Capital tax competition: bane or boon

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Abstract

This paper reviews potential advantages and disadvantages of capital tax competition. Tax competition may introduce, mitigate, or exacerbate inefficiencies in both the private sector and the public sector. In different models, tax competition may either limit or increase public expenditures and taxes on mobile factors, with differing welfare consequences. We also discuss the implications of tax competition for redistributive policies and for policies dealing with risk, and we identify some of the possible empirical implications of tax competition.
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1. Introduction

Early contributions to the theory of tax competition emphasized the possibility that competition for capital leads to inefficiently low tax rates and public expenditure levels[1]. This view is articulated by Oates (1972) and formally modeled by Zodrow and Mieszkowski (1986) and Wilson (1986). If regions differ in the extent to which they compete for capital, tax competition also leads to the misallocation of capital. Numerous subsequent writers have extended and refined the view that tax competition lowers

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[1] Although issues of fiscal competition arise in other contexts (commodity taxation and the fiscal treatment of labor and population), our discussion in this paper focuses primarily on the tax treatment of capital. For surveys that address some of these other forms of fiscal competition, see Cremer et al. (1996), Wildasin (1998), Lockwood (1998), Keen (1998) and Wilson (1999).

welfare[2]. More recently, researchers have begun to investigate the possibility that tax competition can have desirable effects. Actually, this possibility dates back to Brennan and Buchanan (1980) model of government as a Leviathan that needs to be "tamed", and it has already been the subject of extensive empirical testing by Oates (1985, 1989) and others. In contrast, the "standard model" (i.e. Zodrow–Mieszkowski and its variations) assumes welfare-maximizing governments and models an economy that would be fully efficient if capital were not interregionally mobile. This seems to stack the deck against tax competition.

This paper describes some approaches to modeling the potential benefits of tax competition, including both existing approaches and some new approaches, and how they contrast with models of welfare-worsening tax competition. We discuss issues associated with how tax competition handles inefficiencies in both the private sector and the public sector. One theme that emerges is that tax competition can lead to higher public expenditures and taxes on mobile factors, and that such effects can be a sign of efficiency-enhancing tax competition. These possibilities seem to be consistent with the difficulties researchers have encountered in documenting a negative relation between total tax revenue and various indicators of tax competition, although there are certainly competing explanations.

The plan of this paper is as follows. We begin by providing a definition of tax competition that is then used throughout the paper. In Section 3, we discuss the efficiency effects of tax competition on the location of firms, beginning with the Tiebout Hypothesis (Tiebout, 1956), which implies that firm location is efficient. We stress, however, that the assumptions of Tiebout models are quite stringent. Section 4 examines the implications of tax competition for the size of government, and Section 5 looks at the impact of tax competition on the mix and levels of taxes used to finance government expenditures. In both cases, we focus on the efficiency effects of tax competition, and whether these effects can be distinguished empirically. Sections 6 and 7 then examine models that generate variations in tax policies across the competing regions, including the role of international goods trade in creating such differences. The special considerations associated with the government's role in redistributing income and allocating risk are dealt with in Section 8. Section 9 briefly reviews some of the key empirical approaches to testing for tax competition, including the difficult task of distinguishing between good and bad types of tax competition. Section 10 concludes.

2. Defining tax competition

To investigate the empirical evidence on tax competition, we first need a definition of tax competition. The literature on tax competition has devoted surprisingly little attention to defining this phenomenon. In some cases, tax competition seems to be defined very broadly as any form of noncooperative tax setting by independent governments.

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[2] See Wilson (1999) for a review.

A somewhat narrower definition adds the requirement that each government's tax policy influences the allocation of tax revenue across government treasuries. This requirement eliminates a broad class of models known as "yardstick competition". Rather than governments being linked through their treasuries, yardstick competition links them through the informational content of each other's tax policies. In particular, a comparison between taxes in a given jurisdiction and those in a "similar" jurisdiction enables voters in the former jurisdiction to assess the performance of current government officials and vote accordingly[3]. There is nothing in this story about interdependencies between government budgets, and so we exclude it from this "broad definition" of tax competition.

For our narrowest definition, we narrow the reasons for why government budgets are interdependent. In particular, we define tax competition as noncooperative tax setting by independent governments, under which each government's policy choices influence the allocation of a mobile tax base among "regions" represented by these governments[4]. In particular, governments may compete over the allocation of workers, firms, capital, or shoppers. This definition eliminates "vertical tax competition", where different levels of governments (e.g. federal, state, and local) impose taxes on the same tax base. Rather, it encompasses the large class of models known as "horizontal tax competition", under which governments at the same level are competing. We refer to this definition as the "narrow definition", or simply competition for mobile factors.

Our view is that the broadest definition encompasses too many phenomena to be of much interest. In fact, tax competition in this case would exist between two large trading economies that engage in tariff wars in an effort to manipulate their terms of trade in desirable ways. This is not what most researchers mean by "tax competition".

The broad definition seems overly broad, too, if we are to allow the label "tax competition" to carry much descriptive power. Accordingly, the focus of this paper will be on competition among independent governments over a mobile tax base. To keep the discussion manageable, we specifically focus on competition for mobile firms or factors (primarily capital) and do not deal with the sizable literature on commodity tax competition or vertical tax competition[5].

3. Firm location

The basic argument for why tax competition for mobile capital or firms is good goes back to the Tiebout Hypothesis (1956), which states that competition among jurisdictions for households leads to an efficient provision of local public goods. In particular,

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[3] See Besley and Smart (2001) for a recent theoretical analysis of yardstick competition, along with related references.

[4] In this paper, the term "region" may be interpreted as countries or states or localities within countries, depending on the context.

[5] See references cited in Footnote 1 above. We also do not address the special problems associated with the double taxation conventions and informational asymmetries involved in taxing foreign-source income; see Gresik (2001) for a review. Finally, we do not explicitly address the related area of a "race to the bottom" in environmental quality; see Wilson (1996) for a review.

households vote with their feet by efficiently sorting themselves across jurisdictions, and local governments respond by tailoring their taxes and expenditures to the preferences of their residents. Although this theory was originally applied to household mobility, it can also be applied, almost unaltered, to competition among jurisdictions for mobile firms. See White (1975) and Fischel (1975) for the original application, and Wellisch (2000) for more recent formulations. In this case, it is firms that benefit from public expenditures (e.g. infrastructure investment). In an equilibrium with many competing governments, they are taxed at a rate that reflects the cost of providing "public inputs" to the marginal firm. The result is an efficient division of firms across regions. Even in cases where the number of competing regions is limited, the use of a bidding process can result in efficient firm location. See, in particular, papers by Black and Hoyt (1989) and King et al. (1993). It is interesting that the latter paper provides an example of jurisdictions that choose different policies, although they are ex ante identical. Here, two jurisdictions choose different "infrastructure" levels in the first stage of the game. Although the region with less infrastructure knows that it will fail to attract the firm, it nevertheless chooses a positive level because there is some probability that it will then attract the firm in a later stage of the game. In fact, this pattern of infrastructure investment is fully efficient.

These efficiency results apply equally well to models where capital investments come in infinitely-divisible quantities, rather than the lumpy investments associated with firm location decisions[6]. A critical property is that this investment is efficiently taxed. In other words, any tax on a unit of investment equals the cost incurred by the government in providing public goods and services; there is "marginal-cost pricing".

In contrast to these efficiency results, much of the tax competition literature is concerned with a form of spillover effects, "fiscal externalities", that occurs when capital or firms are not efficiently taxed for various reasons[7]. But spillover effects can also occur even in the case where efficient pricing is fully available. Consider the example of regions within a country competing for an internationally-mobile firm. If the firm locates a plant within the region, then it no longer has to incur the transport costs associated with exporting goods to the country. Instead, it will locate within one region and supply the good to all regions. Transport costs will then be substantially lower, and so the firm will sell the good at a lower price. Although only one region has attracted the firm, all regions within the country benefit in terms of higher consumers' surplus. This example assumes that the firm is large enough to influence market prices in the home country, suggesting other sources of inefficiency associated with imperfect competition. Pollution externalities are another source of spillover effects. In all cases, local governments fail to efficiently tax or subsidize the firm, because they do not account for these spillover effects[8].

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[6] Devereux et al. (2001a) uncover some empirical evidence that governments treat the location choices of multinational firms as discrete.

[7] One potential explanation for the lack of efficient pricing is informational asymmetries. Such asymmetries have been advanced as an explanation for tax holidays, by which government officials are able to signal to potential investors various attributes of their regions. See, for example, Bond and Samuelson (1986) and Wen (1997). In contrast to the tax competition literature's concern with the efficiency properties of a system of regions, these papers confine their attention to the tax problem facing a single region.

[8] See Rauscher (1995) for an analysis of competition for a firm that generates nontransboundary pollution externalities.

In the above example, we are decomposing the world into countries that are relatively unintegrated (high transport costs), compared with regions within countries. Regions within these countries then engage in tax competition. If countries are "asymmetrically integrated" (Europe vs. the US?), then such competition can be expected to produce inefficient firm location[9].

4. The size of government

Perhaps the main theme of the tax competition literature has been that it lowers government spending and taxes below their efficient levels. This theme emerges from the framework developed by Wilson (1986) and Zodrow and Mieszkowski (1986). We begin by describing the Zodrow–Mieszkowski model, which has been used extensively in the literature, in part because of its relative simplicity. We then discuss some challenges to the conclusions from this model. Throughout the discussion, the comparison between tax competition and its absence is determined by whether capital is mobile across regions[10]. Similarly, "increased" tax competition may be viewed as the result of either a decline in the costs involved in investing abroad or an increase in the number of competing regions.

4.1. Inefficiently low taxes and spending

The Zodrow–Mieszkowski model assumes a world consisting of a fixed number of identical regions, each containing an immobile factor that we will call labor. Within each region, competitive firms use a constant-returns technology to produce output from this labor and interregionally-mobile capital. In other words, the discrete firms in the previous subsection are replaced with capital, which can be allocated continuously across regions but is fixed in supply for the "world economy". Consumers use their income from capital and labor endowments to purchase output as a final consumption good, c. The government also purchases output to use as the sole input into the production of a public good, g. A tax on the capital located within the region's borders is used to finance g. Such a tax will be referred to as a source-based capital tax. It is important to distinguish this tax from a residence-based capital tax, which is imposed on a resident's worldwide income, regardless of where it is earned. The tax competition literature has focused on source-based taxes in part because of the practical problems encountered in trying to tax worldwide income. Throughout the current paper, "capital taxes" refer to source-based taxes.

The Zodrow–Mieszkowski model assumes that the public good and tax rate are set to maximize a representative resident's utility, $u(c, g)$, subject to the budget constraint,

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[9] Imperfect political institutions may also result in policies that distort firm location decisions. In particular, elected officials may respond to voter ignorance by using their success at attracting mobile firms as a signal of their "abilities". See Biglaiser and Mezzetti (1997) for a model of this type.

[10] For the purposes of this discussion, "regions" means "independent" or "uncoordinated" regions. As discussed further in Section 8 below, coordination of policy (tacitly, through explicit "harmonization", or through the creation of new institutional structures) provides a means by which to suppress the operation of competitive forces.

$g = tK(r + t)$, where r is the after-tax return on capital, t is the unit tax rate, and $K(r + t)$ is the region's demand for capital as a function of the before-tax return. Otherwise, the regions play a Nash game in tax rates, recognizing that the vector of all tax rates determines the equilibrium r[11]. In either case, the critical condition for the optimal public good supply is[12],

$$\frac{u_g}{u_c} = \frac{1}{1 - \tau \varepsilon_K (1 + \mathrm{d}r/\mathrm{d}t)}, \tag{1}$$

where ε_K denotes the elasticity of demand for capital with respect to the before-tax return (measured positively), τ is the ad valorem tax rate (i.e. $\tau = t/(r + t)$), and $\mathrm{d}r/\mathrm{d}t$ gives the marginal impact of the region's tax on the equilibrium r, which is negative or zero depending on whether the large or small region case is considered. The left side gives the marginal rate of substitution between the public good and private income, and the right side is the marginal cost. Notice that this marginal cost exceeds one because the denominator contains a term reflecting the cost of the capital outflow that occurs when a single region raises its tax rate. With the world economy's capital stock treated as fixed, this capital outflow represents a capital inflow for other regions. This inflow benefits these other regions, because the marginal value of capital exceeds the opportunity cost from their viewpoint, by an amount equal to the unit tax rate.

In other words, there is a "fiscal externality" in this model. The size of this externality clearly depends on the number of competing regions. If this number is large, the elasticity of the supply of capital to a single region with respect to its tax rate is less than infinite and a rise in the tax rate depresses the return on capital, r. Hoyt (1991) shows that the equilibrium capital tax and welfare fall as the number of regions rises. This finding provides a possible empirical indicator of tax competition, but we shall identify models of welfare-improving tax competition that give the same indicator.

These results remain valid if the capital tax is replaced by a uniform tax on all income earned within the region's borders. Such a tax has some relevance, given the difficulties that governments face in taxing income earned outside the borders, along with the difficulties involved in distinguishing between different sources of income earned within the borders. However, some differentiation between different sources of income is surely possible, and the model also fails to recognize the distortionary effects of taxes on labor, an omission that we later address.

Whereas the original Zodrow–Mieszkowski model concerned the overall level of government spending, subsequent research has also examined the composition of spending. In particular, Keen and Marchand (1997) indicate that governments have an incentive to increase their expenditures on public inputs relative to public goods, since the former attract capital by increasing its productivity. We shall have more to say about composition issues in Section 9.

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[11] Wildasin (1988, 1991a) explores the use of the public good level g as the strategic variable, but this difference does not appear to cause qualitative changes in the main results reported here.

[12] We ignore "terms-of-trade effects" here, which arise when a large region is a capital importer or exporter. In the importer (exporter) case, the negative impact of t on r lowers (raises) the marginal cost. Condition (1) holds exactly in the case of a system of identical regions.

4.2. Leviathan models

Perhaps the strongest challenge to the notion that tax competition reduces welfare comes from Leviathan models. The basic idea, as developed by Brennan and Buchanan (1980), is that the total size of government would be excessive in the absence of this competition. Rauscher (1996, 1998) and Edwards and Keen (1996) examine this view formally in various "Leviathan models", where governments are concerned in part with maximizing the size of the public sector. Their conclusions about the welfare implications of tax competition are mixed, but all three papers assume that governments retain some degree of "benevolence", perhaps caused by re-election concerns that are not formally modeled.

Despite these different welfare conclusions, Leviathan models and the Zodrow–Mieszkowski model both agree that tax competition lowers the size of government. Thus, it is difficult to distinguish empirically between these two types of models[13].

4.3. Divided government

This discussion raises the issue of whether there might exist cases where tax competition is welfare-improving but leads to a greater size of government. Wilson (2001) constructs such a model. This model is based on the Zodrow–Mieszkowski model, except that self-motivated government officials are introduced and the revenue from capital taxation is used to finance a public input, rather than a public good. The framework is based on the idea that tax policies should be relatively more transparent to voters than the composition of public expenditures[14]. Decision-making within a single region takes place in two stages. First, tax rates on wage and capital income are chosen to maximize the welfare of residents, recognizing that these tax rates will then influence the behavior of government officials. In the second stage, these officials choose the level of a public input, given the tax rates that they face. Additional provision of the public input raises the productivity of capital, thereby attracting more capital into the region and causing the equilibrium wage to rise. Depending on the tax system, additional public input provision can, therefore, significantly increase tax revenue. As in Leviathan models, government officials are assumed to benefit from the greater tax revenue. Hence, the mix of taxes is chosen in the first stage to make tax revenue sensitive to public input provision. In particular, the tax on capital may be positive or negative, depending on properties of the production technology.

The mobility of capital may be viewed here as lowering the cost of public input provision from the viewpoint of government officials. It does so by increasing the

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[13] Kehoe (1989) also presents a model in which reduced taxes are welfare-improving, but his argument is based on the idea that competition for capital constrains governments from taxing away the returns to previously-accumulated capital, thus solving a time-consistency problem by preserving incentives for capital accumulation in the first instance. In a related analysis, Janeba (2000) explains how a firm can take advantage of fiscal fragmentation by designing its investment projects in a way that stimulates tax competition. The resulting fall in taxes may then allow socially beneficial projects to be profitable for the firm.

[14] See Gordon and Wilson (1998).

sensitivity of tax revenue to public input provision. In other words, a dollar of revenue spent on the public input costs these officials significantly less than a dollar in terms of the revenue left for "wasteful activities".

Unlike the standard tax competition model, this theory does not predict that there must be a negative relation between the overall size of government and measures of the intensity of tax competition, such as the number of competing regions. Although there is less waste in government, the decline in the effective marginal cost of productive public expenditures leads residents to increase their demand for these expenditures. This second consideration may lead to a greater size of government, despite the presence of less waste.

4.4. Tax competition as a cure for tax exporting

Whereas tax competition may lead to inefficiently low taxes and spending levels, "tax exporting" creates the opposite problem. If, for example, a property tax on land and capital is employed, then it will be partially borne by nonresident landowners. In cases where individual regions have some ability to tax away the returns earned by foreign investors (the "large-region" case), such taxes represent another source of tax exporting. In these cases, taxes may be set inefficiently high unless competition for mobile factors limits this tendency. Sorensen (2000) uses tax exporting as an explanation for why effective tax rates have not changed much in OECD countries as economic integration has increased. The potential for this type of tax exporting, however, depends on the extent of cross-ownership of assets, which may itself be influenced by tax policies, as discussed further in Section 9 below.

4.5. Conclusion

Most models predict that tax competition should reduce the size of government, but the welfare implications are model-specific. In more recent work, tax competition is welfare-improving but has an ambiguous impact on the size of government. This finding suggests that a possible indicator of welfare-improving tax competition— sometimes sufficient, but not generally necessary—is that it increases the size of government.

5. The mix and levels of taxes

Underlying condition (1) is the assumption that only a capital tax is available to finance public good expenditures. Subsequent research has sought to break the link between these expenditures and capital taxation. Once the choice among tax instruments is recognized, inefficiencies in this choice become an issue. Bucovetsky and Wilson (1991) amend the Zodrow–Mieszkowski model by adding savings and labor-supply decisions and allowing governments to choose between a tax on labor income and a source-based capital tax. Despite the limited alternatives, governments in a system of many regions choose to tax only labor. The simple intuition here is that capital is in

infinitely elastic supply from a viewpoint of a single small region, whereas the labor supply elasticity is finite[15].

Moving to a system of "large" regions (i.e. regions than can influence the after-tax return on capital), Bucovetsky and Wilson find that regions now choose to tax capital at a positive rate. In other words, the model suggests that large regions choose a mix of taxes that is weighted more towards capital taxation. As long as there are competing regions, however, the chosen tax mix is inefficient, due to the fiscal externalities resulting from a move towards capital taxation[16].

The general lesson here appears to be that tax competition causes regions to reduce their taxation of mobile factors relative to immobile factors, with the size of the reductions depending on the number of competing regions in a world economy of a given size. Moreover, these tax reductions are inefficient. In a related analysis, Boadway et al. (2002) consider the elimination of taxes on mobile firms, not by choice, but rather because a central authority mandates this elimination. Welfare declines because regions compete for these firms through the use of inefficient redistributive policies.

On the other hand, recent research has identified cases under which tax competition is welfare-improving because it leads to higher taxes or lower subsidies on mobile factors or firms. A good example is provided in a paper by Janeba (1998), who combines competition over strategic trade policies with tax competition. In the standard model of strategic trade policy, two countries each contain a firm that plays a Cournot game in a foreign market (a "third market"). Each country has an incentive to subsidize exports to this market, in an attempt to shift profits, but when both compete in export subsidies they merely reduce total profits, leaving both countries worse off. Janeba allows each firm to locate its production activities in the country with the highest subsidy rate (or lowest tax rate). Now the subsidies not only affect output decisions, but also firm location decisions. In particular, each government may seek to attract the other country's firm and thereby capture some of its profits through taxation. Janeba assumes that the tax system must be nondiscriminatory, meaning that a country imposes the same tax rate on the outputs of all firms that operate within its borders, whether domestic or foreign.

Janeba's surprising conclusion is that competition for mobile firms causes the countries to compete their subsidies to zero. No country offers a positive subsidy, because the

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[15] The zero-tax result is actually an implication of the Diamond and Mirrlees (1971) conclusion that aggregate production efficiency is desirable when the optimal commodity taxation is available. In the present instance, the tax on labor income is the only commodity tax that is needed. See Gordon (1986) for a similar result in the case where a residence-based capital tax is also available. On the other hand, Huber (1999) finds that the equilibrium capital tax may be positive or negative, but he assumes a nonlinear income tax, which imposes the same rate structure on the incomes of different types of labor. It may be noted that while production efficiency is optimal from the viewpoint of a single jurisdiction, it may not be efficient from the viewpoint of a system of jurisdictions: see, e.g. Keen and Wildasin (forthcoming) and references therein.

[16] It is interesting to note that even in the case of many regions, public good levels are inefficiently low, although only labor is taxed. Bucovetsky and Wilson explain that labor-financed increases in public good provision also create fiscal externalities, due to the linkage between the capital market and each region's distorted labor market. World welfare can be increased if all regions raise either their labor taxes or capital taxes to finance additional public good provision.

transfer of subsidy revenue to the foreign firm would harm the country[17]. The resulting equilibrium is not fully efficient, since the inefficiencies associated with imperfect competition are still present. But tax competition does improve welfare through the elimination of wasteful subsidies.

A crucial ingredient of this model is that government policy in the absence of firm mobility is inefficient; mobility then plays a role in improving efficiency. Another example is the divided-government model discussed in the previous section. In that model, the equilibrium mix of capital and labor taxes is chosen to enhance the incentives for government officials to reduce waste in government. Wilson (2001) demonstrates that capital will be positively taxed if the substitution elasticity between labor and capital is above one, but negatively taxed for smaller elasticities. In contrast, the optimal mix of taxes is indeterminate in the absence of capital mobility.

Yet another example where capital mobility can improve welfare while leading to higher taxes is obtained by assuming that a region's capital uses costly public services. As already noted, factors should be taxed according to their marginal costs. Few studies have attempted to assess the degree of congestion caused by "capital", but the amount of expenditures required to finance many public services, including transportation, public safety, water, waste disposal, and electrical and communications infrastructure, is likely to depend on the level and composition of industrial development. Such, at least, seems to be the premise of many economic development initiatives that aim to enhance local or regional investment. Indeed, some of the congestable public services provided to households, including education, are also closely intertwined with economic development, and disentangling the congestion effects associated with labor and capital mobility empirically is not a simple task. In general, however, there is little reason to assume that the congestion effects attributable to capital mobility are negligible in magnitude, and, in the absence of empirical analysis, it is perhaps more plausible to postulate that expenditures on the public services that serve private capital investment are likely to rise in proportion to the level of investment. In this case, competition for mobile capital would drive the tax rate per unit of capital to a level equal to the amount of public expenditure per unit of capital, which could be substantially greater than zero[18]. On the other hand, the absence of capital mobility eliminates the need to tax capital as a method of controlling congestion.

To conclude, we have identified several instances where a positive connection between tax competition and taxes on mobile factors implies the existence of welfare-improving tax competition.

6. Tax diversity

We now explicitly recognize variations in the tax policies chosen by different regions. In particular, we argue that such variations can persist and expand under tax competition,

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[17] Janeba is also able to generalize the zero-subsidy (and zero-tax) result to include cases where the firms' outputs are sold to the consumers in one of the two countries, rather than in a third country. In these cases, the country containing these consumers cares about consumers' surplus, along with tax revenue and its firm's profits.

[18] Moreover, restrictions on the use of other taxes to finance expenditures that do not directly benefit capital could leave equilibrium capital taxes higher than this level.

and their presence can be viewed as another source of wasteful inefficiency under tax competition.

6.1. Diversity and regional size

According to Bucovetsky (1991) and Wilson's (1991) analysis of "asymmetric tax competition", small regions tend to set lower tax rates than large regions, since the former have the higher capital elasticities. As a result, capital is misallocated across these regions[19]. Note, also, that there is no second-best argument here for tax rate differences. Regions differ in size only because they contain different numbers of individuals, not because these individuals differ in incomes or preferences. Despite the inefficiencies associated with different tax rates, however, a tax harmonization policy without lump-sum transfers between regions will not necessarily make both regions better off, because it removes the ability of small regions to exploit large regions by undercutting their taxes[20].

6.2. Diversity and goods trade

A more striking result is that regions that are ex ante identical will nevertheless choose different tax rates in some cases. In particular, Wilson (1987) obtains this property by extending the Zodrow–Mieszkowski model to a system of many regions that import and export two private goods. In equilibrium, some regions choose a relatively low tax rate on capital and produce the capital-intensive good, whereas other regions choose a relatively high tax rate and produce the labor-intensive good. No region produces both goods, because then a tiny reduction in its tax rate would discontinuously eliminate all production of the labor-intensive good, creating only capital-intensive production in its place. As a result, there would be a discontinuous jump in tax revenue, at almost no cost in terms of reduced wages. Once again, this diversity in tax rates is truly wasteful, since there are no ex ante differences between regions to justify it.

We should not expect the absence of a convergence in tax rates over time to reflect an absence of wasteful tax competition. Some regions "give up" on trying to attract the capital-intensive industry and instead choose high tax rates and settle for relatively high levels of public expenditures but low wage rates, whereas others do the reverse. Both types of regions are equally well off, but for different reasons.

This model is based on the Heckscher–Ohlin model from international trade, extended to include mobile capital and a public good that is financed with a tax on capital. The basis for trade in the Heckscher–Ohlin model is comparative advantage based on exogenous factor-endowment differences. In the current model, factor-endowment differences again determine trade, but they are endogenous.

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[19] In contrast to Bucovetsky and Wilson, Haufler and Wooton (1999) consider competition between two countries for a foreign-owned monopolist and conclude that the larger country "wins" the competition, because the monopolist benefits from a larger market, due to the assumed existence of transport costs in goods trade. Other models with goods trade are considered below.

[20] Harmonization issues have figured prominently in the literature on commodity tax competition. See Lockwood (1998) and Wilson (1999).

Trade theorists have posited alternative models to explain the large amounts of trade that seem not to be based on comparative advantage. In particular, models of monopolistic competition are used to explain trade in similar products between similar countries. These models are based on the existence of scale economies, and Krugman (1991) and others have extended them to investigate the tendency for industrial activity to concentrate in particular regions. This tendency depends on the importance of agglomeration forces and transportation costs.

Ludema and Wooton (2000,Kind et al. (2000) and Baldwin and Krugman (2000) have used this type of model to investigate tax competition. While there are differences in the equilibrium concepts used in these papers, they all provide examples where tax competition does not lead to equal tax rates between regions. In this case, all manufacturing locates in the "core", leaving the "periphery" with only agriculture. The advantages of agglomeration then enable the core to raise its tax rate above the periphery's rate. Baldwin and Krugman use the model to explain why, in the European economy, "it has by no means been uniformly the case that integration has led even to a narrowing of tax differentials. Tax rates have always been higher in the core than in the periphery. Only since 1978 have some faint signs of increased tax competition started to appear. However, tax rates in the core nations leveled off while periphery rates converged upward" (p. 5). Note that agglomeration economies represent an efficiency justification for locating some industries in a subset of regions. While such asymmetries complicate efficiency comparisons, there does not seem to be an efficiency role for tax competition in these models. In fact, Baldwin and Krugman argue that intervention in the form of a "tax floor" would make both the core and periphery better off. In any case, the conclusion from both Wilson (1987) and the new-geography models seems to be that we cannot use narrowing tax rate differentials as an indicator of the presence of welfare-worsening tax competition.

In addition to diversity, there is the issue of how tax competition affects the overall level of taxation. The next section deals with this issue.

7. Tax competition and economic integration

Adding goods trade to the analysis allows us to describe "economic integration" not only in terms of increased factor mobility, but also reduced transport costs in goods trade. The papers by Baldwin and Krugman (2000,Kind et al. (2000) and Ludema and Wooton (2000) all show that reduced transport costs can lead to higher taxes, over the range where these cost reductions increase agglomerative forces. Baldwin and Krugman assume a Stackelberg game, where the core region has the advantage of moving first. In contrast, the other two papers assume Nash behavior, in which case there exist problems with multiple equilibria unless some type of equilibrium refinement is employed (see Ludema and Wooton).

The point we wish to make here is that Heckscher–Ohlin trade theory also provides an explanation for why free trade may lead to higher tax rates, at least in some regions. To see this, recall that regions following condition (1), given above,

choose their public good levels to equate the marginal benefit with a measure of marginal cost that includes the cost associated with a tax-induced outflow of capital. This latter cost, given in the denominator in (1), depends positively on the elasticity of capital with respect to the tax rate. Thus, the comparison of equilibrium tax rates between economies with and without goods trade will depend to an important extent on how goods trade affects this capital elasticity. Matters are complicated by the observation that the elasticity depends not only on the substitutability between factors within industries, but also on changes in the composition of output that occurs as a region's capital tax rises. Increased goods trade affects this composition and how it changes. We next describe a case where this consideration suggests that goods trade lowers the capital elasticity, thereby putting downward pressure on a region's equilibrium tax rate.

Consider first the free-trade equilibrium in the Wilson (1987) model of many regions. This model follows the Heckscher–Ohlin setup by assuming two goods and two factors, capital and labor, but with capital treated as mobile. As described above, each region specializes in the production of one of the goods, with the low-tax region choosing the capital-intensive good. Suppose now that we eliminate goods trade, so that both goods are produced in each region[21]. To simplify the argument, suppose that the utility function takes the separable form, $u(f(c_1, c_2), g)$, where c_i is consumption of good i, g is the public good, and the function f is assumed homogeneous of degree one. We may then refer to $c_a = f(c_1, c_2)$ as "aggregate consumption". Normalizing its price to equal one, the after-tax return on capital, r, represents a "real return". A region's before-tax return is again $r + t$, and the wage and relative product prices are determined by the requirement that both industries earn zero profits.

Consider now the critical elasticity ε_K in condition (1). Under free trade, this elasticity depends on the substitutability between labor and capital in the single industry that produces within a region's borders. But with each region producing both goods in the absence of goods trade, this elasticity now depends on both factor substitutability within the two industries and the substitutability between goods in consumption, which is a property of the function $f(c_1, c_2)$. As the tax rate rises, causing the before-tax return on capital to rise, the wage rate falls and the price of the capital-intensive good increases relative to the labor-intensive good so that zero profits are maintained. Consumers, therefore, substitute away from the capital-intensive good and towards the labor-intensive good, which tends to reduce the overall capital intensity of production in the region. This latter consideration works to raise the overall elasticity of a region's capital usage with respect to the tax rate. As a result, at least the region with the relatively high tax rate under free trade can be expected to lower its tax rate when trade is eliminated. While matters are more complicated for

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[21] Strictly speaking, if goods trade is eliminated, then foreign capitalists are unable to repatriate their earnings and must, therefore, consume them where they are earned. Equivalently, we may assume that there is trade in capital and "aggregate consumption", as defined in the text, but not trade in the separate consumption goods. In either case, the model is capturing the inability of regions to alter their output patterns independently of their consumption patterns.

low-tax regions[22], it should be clear that we cannot say that economic integration in the form of increased "trade free-ness" uniformly leads to lower tax rates.

Mathematically, if high-tax regions produce good 1 under free trade (in which case Wilson, 1987, shows that good 1 is labor-intensive), then the capital elasticity takes the following form for these regions:

$$\varepsilon_K = \frac{\sigma_1}{\theta_{L1}} \tag{2}$$

where θ_{ij} is factor i's income share in industry j ($\theta_{Lj} + \theta_{Kj} = 1$), and σ_j is the elasticity of substitution between factors in industry j (measured positively). In contrast, the elimination of trade implies that both goods are produced in both regions, and the capital elasticity can then be shown to take the form,

$$\varepsilon_K = \lambda_{K1} \frac{\sigma_1}{\theta_{L1}} + \lambda_{K2} \frac{\sigma_2}{\theta_{L2}} + \lambda_{L1}\varepsilon_{L1} \left(\frac{k_2 - k_1}{k} \right) \tag{3}$$

where λ_{ij} is the physical share of a region's factor i located in industry j ($\lambda_{i1} + \lambda_{i2} = 1$), ε_{L1} is the elasticity of the industry 1's demand for labor with respect to $R = r + t$, k_j is industry j's capital–labor ratio, and k is the region's capital–labor ratio. Note, in particular, that ε_{L1} is a "derived elasticity", which includes the wage and product-price changes that accompany a rise in R, and therefore, depends on the substitutability between the different goods in resident consumption.

In contrast to (2), the first two terms on the right side of (3) are a weighted average of the capital elasticities for the two industries, holding fixed the labor devoted to each industry, i.e. these are the elasticities that the regions would face in the free-trade equilibrium. The third term represents the new consideration that arises as a result of incomplete specialization. With good 1 assumed to be labor-intensive, k_2 exceeds k_1 and ε_{L1} is positive, since a higher tax rate raises the relative price of good 2, causing consumers to demand more good 1 relative to 2. Thus, the third term is positive, verifying our claim that this "composition effect" works in favor of a higher capital elasticity.

To conclude, increased economic integration does not necessarily cause taxes to fall in all regions. Since these rates are inefficiently low in the absence of integration, it may be possible for increased integration to improve welfare, even when wasteful trade occurs. This possibility deserves further analysis.

8. Competition, redistribution, and risk: welfare enhancing or welfare reducing

A large fraction of public expenditure in modern advanced economies is devoted to policies that transfer resources, in cash or in kind, from one group to another. Sometimes,

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[22] Under free trade, these regions choose tax rates just low enough to attract the capital-intensive industry [see Wilson, 1987]. At the margin, these regions, therefore, face an infinite capital elasticity with respect to the tax rate; any higher tax rate flips domestic production from the capital-intensive industry to the labor-intensive industry. This discontinuity means that condition (1) is not valid for the low-tax regions. Without a more detailed analysis, we cannot say whether goods trade raises or lowers tax rates in these regions.

these transfers are explicitly designed to insure against specific risks, such as unemployment or illness. In other cases, they finance payments to the aged or to the poor. Agricultural subsidies, intergenerational transfers, regional development policies (including investment subsidies targeted at low-income regions), housing subsidies, and many forms of government intervention in capital markets purportedly benefit groups that are disadvantaged in some respect. These policies can be characterized as ''redistribution'' and may be viewed as the outcomes of political processes in which different groups attempt, through lobbying, voting, or by other means, to transfer resources toward themselves.

From an ex ante perspective (or from behind a veil of ignorance), on the other hand, such policies may be viewed as ''insurance'' against various risks. These ''risks'' may include the impacts on earnings in specific industries attributable to technological and demographic change, whether sudden or protracted. They may arise partly from accidents of birth, including place of birth, race, cognitive and physical ability or disability, and family wealth. Intergenerational transfers may raise the incomes of those borne in less-advanced times at the expense of subsequent generations, who are able to take advantage of better technology. All of these benefits, of course, are financed by taxes imposed on others, typically with a mix of revenue instruments including taxes on earnings, personal income, consumption, and—of particular interest for present purposes—source-based taxes on capital or the return to capital. The mobility of capital, high-income households, or other resources that are net contributors to the fiscal system can undermine the ability of governments to finance these programs of redistribution or insurance.

To see some of the potential consequences of factor mobility for redistributive policy, consider an economy where three different inputs are used in the production process, and where the government imposes a tax on one of these inputs in order to finance cash or in-kind transfers for another. As one illustrative case, these inputs might consist of capital, high-skilled labor, and low-skilled labor. As another possibility, suppose that the government subsidizes one type of capital investment, k_1 (say, agriculture or small businesses) relative to other types of capital, k_2 (say, large corporate enterprises), while homogeneous labor is a third factor of production. If all of these inputs are immobile and inelastically supplied, then this tax-transfer policy would have no allocative consequences. It would, however, raise the net return to type-1 capital while reducing the net return to type-2 capital, while leaving the return to labor unaffected. Suppose, on the other hand, that one of these types of capital-say, type-2 capital-is freely mobile, and that it can earn a net rate of return, r_2 in the rest of the world. If the local economy is small, then this redistributive policy cannot affect the net return to type-2 capital; rather, it will drive this capital out of the local economy until the local before-tax rate of return, R_2, rises sufficiently to offset the local tax. In this case, the tax-transfer policy does have real allocative consequences, but one part of its distributional impact—the reduction in the net rate of return on type-2 capital—is nullified. This tax/transfer policy would still benefit the owners of type-1 capital by financing fiscal transfers in their favor, but it would reduce the aggregate net income accruing to type-1 capital and labor by driving capital from the local economy. The precise distributional effect of this policy on local type-1 capital and labor would depend on the substitutability/complementarity relationships between the mobile and immobile resources; it is possible, but not necessary, that the policy would, on net,

harm the beneficiaries of fiscal transfers by reducing their gross income by an amount greater than any transfers they receive.

Now consider a variant on this model in which both types of capital are mobile, while labor remains immobile. A tax on type-2 capital tends to drive it out of the taxing jurisdiction, while a subsidy on type-1 capital tends to attract it. In neither case does the local redistributive policy actually redistribute real income between owners of different types of capital, since net factor returns are fixed outside of the jurisdiction. Rather, the outflow of taxed capital drives up its gross (before-tax) rate of return while the inflow of subsidized capital drives down its gross (net-of-subsidy) rate of return until net rates of return for both are restored to the same values that they would have had in the absence of the tax-transfer policy. This policy, in other words, is ineffective, in the sense that redistributive taxes and transfers cannot actually alter the real distribution of net incomes; redistributive policies merely give rise to completely offsetting changes in the gross distribution of income. The policy nonetheless does have real effects. Specifically, by influencing the equilibrium amount of taxed and subsidized resources employed within the locality, redistributive policies can harm the welfare of the owners of immobile resources—in this case, immobile workers—even if these resources themselves are neither taxed nor subsidized[23]. Redistributive policy, in a competitive environment, may thus be inefficient as well as ineffective, and the burden of resource misallocation may well fall on ''innocent bystanders'' who are only affected indirectly by the policy.

From a general-equilibrium perspective, this analysis is incomplete because it fails to take into account the impact of the outflow (or inflow) of taxed (or subsidized) capital (or other mobile resources) on the external (rest-of-the-world) economy. If the local economy is very small, the impact of its tax policy on the rate of return to taxed capital in the rest of the world will also be very small. However, as observed by Bradford (1978), even though the policies of a small local economy result in very small changes in the rates of return to mobile resources, these very small changes accrue to very large stocks of resources—namely, the worldwide stocks of mobile resources. As Bradford shows, the total impact of a small locality's taxes or subsidies on the worldwide incomes of factor owners will be of the same order of magnitude as the total amount of local taxes or subsidies. This effect will still be small in absolute terms if the locality in question is small relative to the entire world, but it is erroneous to say that it is zero. Indeed, it is apparent that the net return to a mobile resource can be affected quite significantly by a coordinated policy change—say, an increase in capital taxation—undertaken by a large number of small jurisdictions, such as a group of many small countries (or many small cities or subnational governments), precisely because such a coordinated change cumulates the small but non-zero impacts of the changes implemented in each small jurisdiction.

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[23] Let $f(k_1, k_2)$ be the value of total output in the locality, expressed as a strictly concave function of the two variable inputs, k_1 and k_2. The income accruing to immobile labor is given by $Y = f - k_1 f_1 - k_2 f_2$, assuming competitive labor markets. If t is the tax on type-2 capital and s is the subsidy on type-1 capital, the equilibrium conditions, $f_1 + s = r_1$ and $f_2 - t = r_2$ (where r_i is the external net rate of return on type-i capital), together with the government budget constraint $sk_1 = tk_2$, imply that $Y = f - r_1 k_1 - r_2 k_2$. The welfare of workers is maximized when $s = t = 0$, and any expansion of the size of redistributive programs normally reduces Y. See Wildasin (1992) for additional details.

This observation immediately raises the question of whether and how coordinated policy changes can occur. Within countries, the national government often provides an institutional framework within which the policies of subnational governments can be coordinated. For example, the administration and enforcement of state/provincial corporation income taxes is typically greatly facilitated by the existence of national-level corporation income taxes, which provides a common accounting and legal foundation for lower-level taxes. Greater uniformity of policy in its administrative dimensions certainly reduces the cost of coordination among subnational governments. Furthermore, national constitutional and policy arrangements also reduce the cost of coordination among subnational governments by providing a legal and institutional framework within which binding agreements can be made, if desired[24]. Sometimes, higher-level governments impose explicit constraints on the fiscal policies of subordinate governments, in the form of either caps or floors on rates of taxation or subsidization, which may be viewed as a form of policy "coordination", implemented through the operation of the superior government. Higher-level governments can also offer inducements, such as conditional fiscal transfers, matching grants, or revenue-sharing arrangements, to influence the tax and expenditure policies of lower-level governments. This is exemplified by some of the major redistributive transfer policies in the US. Fiscal transfers from the national government to the states in support of welfare and health care for the poor, or from the state governments to the local governments (especially in the area of education), potentially internalize some of the general-equilibrium spillover effects of redistribution at lower levels of government (Wildasin, 1991b).

In practice, explicit coordination of policy by subnational governments, in the absence of regulatory constraints or fiscal inducements from higher-level governments, appears to be difficult to implement. For example, US states vary widely in their tax treatment of corporate income, not only with respect to tax rates but with respect to the determination of taxable income itself. A far more important form of "coordination", if that is an apt term, is embodied in the policies of national governments themselves. One can, for instance, think of the US corporation income tax (which is levied at a much higher rate, and which collects far more revenue, than state-level taxes) as the principle means by which the states, or their residents, raise revenue from the taxation of corporate income. The national government, viewed from this perspective, is simply a form of contract through which lower-level governments, or their residents, achieve a policy outcome which they could, in principle, achieve through explicit interstate agreements but which is more readily achieved by delegation of authority to the national government (Wildasin, forthcoming). This perspective accords with the normative tradition in fiscal federalism that would

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[24] In the US, for example, the Multistate Tax Compact provides an institutional mechanism for states to coordinate some aspects of their policies. One main issue of coordination among the states in the sphere of corporation income taxation concerns the division of a multistate corporation's income among the states for tax purposes. The Uniform Division of Income for Tax Purposes Act is a model agreement created by the MTC which provides one possible solution to this problem. It has not, however, been widely adopted, and in fact the states exhibit wide variation in the procedures by which they determine the "sharing" of corporation income for tax purposes. For analyses of formula apportionment and related topics, see, e.g. Gordon and Wilson (1986), Edmiston (1999), Goolsbee and Maydew (1999), Nielsen et al. (2003) and Wildasin (2002).

"assign" the redistributive function of government to central rather than local government authorities. As discussed in early contributions by Stigler (1957) and Oates (1972), and others, local redistribution is likely to "fail"—i.e. to be ineffective—for the reasons described above. Their normative conclusion—that major redistributive policies should be implemented (or at least assisted) by central government authorities—matches well with the empirical reality that national rather than subnational governments in modern societies do take major responsibility for redistributive taxes and transfers.

As described above, increased mobility of capital at the international level can undermine the effectiveness, and raise the cost, of using corporation income taxes (and other taxes or subsidies on capital) as elements in the national systems of taxes and transfers that have evolved over the past century, especially in the advanced economies. Conceivably, national governments will enter into explicit or implicit agreements to maintain corporation income taxes at the levels that have prevailed in past decades. Institutions such as the Organization for Economic Coordination and Development (1998, 2000a,b) have drawn attention to the issue of international tax competition and may provide a suitable mechanism for policy coordination. Alternatively, effective coordination of redistributive policies may be achieved by "upward delegation" of national authority to supranational institutions such as the European Union (EU)—thus, for example, allowing the EU as an institution to exercise taxing powers analogous to those of the Federal government in the US. There are, of course, very substantial obstacles that stand in the way of major transfers of fiscal authority to the EU or to other supranational entities. Some EU institutions—the CAP and the structural funds—do undertake policies with significant distributional impacts, though their scale is still very modest relative to the size of national-level redistributive programs. Over time, competitive pressures among EU member states and other nations may lead them to coordinate their tax and transfer policies through explicit agreements or through the evolution of supranational institutions; such developments, if they occur, could be among the more significant policy responses to international competition for capital and other mobile resources.

As noted earlier, some government policies may be viewed either as "redistribution" or as "insurance", depending partly on the time horizon and informational context within which they are evaluated. As is well known, private insurance markets may fail to protect households from various kinds of risks because of moral hazard and adverse selection problems, and government "insurance" and "redistribution" policies are often seen as responses to these forms of market failure. If greater competition for mobile resources constrains the ability of the public sector to insure against these risks, it may impose real social costs. Furthermore, as noted long ago by Domar and Musgrave (1944), tax and other policies that pool otherwise uninsurable risks through the public sector may improve the allocation of resources between more and less risky activities (e.g. Boadway and Wildasin, 1990). Competition for mobile resources may, therefore, be harmful to social welfare (Bureau and Richard, 1997; Sinn, 1995, 1996, 1997). Whether this is the case or not depends critically on whether and how private markets fail to insure risk, and, equally important, on the way that factor mobility itself affects the magnitude and distribution of risk.

For example, suppose that a region uses immobile capital and labor in a production process that is subject to stochastic shocks (e.g. technological shocks, or variability of

output prices on external markets for traded goods) so that the value of local production $f(k, l, \theta)$, and thus total regional income, is random. Gross wage income and the gross return to capital are also stochastic, in general, although the relative degree of variability of wage and capital income depends on the precise nature of the production function and on the precise nature of the shocks. If the recipients of wage income are highly risk-averse and the recipients of capital income are risk-neutral, and if earnings are not privately insurable, then a government policy that uses taxes and transfers to smooth the incomes of wage earners, while raising the variability of capital income, can be welfare-improving. If capital now becomes freely mobile, and if shocks are uncorrelated (or at least less than perfectly correlated) across regions, the net return to capital in a small region must be state-independent (or at least less state-dependent). Favorable shocks would (typically) result in higher capital productivity and capital inflows, while adverse shocks would reduce the local stock of capital, and the variability of wage income might increase as a result. In the absence of redistributive policies, capital mobility could thus increase the social cost of income risk. At the same time, capital mobility would make it impossible to shift the risk of adverse shocks from labor to capital through tax/transfer policies; the best ex post policy for wage-earners, in favorable or unfavorable states of the world, is to have a zero tax on capital. In this case, capital mobility causes redistributive policies that reduce the social cost of risk to become ineffective and costly, and, presumably, to disappear.

While competition for a mobile factor can thus undermine social policies for managing costly risk, this conclusion can easily be reversed (Wildasin, 1995). For example, suppose that the mobility of workers (or perhaps a particular type of worker, such as skilled workers) increases. Region-specific shocks may now result in inflows or outflows of labor, reducing the riskiness of wages and thus the cost of earnings risk. While labor mobility may limit the ability of a government to insure earnings, the market itself provides insurance against earnings risk, and the ability to deploy labor in regions where it is most productive raises total output and income for the system of regions. Competition for mobile factors may thus obviate the need for some types of social insurance while raising overall productivity.

If factor mobility shifts the distribution of risks away from mobile resources and toward other (immobile) resources, the demand for private insurance may shift. Multinational corporations may be able to bundle (and perhaps to pool) regional risks, for example, so that acquisition of equity in one firm may enable investors to achieve protection from certain region-specific risks. On the other hand, regional equity markets may provide better mechanisms for investors to achieve preferred exposure to and diversification of local risks (Asdrubali et al., 1996). While diversification of local risks to immobile non-human resources (fixed capital, land, or other natural resources) can be achieved through cross-ownership of these assets, this may increase the incentive for governments to tax the returns to these assets in order to reap the gains from tax-exporting, as discussed above. In the extreme, governments could impose confiscatory taxes on the returns to any immobile resources that might accrue to non-residents, but in doing so they would destroy the incentives for non-resident ownership and thus the potential gains from diversification (Wildasin and Wilson, 1998). Changes in the riskiness of returns to different factors can also affect the attractiveness of investment and employment in different sectors and

occupations, such as the incentive to invest in human capital (Wildasin, 2000; Poutvaara, 2001).

Analysis of the interaction between factor mobility, the structure of financial markets and institutions, and their implications for both the benefits and costs of social insurance policies, is still at an early stage. The literature to date has shown, however, that the welfare implications of fiscal competition for mobile factors are likely to be ambiguous in a world with imperfect insurance markets: in such a second-best environment, factor mobility may undermine important public-sector social insurance mechanisms that help to offset market failures or, on the other hand, may help to reduce the costs of imperfectly-insured risks and thus obviate the need for (possibly imperfect and socially-costly) social insurance policies.

9. Empirical approaches

There is a huge amount of empirical work related to the issue of fiscal competition between governments, particularly when one recognizes that the literature on the Tiebout hypothesis is essentially about competition for resident households (labor) by local governments. In this section, we point out some central approaches and how they relate to the theories described in the previous sections.

Much of the literature fails to distinguish between good and bad tax competition, and so let us start by testing for any tax competition of either the Zodrow–Mieszkowski "bad" type or Leviathan "good" type. Even if we are not trying to make this distinction, a more basic problem must first be addressed: competition between governments may not involve the factor-mobility considerations that are the subject of the present paper. Instead, there may be "yardstick competition", under which voters use taxes or other fiscal variables in neighboring jurisdictions as a signal of the productivity of their own government officials. Due to this signaling effect, government officials in one jurisdiction find it desirable to respond to tax rate reductions in neighboring jurisdictions by reducing their own tax rates. This is one type of "strategic interaction" among governments that is reviewed by Brueckner (forthcoming). The basic methodology in the "strategic-interaction" literature is to estimate an equation relating fiscal variables (e.g. taxes) in one jurisdiction to fiscal variables in other jurisdictions. The problem is that a positive relation between the tax rates of competing governments tells us nothing about what form of competition is occurring. Note, also, that for the Zodrow–Mieszkowski type of tax competition, reaction curves may slope up or down. See Brueckner and Saavedra (2001), for example.

One way to distinguish between tax competition and yardstick competition would be to distinguish between different components of a government's policy vector according to their impacts on mobile factors. In fact, Besley et al. (2001) conduct such an exercise by distinguishing between taxes on relatively mobile and immobile factors. A country's tax rates on mobile factors are found to be correlated with the average tax rates on mobile factors in other countries, with this correlation highest for tax changes within the EU (where capital should be more mobile). This finding suggests the presence of tax competition, since there does not seem to be any reason

for taxes on mobile and immobile factors to behave differently under yardstick competition[25].

A second approach is to examine directly the effects of fiscal policies on factor allocations. A number of studies, for instance, have examined whether poor households move among states in the US in response to differing levels of welfare benefits. Conway and Houtenville (2001) find that the allocation of elderly households among states in the US depends on the fiscal policies of state governments. Other studies (e.g. Buettner, 2001) estimate whether the capital tax base in one jurisdiction depends on its own tax rate and on that of neighboring jurisdictions. Mintz and Smart (2001) analyze the potential for income shifting among jurisdictions by multi-jurisdictional enterprises. Bartik (1991) summarizes a large body of empirical studies that examine whether business investment depends on state and local government tax and expenditure policies. In these and other analyses, yardstick competition is potentially clearly distinguishable from competition for mobile factors because the effects of fiscal policies on spatial factor allocations are directly estimated. Of course, if jurisdictions are competing for mobile factors and if their policies are influenced by factor mobility, the policies and the factor allocations are simultaneously determined, which complicates the task of empirical analysis (see, e.g. Shroder, 1995).

Still a third approach would be to test the Keen and Marchand (1997) idea that tax competition leads to an increase in public inputs relative to public goods, since more of the former attracts capital. Yardstick competition does not seem to favor either public goods or public inputs (although perhaps a model could be constructed where this is the case, based on differences in the "observability" of goods and inputs). This approach suggests that we investigate differences in spending patterns across economies that should differ, according to theory, in the level of tax competition, such as economies that differ in the number of competing governments in a given area, or in the degree to which factors are mobile between them.

But before tackling issues related to spending or tax patterns, a more basic issue is how the total size of government varies across economies with different degrees of tax competition. Recall from our discussion of tax competition that we should expect taxes and expenditures to fall as factor mobility increases, or as the market power possessed by the competing governments declines. The work of Oates (1985, 1989) and others addresses the importance of these factors by examining the relation between various measures of the size of government and two variables: the level of "decentralization", measured by the "top-tier" government's shares of total government expenditures and revenue; and the level of "fiscal fragmentation", measured by the number of independent government units within a given area. The top-tier government ranges between studies, from national governments to county governments in the US, and the lower-tier governments similarly range widely. The motivation for these studies is that household mobility is likely to constrain governments from becoming inefficiently large, but capital mobility

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[25] As a technical point, it should be emphasized that theoretical models of strategic competition with several different types of tax and expenditure instruments become extremely complex. General results on the existence and uniqueness of non-cooperative equilibria with many fiscal instruments are so far unavailable, and the nature of best-reply relationships with multiple fiscal instruments is highly problematic. Empirical analyses may help to guide theory in determining what sorts of interactions may be important or unimportant in practice.

could also serve this role. It is intriguing that a study by Zax (1989) is significantly more successful than most other studies in uncovering a relation between government size and the levels of decentralization and fragmentation. In Zax, the top-tier governments are county governments, whereas they are state governments in Oates (1985). Presumably there is a lot more factor mobility within counties than within states. This may help explain the failure of most studies to relate cross-country variations in total tax burdens to variations in the level of decentralization[26].

Once again, the methodology employed here does not strongly distinguish between yardstick competition and tax competition. If most government expenditures are centralized, for example, then there is little or no "yardstick" for voters to use as a measure of efficiency, and so the yardstick theory also predicts bigger government. Again, studies that disaggregate different types of expenditures or taxes may be helpful here.

In addition to examining economies that differ in decentralization or fragmentation dimensions, another approach is to investigate how countries or jurisdictions within a country differ in their fiscal policies. Recall from our discussion of asymmetric tax competition that large countries or jurisdictions tend to have relatively high tax rates and expenditure levels. But Leviathan models suggest a similar relation. More generally, the literature does not suggest that we should see tax rates converging in any sense, although Slemrod (2001) has found this to be the case for countries in the time period 1985–1995.

Where does this leave us with distinguishing between good and bad tax competition? If "good" is defined in terms of efficiency criteria, then good tax competition either corrects distortions that would otherwise exist in the private or public sectors, or it optimally allocates factors of production across locations. On the latter issue, we have noted that factors should be taxed according to their marginal costs. This suggests that we should examine whether governments actually follow this tax rule. As previously discussed, these marginal costs may be sizable. In this case, efficient competition for mobile capital would drive the tax rate per unit of capital to a level equal to the amount of public expenditure per unit of capital, which could be substantially greater than zero[27]. If, however, competition drives the tax rates on mobile capital substantially lower, then this is a sign of welfare-worsening tax competition. Slemrod (2001) finds a positive and significant relation between the extent of electrification in a country and its statutory corporate tax rate, suggesting some use of the tax system to marginal-cost price.

Turn now to theories of tax competition based on the view that this competition is correcting some pre-existing distortion. In Leviathan models, this correction consists of additional incentives for government officials to reduce waste in government. We have already noted that the empirical implications of these models are virtually indistinguishable from the implications of the standard models of welfare-reducing tax competition. But Parry (2003) essentially questions the importance of distinguishing between these models. He examines the possible magnitude of the welfare effects of tax competition in a model that generalizes the Zodrow–Mieszkowski model by allowing for Leviathan behavior. In

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[26] For a recent study and additional references, see Anderson and Van den Berg (1998).
[27] Moreover, restrictions on the use of other taxes to finance expenditures that do not directly benefit capital could leave equilibrium capital taxes higher than this level.

particular, he allows government officials to care not only about the welfare of residents, but also about tax revenue per se. Extending the analysis of Wildasin (1989), he identifies production and preference parameters (including local demand/substitution elasticities for capital and for local public goods), numbers (or size) of jurisdictions, and the potential magnitude of Leviathan behavior. Although the introduction of Leviathan behavior produces a wide range of outcomes, with taxes and spending either too low or two high, the welfare losses from tax competition appear to be quite modest over a range of values of relevant parameters. Sorensen (2000, 2001) also finds that the welfare losses from tax competition are modest, at least if one restricts attention to competition among a group of countries (the EU, for instance) that constitute only a portion of the totality of all jurisdictions. It is not clear, however, whether similar results hold for the other types of models that we have considered.

In the divided government model from Section 4, the pre-existing distortion is waste in government, rather than excessive government size. As noted there, this theory provides a possible explanation for the difficulty empirical work has encountered in identifying a relation between tax competition and the size of government. While an increase in tax competition leads to less waste in government, it also raises consumer demands for public goods and services, since their effective marginal costs are reduced. As a result, the total size of government may expand.

Other models show that tax competition leads to higher taxes (or lower subsidies) on mobile factors or firms. In the Janeba (1998) model, for example, the distortion corrected by tax competition is wasteful competition in ''strategic trade policies''. In other words, tax competition acts as a substitute for export-subsidy competition, leading to an elimination of wasteful export subsidies.

Not only may increased factor mobility lead to higher taxes, but we have also seen that lower transport costs in goods trade may have the same effect, in both models with agglomerative economies and models based on Heckscher–Ohlin trade theory. In both cases, higher taxes have the potential to be welfare-improving. The difficulty that Slemrod (2001) encounters in identifying empirically an association between corporate tax rates and the degree to which a country has open trade is consistent with the lack of a clear theoretical consensus that freer trade leads to lower taxes.

Pre-existing distortions can also take the form of the economy's imperfect handling of risk. In the discussion of risk, redistribution, and insurance in Section 8, we saw that factor mobility may increase or decrease the riskiness of different types of income. Empirical analyses like that of Asdrubali et al. (1996) suggest that integration of factor markets may lead to significant amounts of risk pooling, thereby presumably mitigating market imperfections, but also reducing the potential benefits of social insurance policies which in practice may introduce important distortions of their own. On the other hand, mobility of some factors, like capital, may increase the riskiness of income from other factors, like labor, and the social cost of earnings risk may well be substantially higher than the cost of capital-income risk; if so, perhaps factor market integration may exacerbate market imperfections, even as it limits the capacity of governments to institute policies that offset them. In this regard, one should note the positive empirical relationship between openness to trade and the size of the public sector, as discussed by Rodrik (1998). One impact of freer trade may be to increase earnings risk, giving rise to greater demands for social

insurance and regulatory policies (see also Agell, 1999, 2000). If these policies are undermined by factor mobility, fiscal competition may be harmful; moreover, in a political-economy context, it may create pressures for more restrictive trade policies that help to insulate domestic factor markets from the income risks associated with freer trade. This is a potentially interesting topic for future research.

Finally, while most of the theoretical literature on fiscal competition focuses on static or long-run equilibrium policies, empirical research will naturally investigate changes in policies over time. For example, Slemrod (2001) and Devereux et al. (2001b) both find evidence that various measures of corporate tax rates have declined over time. Explicit theoretical modeling of the dynamics of factor mobility and of policy adjustment, neither of which can realistically be assumed to be instantaneous, would be helpful in guiding and interpreting such empirical analysis. For example, if capital and labor adjustment is gradual, the effects of institutional and technological changes that reduce barriers to factor mobility, such as various liberalizing initiatives of the EU or innovations in communications and information technology, would not result in immediate movements to a new long-run equilibrium allocation of capital and labor. Factor stocks may be perfectly mobile in the long run but only imperfectly mobile in the short run, and the desired fiscal treatment of these factors depends, in general, on the speed with which factor adjustments occur (Wildasin, forthcoming).

10. Concluding remarks

This study has reviewed both the good and bad aspects of tax competition. Several cases have been uncovered where tax competition is welfare-improving. Whereas some of these models share the same prediction of lower tax rates with models of welfare-worsening tax competition, several other models suggest that increased tax competition, through greater fiscal fragmentation or lower impediments to capital mobility, can lead to higher tax rates. The analysis of welfare-improving tax competition is still in its infancy, however. More work is needed to incorporate reasonable political processes into tax competition models, leading to sharper empirical distinctions between good and bad tax competition.

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