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TAX COMPETITION AND TRADE PROTECTION

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ABSTRACT

This paper reconsiders the question of whether tax competition for mobile capital leads to tax rates on capital that are too low or too high from the combined viewpoint of the competing regions (or countries in an economic union). In contrast to standard models of tax competition, both commodity trade and capital mobility is allowed to occur between the competing regions and the rest of the world. A key result of the analysis is that whether the capital taxes are too low or high depends on the degree of external trade protection. When the country's central government is free to set the tariff, tax competition leads to inefficiently low tax rates. But in the absence of a tariff, tax rates can be too high. In particular, regions may choose to subsidize capital in equilibrium as a means of inducing favorable terms-of-trade effects, but the subsidy (i.e., a negative tax) will then be too low because an increase in a single region's subsidy benefits other regions by reducing their relative quantities of subsidized capital. These results are discussed in the context of the European Union's Single Market, where non-EU firms have responded to the 'Fortress of Europe' by increasing foreign direct investment.

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1. Introduction

A common result in the literature on tax competition is that the tax rates on capital are too low when independent regional governments choose them. Welfare could be improved if all regions increased their tax rates by a small amount. Wilson (1999) provides a review of the vast literature surrounding this result. The models typically employed assume a system of many competing regions within a country, or block of countries, which is characterized by free capital mobility within its borders but not across its borders. This focus it surprising, however, because cross-border capital flows characterize some economies in which tax competition is believed to be strong. In particular, the member countries of the European Union trade a lot with the rest of the world and are recipients of foreign direct investment from the U.S. and East Asian countries in particular. Likewise, tax competition among states and localities in the U.S. is often particularly strong when localities compete for multinational firms from the outside of the U.S.

The present paper argues that the role of openness with the rest of the world is crucial for our understanding of whether tax competition leads to tax rates being too high or too low. The cross-border inflow of capital depends not only on capital taxation at home (or inside the EU), but also on the country's tariff policy. Both of these policies affect the terms at which capital and goods are traded with the rest of the world, i.e., the 'factor terms of trade' and the 'commodity terms of trade'. We assume that the country's central government (or the EU) sets the external trade policy by choosing a tariff on imports, while the tax on capital is chosen either by the central government of the home country ('centralization') or by the country's regional governments ('decentralization'). Throughout the analysis, the economy's import-competing industry is assumed to import capital. The interdependence between the commodity and factor terms of trade requires a simultaneous analysis of tax and tariff policies. A key purpose of the paper is to shed light on the relationship between tax and tariff policies in the comparison between the centralized and decentralized tax setting.

Our analysis demonstrates that decentralized control over tax rates can lead to inefficiently low or high tax rates, depending on the level of the tariff. When the tariff is set optimally by the central government, regional tax competition leads to inefficiently low, but positive, tax rates. Following the tax competition literature, the driving force behind this result is the existence of interregional externalities, but now these externalities are composed

of much more than just capital flows. In addition, they include terms-of-trade effects and changes in tariff revenue. Nevertheless, we are able to sign the combined welfare impact of these externalities by examining the capital flows. When one region reduces it tax rate, it harms other regions by reducing their share of the country's taxed capital. As a result, we find that the tax reduction creates a negative externality, allowing us to conclude that regions choose inefficiently low tax rates on capital. In the absence of a tariff, however, the regions may choose to subsidize capital in equilibrium, as a means of improving the commodity terms of trade. In this case, the sign of the relevant interregional externality is reversed. Specifically, an increase in any region's subsidy rate increases its capital supply relative to the other regions' capital supplies, thereby decreasing their share of the country's total subsidy bill. Since the individual regions ignore this positive externality, they set their subsidy rates at inefficiently low levels. Stated differently, the capital taxes (negative subsidies) are now too high.

Our theoretical analysis builds on and extends the work by Brecher and Feenstra (1983), who analyze the effect of capital taxes and tariffs in a two-country, two-good, two-factor HOS model, in which the two countries, "home" and "foreign," trade goods and capital. We work instead with a specific-factors trade model but retain their assumption that the foreign country is passive in the sense that it does not interfere with the free flow of capital and goods. Within this framework, the optimal policy for home consists of a positive capital tax and positive tariff, a finding that Wong (1995) suggests, but does not prove, for the HOS model. We then go beyond Brecher-Feenstra, Wong, and other contributions to the literature on trade and capital mobility by dividing the home country into many regions so that the effects of tax competition can be studied.

After analyzing the general model, a simple parametric example is used to study additional properties of the model. In particular, we find that the optimal value of each policy instrument (tariff and capital tax) is an increasing function of the other instrument. Consequently, when tax competition leads to lower capital taxes, the central government responds by lowering its tariff. In other words, regional tax competition can lower protectionism in the world economy. The example also has the property that the optimal value of each instrument for the central government is positive when the other instrument is zero. However, a negative optimal tax becomes possible when we extend the model to include a factor-market

distortion. We consider the case in which the wage rate in the import-competing sector of home is fixed above the wage in the export sector, perhaps due to strong unionization. This distortion creates an incentive for the government to subsidize capital imports because the resulting capital inflow raises employment in the high-wage sector. Despite this ambiguity in the sign of the optimal tax rate, we find that regions benefit from additional capital. As a result, tax competition leads to inefficiently low tax rates or high subsidies.

Our analysis complements recent research on tax competition in which authors focus on the interaction between tax rates on capital and other government instruments. Fuest and Huber (1998) show that in a non-cooperative framework, coordination of a subset of fiscal instruments (e.g., introduction of a minimum tax on one factor or the harmonization of a tax base) may leave the equilibrium allocation unchanged. Governments neutralize the introduction of a constraint by adjusting other instruments. Konrad and Schjelderup (1998) use a standard tax competition model to demonstrate that tax harmonization among a subgroup of countries increases welfare of all countries if tax rates are strategic complements. Raff (1998) analyzes a model in which two countries consider forming a free trade area or customs union in the presence of an outside firm. The firm can serve the two markets either through exports or foreign investment. The formation of a preferential trade agreement not only reduces the number of tariff rates or how tariffs are set, but also influences how fiercely governments compete for foreign investment via profit tax rates. While our analysis shares some elements of each of the above papers, it differs in terms of who controls instruments other than capital tax rates.

The paper is organized as follows. Section 2 sets out the general model. We consider the case of centralized tax setting in section 3, while section 4 deals with tax competition when the tariff is optimally set by the central government. In section 5 we reconsider the case of decentralized decisionmaking over tax rates by assuming that the tariff is zero. In section 6, we discuss how the decentralization of tax policy affects trade policy. A specific example is studied in section 7. The paper concludes with a discussion of applications and avenues for future research.

2. The Model

We consider a standard specific-factors model from international trade, modified to ac-

count for international capital mobility. The country with the active trade policy is called home, and the rest of the world is referred to as foreign. In each country, good E is produced from labor and an industry-specific factor, land, and good M is produced from labor and another industry-specific factor, capital. Both industries exhibit constant returns to scale, and markets are competitive. There is free trade in both capital and goods, and equilibria are considered in which home imports both good M and capital, in exchange for E.

To investigate tax competition, we shall later divide home into different regions with independent tax policies. But for now, we treat home as a single region, with a central government choosing its tariff rate, t, and a capital tax rate, T, which are defined in unit terms. The revenue obtained from these policy instruments is returned to residents as a lump-sum subsidy (or a lump-sum tax is collected to fund negative values of t or T).

The equilibrium for the world economy may be described by two conditions. First, the after-tax returns on capital must be identical between the two countries. To state this condition, note that the before-tax return on capital in each country is fully determined by the domestic price of M, p^* in foreign and $p = p^* + t$ in home, and by the level of capital in each country. Given the two countries' initial endowments of capital, these capital supplies depend only on the amount of capital that home imports from foreign, denoted I. Thus, home's before-tax return is a function of p and I, $r(p, I)$, and foreign's before-tax return is a function of p^* and $-I$, $r^*(p^*, -I)$, where each function is increasing in both arguments. In equilibrium,

$$r(p, I) - T = r^*(p^*, -I). \tag{1}$$

For the second equilibrium condition, we require that the world market for M clears. This condition may be written in terms of the two countries' import, or excess demand, functions, $Z^*(p^*, -I)$ for foreign and $Z(t, p^*, I)$ for home, where we follow the usual practice in international trade of assuming that consumer demands in each country can be determined using a representative consumer's utility function. Letting $Z^w(t, p^*, I)$ denote the world excess demand function, we have the following equilibrium condition:

$$Z^w(t, p^*, I) \quad = \quad Z(t, p^*, I) + Z^*(p^*, -I) \quad = \quad 0. \tag{2}$$

Both goods are assumed to be normal. Thus, increases in p^* and t both lower home's domestic demand for M, whereas they raise home's domestic supply of M, implying a reduction in imports:[1]

$$Z_t(t, p^*, I) < 0 \quad \text{and} \quad Z_{p^*}(t, p^*, I) < 0. \tag{3}$$

Throughout this paper, we assume that the world excess demand function is well-behaved in the sense that the excess demand decreases with p^*:[2]

$$Z^w_{p^*}(t, p^*, I) < 0. \tag{4}$$

It follows from (3) and (4) that (2) uniquely determines p^* as a function of t and I: $p^* = p^*(t, I)$, where $p^*_t < 0$. We assume that this price derivative is not large enough to create the Metzler Paradox. In other words, if $p(t, I) = p^*(t, I) + t$, then

$$p^*_t < 0 \quad \text{and} \quad p_t = p^*_t(t, I) + 1 \quad > \quad 0. \tag{5}$$

Substituting the price function into (1) gives the single equilibrium condition,

$$r(p^*(t, I) + t, I) - T \quad = \quad r^*(p^*(t, I), -I), \tag{6}$$

which may be solved for the equilibrium imports of capital, $I(T, t)$. Substituting this function back into the price function, $p^*(t, I)$, then allows us to define the functions, $Z(T, t)$, $Z^*(T, t)$, $r(T, t)$, $r^*(T, t)$, and $p^*(T, t)$. To limit the possibilities in a reasonable way, we assume that the capital market is stable. In particular, additional flows of capital from foreign to home are assumed to lower $r - r^*$, taking into account changes in p^*. In symbols,

$$\frac{d(r - r^*)}{dI} < 0. \tag{7}$$

[1] The increase in p^* also raises $r^*(p^*, -I)$, and the increases in r^* and p^* both represent adverse terms-of-trade effects for home. As such, they have income effects, which lower the demand for imports.

[2] This assumption holds if (but not only if) foreign and home residents possess identical homothetic preferences and the tariff rate is sufficiently small.

Using this condition, (6) implies that a rise in T lowers I:

$$I_T(T,t) < 0. \tag{8}$$

This completes the description of the model.

3. Optimal Policies for Home's Central Government

The home government chooses T and t to maximize home welfare, measured by the representative consumer's utility from the two goods. The problem is standard, and so we move immediately to the first-order conditions [which correspond to (11.14a) and (11.14b) in Wong (1995)]:

$$-(Zp_a^* + Ir_a^*) + TI_a + tZ_a = 0; \qquad a = T, t; \tag{9}$$

where, unless otherwise noted, subscripts T and t henceforth represent derivatives of functions with T and t as the arguments. In words, an increase in the tariff or capital tax creates terms-of-trade effects, which the government offsets against marginal deadweight losses or gains. Throughout this paper, the optimal T and t for the home country's central government will be referred to as the "centrally optimal" T and t, or the "centralized optimum," and the regional governments' choice of T sometimes will be called the "decentralized T."

We are now in a position to prove-

Proposition 1 *The centrally optimal tariff and tax are both positive.*

Proof. Raise t by a unit, while adjusting T by dT to keep the equilibrium I fixed. At the optimum, the first-order welfare effect is zero, and an expression for this welfare effect is obtained from (9), using the assumption that $dI = I_t + I_T dT = 0$:

$$-(Zdp^* + Idr^*) + tdZ \quad = \quad 0. \tag{10}$$

Since I is not changing, the tariff has the usual effects. In particular, p^* declines, representing an improvement in the commodity terms of trade. Since $r^*(p^*, -I)$ increases with

p^*, it follows that r^* declines, which is an improvement in the factor terms of trade. The combination of these terms-of-trade improvements and the rise in home's domestic price, $p = p^* + t$, implies that imports of M decline ($dZ < 0$). Thus, (10) gives $t > 0$.

Starting again from the optimum, reduce T by a small amount, so that I rises under stability assumption (7). At fixed p^*, $r^*(p^*, -I)$ rises, since the increase in I represents a decline in foreign's capital supply. We can then adjust the tariff to ensure that p^* falls enough as I rises to offset this deterioration in the factor terms of trade, i.e., $dr^* I + dp^* Z = 0$. The first-order conditions given by (9) then imply that

$$tdZ + TdI = 0. \tag{11}$$

Given that p^* has fallen, whereas the combined terms-of-trade effects are neutral for home and foreign, foreign demand for good M rises. Moreover, the fall in p^* and rise in I imply a reduction in foreign's supply of M. Thus foreign's exports of M to home fall: $dZ < 0$. Since $dI > 0$, we may conclude from (11) that T and t have the same signs. Q.E.D.

4. Equilibrium Policies for Regional Governments

We move now to a home country that is fragmented into $N > 1$ regions, each with a government that chooses its capital tax to maximize the welfare of the region's residents. This is the tax competition problem previously discussed. In particular, let us consider a Nash game in which each regional government treats all other regional governments' tax policies as fixed, with the central government retaining control over the tariff. Assume also that the central government redistributes the tariff revenue in equal amounts to each region. The question we ask is whether the equilibrium capital tax is too high or too low. An answer is provided by the following proposition, where (T^c, t^c) denotes the centralized optimum.[3]

Proposition 2 *With the tariff fixed at t^c, regional governments tax capital at a rate below T^c.*

Proof. We start by fixing all regions' tax rates on capital at a common positive level and

[3]Throughout this paper, we investigate the properties of any Nash equilibrium that exists. Section 7 provides an example with a unique equilibrium, but uniqueness is not required for Proposition 2.

identifying the welfare effects of a rise in one region's tax rate. Note first that the marginal impact of a rise in region i's tax rate on region j's welfare is

$$-(Z^j p_i^* + I^j r_i^*) \quad + \quad \frac{tZ_i}{N} \quad + \quad T^j I_i^j, \tag{12}$$

where superscripts denote regions and the subscript i denotes a derivative with respect to T^i. With all regions initially choosing the same tax rate, the first three derivatives in (12) equal $1/N$th of the corresponding derivatives in the central government's first-order condition for T:

$$p_i^* = \frac{p_T^*}{N}; \qquad r_i^* = \frac{r_T^*}{N}; \qquad Z_i = \frac{Z_T}{N}. \tag{13}$$

By inserting (13) into (12) and noting that $Z^j = \frac{Z}{N}$ and $I^j = \frac{I}{N}$ by symmetry, we have

$$\frac{-(Zp_T^* + Ir_T^*) \quad + \quad tZ_T}{N^2} \quad + \quad T^j I_i^j. \tag{14}$$

On the other hand, the impact on a single region's welfare from a simultaneous increase in all regions' tax rates is

$$\frac{dW}{dT} \quad = \quad \frac{-(Zp_T^* + Ir_T^*) \quad + \quad tZ_T \quad + \quad T^j I_T}{N}, \tag{15}$$

which equals zero at the central government's optimal T [see first-order condition (9)]. Substituting this expression into (14) and using the equivalence between (14) and (12) enables us to conclude that

$$-(Z^j p_i^* + I^j r_i^*) \quad + \quad \frac{tZ_i}{N} \quad + \quad T^j I_i^j \quad = \quad \frac{dW}{dT}\frac{1}{N} \quad + \quad T^j \left[I_i^j - \frac{I_T}{N^2} \right]. \tag{16}$$

Thus, the distribution of the welfare effects from a rise in one region's tax rate depends on a comparison of the terms, I_i^j and I_T/N^2. To make this comparison, note that a marginal rise in one region's tax rate reduces home's total capital supply by $1/N$th of the reduction that occurs when all regions raise their capital taxes by the same amounts. In symbols,

$$\sum_j I_i^j = \frac{I_T}{N}. \tag{17}$$

To see how I_i^k differs from $I_i^i, k \neq i$, observe that the following equilibrium condition must hold for any region j:

$$r^j(p, I^j) - T^j \quad = \quad r^*(p^*, -I), \tag{18}$$

where $r^j(p, I^j)$ denotes regions j's before-tax return as a function of p and I^j. Since all regions face the same after-tax return on capital, r^*, it follows that when region i raises T^i by some small amount, dT^i, we have

$$dr^i - dr^k = dT^i > 0 \tag{19}$$

for $k \neq i$. Since all regions face the same p and possess the same capital-return function, $r^j(p, I^j)$, which is decreasing in I^j, (19) can be maintained in all regions only if

$$I_i^i < I_i^k. \tag{20}$$

Combining (20) with (17) then gives

$$I_i^i < \frac{I_T}{N^2} \quad \text{and} \quad I_i^k > \frac{I_T}{N^2}. \tag{21}$$

It follows from (21) and (16) that

$$-(Z^i p_i^* + I^i r_i^*) \quad + \quad \frac{tZ_i}{N} \quad + \quad T^i I_i^i \quad < \quad \frac{dW}{dT}\frac{1}{N}, \tag{22}$$

whereas

$$-(Z^k p_i^* + I^k r_i^*) \quad + \quad \frac{tZ_i}{N} \quad + \quad T^k I_i^k \quad > \quad \frac{dW}{dT}\frac{1}{N}. \tag{23}$$

Using these results, we now set each region's capital tax at a common value, T', above the centrally optimal level, T^c, and demonstrate that a Nash equilibrium cannot occur at T' because a single region has an incentive to deviate from T'. In particular, suppose that region i unilaterally reduces its tax rate from T' to T^c, and let ΔW^i be the resulting change in welfare. Since (22) applies to a marginal tax increase, it tells us that if all other regions were to also lower their tax rates so that they stayed equal to i's tax rate as it were reduced to T^c, then each region's welfare change, ΔW, would be less than $N\Delta W^i$ (i.e., both sides of (22) are multiplied by minus one for a tax reduction, reversing the inequality). But $\Delta W \geq 0$ by the optimality of T^c. Hence, $\Delta W^i > 0$, implying region i gains by deviating from T'.

On the other hand, if all regions initially choose T^c, then (22) also implies that a single region gains from lowering its capital tax below T^c by a sufficiently small amount, since the marginal welfare change on the right side of (22) equals zero when evaluated at T^c. Hence the tax rates chosen by each region in a Nash equilibrium must lie below T^c. Q.E.D.

This proposition provides a sense in which regions engage in wasteful tax competition. The basic idea can be explained in terms of interregional externalities. A marginal rise in region i's tax on capital benefits all regions through a combination of terms-of-trade and tariff-revenue effects. The cost to the home country as a whole is the capital outflow created by the higher tax. But region i shares disproportionately in this cost, since it alone has raised its tax and therefore will attract less capital than other regions. Consequently, when region i sets its capital tax where the marginal benefits equal the marginal costs, other regions benefit from a marginal rise in the capital tax, i.e., there is a positive externality. As a result, each region sets its tax rate too low.

Note that this argument does not require us to sign the effect of region i's tax increase on the other regions' capital imports. In the standard models of tax competition in a closed system of regions, one region's capital outflow represents a capital inflow for other regions. But here, the capital supply for the system of regions is not fixed. Looking back over the proof of Prop. 2, however, all that matters is how a tax increase in one region affects its capital supply relative to the capital supplies in other regions [see (20)]. In this sense, asymmetric capital flows remain the basic cause of the interregional externalities described above.

There exist many extensions to the analysis, some of which will be described below. Here we discuss the role of factor market distortions within regions. Suppose, in particular, that the wage in the M sector fails to adjust to clear markets. Instead, it remains above the E sector wage by some fixed amount (measured in terms of the numeraire good), thereby distorting the allocation of labor. In other words, there exists "underemployment." In this case, an inflow of capital to home will increase the M sector's demand for labor, causing workers to switch from relatively low paying E jobs to the higher paying M jobs. This labor reallocation is a social benefit that did not previously arise, since all workers were equally productive at the margin in both sectors. In symbols, the benefit to home from another unit of capital (calculated holding fixed the terms of trade) is

$$B = T + (w^M - w^E)\Delta L, \tag{24}$$

where w^i is the wage in sector i, and ΔL is the transfer of labor from sector E to sector M as a result the unit inflow of capital.

In the absence of a fixed wage, the second term in (24) disappears, and so B and T coincide. But when a fixed wage exists, Proposition 1 can be generalized by replacing T with B. In other words, the central government chooses positive levels of B and t. As before, this means that it discourages capital imports relative to their efficient level in an effort to achieve desirable terms of trade effects. When capital taxes are left in the hands of individual regions, however, the interregional externalities identified above again come into play, giving us Prop. 2: taxes are set inefficiently low from the viewpoint of the entire home country.

We return to the issue of underemployment when we work through a numerical example in Section 7. In the next two sections, we focus on the role of the central government's tariff policy, again assuming flexible wages.

5. No Tariffs

The proof of Proposition 2 rests on the previous conclusion that the optimal capital tax for the central government is positive. If the tax were negative (a positive subsidy) and regions were to choose even lower taxes, then the sign of the interregional externality identified

above would be reversed. When region i raised its tax on capital (lowered its subsidy), it would discourage investment, leaving itself with less capital than any other region. But this unequal distribution of capital would now benefit region i at the expense of other regions, since its subsidy bill would fall relative the subsidy bills in other regions. For this reason, the externality created by a tax increase would now be negative. In contrast to Proposition 2, regions would now choose inefficiently high tax rates in the Nash equilibrium. In other words, they would reduce their subsidies below the efficient level, in contrast to the usual arguments that regions engage in wasteful "subsidy competition."

The possibility that the central government chooses to subsidize capital must be considered when the tariff is eliminated as a policy instrument. In the absence of a tariff, only the capital tax is available to influence both the factor and commodity terms of trade. Moreover, a case can be made for expecting that a positive capital tax will increase p^*, thereby worsening the commodity terms of trade. At fixed p^*, the capital tax will reduce I, causing some production of good M to shift from home to foreign. But it is often argued that foreign direct investment is driven by variable cost advantages in the host country. If the effective marginal cost of production is indeed lower in home than in foreign, the reduction in I can be expected to lower the world supply of M, thereby requiring that p^* rise to clear markets.

But what about the factor terms of trade, given by r^*? In fact, the rise in p^* contributes towards a deterioration in this terms of trade, since $r^*(p^*, -I)$ rises with p^*. On the other hand, the rise in capital abroad induced by the capital tax causes $r^*(p^*, -I)$ to fall, so the net change in r^* is inherently ambiguous. Suffice it to say, however, that a subsidy on capital may be optimal.

A simple example illustrates this possibility. Assume that good M is characterized by a fixed-proportions production technology in each country, with one unit of capital producing one unit of M in foreign and $\alpha > 1$ units of M in home. Assume also that good E uses only labor in foreign, in which case foreign's wage is technologically fixed. Finally, simplify the demand side of the market for M by assuming that all home and foreign residents have the same demand function for M, which contains only its own price, p^*, as an argument.

Suppose now that home imposes a positive capital tax, causing a reduction in capital imports I. At a fixed p^*, world output falls by $1 - \alpha$ times the change in I. To clear product

markets, p^* must rise, causing r^* to rise. Given the fixed wage in foreign, $r^*(p^*, -I)$ is now independent of I, since p^* uniquely determines the value of r^* that gives foreign producers of M zero profits. Thus, both r^* and p^* must now remain higher than before the tax change, allowing us to conclude that both the commodity and factor terms of trade deteriorate. Reversing the argument, we conclude that the central government will subsidize capital as a means of improving the terms of trade, and regional governments will err by not subsidizing capital enough.

If we put a specific factor ("land") back into foreign's production technology for E, then foreign's wage will rise as its capital supply expands in response to home's tax rate, and so r^* may now have to fall to maintain zero profits, i.e., a desirable change in the factor terms of trade. But if the price elasticity of demand for M is sufficiently low relative to the wage elasticity of demand for labor by E producers in foreign, then p^* will still rise enough relative to r^* to ensure that home is hurt by the combined terms-of-trade changes. Thus, we must recognize that capital subsidies are possible in the absence of tariffs, and that regional governments may set these subsidies at inefficiently low levels.

6. The Impact of Tax Competition on Trade Policy

The previous sections have considered the impact of tax competition on the capital tax, first holding the tariff fixed at its centralized level and then considering a zero tariff. Another approach is to allow both the tariff and capital tax to endogenously adjust in response to tax competition. In this case, we need a theory of how the central government adjusts the tariff, given that the regional governments have control of the capital tax. Let us assume that the central government is another Nash player. In other words, it chooses its optimal tariff rate, treating as fixed the capital tax rates chosen by all regional governments (which are treating as fixed the tariff rate).

Figure 1, adopted from Wong's (1995) Fig. 11.3 but with different notation, illustrates the comparison. Curve tt represents the centrally optimal tariff at each level of the capital tax, and curve TT represents the centrally optimal capital tax at each level of the tariff. The centralized optimum, given by point (T^c, t^c), is located where two curves intersect. We follow Wong be assuming that both curves are positively sloped, i.e., an increase in one policy instrument increases the optimal value of the other. For our current concerns, the

upward-sloping property of the tt curve is critical, and so we return to this assumption below.

Suppose now that the central government gives control of the capital taxes to regional governments. Holding t fixed at t^c, we have seen (Prop. 2) that the decentralized T lies below T^c. In *Fig. 1*, this decentralized T is denoted T^d and is located on curve $T'T'$, giving the decentralized T at each level of t. The Nash equilibrium is located where $T'T'$ and tt cross. It is straightforward to generalize Prop. 2 to show that $T'T'$ lies to the left of TT at each t where the centralized T is positive. As a result, *Fig. 1* shows that decentralizing the choice of capital taxes leads not only to lower capital taxes, but also to lower tariffs.

Thus we reach the conclusion that the central government responds to tax competition by pursuing a less protectionist trade policy. This conclusion rests on the assumption that a fall in the capital tax lowers the optimal tariff (i.e., an upward-sloping tt curve). One way to justify this assumption is to recall the standard tariff-jumping argument, which states that a rise in a country's tariff causes firms that export goods to that country to avoid the tariff by setting up production facilities inside the country. When regional governments lower their capital taxes, tariff-jumping is encouraged, creating a greater incentive for the central government to respond by reducing the tariff.

To conclude, we see that tax competition may have desirable efficiency effects from the standpoint of world welfare, in the form of lower protection, both in capital markets and in commodity markets. To bolster the intuitive argument for an upward-sloping tt curve, we next work through a specific example where this property necessarily holds.

7. A Simple Parameterized Example

The purpose of this section is to study a simple parameterized example which allows us to verify certain properties of the general model and to address also an extension of the base model by considering a fixed wage case. To obtain closed-form solutions, the numerical example departs from the general model in one respect. Specifically, trade in both capital and good M entails "mobility costs." Our approach parallels Persson and Tabellini (1992).[4] Note that mobility costs could be added to the general model without changing the results derived so far. The advantage of having mobility costs is that it allows us to drop the fixed

[4] An alternative way is to assume that a certain fraction of the good is lost on the way, similar to Samuelson's iceberg model.

factor in sector E. This fixes the wage in both economies, thereby making the model much more tractable.

In each region i of the home country, there is a representative consumer, whose preferences are

$$U(C^{Ei}, C^{Mi}) = C^{Ei} + C^{Mi} - N(C^{Mi})^2. \tag{25}$$

The budget constraint of an individual is $C^{Ei} + pC^{Mi} = Y^i$, where income is Y^i (which will be derived later). Let total income be Y, and again let good E serve as the numeraire. Utility maximization gives demands for good M as $C^{Mi} = (1-p)/N$. Home's total demand for M is $C^M = 1 - p$. The representative consumer's utility function is

$$V(p, Y^i) = \frac{(1-p)^2}{4N} + Y^i. \tag{26}$$

The central government maximizes the sum of utilities $V = \sum V^i$. In the centralized case, or when all regions choose the same tax policy, this means $V = \frac{(1-p)^2}{4} + Y$. Individuals derive income from labor and capital. Both countries are endowed with fixed amounts of labor and capital, $\overline{L}, \overline{L^*}, \overline{K}, \overline{K^*}$.

Both countries have access to identical technologies. Production in sector E is linear and uses only labor, while in sector M labor and capital are used in fixed proportions:

$$\begin{aligned} X^E &= aL^E; \\ X^M &= \min\{K, L^M\}; \end{aligned} \tag{27}$$

for parameter $a > 0$. Attention is again limited to equilibria where home's imports of both M, $Z = C^M - X^M$, and capital, $I = K - \overline{K}$, are positive. There are strictly convex cost functions for exporting good M and capital (but not for good E). Let us assume that the marginal costs of exporting good M and capital equal the volume of these exports, Z and I, respectively (there is a quadratic cost of export function).

An equilibrium with incomplete specialization is characterized by the following profit maximization conditions:

$$\begin{aligned} a &= w = w^*; \\ p &= w + r; \\ p^* &= w^* + r^*. \end{aligned} \tag{28}$$

Furthermore all factor and goods markets must clear. The current account is balanced by Walras' Law. The final equations relate prices across countries:

$$\begin{aligned} r - T - I &= r^*; \\ p - t - Z &= p^*. \end{aligned} \tag{29}$$

The factor and commodity terms of trade are then $r^* + I$ and $p^* + Z$, respectively. The above set of equations can be solved as functions of policy parameters. We obtain

$$\begin{aligned} p &= \frac{5 + t + T - 3\overline{K} - 2\overline{K}^*}{5}; \\ p^* &= \frac{5 - t - T - 2\overline{K} - 3\overline{K}^*}{5}; \\ r &= \frac{5(1-a) + t + T - 3\overline{K} - 2\overline{K}^*}{5}; \\ r^* &= \frac{5(1-a) - t - T - 2\overline{K} - 3\overline{K}^*}{5}; \\ I &= \frac{2t - 3T - \overline{K} + \overline{K}^*}{5}; \\ Z &= \frac{2T - 3t - \overline{K} + \overline{K}^*}{5}. \end{aligned} \tag{30}$$

All other values can be derived from the equilibrium conditions. Note that $a, \overline{K}$, and $\overline{K}^*$ need to be sufficiently small for r and r^* to be positive. In the following we will assume

$\overline{K} \leq \overline{K}^*$. This assumption makes sure that in a laissez-faire situation capital inflows and imports of good M are positive.

Our first insight can be derived from the solutions for the endogenous variables. *An increase in the tax rate improves both the factor and commodity terms of trade unambiguously. A raise in the tariff, by contrast, improves the commodity terms of trade, but worsens the factor terms of trade.*

In the centralized case T and t are chosen by the central government to maximize $V(p, Y)$. Income can be written

$$Y = X^E + pX^M - (r - T)I + tZ = a\overline{L} + p\overline{K} + TI + tZ. \tag{31}$$

Note that $V(p, Y)$ is concave in (T, t). The first-order condition for the optimal tariff and tax under centralization give us the best response schedules $(T^c(t), t^c(T))$:

$$\frac{dV}{dt} = -59t + 41T - 3\overline{K} + 8\overline{K}^* = 0; \tag{32}$$

$$\frac{dV}{dT} = -59T + 41t - 3\overline{K} + 8\overline{K}^* = 0. \tag{33}$$

Hence the tax and tariff are each an increasing function of the other instrument. Moreover, in the absence of the other instrument, the optimal tax and tariff are strictly positive, $t^c(0) > 0$ *and* $T^c(0) > 0$. Equations (32) and (33) are therefore consistent with *Figure 1.*

The solution to the central government's problem ('centralization') is then

$$t^c = T^c = \frac{4}{9}\overline{K}^* - \frac{1}{6}\overline{K} > 0. \tag{34}$$

The tax and tariff under centralization are positive because $Z, I \geq 0$ requires $\overline{K} \leq \frac{2}{3}\overline{K}^*$, a condition which is even tighter than the condition under laissez-faire.

In the decentralized case, each region i chooses a tax rate T^i, and the central government chooses the tariff. A regional government maximizes $V(p, Y^i)$ where now $Y^i = \frac{a\overline{L}}{N} + p\frac{\overline{K}}{N} +$

$T^i I^i + t\frac{Z}{N}$. We first need to solve for p, K^i, Z etc. as functions of all tax rates and the tariff. This can be done as above. The basic maximization problem is structurally the same, but all the calculations are more tedious, however. For a given tariff rate, the symmetric Nash equilibrium in regional taxes is

$$\begin{aligned} T^d(t) &= \frac{(4N^2+5N-1)\overline{K}^* - (4N^2+3N-4)\overline{K} + (8N^2+20N+13)t}{N(8N^2+28N+23)} \\ &\equiv A(\overline{K}, \overline{K}^*, N, t). \end{aligned} \tag{35}$$

Note that this expression coincides with the first order condition for the centralized case when $N = 1$. We can establish several important properties: *For any nonnegative tariff, the equilibrium capital tax under decentralization is positive and decreasing in the number of regions for* $N = 1, 2, 3, ...$ Again, this is consistent with *Figure 1.* Together with our previous results, we obtain an additional insight. The tariff under decentralization of tax policy is lower than the tariff under centralization $t^d < t^c$. *Hence decentralization of tax policy lowers external trade barriers.* This is so because the best response functions $T^d(t), T^c(t)$, and $t^c(T)$ are all upward sloping.

We can use our example to incorporate a factor market distortion. This possibility was mentioned in section 5. Let us assume that in the home country's M sector, the wage w^M is fixed above $w^E = a$ (the wage in the E sector), perhaps due to strong unionization. Workers wish to be employed now in the M sector, but this requires enough capital. Note that for any given price p, a higher fixed wage reduces the return on capital. There is now an additional incentive for governments to import capital. We want to study whether this effect is sufficient to change the sign of the optimal tax rate.

Consider first the case of centralized tax setting. Solving the model in the same way as above, we find that the optimal tariff (but not the best response function $t^c(T)$) stays the same. The best response function for the tax is shifted to the left by an amount equal to the wage difference between sectors M and E, that is the tax schedule now reads

$$T^c(t) = \frac{41t - 3\overline{K} + 8\overline{K}^*}{59} + w^E - w^M. \tag{36}$$

Given that the optimal tariff does not change, *the optimal tax therefore may become negative for a sufficiently high fixed wage in sector M.* This possibility is shown in *Figure 2.* In section 4 we found that Proposition 2 extends to the fixed wage case. An increase in a region's tax creates a positive externality, as is indicated by (24). An inflow of capital is socially beneficial. We show now that this holds in our example. *Thus, even when the home's central tax is negative as a result of high fixed wage in sector M, tax rates under decentralization are too low.* A comparison of *Figure 1* and *Figure 2* illustrates that the TT and $T'T'$ schedules are shifted to the left by the same amount, while the tt schedule is shifted upwards such that the optimal tariff under centralization is the same as under the flexible wage.

To show the result analytically, consider the best response schedule $T^d(t)$ under the fixed wage. This schedule differs from the case with no factor market distortion by the difference in wages across sectors, that is

$$T^d(t) \;=\; A(\overline{K}, \overline{K}^*, N, t) \;+\; w^E \;-\; w^M. \tag{37}$$

The proof is then straightforward. An inflow of one unit of capital in region i creates a social benefit B which equals the additional tax revenues $T^d(t)$ plus the increase in net wages when labor is allocated from sector E to sector M. The wage change is $w^M - w^E$. The net welfare effect is then equal to

$$B \;=\; T^d(t) + w^M - w^E \;=\; A(\overline{K}, \overline{K}^*, N, t) \;>\; 0. \tag{38}$$

In other words, the social benefit of an additional unit of capital is independent of the fixed wage in sector M.

8. Discussion

This paper sheds new light on the question whether tax competition leads to too low or too high tax rates. While most of the existing literature concludes that tax rates are too low when decisionmaking is decentralized, we find that this does not have to be the case. Our theoretical analysis differs from the literature by allowing for trade in goods and capital with

the rest of the world. This possibility necessitates a simultaneous analysis of factor terms of trade and commodity terms of trade. Since the latter are determined in part by tariffs, it is important to consider both tax and tariff policy. We show that tax rates can be too high in the absence of a tariff, but tax rates are too low when the central government sets the tariff optimally. It may seem that the former case is less realistic, but it clearly generalizes to the case where the tariff is positive but sufficiently small. Taken as a whole, our results suggest that the welfare effects of tax competition may change when worldwide trade liberalization reduces tariffs.

In the remainder of this paper we wish to point out and discuss applications and extensions of our analysis. In Section 6, we treat the central government as a Nash player in a game with regional governments and analyze the equilibrium tariff and tax policies. If, instead, the central government can move first, setting its tariff rate before the capital tax rates are chosen by regional governments, then it has an opportunity to influence the tax choice. Thus, assume that the central government is the "Stackelberg leader," and let $T(t)$ denote the tax chosen by regional governments as a function of this tariff, as described by curve $T'T'$ in *Fig. 1*. Assume that the tt and $T'T'$ curves are upward sloping, as in our example. The central government now maximizes the function $V(T(t), t)$, which expresses welfare as function of policy instruments. In the Stackelberg equilibrium, we have

$$\frac{\partial V}{\partial T}\frac{dT}{dt} + \frac{\partial V}{\partial t} = 0. \tag{39}$$

To understand how the central government can improve welfare over its level in the Nash equilibrium, suppose that t is initially fixed at its Nash level, identified by the intersection of curves tt and $T'T'$ in *Fig. 1*. Then the welfare impact of a marginal rise in the tariff is

$$\frac{\partial V}{\partial T}\frac{dT}{dt}, \tag{40}$$

since $\partial V/\partial t = 0$ by the optimality of the tariff at the Nash equilibrium. Recall that regions set their taxes inefficiently low, since each region ignores the positive externality that a rise in its tax provides other regions. Such an externality is necessarily created by a marginal rise in T from its Nash value. As a result, $\partial V/\partial T$ is positive. Moreover, the regions' reaction function dT/dt is upward sloping by assumption. It follows then from (39) and (40) that the central government can improve welfare by raising t above its Nash level. Given that $T'T'$ is

positively sloped, as illustrated in *Fig. 1*, this rise in t leads to an increase in each region's tax rate.

To conclude, we find that greater tariff protection can be used to alleviate the tax competition problem, which causes tax rates to be too low. Assuming $V(T,t)$ is concave, the analysis may be used to show that the Stackelberg leader's optimal tariff lies above the Nash tariff. We have not ruled out the possibility that the Stackelberg leader's optimal tariff can actually exceed the centrally optimal tariff.

One way to interpret our two-good model is to think of the import-competing good as a narrowly-defined commodity, like automobiles, while the other sector represents the rest of the economy. Both in the EU and the U.S., trade with the rest of the world is restricted for many goods. Husted and Melvin (1998) provide an account of the nominal and effective rates of protection in several sectors in the U.S. and the EU. Feenstra (1992) summarizes and discusses the literature on the costs of protectionism. He finds that the costs are significant. Outside firms have responded to this tariff wall (e.g., 'Fortress of Europe') by engaging in tariff-wall jumping foreign direct investment. A good description of the effect of the Single Market in Europe on outside FDI from the U.S. and Japan can be found in European Commission (1998). At the same time there has been intense tax competition within the EU and the U.S. for these outside firms. In the U.S., investment in new automobile plants has received a lot of attention, in particular the cases of BMW in South Carolina, Toyota in Indiana and Mercedes in Alabama.

Following most of the literature on tax competition, we have assumed that all markets are perfectly competitive. Clearly this need not be the case, in particular if one thinks of the capital-importing sector as one good like automobiles. Suppose then that sector M is imperfectly competitive, while in sector E perfect competition prevails. Despite the difference in market structure, the main conclusions from our analysis may extend to the modified model. If a region lowers its tax, additional M firms may jump the tariff wall and locate in the region. This has several effects. The additional firms produce at lower marginal costs than before by avoiding the tariff. This increases output and lowers the price of good M, a favorable terms of trade effect. In addition, assuming that firms compete by choosing outputs (i.e., Cournot-Nash competition), the existing firms in the home country will respond to the inflow of new firms by lowering their output. This creates revenue losses

for the governments of the regions with the existing firms, similar to the perfect competition case. The latter effect is not taken into account by the region that lowers its tax, suggesting that decentralized tax setting leads to inefficiently low tax rates.

We have considered cases where either the central government or regional governments fully control T. It would be useful to endogenously determine the division of this control, perhaps using a model of a political process. In the absence of such a model, however, one simple generalization is to assume that the central government's T is exogenously fixed at some nonoptimal level, not necessarily zero, leaving regional governments to choose their capital tax rates. We may then examine the efficiency of the "total capital tax rate," determined by summing the rates chosen by the central government and a regional government. As long as the central government's T is below the centrally optimal T, given its choice of t, the results reported above will continue to hold. In particular, there is wasteful tax competition (i.e., inefficiently low capital taxes) in the case where t is set at its value under the centralized optimum, but wasteful subsidy competition may occur in the absence of a tariff.

In our analysis we have assumed that governments maximize the welfare of a representative resident. Policy instruments are used to manipulate the terms of trade in the factor and goods market. These assumptions may be questioned because often trade policy is viewed as the result of lobbying by groups with heterogeneous interests (see Grossman and Helpman, 1994 and 1995). Our model can be extended in this direction. We use a specific-factors model of international trade, where capital is specific to the import sector. There is a potential conflict of interest between workers and capital owners which we have neglected so far. This conflict is sharpened when there is a factor market distortion. It is also conceivable that such a conflict of interest has important implications for who has the most influence over the two policy instruments. Suppose that the domestic ownership of capital is diffused over all regions. Immobile workers have then a strong interest to use local tax policy to improve local labor compensation at the expense of capital owners. By contrast, consumer interests are often difficult to organize and hence it is possible that capital owners have a higher incentive to use federal trade policy to induce favorable terms of trade changes. Future research should take into account how the political process affects tax and tariff policies in open economies.

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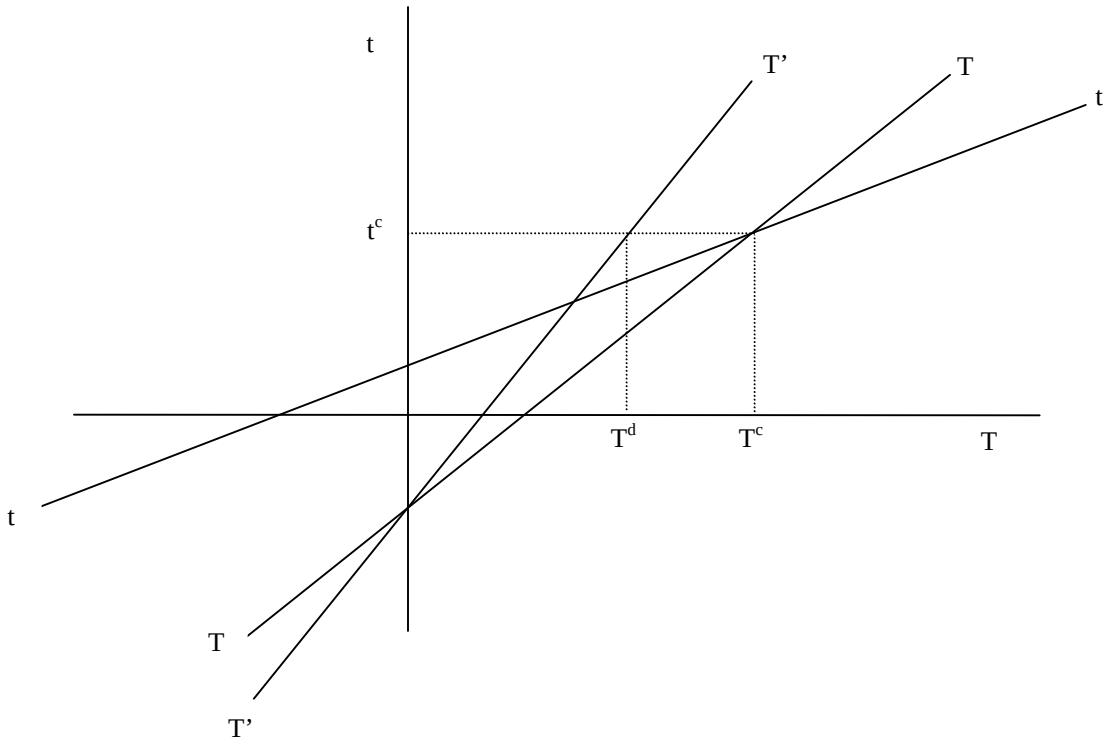

Figure 1

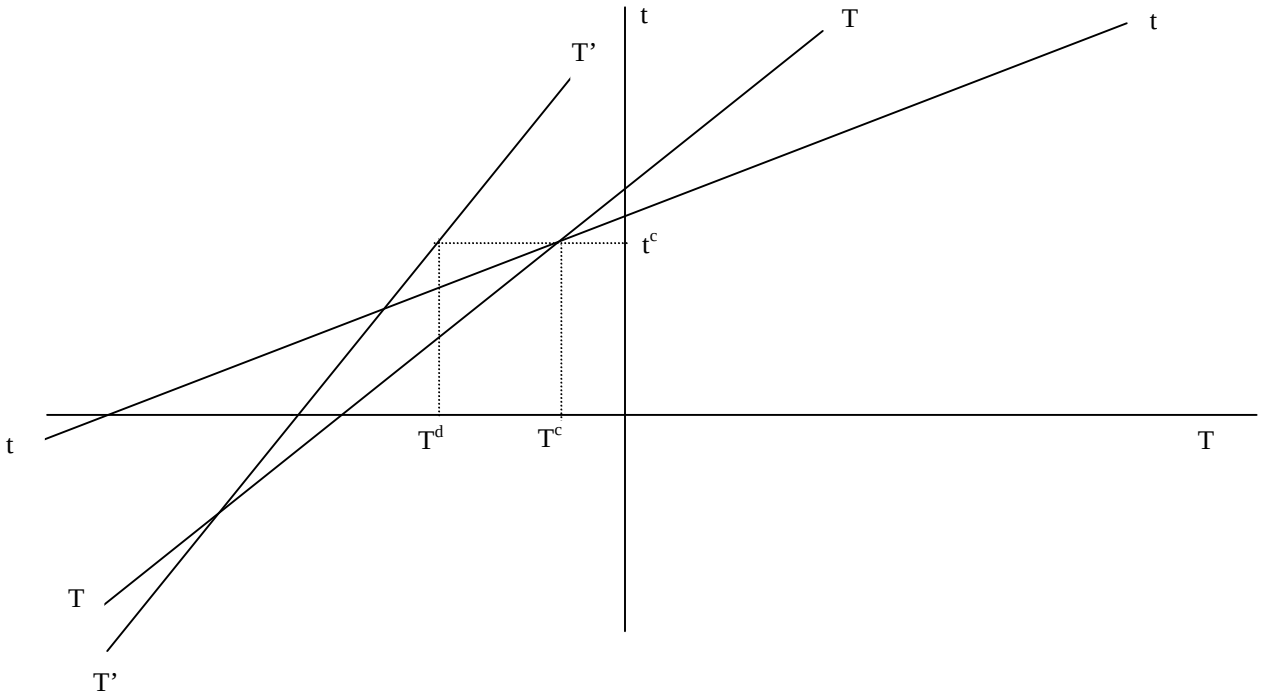

Figure 2

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