(1 - t)$ and

(2b) $f'(W_{NS}^{H})(1 - v) = r_N(1 - t)$,

$$W_{NS}^{H} + W_{NS}^{L} + W_{NN} = \bar{W}_N$$

where $v = (1 - \gamma) u + \gamma \max(u, t)$.

Equilibrium for the world economy is characterized by capital stock and wealth allocations such that both investors are in investment equilibrium.

2.5 No-Tax Equilibrium

As a prelude to the characterization of equilibrium with taxes, it is worthwhile to first consider the nature of world equilibrium in the absence of any taxes, so that $t = u = v = 0$. In this case Northerners will invest in Southern high-tech capital until $f'(W_{NS}^{H}) = r_N$.

The nature of the equilibrium rests on whether $g'(\bar{W}_S)$ is greater or less than r_N. If $g'(\bar{W}_S)$ is exactly equal to r_N, then the equilibrium will feature no foreign portfolio investment in either direction, so that $W_{SN} = W_{NS}^{L} = 0$, which implies that $c' = 0$ as well. Equilibrium is characterized by $g' = f' = r_N$.

In the case where $g'(\bar{W}_S) < r_N$, Southern wealth is on net invested in the North. The net cross-border holdings are accomplished with zero resource cost at a point where $W_{NS}^{L} \leq 0$ and $W_{SN} \geq 0$. In this case the values of W_{NS}^{L} and W_{SN}, for a given $W_{NS}^{L} - W_{SN}$, are indeterminate within this range.

Next consider the case where $g'(\bar{W}_S) > r_N$. In this case there are net Northern portfolio holdings in Southern capital. This equilibrium will feature $W_{NS}^{L} \geq 0$ and $W_{SN} \leq 0$; i.e., both Southern borrowing from the North and Northern portfolio investment in the South will occur. The precise mix of W_{NS}^{L} and W_{SN} that yields a given net portfolio flow of $W^L_{NS} - W_{SN}$ is, however, indeterminate. Negative values of W^L_{NS} or positive values of W_{SN} will never be observed, as these equilibria feature higher resource costs then is minimal. Regardless of the mix, in equilibrium $g' = r_N + c'[\max(W^L_{NS}, 0) - \min(W_{SN}, 0)]$. The level of the Southern capital stock is lower than otherwise because of the necessity of cross-border capital flows, which have real resource costs.

2.6 Equilibrium with Taxes

The pair of tax systems described earlier puts a penalty on the income from all capital holdings except for one type--there is no tax on Southern ownership of Northern capital. This provides an incentive for W_{SN} and W^L_{NS} to be larger than in a notax equilibrium. Although it need not be true for all parameterizations, for expositional convenience in much of what follows I will assume that the equilibrium is characterized by positive values of W_{SN} and W^L_{NS}. In this case the equilibrium values of W_{SN} and W^L_{NS} are unique.

In the tax equilibrium Northern portfolio investment in the South will proceed until $c' = g'\left(1 - \frac{(1-u)(1-t)}{(1-v)}\right)$.[4] Using the fact that $v = (1-\gamma)u + \gamma\max(u, t)$, it can be shown that this must always be positive. Denote this value of c' as $\hat{c}'$, and the value of W^L_{NS} for which $c' - \hat{c}'$ as $\hat{W}^L_{NS}$. Total low-tech investment in the South will satisfy $g'(K^L_S) = \frac{r_N}{1-u}$; denote that level as $K^L_S\left(\frac{r_N}{1-u}\right)$. Then the level of Southern investment in the North, W_{SN}, is equal to $\bar{W}_S - K^L_S\left(\frac{r_N}{1-u}\right) + \hat{W}^L_{NS}$.

The equilibrium of this model captures several important characteristics of North-South economic relations. Northern investors make direct (high-tech) and portfolio (low-tech) investments in the South. At the same time Southern wealth owners have portfolio investments in the North. How these cross-border capital flows respond to changes in taxation is the subject of the next section.

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[4]To derive this and the expression for g' below from expressions (1) and (2) note that $c'(W_{SN})$ is zero when, as is assumed here, W_{SN} is positive.

3. THE EFFECT OF TAXES ON THE EQUILIBRIUM

Assume that $W_{SN} > 0$ and $W^L_{NS} > 0$, so that $c'(W_{SN})$ and $c''(W_{SN})$ are zero, and $c'(W^L_{NS}) > 0$. Taking the total derivatives of (1), (2a), and (2b), but holding t constant, yields

(3a) $(1 - u)\, g''(dK^L_S) - g'du = 0$

(3b) $(g' - c')(-dv) + (1 - v)(g''(dK^L_S) - c''(dW^L_{NS})) = 0$

(3c) $f'(-dv) + (1 - v)f''(dK^H_S) = 0.$

I first solve for the changes in capital and wealth holdings in terms of du and dv. Note that c' and c'' refer to $c'(W^L_{NS})$ and $c''(W^L_{NS})$, respectively. Using the fact that $dW_{SN} = dW^L_{NS} - dK^L_S$, this yields

(4a) $dK^H_S = \frac{f'dv}{(1 - v)f''}$

(4b) $dK^L_S = \frac{g'du}{(1 - u)g''}$

(4c) $dW^L_{NS} = \left[\frac{g}{(1 - u)c''}\right] du - \left[\frac{(g' - c')}{(1 - v)c''}\right] dv$

(4d) $dW_{SN} = \left[\frac{g'(g'' - c'')}{(1 - u)c''g''}\right] du - \left[\frac{(g' - c')}{(1 - v)c''}\right] dv.$

Several aspects of (4a)-(4d) are worth noting. First, K^H_S is affected only by the effective tax rate applying to Northerners, v, while K^L_S is affected only by the Southern tax rate. The former property implies that, when the North is on a foreign tax credit system ($\gamma = 1$), variations in u will not influence high-tech investment as long as u remains below t. High-tech capital will respond negatively to u when the North is not completely foreign tax credit ($\gamma < 1$) or when u exceeds t. The dependence of the capital and wealth allocations on the tax rates are explored in more detail in the appendix to this paper.

The stock of low-tech capital in the South depends only on the Southern tax rate, with capital declining as u increases. It will not respond to a change in Northern tax policy, v, when u is held constant. A decrease in v will increase the amount of Northern investment in Southern low-tech investment, but this will be offset exactly by an increase in Southern investment in the North.

When W_{SN} is less than zero (Southerners are borrowing from the North), so that $c''(W_{SN})$ is not always zero, these conclusions must be slightly modified. (The response of capital and wealth allocations to taxation is presented in the appendix.) For example, in this case v does have an (inverse) affect on K_S^L holding u constant. Consider a decrease in v. This attracts Northern investment to the South. As g' falls, Southerners reduce their borrowing from the North. This decreases c', so that in the new equilibrium the total cost of borrowing, $r_N + c'$, is lower. Thus Southern investors are willing to hold Southern capital with a lower return, enabling a higher level of K_S^L to persist. When W_{SN} is positive so that $c''(W_{SN})$ is zero, changing levels of cross-border wealth holdings do not alter the attractiveness (r_N) of the Southern wealth owner's alternative to K_S^L. Thus K_S^L does not change from $K_S^L\left(\frac{r_N}{1 - u}\right)$.

4. THE EFFICIENCY COST OF SOUTHERN TAXATION

National income in the South, denoted Y_S, is equal to

$$(5) \qquad f(K_S^H) - r_{QH} K_S^H + g(K_S^L) - r_{QL} W_{NS}^L + r_N W_{SN} + u[r_{QH} K_S^H + (r_{QL} - c')W_{NS}^L]$$

$$+ [c'W_{NS}^L - c(W_{NS}^L)]$$

Here r_{QH} and r_{QL} denote the return, gross of Southern taxes and monitoring costs, that Northern investors require to invest in Southern high-tech and low-tech capital, respectively. Note that taxes paid by domestic residents do not affect national income, although taxes paid to the South by Northern wealthowners, equal to $u[r_{QH}K_S^H + (r_{QL} - c')W_{NS}^L]$, do increase national income. Expression (5) embodies the assumption that the profits of the monitoring sector, $c'W_{NS}^L - c(W_{NS}^L)$, accrue to Southern residents.

From (2a) and (2b) it is clear that

(6a) $$r_{QL} = \frac{r_N(1 - t)}{1 - v} + c' \text{ and}$$

(6b) $$r_{QH} = \frac{r_N(1 - t)}{1 - v}$$

Substituting for r_{QH} and r_{QL} into expression (5) and differentiating with respect to u yields the following:

(7a) $$dY_S = [f' - ar_N]dK_S^H + [g' - (ar_N + c')]dK_S^L$$

$$+ [(1 - a)r_N - c']dW_{SN} - [a'r_N](K_S^H + W_{NS}^L),$$

or, rearranging terms slightly,

(7b) $$dY_S = [f' - ar_N]dK_S^H + [g' - r_N]dK_S^L + [(1 - a)r_N - c']dW_{NS}^L -$$

$$a'r_N(K_S^H + W_{NS}^L)$$

where $a = \frac{(1 - u)(1 - t)}{1 - v}$ and $a' \equiv \frac{da}{du} = \frac{-1 + a(1 - \gamma)(1 - t)}{1 - v}$ when $u < v$ and $a' = 0$ if $u \geq v$.

It is useful for interpreting expressions (7a) and (7b) to consider two cases. In the first case Southern taxation exceeds Northern taxation, i.e., $u > t$. In this case the total effective tax on Northern investment in the South is simply the Southern rate u. Thus v = u, a = 1 - t and a' = 0. Then (7a) reduces to

$$(8) \qquad dY_S = [f' - r_N(1 - t)]dK_S^H + [g' - (r_N(1 - t) + c')]dK_S^L + [tr_N - c']dW_{SN}.$$

The first two terms of expression (8) measure the welfare loss due to the reduction of the domestic capital stock below its efficient level (i.e., where the marginal product equals the opportunity cost of funds). The size of this cost depends on the elasticity of the marginal product of high- and low-tech capital, and the tax wedge between the marginal product and the opportunity cost.

The final term indicates that there are welfare implications from induced changes in Southern holdings of Northern capital. Increases in holdings of Northern capital increase welfare by tr_N because the opportunity cost to the South of borrowing capital is $r_N(1 - t) + c'$, but the return to investing in the North is r_N. There is a net change in national income of $tr_N - c'$ per unit of induced investment. Even if $tr_N - c'$ is positive, this potential gain to the country is not taken advantage of by private investors because the cost of obtaining funds to the individual is r_N, not $r_N(1 - t)$, of which tr_N is remitted to the Southern government.

When u increases, dK_S^H and dK_S^L will be unambiguously negative, implying a welfare loss. Both components of the third term may be of either sign, as may be the third term itself.

Thus, increasing u beyond t causes a welfare loss due to reducing the domestic capital stock below its efficient size, but there may be an offsetting increase in welfare if it induces the country to make tax arbitrage profits by in essence borrowing at the after-tax world rate of interest and investing at the pre-tax rate of interest.

I turn now to the case where u is less than t (and v). Because the Northern investors are partially subject to a foreign tax credit, increases in u raise revenue from

Northern investors that are not completely reflected in decreases in their after-tax rate of return. To the extent that the foreign tax credit is operative (γ close to one), increases in tax paid to the Southern Government are offset by tax credits granted by the Northern government.

First assume that the foreign tax credit is complete, so that $\gamma = 1$, $v = t$, $a = 1 - u$, and $a' = -1$. Referring to expression (7a) for the change in national income, it is clear that each of the three terms in expression (8) is modified and a fourth term is added. When $\gamma = 1$, the fourth term reduces to $r_N(K_S^H + W_{NS}^L)$. Remember that K_S^H, the domestic high-tech capital stock, is owned completely by Northerners, so that $K_S^H + W_{NS}^L (= W_{NS}^H + W_{NS}^L)$ represents total Northern holdings of Southern capital. An increase in u therefore increases Southern welfare to the extent there is foreign investment, because revenue is collected without raising the cost of capital to the country.

A change in u will have no effect on K_S^H, so that the first term is irrelevant. An increase in u will, though, decrease domestic investment in domestic capital, pushing up g', which attracts foreign investment in domestic capital. Total domestic capital will be lower, though, because the increased Northern investment pushes up c'--the same capital is less attractive to the Northern wealth owner than to the Southern wealth owner. So, with respect to an increase in u, $dK_S^H = 0$, $dK_S^L < 0$, and $dW_{SN} > 0$.

The welfare implications of these changes are different than the case when $u \geq t$, though. A decrease in K_S^L is less deleterious because the cost to the South of foreign investment is $r_N(1 - u) + c'$, which is greater than $r_N(1 - t) + c'$ when $u < t$. This is because, in order to earn $r_N(1 - t)$ after all taxes, the Northern investor must still be paid $r_N + c'$ before any taxes. When $u < t$, though, the Southern government claims only ur_N of this return, while the Northern government receives $(t - u)r_N$. Thus the net cost to the Southern country is $r_N(1 - u) + c'$.

The welfare implications of changes in W_{SN} are also different than when $u \geq t$. [First, note that $dW_{SN} = -dK_S^L + dW_{NS}^L$. That is, increases in Southern investment in the

North imply offsetting decreases in the Southern capital stock, except for increases in Northern investment in the South.] The tax arbitrage gains to the Southern country of increasing W_{SN} are now lower. When $u \geq t$, the South could essentially borrow capital at $(1 - t)r_N$ and invest in the North to earn r_N. When $u < t$, the cost of borrowing is $(1 - u)r_N$, so that the tax arbitrage gain is ur_N, which is less than tr_N.

5. CAN THE NORTH HELP THE SOUTH BY TAXING SOUTHERNERS?

In the absence of distortions, national income of the South would decline if the North imposed taxes on Southern residents investing in the North, because it would limit the income-earning opportunities of its residents. In this model with distortions, the North can impose a withholding tax on income paid to foreigners that would increase Southern welfare.

To see this, I introduce a withholding tax, denoted w. This alters the equilibrium condition of the Southern wealthowner, assuming that $W_{SN} > 0$ so $d' = 0$, to

(9) $g'(K_S^L)(1 - u) = r_N(1 - w)$

The equilibrium conditions for the Northern wealthowner remain

(2a) $(g'(K_S^L) - c'(W_{SN}^L))(1 - v) = r_N(1 - t)$ and

(2b) $f'(K_S^H) = r_N(1 - t)$.

Differentiating with respect to w yields:

(11a) $(1 - u)g''(dK_S^L) = - r_N(dw)$

(11b) $(1 - v)(g''(dK_S^L) - c''(dW_{NS}^L)) = 0$

(11c) $(1 - v)f''(dK_S^H) = 0$.

Solving for the allocation changes yields

(12a) $\frac{dK_S^H}{dw} = 0$

(12b) $\frac{dK_S^L}{dw} = \frac{r_N}{(1 - u)g''} > 0$

(12c) $\frac{dW_{NS}^L}{dw} = \frac{-r_N}{(1 - u)c''} < 0$

(12d) $\frac{dW_{SN}}{dw} = \frac{r_N}{(1 - u)}\left[\frac{1}{g''} - \frac{1}{c''}\right] < 0.$

The withholding tax causes Southerners to return some of their wealth from the North to the South, causes Northerners to return some of their wealth from the South, and results in a net increase in the low-tech Southern capital stock.

The welfare consequences can be seen by adjusting the last term of (5) from $r_N W_{SN}$ to $r_N(1 - w)W_{SN}$ and rederiving (7a) to yield

$$(13) \quad \frac{dY_S}{dw} = -(g' - r_N)\left(\frac{dK_S^L}{dw}\right) + [tr_N - c' + (1 - a)r_N(1 - t) - wr_N]\left(\frac{dW_{NS}^L}{dw}\right) - W_{SN}.$$

The first term is positive as long as w is below u. This represents the welfare gain from increasing the domestic capital stock toward its optimum. The second term represents the change in the tax arbitrage gain. The tax arbitrage from Southerners investing in the North is now lower by the tax collected by the Northern government, wr_N, and may be positive or negative. The third term represents the direct loss to Southerners due to the tax collected by the Northern government.

The change in Southern welfare can be positive if the welfare gain from increasing the domestic capital stock can offset the revenue lost to the Northern government (and, possibly, the loss of tax arbitrage gains). This is more likely to be true if the distortion in the domestic capital stock (measured by $g'-r_N$) is large, if the responsiveness of the domestic capital stock is large ($|g''|$ is small), and if Southern wealthholdings in the North (W_{SN}) are relatively small.

6. SHOULD THE SOUTH TRY TO TAX ITS RESIDENTS' FOREIGN-SOURCE INCOME?

Up to now I have assumed that the Southern government cannot collect any tax on its residents' foreign-source capital income. More generally, it can raise some tax revenue, but only at a substantial resource cost. Should it levy such a tax and, if so, at what rate? Let z be the tax on foreign-source income, and let e(z) be the resource cost of levying a tax at rate z. Using the same type of reasoning as above, the change in Southern welfare with respect to z can be written as

$$(14)\quad \frac{dY_S}{dz} = -(g' - r_N)\left(\frac{dK_S^L}{dz}\right) + [tr_N - c' + (1-a)r_N(1-t)]\left(\frac{dW_{NS}^L}{dz}\right) - e'(z).$$

The allocational effects of increasing z are identical to that of increasing w, so that $\frac{dK_S^L}{dz} = \frac{dK_S^L}{dw}$ and $\frac{dW_{NS}^L}{dz} = \frac{dW_{NS}^L}{dw}$. Thus, expression (14) looks quite similar to that of (13). The key difference (other than the absence of terms including w, which is assumed to be zero) is that the term $-W_{SN}$ is absent from (14). When the Southern government imposes the tax instead of the Northern government, the tax revenue does not represent a loss to the economy. Expression (14) does include the term $-e'(z)$, which is the marginal resource cost of imposing a tax of z. If, when evaluated at z equal to zero, $\frac{dY_S}{dz}$ is negative, then the optimal z is zero--the gain from a more efficient level of the domestic capital stock is more than offset by the resource cost of raising z. If $\frac{dY_S}{dz}$ is positive at z = 0, then the optimal z occurs at that positive value of z where $\frac{dY_S}{dz}$ is zero.

If the Southern government had to choose between trying to enforce a tax on its residents' foreign-source income or having the North do it for them, the choice boils down to a comparison of the cost of enforcement, e(z), and the revenue loss, W_{SN}. The best of all worlds is for the North to impose the tax but refund it to the Southern government. This saves the South the cost of enforcement but allows them to retain the revenue.

The analysis to this point assumes that the Southern government has an alternative source of revenue which has no distortionary impact. If this unrealistic assumption is abandoned, any revenue increases due to tax policy changes increase national income, because they allow the government to reduce other distortionary taxes. Incorporating this consideration into the analysis would be straightforward and would, for example, make imposing a residence-based tax look better compared to the Northern withholding tax.

7. WORLD EFFICIENCY

Taxes can cause the worldwide allocation of capital and wealth to fail to achieve Pareto efficiency. To see this, first consider that Northern welfare can be written as

$$(15) \quad Y_N = r_N W_{NN} + wr_N W_{SN} + f'(1 - u)K_S^H + [(1 - u)(g' - c')]W_{NS}^L.$$

I continue to assume that the rate of return to Northern capital, r_N, is fixed. The conditions for worldwide Pareto efficiency can be derived by allowing lump-sum transfers between the North and South and then maximizing, with respect to capital and wealth allocations, Southern welfare, holding constant the value of Northern welfare. Alternatively, the conditions can be derived by maximizing the sum of Northern and Southern national income. I do the latter.

There are only three independent allocation dimensions, which can be represented by K_S^H, K_S^L and W_{NS}^L. As Figure 1 shows, knowing those and the wealth and capital identities is sufficient to determine all other allocations. Rewriting expression (15) in these terms yields

$$\text{(16a)} \quad Y_N = r_N(\bar{W}_N - W_{NS}^L - K_S^H) + wr_N(\bar{W}_S - K_S^L + W_{NS}^L) + f'(1-u)K_S^H$$

$$+ [(1-u)(g' - c')]W_{NS}^L, \text{ or}$$

$$\text{(16b)} \quad Y_N = (f'(1-u) - r_N)K_S^H + (-wr_N)K_S^L + (-r_N + wr_N + (1-u)(g' - c'))W_{NS}^L$$

$$+ r_N\bar{W}_N + wr_N\bar{W}_S.$$

National income of the Southern country is

$$\text{(17a)} \quad Y_S = f(K_S^H) - ar_N K_S^H + g(K_S^L) - (1-u)\left[\frac{r_N(1-t)}{1-v} + c\right]K_S^L$$

$$+ r_N(1-w)W_{SN} - c(\max(W_{NS}^L, 0) - \min(W_{SN}, 0)) - e(z)$$

or, in terms of K_S^L, K_S^H, and W_{NS}^L, it is equal to

$$\text{(17b)} \quad Y_S = f(K_S^H) - \frac{(1-u)r_N(1-t)}{1-v}K_S^H + g(K_S^L) - \left[\frac{(1-u)r_N(1-t)}{1-v}\right.$$

$$\left. + (1-u)c - r_N(1-u)\right]K_S^L + r_N(1-w)W_{NS}^L + r_N(1-w)\bar{W}_S$$

$$- c[\max(W_{NS}^L, 0) - \min(W_{SN}, 0)] - e(z).$$

Adding (16b) and (17b), and using the equilibrium conditions (1), (2a), and (2b), yields

$$\text{(18)} \quad Y_W \equiv Y_N + Y_S = [f(K_S^H) - r_N K_S^H] + [g(K_S^L) - r_N K_S^L]$$

$$- c[\max(W_{NS}^L, 0) - \min(\bar{W}_S - K_S^L + W_{NS}^L, 0] + r_N\bar{W}_N + r_N\bar{W}_S - e(z).$$

Maximizing Y_W with respect to K_S^H yields the familiar condition

(19) $f' = r_N$,

stating that the marginal product of high-tech Southern capital should equal the Northern return.

Differentiating Y_w with respect to W_{NS}^L reveals that there is no unique interior optimum value of W_{NS}^L. When $W_{NS}^L \leq 0$ and $W_{SN} \geq 0$, or when $W_{NS}^L \geq 0$ and $W_{NS} \leq 0$, global welfare is unaffected by the value of W_{NS}^L because total monitoring costs are constant. When $W_{NS}^L \leq 0$ and $W_{SN} \geq 0$, the monitoring costs are constant at zero because there is no gross North-to-South movement of funds. When $W_{NS}^L \geq 0$ and $W_{SN} \leq 0$, monitoring costs are positive but unaffected by W_{NS}^L for given values of K_S^H and K_S^L because any increase in W_{NS}^L (Northern portfolio holdings in the South) must be accompanied by an increase in W_{SN} (decrease in Southern borrowing from the North). This does not affect the total gross cross-border holdings which incur monitoring costs. When W_{NS}^L and $W_{SN} \geq 0$, any increase in W_{NS}^L decreases world welfare, because it increases the monitoring cost of Northern portfolio holdings in the South with no offsetting decrease caused by the accompanying increase in W_{SN}, because W_{SN} is positive.[5]

The first-order condition with respect to K_S^L is

(19b) $g' - (c')^* = r_N$,

where $(c')^*$ is zero if $W_{SN} \geq 0$ and $W_{NS}^L < 0$ and $(c')^* = c'(W_{NS}^L) = c'(-W_{SN})$ if $W_{SN} \leq 0$ and $W_{NS}^L \geq 0$. In the first case, the South is a net capital exporter, so that all the capital

[5]Similarly, when W_{NS}^L and $W_{SN} \leq 0$, any decrease in W_{NS}^L decreases world welfare because, while decreases in W_{NS}^L have no monitoring cost effect, the accompanying decline in W_{SN} (increased Southern borrowing) does increase monitoring costs.

movement can be effected without monitoring costs. In this case the marginal product of Southern capital should equal its opportunity cost, r_N. In the second case, the South is a net capital importer, so that there are increased monitoring costs when K_S^L is increased, either because W_{NS}^L is increased or W_{SN} is decreased (more borrowing), or some combination of the two.

As demonstrated earlier, the global efficiency conditions will be satisfied in a no-tax equilibrium. They will also be satisfied if North and South both operate a source-based tax with equal rates so that $t = u = w$ and $\gamma = 0$ so that $v = u$.

If both countries operate residence-based taxes (with equal or unequal rates), so that $u = z$, $v = t$, and $w = 0$, the first-order conditions (19a) and (19b) are satisfied, but because $e(z)$ is positive, whenever u is positive this equilibrium results in a lower value of Y_W than in the no-tax equilibrium or in the equilibrium with equal source-based taxes. The residence-based tax requires the Southern country to expend resources for enforcement.

The stylized actual pair of tax structures (where $w = z = 0$) is not consistent with global efficiency. Depending on the precise values of t, u, and v the levels of both kinds of capital and the allocation of wealth may be inefficient. The marginal product of high-tech capital, f', will equal $r_N\frac{(1 - t)}{(1 - v)}$, so that its level will be inefficient whenever $t \neq v$. The marginal product of low-tech capital, g', will be greater than r_N by $c'(W_{NS}^L)$ + $r_N\frac{(v - t)}{(1 - v)}$.[6] Compared to the globally efficient allocation, Southern low-tech capital will be too low for either of two reasons. The first is if v exceeds t, so that the effective tax on Northern investment in the South exceeds the tax on Northern holdings located in the North. The second reason for inefficiently low K_S^L is if c' is higher than its minimal value of $(c')^*$. In fact, it is quite plausible that c' will be higher than $(c')^*$ in the tax equilibrium, because for a given value of W_{NS}^L - W_{SN} (net Northern portfolio holdings in the South),

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[6]I am assuming here that the tax equilibrium is characterized by W_{SN} and W_{NS}^L greater than zero.

Southerners are encouraged to hold portfolio assets in the North, pushing North-South cross-holdings into the inefficient region where both W_{NS}^{L} and W_{SN} are positive. This makes the resource cost of a marginal investment higher than is minimal. The inability of the Southern government to impose a tax on its citizens' Northern investments and the North's unwillingness to impose withholding taxes on Southern investments combine to produce an inefficiently large amount of cross-border holdings.

Thus, the inefficiency of K_{S}^{L} is intimately connected to the inefficiency of wealth allocation. The tax system induces Southerners to hold Northern capital. This increases the rate of return on Southern capital, attracting Northern investors. The increasing resource cost of cross-border holdings implies that the equilibrum level of the Southern capital stock is below what it would be if owned by Southerners.

8. PROMISING DIRECTIONS FOR FUTURE RESEARCH

There are several promising directions for future research. First, the model should be made intertemporal. This would allow us to investigate the effect of the tax systems on the magnitude of saving and investment, in addition to its location. In a two-period model, Giovannini (1987) has studied the relative efficiency of a residence-based tax, which distorts only the intertemporal pattern of saving, and a source-based tax, which distorts only the locational aspects of capital investment.

Second, the role of Southern government borrowing is worth studying. In popular discussions, the problem of capital flight is linked to the problem of developing countries' government debt. By assuming the private sector's debt to the North, the Southern government may be acting (at least apparently) to reduce the resource costs of international borrowing. This would be offset to some degree by increased holdings in the North by non-government Southerners.

It would also be interesting to investigate the incentives of the Northern government in setting taxes. The reason that withholding taxes are low or nonexistent is probably that the Northern countries are in competition with each other to attract financial capital. Why this incentive does not apply to business investment in the North, which is taxed, is a question worth some thought.

The ability of direct investment to eliminate the monitoring costs of cross-border investment may be important. I've assumed a one-to-one correspondence between the nature of the technology and the form of investment. Foreign investment in high-tech firms is done via direct ownership, which eliminates monitoring costs, and low-tech investment is accomplished via portfolio investment, which does not eliminate monitoring costs. A more general model would allow the form of investment to be endogenous.

Finally, the role of the monitoring/financial sector should be explored. I've assumed that the financial firms that monitor Southern investments are owned by Southerners, who receive the industry's profits. If the sector is owned by Northerners, the welfare implications of Southern tax policies are altered, as the Southern government now views less favorably policies that increase the monitoring costs incurred by foreign investors.

APPENDIX

I first consider the comparative statics in some special cases. When $u > t$, then $v = u$ and $dv = du$. Then expressions (4a) to (4d) reduce to

$$\text{(A-1a)} \quad \frac{dK_S^H}{du} = \frac{f'}{(1-u)f''} < 0$$

$$\text{(A-1b)} \quad \frac{dK_S^L}{du} = \frac{g'}{(1-u)g''} < 0$$

$$\text{(A-1c)} \quad \frac{dW_{NS}^L}{du} = \frac{c'}{(1-u)c''} > 0$$

$$\text{(A-1d)} \quad \frac{dW_{SN}}{du} = \frac{1}{1-u}\left[\frac{-g'}{g''} + \frac{c'}{c''}\right] > 0.$$

Increasing u beyond t thus reduces the Southern country's stock of both low-tech and high-tech capital, in an amount related to the elasticity of the respective marginal products. Both Southern purchases of Northern capital and Northern purchases of Southern capital increase, although the former exceeds the latter (thus decreasing the Southern capital stock).

When $u < t$, $v = (1-\gamma)u + \gamma t$, and $dv = (1-\gamma)du$. Then expressions (4a) to (4d) reduce to

$$\text{(A-2a)} \quad \frac{dK_S^H}{du} = \frac{f'(1-\gamma)}{[1-u-\gamma(t-u)]f''} < 0$$

$$\text{(A-2b)} \quad \frac{dK_S^L}{du} = \frac{g'}{(1-u)g''} < 0$$

(A-2c) $$\frac{dW^L_{NS}}{du} = \frac{-1}{c''}\left[\frac{(g' - c')(1 - \gamma)}{1 - u - \gamma(t - u)} - \frac{g'}{1 - u}\right] > 0$$

(A-2d) $$\frac{dW_{SN}}{du} = \frac{-g'}{(1 - u)g''} - \frac{1}{c''}\left[\frac{(g' - c')(1 - \gamma)}{1 - u - \gamma(t - u)} - \frac{g'}{1 - u}\right] > 0.$$

When the tax system of the Northern country is completely foreign tax credit ($\gamma = 1$), then we have

(A-3a) $$\frac{dK^H_S}{du} = 0$$

(A-3b) $$\frac{dK^L_S}{du} = \frac{g'}{(1 - u)g''} < 0$$

(A-3c) $$\frac{dW^L_{NS}}{du} = \frac{g'}{(1 - u)c''} > 0$$

(A-3d) $$\frac{dW_{SN}}{du} = \frac{g'}{1 - u}\left(\frac{g'' - c''}{c''g''}\right) > 0$$

As noted in the text, K^H_S does not respond to u in this case. K^L_S does increase when w falls, though, because it reduces the incentive for Southern wealth to move to the North. The response of Northern investors investing in the South does not fully offset this, due to the increase in c'.

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