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The Effects of Tax Competition When Politicians Create Rents to Buy Political Support

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Abstract

We set up a probabilistic voting model to explore the hypothesis that tax competition improves public sector efficiency and social welfare. In the absence of tax base mobility, distortions in the political process induce vote-maximising politicians to create rents to public sector employees. Allowing tax base mobility may be welfare-enhancing up to a point, because the ensuing tax competition will reduce rents. However, if tax competition is carried too far, it will reduce welfare by causing an underprovision of public goods. Starting from an equilibrium where tax competition has eliminated all rents, a coordinated rise in capital taxation will always be welfare-improving. For plausible parameter values it will even be welfare-enhancing to carry tax coordination beyond the point where rents to public sector workers start to emerge.

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THE EFFECTS OF TAX COMPETITION WHEN POLITICIANS CREATE RENTS TO BUY POLITICAL SUPPORT

Wolfgang Eggert and Peter Birch Sørensen

1. Tax competition and Leviathan

The globalisation of economic activity has sharpened the international debate on the costs and benefits of tax competition. Critics argue that such competition will lead to an underprovision of public goods as governments undercut each others' tax rates in an attempt to attract mobile tax bases. The theoretical foundations for this view were laid by Oates (1972), Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1989) and Janeba and Peters (1999), among others. In the opposite camp it is argued that tax competition helps to reduce government waste and to discipline rent-seeking politicians and bureaucrats. According to Public Choice theorists such as Brennan and Buchanan (1977, 1980), government is an ever-expanding Leviathan that needs to be tamed, and one way of 'starving the beast' is to allow interjurisdictional competition for mobile tax bases.[1]

This sceptical view of government which welcomes tax competition seems to have gained ground in recent years. A popular version of the argument that tax competition increases public sector efficiency assumes that self-serving politicians and bureaucrats are somehow able to divert the taxpayer's money away from uses that benefit the general public and into uses that are pure waste from society's viewpoint. It is then argued that tax competition hampers this diversion of resources away from beneficial public use, since growing mobility of tax bases raises the marginal cost of public funds, thereby hardening voter resistance to government waste. For example, the World Bank (2004, p. 53) vividly argues that decentralization 'permits a degree of institutional competition between centers of authority that can ... reduce the risk that governments will expropriate wealth'.

Edwards and Keen (1996) attempted to synthesize the conflicting views on tax competition. In their analysis politicians maximise an objective function of

[1] This argument for tax competition is very different from those offered in the classical contributions by Hayek (1939) and Tiebout (1956). Tiebout did not assume a Leviathan government, but argued that fiscal competition would allow mobile households to locate in those jurisdictions that offered their most preferred level and mix of public services.

the form $V(R, U)$, where R is the rent appropriated by the politicians themselves (which is modelled as pure waste), and U is the welfare of the representative citizen. Thus politicians trade off the interests of voters against rents to themselves. Combining this objective function with a standard model of tax competition where the marginal source of public funds is a source-based tax on mobile capital, Edwards and Keen demonstrated that tax competition will have two offsetting effects on consumer welfare. On the one hand it will tend to raise welfare by reducing the volume of rents appropriated by politicians. On the other hand it will tend to cause an underprovision of public goods by raising the marginal cost of public funds. On balance, Edwards and Keen found that if the elasticity of the tax base with respect to the tax rate is lower than the politicians' marginal propensity to spend public funds on 'waste', tax competition will be preferable to tax coordination, and vice versa.

Several other authors including Oates and Schwab (1988), Fuest (2000), Rauscher (2000), Eggert (2001), Keen and Kotsogiannis (2003), Sato (2003), Wilson and Gordon (2003) and Wilson (2005) have analysed the effects of tax competition in Leviathan models where policy makers appropriate part of the tax revenue for their own purposes. Janeba and Schjelderup (2002) have studied how tax competition affects the ability of politicians to appropriate rents under alternative political institutions, and Besley and Smart (2007) have investigated the effects of various constraints on fiscal policy (including tax competition) when imperfectly informed voters face the challenge of distinguishing Leviathan-type politicians from benevolent political candidates. Whereas these contributions have tended to find that tax competition may play an efficiency-enhancing role, Cai and Treisman (2005) show in a Leviathan type model with asymmetric regions that tax competition may actually generate more government 'waste' in poorly endowed regions.

While all of these studies have generated valuable insights, the positive and normative analysis of public policy in traditional Leviathan models has several problematic features. First, the modelling of rents as pure waste goes against the fundamental normative principle that the welfare of all citizens (including rent-seekers) should be allowed to count in the social welfare function. Second, in Leviathan models rent creation typically reduces political support for the policy maker because rents are achieved at the expense of the welfare of voters. This may be a reasonable way of modelling the kind of rent-seeking that takes the form

of unnecessary and wasteful luxury for top government officials, but in most western democracies this type of rent is probably of minor quantitative importance relative to total income. Instead it appears that rents are typically created with the purpose of obtaining political support from the recipients. Thus, whereas the Leviathan literature assumes that rent creation always *reduces* the policy maker's political backing, it seems more realistic to assume that rents are generated because they *increase* the likelihood that those responsible for creating them will remain in government office.[2] Third, a variable such as the fraction of public revenue that is wasted - which plays a crucial role in the Leviathan literature - is not very operational from an empirical perspective. The concept of government waste is very subjective; what seems waste to one person may be a useful government activity in the eyes of another person. To be able to subject political economy models of tax competition to empirical testing, it seems desirable to develop measures of 'political distortions' that are more objective and hence easier to identify empirically.[3]

In this paper we present a political economy framework allowing an analysis of the effects of tax competition and tax coordination on rent seeking and social welfare in a setting where rents are created as part of a political strategy to maximise the probability of winning the election. Instead of considering rents as pure waste, we thus treat them as a means of redistributing income in favour of politically influential groups. Our model allows for a political distortion in favour of public sector workers, say, due to the existence of strong public sector trade unions. As an empirical matter, we do not actually postulate that public sector employees always have a disproportionate influence on the political process,

[2] Ansolabehere and Snyder (2006) provide evidence from the United States that governing political parties at the state level do in fact skew the distribution of public funds in favour of areas that provide them with the strongest electoral support.

[3] In an interesting recent paper Angelopoulos et al. (2006) incorporate rent-seeking into an otherwise standard Dynamic Stochastic General Equilibrium model of the European economies. The calibrated version of this model allows an estimate of the fraction of time spent on unproductive rent-seeking activities aimed at diverting public revenues into private hands. In the model of Angelopoulos et al. this fraction turns out to be large. However, as the authors recognize themselves, the ability of a standard DSGE model to generate realistic employment fluctuations (with a plausible labour supply elasticity) is improved whenever one introduces a third use of time in addition to leisure and market work. In the authors' model rent-seeking represents such a third use of time, but a similar improvement in the model's ability to fit the data might have been achieved by introducing another alternative use of time such as home production (see, e.g., Greenwood et al. (1995)).

but we explore the implications of this assumption because it is implicit in the reasoning of many advocates of tax competition.

Our study offers a synthesis of the traditional Public Finance view of tax competition and the view of the Public Choice school by embedding a probabilistic voting model of the type proposed by Persson and Tabellini (2000, ch. 3) in a tax competition model similar to the one used by Edwards and Keen.[4] In our model the often vague concept of 'political distortion' has a very precise meaning. Our indicator of the degree of political distortion depends on the size of the public sector lobby and on the relative political influence of an individual lobby member, measured by the derivatives of the voting function maximised by politicians. The greater the sensitivity of voting behaviour to a change in economic benefits offered to a lobby member, the greater is his political influence relative to the influence of a voter outside the lobby.[5]

In our framework tax competition is a powerful institutional device which may completely wipe out rents to public sector workers, but only at the cost of an underprovision of public goods. Unlike the Leviathan literature, this paper offers a theory of the 'political transmission mechanism' through which tax competition leads to reduced rent creation as well as reduced public goods provision. In our set-up politicians may capture more votes from public sector workers by paying them higher wages, and they may also attract votes by creating additional high-paying public sector jobs. At the same time politicians may gain votes by offering higher private consumption opportunities through lower taxes. In political equilibrium, political candidates strike a balance between these competing ways of gaining votes, accounting for the government budget constraint. When tax competition is allowed, the amount of private consumption that must be sacrificed to raise

[4] Our paper may also be seen as an extension of some ideas in Wilson (1989) who studies optimal constraints on the tax base in a world where the tax rate is controlled by a policy maker who diverts resources from spending on public goods towards a favoured group of consumers. Such behaviour by the policy maker could be interpreted as an attempt to buy votes from an influential interest group, but unlike us, Wilson (op.cit.) does not explicitly model the political process, and he does not consider the effects of tax competition.

[5] To limit the scope of the paper, we do not consider whether tax competition leads to less corruption and whether it can be used to generate valuable information to voters. Much empirical work on the efficiency effects of fiscal federalism has focused on the relationship between fiscal decentralisation and corruption. In a cross-country panel study using the International Country Risk Guide's corruption index, Fissman and Gatti (2002) find a significant negative relationship between corruption and decentralization. Huther and Shah (1998) obtain similar results using similar indicators of corruption constructed by the World Bank.

a unit of tax revenue goes up, so financing the public sector wage bill becomes costlier in economic and political terms. The vote-maximizing political strategy will then involve lower rents to public sector workers and fewer public sector jobs (and hence less public service provision).

A main point in this explanation of the impact of tax competition on the political equilibrium is that the public sector workers earning rents are part of the voting population, so a cut in rents comes at a cost to vote-maximizing politicians. Obviously, this political cost arises from the fact that the fall in rents induced by tax competition reduces the utility of public sector workers. By recognizing this, our framework allows us to identify an optimal degree of tax competition, accounting for the welfare of all citizens. The standard Leviathan models of tax competition are unsuited for this purpose because they postulate that rents do not generate welfare for any citizen, and because they do not account for the fact that tax competition - by changing the size of the public sector - will also change the composition of the voting population, thereby affecting the political equilibrium and the distribution of welfare.

Qualitatively, tax competition affects social welfare through three different channels in our model: 1) By driving a wedge between the marginal rate of substitution and the marginal rate of transformation between public and private goods, it tends to reduce aggregate welfare. This is the welfare-reducing effect of tax competition emphasized in the literature assuming that policy is made by a benevolent social planner. 2) By reducing rents to public sector workers, tax competition equalizes the marginal rate of substitution between public and private goods across private and public sector workers. Ceteris paribus, this results in an outward shift of the utility possibility frontier which tends to increase social welfare. 3) By curbing rents to public sector workers, tax competition also equalizes the marginal utility of income for all citizens. In a society concerned about equality, this likewise tends to increase social welfare. By including the mechanisms 2) and 3), our analysis accounts for both of the standard criticisms against rent-seeking, i.e., the objections that it inefficient as well as unfair.

We first consider the case where governments non-cooperatively choose the level of capital taxation, public sector rents and employment. We show that an increase in tax base mobility will initially tend to be welfare-increasing, but beyond a certain point which depends inter alia on the political strength of the public sector lobby, a further increase in tax base mobility will reduce welfare

as the underprovision of public goods becomes more serious. In a quantitative version of the model we trace the impact of increasing the number of competing tax jurisdictions and rank different scenarios in welfare terms to identify the economic and political conditions under which tax competition is preferable to autarky. Our findings suggest that tax competition is a badly targeted remedy against political distortions.

We then analyze the effects of international tax coordination on social welfare. When individual countries are too small to affect the world interest rate, some amount of international tax coordination will be welfare-improving under very mild conditions. Indeed, we find that it may be welfare-enhancing to carry tax coordination beyond the point where rents to public sector workers start to emerge.

In section 2 we set up our model. Section 3 analyses how the political equilibrium is influenced by tax competition while section 4 studies how international tax coordination affects rent seeking and social welfare. Section 5 summarises our main conclusions, and three technical appendices document the results reported in the text.

2. The model

We consider a world economy consisting of n symmetric countries. Residents in each country can either work in the private or in the public sector, and they consume private goods as well as a pure public good. Labour is the only input into the production of the public good, while private goods are produced by means of capital and labour. Capital is perfectly mobile across countries, whereas labour is immobile internationally. There are no international spillovers from the supply of public goods, but since public expenditure is financed by a source-based tax on capital, there is a fiscal externality arising from interjurisdictional competition for the mobile tax base. All countries produce the same good, so national tax policies have no effects on the commodity terms of trade.

Politicians choose the level of taxation, the level of public service provision and the public sector wage rate with the purpose of maximising the probability of being voted into office. Voters are split into a group of well-organised 'insiders' employed in the public sector and a group of non-organised 'outsiders' mainly employed in the private sector. By increasing the economic welfare of the members of a

particular group, politicians can increase the expected number of votes from that group. The model enables us to specify the exact conditions under which rents to public sector employees will arise. A central issue to be explored is whether tax competition will tend to reduce such rents and move public sector employment closer to its socially optimal level.

Below we present the details of the model.

2.1. Tastes and technology

We use the subscript g for variables relating to a government sector employee and the subscript p for variables referring to a private sector employee. All agents have identical preferences with respect to consumption (but not with respect to non-economic aspects of public policy, see sec. 2.4), and the total economic welfare U_j of a worker employed in sector j is

$$U_j = u\left(C_j\right) + g\left(G\right), \qquad j = g, p; \tag{2.1}$$

$$u' > 0, \qquad u'' < 0, \qquad g' > 0, \qquad g'' < 0,$$

where C_j is private consumption and G is the non-rival consumption of the public good. Note that since individual working time is assumed to be institutionally fixed, there is no need to allow for the disutility of work in the utility function (2.1).

The total population and labour force is normalised to unity and the fraction of the labour force employed in the public sector is denoted by α, $0 < \alpha < 1$. Total capital input into private sector production is $(1-\alpha)\,k$, where k is the capital-labour ratio, and the total output of private goods (Y) is given by the linearly homogeneous production function

$$Y = F\left(\left(1-\alpha\right)k, 1-\alpha\right), \tag{2.2}$$

implying that the average productivity of a private sector worker is

$$y \equiv \frac{Y}{1-\alpha} = F\left(k, 1\right) \equiv f\left(k\right), \qquad f' > 0, \qquad f'' < 0. \tag{2.3}$$

The public good is produced by a simple linear technology with labour as the only input:

$$G = \alpha. \tag{2.4}$$

At the start of the period considered, each country in the world is endowed with a fixed total capital stock $\overline{k}$. All countries are assumed to be symmetric, with identical labour forces, capital endowments, tastes and technologies.

2.2. The first-best allocation

For later reference it will be useful to characterize the first-best allocation of resources in our simple world economy, assuming that the social planner in the representative country wishes to maximise the utilitarian social welfare function

$$SW = \alpha \left[u \left(C_g \right) + g \left(\alpha \right) \right] + \left(1 - \alpha \right) \left[u \left(C_p \right) + g \left(\alpha \right) \right]. \tag{2.5}$$

One condition for global optimality is global production efficiency which requires that capital's marginal product be equalized across countries. With identical countries this is achieved when investment in each country equals the country's fixed capital endowment. Hence optimality is attained when the social welfare function (2.5) is maximised with respect to C_g, C_p, and α, subject to the resource constraint

$$\alpha C_g + \left(1 - \alpha \right) C_p = F \left(\overline{k}, 1 - \alpha \right). \tag{2.6}$$

Denoting the marginal product of private sector labour input by F_L, the first-order conditions for the solution to this problem can be shown to imply

$$u' \left(C_g \right) = u' \left(C_p \right) \quad \Longrightarrow \quad C_g = C_p = C, \tag{2.7}$$

$$\frac{g' \left(\alpha \right)}{u' \left(C \right)} = F_L \left(\overline{k}, 1 - \alpha \right). \tag{2.8}$$

Equation (2.7) states that private consumption levels must be equalized so as to equalize the marginal utility of consumption across the two groups of workers. This condition may be said to reflect policy concerns about equity. Equation (2.8) is the Samuelson condition for the optimal supply of public goods, stating that the sum of the marginal rates of substitution between private and public goods should equal the marginal rate of transformation (recall that the total population

is normalised to unity, so the left-hand side of (2.8) is the sum of the marginal rates of substitution). Clearly, (2.8) captures policy concerns about efficiency.

We will now study whether the market-based allocation will differ from this first-best optimum.

2.3. The market economy

Competitive profit-maximising firms invest up to the point where capital's marginal product equals the cost of capital, implying

$$f'(k) = r + \tau, \tag{2.9}$$

where r is the after-tax interest rate and τ is a source-based unit tax on capital. From (2.9) it follows that capital intensity is given by

$$k = k(r + \tau), \qquad k' = 1/f'' < 0. \tag{2.10}$$

Moreover, (2.9) and the linear homogeneity of the production function imply that the private sector real wage (w) is

$$w(r + \tau) = f(k(r + \tau)) - (r + \tau)\, k(r + \tau), \qquad w' = -k. \tag{2.11}$$

Capital is perfectly mobile across countries. With source-based capital taxation, this means that all the n countries in the world face the same after-tax interest rate r. A global capital market equilibrium is attained when

$$(1 - \alpha)\, k(r + \tau) + (n - 1)(1 - \widehat{\alpha})\, \widehat{k}(r + \widehat{\tau}) = n\overline{k}, \tag{2.12}$$

where $(1 - \alpha)\, k(r + \tau)$ is capital demand in the domestic country under consideration, and $(1 - \widehat{\alpha})\, \widehat{k}(r + \widehat{\tau})$ is capital demand in each of the $n - 1$ identical foreign countries. Thus the left-hand side of (2.12) measures the global demand for capital which must equal the fixed global capital supply, $n\overline{k}$. By implicit differentiation of (2.12) we may find the isolated effects of domestic tax and spending policies on

the after-tax interest rate, exploiting the symmetry assumption that all countries end up choosing the same policies in equilibrium:[6]

$$\frac{\partial r}{\partial \tau} = -\frac{(1-\alpha)\,k'}{(1-\alpha)\,k' + (n-1)\,(1-\widehat{\alpha})\,\widehat{k}'} = -\frac{1}{n}, \tag{2.13}$$

$$\frac{\partial r}{\partial \alpha} = \frac{k}{(1-\alpha)\,k' + (n-1)\,(1-\widehat{\alpha})\,\widehat{k}'} = \frac{k}{n\,(1-\alpha)\,k'}. \tag{2.14}$$

When choosing their fiscal policy platforms, politicians account for these policy effects on the interest rate.

To focus on the potential conflicts of interest between private and public sector employees, we assume that capital endowments are equally distributed across the working population. Recalling that the total labour force is normalised at unity, this means that each worker owns the amount of capital $\overline{k}$. Denoting the public sector wage rate by W, the private consumption of the two types of workers is then given by

$$C_g = W + r\overline{k}, \qquad C_p = w + r\overline{k}. \tag{2.15}$$

2.4. The political economy of fiscal policy

The policy variables in our model are W, G and τ. We wish to provide a simple framework in which these variables are chosen by politicians competing for votes. Inspired by Persson and Tabellini (2000, ch. 3), we describe the political process by a probabilistic voting model with lobbyism. In our particular version of this model, voters are split into 'insiders' and 'outsiders'. The insiders are all employed in the public sector and all belong to a lobby (say, a trade union) which enforces the wage rate W throughout the public sector in order to prevent underbidding from outsiders. The outsiders are those voters who do not belong to the lobby. These individuals are employed either in the public or in the private sector. Thus the 'marginal' workers in the public sector are outsiders although they are paid the same wage as the insiders. As we shall see below, in the absence of tax competition the public sector wage rate will generally exceed the private sector wage. The marginal high-paying public sector jobs that are not already filled by the insiders are allocated to some of the outsiders. Flexible wage adjustment in

[6] The symmetry assumption implies that $\alpha = \widehat{\alpha}$ and $\tau = \widehat{\tau}$ in equilibrium so that $(1-\alpha)\,k'\,(r+\tau) = (1-\widehat{\alpha})\,\widehat{k}'\,(r+\widehat{\tau})$.

the private labour market ensures that those outsiders who do not get a public sector job are all able to find private sector employment.

Our categorization of public sector workers into insiders and outsiders is motivated by the observation that some groups of civil servants are often employed on long-term contracts providing a high degree of job security whereas other public sector workers are appointed on short-term contracts offering less job protection. Our distinction between public sector insiders who have full job security and the marginal public sector workers who can easily be dismissed captures this observed difference in the terms of employment in a stylised way. Note that the stronger attachment of insiders to the public sector could explain why this group has formed a lobby to protect their interests whereas the marginal workers with a looser link to the public sector do not enter the lobby.

Visser (2006) documents that public sector workers in the OECD area are in fact better organised than workers in the private sector, as reflected in a much higher degree of unionisation in the public sector. Our assumption that only public sector insiders have formed a lobby seeks to capture this marked difference across sectors in a simple way. Whether the higher union density implies that public sector workers actually earn rents is ultimately an empirical issue. As we show in Appendix 1, if private sector workers are a very tightly knit group in terms of ideological preferences, they could be politically more influential than public sector workers even if they have not formed a lobby. However, the probabilistic voting model considered below does imply that public sector workers generally earn rents under autarky. Our assumption that (organised) public sector voters constitute a strong interest group capable of extracting rents is made because it seems to be implicit in the reasoning of many of those who advocate tax competition as a remedy against rent seeking.[7] Our purpose is to investigate whether fiscal competition could indeed be an appropriate means of curbing an excessive political influence of public sector workers. While we do not wish to pass a verdict on whether such an excess influence actually exists, we note that

[7] If private sector workers were politically more influential than those employed in the public sector, the model set up below implies that an unconstrained political candidate would ideally want to keep the public sector wage rate below that in the private sector in order to keep taxes low. However, this scenario would not illustrate the interdependence between public sector rents and tax competition which is the focus of the present paper. Moreover, with flexible wage adjustment preventing involuntary unemployment in the private sector, the public sector would face a recruitment problem if it offered a lower wage rate than the private sector.

most of the empirical studies surveyed by Bender (1998) do find a positive central government-private sector wage differential in the U.S. and Western Europe.[8]

Let us now describe the details of the political process, drawing heavily on the framework proposed by Persson and Tabellini (2000, sec. 3.5). There are two political parties (A and B) competing for government office. Each party chooses a fiscal policy package consisting of a level of public service provision, a public sector wage rate and a capital tax rate. The two parties differ in some 'ideological' dimension and voters have different individual preferences regarding this non-economic aspect of policy. Let U_i^P denote the economic welfare of a public sector insider in case the policy of party P is implemented, $P = A, B$. An individual member j of the public sector insider lobby will then vote for party A if

$$U_i^A > U_i^B + \rho_i^j + \widetilde{\omega}, \tag{2.16}$$

where ρ_i^j is an individual ideological bias in favour of party B, with zero mean value across all lobby members, and $\widetilde{\omega}$ is a general (stochastic) ideological preference in favour of that party, capturing any underlying political mood affecting all voters. Similarly, if U_o^P is the expected economic welfare of an outsider in case party P's economic policy is implemented, voter v in the group of outsiders will prefer party A if $U_o^A > U_o^B + \rho_o^v + \widetilde{\omega}$. The general ideological bias is assumed to be given by

$$\widetilde{\omega} = \omega + h \cdot (\alpha_i Z_B - \alpha_i Z_A), \qquad h > 0, \qquad 0 < \alpha_i < 1. \tag{2.17}$$

Here ω is a stochastic term with mean zero, Z_P is the public sector lobby's campaign effort in support of party P, measured per member of the lobby, and α_i is the predetermined fraction of voters belonging to the lobby so that $\alpha_i Z_P$ is the total lobby support for party P. The campaign effort could take the form of

[8] Falch and Strøm (2005) also find evidence from Norway that various indicators of the political strength of public sector employees have a positive impact on public sector wage rates. However, these authors do not investigate whether public sector workers are generally better paid than corresponding groups of workers in the private sector.

Whether public sector workers earn rents is an issue that is probably hard to settle. In our model rents take the form of a relatively high public sector wage rate, but the wage rates in the model should be interpreted as wages *per unit of effort* for wage differentials to be an appropriate indicator of rents. Thus, even if empirical studies were to reveal that public sector wage rates do not exceed the wages for similar groups of workers in the private sector, this would not necessarily imply the absence of rents in the public sector.

lobby officials working in the political campaign.[9] According to (2.17), the more the campaign effort in support of party B exceeds the effort in favour of party A, the stronger is the voter bias in favour of party B on election day. We assume that campaign efforts cannot be negative, i.e. the lobby cannot extract real resources from politicians, only political concessions. Let p_A denote the probability that party A wins the election so that $1 - p_A$ is the probability that party B carries the election day. Lobby officials choose their campaign efforts to maximise the following objective function (L), representing the lobby members' expected utility from the election outcome, net of the cost of lobby effort:

$$L = p_A U_i^A + (1 - p_A) U_i^B - \frac{1}{2}\left(Z_A^2 + Z_B^2\right) \tag{2.18}$$

The negative third term in (2.18) assumes convex costs of campaign efforts, reflecting increasing marginal disutility of effort. Note that the individual ideological preferences have cancelled out in the lobby's objective function, since the preference variable ρ_i^j has zero mean value and the lobby maximises the average utility of its members.

The timing of political events is as follows: 1) Each party announces a fiscal policy package, taking the number of insiders and the policy platform chosen by the other party as given. 2) Lobby officials choose their campaign efforts. 3) 'Nature' chooses the value of the stochastic voter preference variable ω. 4) Elections are held. 5) The pre-announced policy of the winning party is implemented, and the 'marginal' public sector jobs are allocated among outsiders (by a proces to be specified below). For simplicity we assume that the individual ideological preferences ρ_i^j and ρ_o^v follow an identical uniform distribution and that the general ideological preference variable ω is uniformly distributed on the interval $\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right]$. On these assumptions Appendix 1 demonstrates that the optimal campaign efforts are

$$Z_A = \max\left[0, \alpha_i \psi h\left(U_i^A - U_i^B\right)\right], \qquad Z_B = \max\left[0, \alpha_i \psi h\left(U_i^B - U_i^A\right)\right]. \tag{2.19}$$

[9] The Z_P-variables could also be interpreted as monetary campaign contributions. The exact interpretation is unimportant since Z_P will be zero in political equilibrium, as we demonstrate below.

Thus the lobby will only support a party that offers its members a higher level of economic welfare than the other party. Moreover, Appendix 1 shows that the probability that party A will win the election is

$$p_A = \frac{1}{2} + \alpha_i p_i \cdot \left(U_i^A - U_i^B\right) + (1 - \alpha_i)\, p_o \cdot \left(U_o^A - U_o^B\right), \tag{2.20}$$

$$0 \leq \alpha_i < 1, \qquad p_i = \psi + \alpha_i \psi^2 h^2, \qquad p_o = \psi.$$

In other words, the greater an insider's economic welfare implied by the policy of party A, the greater is the likelihood that he will vote for that party, given the economic policy package offered by party B. In a similar way, party A can increase its voter support from outsiders by choosing a fiscal policy platform that increases the (expected) economic welfare of members of that goup of voters.

Maximisation of p_A, given U_i^B and U_o^B, gives party A's best response to the policy chosen by party B. The latter party faces the symmetric problem of maximising $1 - p_A$, yielding similar first-order conditions and an identical best-response function. In Nash equilibrium the two parties therefore end up choosing the same fiscal policy platforms implying $U_i^A - U_i^B = 0$, so according to (2.19) the public sector lobby will not want to offer any campaign contributions in political equilibrium.[10] Thus the political influence of the lobby derives from the *potential* rather than from the *actual* political support that it offers.

The economic welfare of an insider is simply equal to the utility of a public sector worker (U_g), that is, $U_i = U_g = u\left(W + r\overline{k}\right) + g\left(G\right)$ (since both parties choose the same policy in equilibrium, we no longer attach party superscripts to any variables). The expected economic welfare of an outsider, U_o, depends on the probability that he will be able to get one of the high-paying public sector jobs that have not already been reserved for the lobby insiders. For simplicity we assume that all outsiders face the same probability of getting one of the marginal public sector jobs, as if these jobs were allocated by a lottery. The total number of public sector jobs is α of which $\alpha_i < \alpha$ are reserved for the lobby members. Hence $(\alpha - \alpha_i)$ is the number of public sector jobs offered to outsiders, and $1 - \alpha_i$ is the number of outsiders competing for those jobs. Thus, at the time of voting,

[10] This is why our model specification in section 2.3 did not explicitly allow for lobby activities as one possible use of the economy's resources.

$(\alpha - \alpha_i) / (1 - \alpha_i)$ is the probability that an outsider will gain access to a public sector job, so the *expected* utility of an outsider is

$$\begin{aligned} U_o &= \left(\frac{\alpha - \alpha_i}{1 - \alpha_i}\right) U_g + \left[1 - \left(\frac{\alpha - \alpha_i}{1 - \alpha_i}\right)\right] U_p \\ &= \left(\frac{\alpha - \alpha_i}{1 - \alpha_i}\right) u\left(W + r\overline{k}\right) + \left[1 - \left(\frac{\alpha - \alpha_i}{1 - \alpha_i}\right)\right] u\left(w + r\overline{k}\right) + g\left(G\right) \end{aligned} \tag{2.21}$$

where we recall that U_p is the utility of a private sector employee and that those outsiders who do not get a public sector job (the number of which is $1 - \alpha$) all end up finding employment in the private sector, due to flexible adjustment of the private sector wage rate w.

When choosing a fiscal policy package (W, G, τ), politicians face the technological and market constraints (2.4), (2.13) and (2.14) plus the government budget constraint which requires that the revenue from capital taxation must cover the cost of the wages to public sector employees:

$$\tau\left(1 - \alpha\right) k\left(r + \tau\right) = \alpha W. \tag{2.22}$$

Moreover, in order to be able to attract workers to the public sector, these workers must be offered a utility level at least as high as that enjoyed by workers in the private sector. This recruitment constraint in turn requires that

$$W \geq w. \tag{2.23}$$

Our assumption that public sector insiders have full job security also implies that fiscal policy must satisfy the 'non-firing constraint' $\alpha \geq \alpha_i$. In the analysis below we assume that this constraint is never strictly binding.[11]

Our parsimonious model obviously relies on strong simplifications. First, in a more elaborate political economy framework politicians might try to dole out the marginal high-paying public sector jobs in return for political support. Second, the model feature that campaign contributions are zero in equilibrium derives from an implicit assumption that all voters are equally well informed. As shown by Baron (1994), when voters have different information sets it may be optimal for lobbies to offer positive campaign contributions in equilibrium to influence

[11] If it were binding, we would have a relatively uninteresting scenario with an exogenous allocation of labour between the public and the private sector.

uninformed voters.[12] Third, like other static probabilistic voting models, our model neglects the potential time inconsistency problem in the political process, implicitly assuming that reputation mechanisms keep politicians from defaulting on their campaign promises.

In addition to ensuring analytical tractability, the above simplifications allow a precise definition of the popular concept of 'political distortion'. In the analysis below we shall thus measure the degree of political distortion by the following parameter (using the specifications from (2.20)):

$$\delta \equiv \alpha_i \cdot \left(\frac{p_i - p_o}{p_o} \right) = \alpha_i^2 h^2 \psi. \tag{2.24}$$

The political distortion is the product of the predetermined size of the public sector lobby (α_i) and the relative increase in votes a political candidate may expect to gain by catering to the economic interests of insiders rather than outsiders, $(p_i - p_o)/p_o$. The more δ exceeds zero, the greater is the political influence of public sector insiders relative to that of other voters. It is intuitive that the political distortion is greater the larger the lobby and the greater the impact of lobby efforts on voter preferences (the higher the value of h). We also see that a smaller dispersion of ideological preferences (a higher value of ψ which reduces the interval over which ideological preferences are distributed) increases the political distortion. When ideological preferences are fairly similar across a large number of lobby members, an increase in the economic benefits offered by one party to lobby members will induce many of them to shift their vote in favour of that party, and hence the lobby becomes more influential.

Note how our political setup tries to account for the views of those advocates of tax competition who argue that the public sector tends to employ too many people on overly generous conditions: First, because economic benefits offered to public sector insiders generate more votes than benefits offered to outsiders (as reflected in the fact that $p_i > p_o$), our model includes an incentive for politicians to offer rents to public sector workers. Second, when a political candidate offers high public sector wages, he may also be inclined to promise more jobs in the

[12] Lorz (1998) also offers a political economy model with positive lobbying activity in equilibrium. In his setting tax competition causes a welfare-increasing drop in lobby activity because it reduces the ability of the government to redistribute income, thereby diminishing the expected gain from lobbyism. However, unlike the present paper, Lorz (op.cit.) does not provide an explicit description of the voting process.

public sector, since (2.20) and (2.21) imply that this will increase an outsider's expected economic gain from voting for that candidate.[13] On the other hand, a relatively high public sector wage rate makes the creation of public sector jobs more expensive by requiring a higher tax rate. Hence politicians must trade off the political gain from high public sector wages and public sector job creation against the political cost of having to raise taxes. The next section analyses the resulting political equilibrium.

3. Political equilibrium, tax competition and rents

3.1. Political equilibrium

In political equilibrium the fiscal policy variables W, G, and τ are set so as to maximise the probability of election victory (2.20), subject to the government budget constraint (2.22) and the recruitment constraint (2.23). The first-order conditions for the solution to this problem are derived in Appendix 2. When the constraint $W \geq w$ is not strictly binding, these conditions can be shown to imply that

$$u'_g = \left(\frac{\alpha}{\alpha+\delta}\right)\left(\frac{1-\frac{\alpha}{n}}{1-\frac{\alpha}{n}-\varepsilon}\right)u'_p, \qquad \varepsilon \equiv -\left(\frac{n-1}{n}\right)\frac{\tau k'}{k}, \tag{3.1}$$

$$\frac{g'(\alpha)}{u'_g} + \frac{u_g - u_p}{u'_g(1+\delta)} = \left(\frac{\alpha+\delta}{\alpha+\alpha\delta}\right)\left[1+\frac{\alpha(n-1)}{(1-\alpha)(n-\alpha)}\right]\left(\frac{W}{w}\right)F_L, \tag{3.2}$$

where $u_g \equiv u\left(W+r\overline{k}\right)$ and $u_p \equiv u\left(w+r\overline{k}\right)$ are the total utilities of private consumption for public and private sector workers, respectively; $u'_g \equiv u'\left(W+r\overline{k}\right)$ and $u'_p \equiv u'\left(w+r\overline{k}\right)$ are the corresponding marginal utilities; and ε is the numerical elasticity of the tax base with respect to the tax rate.[14]

To understand the effects of tax competition on public sector efficiency, it is useful to start by considering the benchmark case of autarky where no international capital mobility is allowed. The world economy will then function like a

[13] When $W > w$, we have $U_g > U_p$, so from (2.21) we get $\frac{\partial U_o}{\partial \alpha} = \left(\frac{U_g - U_p}{1-\alpha_i}\right) > 0$. It then follows from (2.20) and (2.21) that $\frac{\partial p_A}{\partial \alpha} = U_g - U_o > 0$.

[14] Note that ε is a general-equilibrium elasticity, allowing for the impact of a change in the domestic tax rate on the world interest rate. Specifically, the tax base elasticity is defined as

$$\varepsilon \equiv -\frac{d(k(r+\tau))}{d\tau}\frac{\tau}{k} = -\frac{k' \cdot \left(d\tau + \frac{\partial r}{\partial \tau}d\tau\right)}{d\tau}\frac{\tau}{k} = -\left(\frac{n-1}{n}\right)\frac{\tau k'}{k}.$$

where we have used the symmetry assumption plus equation (2.13) to derive the last equality.

closed economy which we may model by setting the number of countries $n = 1$. Suppose for a moment that there is no political distortion, i.e. $\delta = 0$. According to (3.1) the political equilibrium under autarky then implies $u'_g = u'_p$ which in turn implies $W = w$ and $u_g = u_p$. For $n = 1$ and $\delta = 0$ equation (3.2) then reduces to the Samuelson condition $g'/u' = F_L$. In other words, a political equilibrium without capital mobility will guarantee a first-best allocation without rents when there is no political distortion. In this case politicians cannot capture more votes by offering particular benefits to one group at the expense of another, so vote-maximising politicians have an incentive to act like a utilitarian social planner who attaches an equal weight to the welfare of each individual citizen.

What happens if we allow political distortions in favour of public sector workers while maintaining the autarky assumption? In that case we obtain

Proposition 1: *Starting from an undistorted political equilibrium under autarky, the introduction of a small political distortion in favour of public sector workers will drive the public sector wage rate above the wage rate in the private sector. It will also drive up the tax rate but will leave public sector employment unaffected.*

Proof: See Appendix 3.

According to Proposition 1 the formation of a lobby for (some of the) public sector workers will induce politicians to create rents to civil servants. Not surprisingly, the tax rate will have to rise to finance the increase in public sector wages. However, the number of public sector jobs will stay the same because of two offsetting political incentives. On the one hand, the emergence of rents to public sector employees provides an incentive for a political candidate to boost public sector employment, since he can thereby capture more votes from outsiders by increasing their chances of getting an attractive public sector job (see footnote 12). On the other hand, the emergence of the lobby makes public goods more expensive by driving up the public sector wage rate. Ceteris paribus, this rise in the cost of public goods provision induces politicians to offer fewer public sector jobs. When there is no lobby initially, it turns out that these two countervailing political incentives exactly neutralize each other.

Since part of the tax increase needed to finance the rise in public sector wage rates is paid by private sector workers, the disposable income and private consumption of public sector workers must go up. With an unchanged value of $\alpha = G$, it

follows that the marginal rate of substitution $g'(G)/u'\left(W+r\overline{k}\right)$ is driven above the marginal rate of transformation $F_L(\alpha)$, so public goods become *under*provided from the viewpoint of public sector workers. However, since the higher capital tax rate causes a drop in r (see (2.13)) and a resulting fall in the private consumption of private sector workers, their marginal rate of substitution $g'(G)/u'\left(w+r\overline{k}\right)$ will fall below $F_L(\alpha)$, so public goods will become *over*provided from the perspective of private sector workers.

3.2. Tax competition, rent destruction and public goods provision

Consider next the role of tax competition, i.e. the case where $n > 1$ so that the tax base elasticity becomes positive, due to international capital mobility. From (3.1) we can show

Proposition 2: *Tax competition will completely eliminate rents to public sector employees if the political equilibrium under tax competition implies*

$$\varepsilon > \left(\frac{\delta}{\alpha+\delta}\right)\left(1-\frac{\alpha}{n}\right). \tag{3.3}$$

Proof: See Appendix 2.

The condition in (3.3) is very intuitive: the higher is the tax base elasticity ε, the higher is the marginal cost of public funds, so the more costly (in economic and political terms) it is for politicians to raise taxes to finance rents to public sector employees. Hence, if the political distortion in favour of public sector insiders is not too high (so that the fraction $\left(\frac{\delta}{\alpha+\delta}\right)$ in (3.3) is not too big), tax competition will prevent rent creation.

However, while tax competition may provide an institutional defence against rent seeking, as emphasized by the Public Choice school, it will also distort the supply of public goods, as claimed by the traditional Public Finance school. This is reflected in

Proposition 3: *When tax competition among small jurisdictions is sufficiently strong to eliminate all rents so that* $u'_g = u'_p = u'$*, public goods will be underprovided and the supply of public goods will satisfy the condition*

$$\frac{g'(\alpha)}{u'} = \left(\frac{1}{1-\alpha}\right)\left(\frac{1}{1-\varepsilon(1-\alpha)}\right)F_L. \tag{3.4}$$

Proof: See Appendix 3.

Under tax competition public goods are underprovided (i.e. $g'(\alpha)/u' > F_L$) since the international mobility of capital causes the tax base to be elastic from the individual country's perspective whereas from the viewpoint of the world economy as a whole it is in fact inelastic. However, under autarky we saw that the supply of public goods is also distorted, due to the bias in the political process. To evaluate which regime is likely to generate the biggest distortions, it is useful to consider a quantitative version of our model.

3.3. Is tax competition good or bad? A numerical general equilibrium analysis

To illustrate how rents, public goods provision and social welfare may evolve as the number of competing jurisdictions increases, we simulate a calibrated version of our model, assuming a Cobb-Douglas production function

$$y = Ak^{\beta}, \qquad A > 0, \quad 0 < \beta < 1, \tag{3.5}$$

and preferences of the form

$$u(C) = \frac{C^{1-\sigma_c}}{1-\sigma_c}, \quad g(\alpha) = \frac{\theta\alpha^{1-\sigma_g}}{1-\sigma_g}, \quad \sigma_c > 0, \quad \sigma_g > 0, \quad \theta > 0, \tag{3.6}$$

where the parameter θ reflects the preference for public goods. Assuming $\beta = 0.25$ and $\sigma_c = \sigma_g = 5$;[15] postulating a political distortion $\delta = 0.12$; setting $\theta = 1$, and calibrating the parameters A and $\overline{k}$ to ensure a realistic relative size of the public

[15] In an intertemporal context, our parameter σ_c would be identical to the inverse of the intertemporal elasticity of substitution in private consumption. Based on the estimates of the latter parameter by Hall (1988), σ_c should be at least 5, whereas the estimates presented in Attanasio and Weber (1995) imply values of σ_c between 2.2 and 4.7.

Table 1. Simulated effects of tax competition

n	ε	$\frac{W}{w}$	α	$\frac{\tau}{r+\tau}$	$\frac{SW-SW^a}{\lvert SW^a\rvert}$
1	0	1.1538	0.1349	0.5396	0
2	0.3006	1.0704	0.1231	0.4508	0.0095
3	0.3800	1.0451	0.1200	0.4275	0.0068
4	0.4166	1.0329	0.1185	0.4166	0.0045
5	0.4377	1.0257	0.1177	0.4104	0.0030
6	0.4515	1.0209	0.1171	0.4063	0.0018
7	0.4611	1.0176	0.1167	0.4035	0.0009
8	0.4682	1.0151	0.1165	0.4013	0.0002
9	0.4737	1.0131	0.1162	0.3997	-0.0003
10	0.4781	1.0116	0.1161	0.3984	-0.0008
20	0.4972	1.0047	0.1153	0.3927	-0.0029
30	0.5037	1.0024	0.1150	0.3908	-0.0036
50	0.5087	1.0006	0.1148	0.3893	-0.0042
100	0.5131	1	0.1147	0.3887	-0.0044
10000	0.5181	1	0.1147	0.3887	-0.0045

Calibration: $\delta = 0.12$, $\sigma_c = \sigma_g = 5$, $\beta = 0.25$, $\theta = 1$, $\overline{k} = 0.1$, $A = 0.1$.

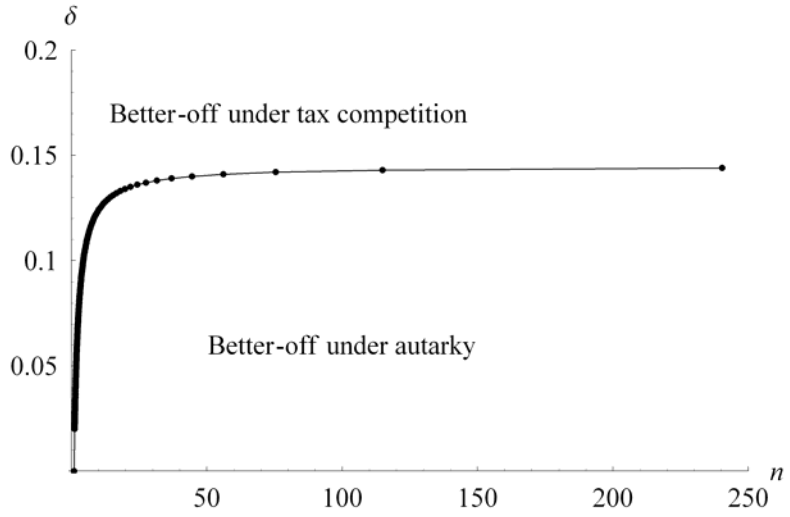
sector (and a realistic effective capital income tax rate $\tau/(r+\tau)$), we obtain the simulation results reported in Table 1.[16] The last column shows the change in the level of social welfare relative to the welfare level SW^a attained under autarky, and the first row in the table shows the situation prevailing under autarky.

The second column in the table shows that the elasticity of the tax base gradually increases with the number of competing jurisdictions. As tax competition grows more intense, the relative public sector wage rate W/w gradually declines, and when the number of jurisdictions becomes sufficiently large, rents are completely eliminated, i.e., the recruitment constraint $W \geq w$ becomes binding. Tax competition also reduces the size of the public sector, but not dramatically so, since our assumed values of σ_c and σ_g imply a relatively low degree of substitutability between public and private goods.

Notice the interesting profile of the welfare change in the last column in Table 1: as the number of countries rises from one to some small number, social wel-

[16] The complete model implied by the specifications (3.5) and (3.6) is documented in a supplementary appendix available from the authors.

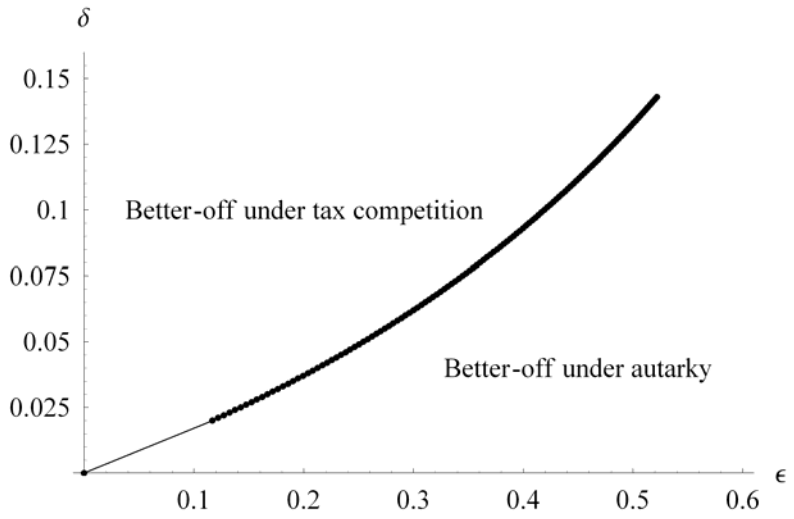
Figure 1: The borderline between welfare-increasing and welfare-reducing tax competition (I)



fare rises above the autarky level, because the positive effect of rent destruction dominates the negative effect of lower public goods provision. However, as the number of countries increases from eight to nine, implying an increase in the tax base elasticity from 0.4682 to 0.4737, the welfare gain from tax competition is turned into a slight loss, as the negative efficiency effect of reduced public service provision starts to dominate. Indeed, in this particular example the maximum welfare gain from tax competition is attained already when the number of countries is two, at a tax base elasticity of about 0.3. Given our calibration, this tax base elasticity represents the optimal intensity of tax competition.

Of course these results are sensitive to the choice of parameter values. One critical parameter is the degree of political distortion, δ. As the value of this parameter increases, it takes a higher intensity of tax competition - reflected in the number of countries and the associated elasticity of the tax base - before the negative welfare effect of reduced public goods provision starts to dominate the positive welfare effect of rent destruction. This is illustrated in figures 1 and 2 which show the combinations of the political distortion and the number of competing jurisdictions (and the implied tax base elasticity) that will lead to exactly the same level of welfare as that attained under autarky, given the other parameter values stated in the note to Table 1. For parameter combinations above

Figure 2: The borderline between welfare-increasing and welfare-reducing tax competition (II)



the graphs in the two figures, tax competition is welfare-improving, whereas in the area below the graphs it is welfare-reducing. As one would expect, the figures illustrate that tax competition is more desirable the greater the political distortion in favour of public sector voters.

The calibrated version of our model suggests that even a large political distortion can only justify a moderate intensity of tax competition. For example, if the public sector lobby is a trade union comprising 10 percent of the total work force ($\alpha_i = 0.1$), the value of $\delta \equiv \alpha_i (p_i - p_o) / p_o = 0.12$ assumed in Table 1 would imply $p_i/p_o = 2.2$, that is, the political influence of a public sector insider would be more than twice the influence of other voters, reflecting a very strong lobby. But even in this case Table 1 indicates that the tax base elasticity will only have to exceed 0.3 before more intensive tax competition starts to reduce welfare, despite the fact that further competition does not reduce public goods provision very much, due to the low substitution elasticity $1/\sigma_p = 1/\sigma_g = 0.2$ between private and public goods. According to the present model tax competition thus seems a badly targeted remedy against political distortions, compared to domestic institutional reform such as restrictions on campaign contributions by lobby groups.

4. Tax coordination, rents and welfare

The analysis in the two previous sections showed that tax competition among small jurisdictions has the potential to destroy rents completely, but in that case it will also cause an underprovision of public goods which could be substantial. This suggests that an internationally coordinated rise in taxation could be welfare-improving even if the political process is biased in favour of public sector workers. Thus, an interesting question is whether tax coordination will raise social welfare and whether it will do so even if it leads to the emergence of rents? In this main section we take a closer look at these issues, focusing on the case where individual jurisdictions are small.

4.1. Tax coordination without rent creation

When the capital tax rate is fixed by some international agreement on tax coordination, politicians in the individual small country cannot influence $k = k(r+\tau)$ and $w = w(r+\tau)$ since they now take τ as well as r as given. However, they must still find the politically optimal combination of W and α, subject to the constraints (2.22) and (2.23). If a political candidate offers to raise the public sector wage rate by the amount dW, it follows from (2.1), (2.20) and (2.21) that the resulting marginal political benefit (MPB) in terms of the increase in the probability of election victory will be

$$MPB = \left[\alpha_i p_i u_g' + (\alpha - \alpha_i) p_o u_g'\right] dW. \tag{4.1}$$

Since the tax rate is fixed by international agreement, a rise in the public sector wage rate can only be financed through a cut in the number of public sector jobs and hence in public goods provision. According to (2.1), (2.20) and (2.21), the marginal political cost (the expected loss of votes) associated with a reduction $|d\alpha|$ in public sector employment is

$$MPC = \left\{\left[\alpha_i p_i + (1-\alpha_i) p_o\right] g'(\alpha) + p_o (u_g - u_p)\right\} |d\alpha|. \tag{4.2}$$

In the absence of constraints on wage-setting, an optimising politician will want to equate the above expressions for the marginal political benefits and costs. However, in a tax competition equilibrium where condition (3.3) holds, it follows

from the proof of Proposition 2 stated in Appendix 3 that the public sector recruitment constraint $W \geq w$ is in fact strictly binding. Using this insight, and noting that (3.3) reduces to $\varepsilon > \delta/(\alpha+\delta)$ for $n \to \infty$, we can establish

Proposition 4: *Starting from a tax competition equilibrium where $\varepsilon > \delta/(\alpha+\delta)$ so that all rents have been eliminated and the public sector recruitment constraint $W \geq w$ is strictly binding, the government of a small country will want to spend all of the extra revenue from an internationally coordinated rise in taxation on additional public goods provision and will not want to create rents to public sector employees.*

Proof: See Appendix 3.

According to Proposition 4, under the plausible assumption that $\varepsilon > \delta/(\alpha+\delta)$, tax competition in the initial political eqilibrium preceding the international agreement has reduced public goods provision to such an extent that it is not politically expedient for national governments to use any of the revenue from tax coordination on rent creation.

The initial increase in public sector employment allowed by an internationally coordinated rise in τ and the resulting effects on factor prices may be found from the capital market equilibrium condition (2.12) and the government budget constraint (2.22), using that $W = w(r+\tau)$ initially:[17]

$$\frac{d\alpha}{d\tau} = \frac{\varepsilon \overline{k}(1-\alpha)^2}{w\alpha\left[\alpha + \varepsilon\alpha^{-1}(1-\alpha)^2\right]} > 0, \tag{4.3}$$

$$\frac{dr}{d\tau} = -\left(\frac{1+\varepsilon\alpha^{-1}(1-\alpha)^2}{\alpha+\varepsilon\alpha^{-1}(1-\alpha)^2}\right) < -1, \tag{4.4}$$

$$\frac{dW}{d\tau} = \frac{dw}{d\tau} = -k\cdot\left(1+\frac{dr}{d\tau}\right) = \frac{\overline{k}}{\alpha+\varepsilon\alpha^{-1}(1-\alpha)^2} > 0. \tag{4.5}$$

The derivative (4.5) gives the increase in the public sector wage rate that politicians must grant to keep satisfying the recruitment constraint, but without offering any rents to public sector workers. The remaining part of the increase in tax

[17] We use the fact that, with symmetric countries and a harmonised capital tax rate which is controlled by some international authority, the capital market equilibrium condition (2.12) simplifies to equation (4.7) below.

revenue is spent on additional public sector employment, as witnessed by (4.3). Using these results, we can prove

Proposition 5: *Starting from a tax competition equilibrium where* $\varepsilon > \delta/(\alpha+\delta)$ *so that all rents have been eliminated, an internationally coordinated rise in taxation will unambiguously increase social welfare, and the welfare gain will be directly proportional to the initial degree of underprovision of public goods, measured by the magnitude* $\left(\frac{g'/u'}{F_L}-1\right)$ *of the initial deviation from the Samuelson condition.*

Proof: See Appendix 3.

Since public goods are underprovided in the initial equilibrium, and since Proposition 4 established that none of the extra revenue from tax coordination will be spent on rents, it is not surprising that some amount of coordination will raise social welfare. Indeed, as long as $g'/u' > F_L$ and $MPC > MPB$, i.e., as long as public goods are underprovided and politicians have no incentive to spend the revenue from tax coordination on rent creation, welfare will be boosted by further coordinated tax increases.

4.2. Tax coordination with rent creation

But could tax coordination improve social welfare even if it is carried beyond the point where rents start to emerge? To investigate this, we must derive the effects of further tax coordination on W, α and r when the supply of public goods has already been raised to a level where politicians would like to spend part of a further revenue gain on rents. In that situation politicians will offer a fiscal policy package (W, G) (with $G = \alpha$) that satisfies the political optimum condition $MPC = MPB$. Using (4.1) and (4.2) and noting from the government budget constraint (2.22) that $dW/|d\alpha| = W/\alpha(1-\alpha)$ when the individual country takes τ and r as given, we find that the condition $MPC = MPB$ implies

$$\begin{aligned}&(1+\delta)\,g'(\alpha)+u\left(W+r\overline{k}\right)-u\left(w(r+\tau)+r\overline{k}\right)=\\&(\alpha+\delta)\,u'\left(W+r\overline{k}\right)\left(\frac{W}{\alpha(1-\alpha)}\right).\end{aligned}\tag{4.6}$$

When the public sector recruitment constraint is no longer strictly binding, the effects of tax coordination on W, α and r in the representative small country

may be found from the simultaneous system consisting of the government budget constraint (2.22), the political equilibrium condition (4.6) and the capital market equilibrium condition

$$(1-\alpha)\,k\,(r+\tau)-\overline{k}=0 \tag{4.7}$$

which follows from (2.12) when all countries are forced to change their capital tax rate in a coordinated manner. In analysing this system, we assume that countries start out from a situation where the public sector recruitment constraint has just ceased to be strictly binding so that $W=w$ in the initial equilibrium. The effects of a coordinated rise in τ on W, α and r are given in equations (A.18) through (A.20) in Appendix 2. Using those results we obtain

Proposition 6: *Once tax coordination has raised public goods provision to the point where the recruitment constraint $W \geq w$ is no longer strictly binding, the following condition is necessary and sufficient to ensure that politicians will use part of the revenue from further tax increases to offer rents to public sector workers:*

$$\begin{gathered}\delta+\alpha\left[1+\alpha+\gamma\sigma_c\left(\alpha+\delta\right)\right]\\ +\varepsilon\left(\frac{1-\alpha}{\alpha}\right)\left[\frac{1+\delta}{1-\alpha}+\gamma\sigma_c\left(\alpha+\delta\right)+\left(\frac{\alpha+\delta}{\alpha}\right)\left(\frac{\sigma_g}{1+\delta}-1\right)\right]>0,\end{gathered} \tag{4.8}$$

$$\gamma\equiv\frac{W}{W+r\overline{k}}.$$

Proof: See Appendix 3.

A sufficient (but far from necessary) condition for (4.8) to hold is that $\sigma_g \geq 1+\delta$. As mentioned in footnote 14, empirical estimates of the coefficient of relative risk aversion in private consumption (σ_c) are typically far above unity, so if the corresponding CRRA parameter for public consumption (σ_g) is not much smaller, it will most likely exceed $1+\delta$ (since δ will not realistically be far above one). Moreover, even if $\sigma_g < 1+\delta$, all the other positive terms on the left-hand side of (4.8) are likely to ensure that the condition will hold. For all plausible parameter values it then follows from Proposition 6 that once tax coordination is carried beyond a certain point, it will start to generate rents to public sector workers. Clearly this accords with the Public Choice view that tax coordination stimulates

rent seeking. However, this does not necessarily mean that a further coordinated tax increase is undesirable once rents start to emerge. More precisely, we have

Proposition 7: *When tax coordination has raised public goods provision to the point where the recruitment constraint $W \geq w$ is no longer strictly binding, a further coordinated rise in the level of taxation will increase social welfare if and only if the following condition is met:*

$$\gamma\sigma_c\left(\alpha+\delta\right)\left[\frac{\alpha+\delta}{\alpha+\alpha\delta}-\left(1-\alpha\right)\right]>\delta+\alpha\left(2-\alpha\right)+\left(\frac{\alpha+\delta}{1+\delta}\right)\left(\frac{\alpha^2+\delta}{\alpha\left(1-\alpha\right)}\right). \quad (4.9)$$

Proof: See Appendix 3.

Condition (4.9) may very well be satisfied. For example, suppose that $\rho = 0.12$, $\gamma \equiv \frac{W}{W+r\overline{k}} = 0.8$ and $\alpha = 0.13$. The inequality in (4.9) will then hold for all values of σ_c above 3.74. The empirical estimates in Hall (1988) imply that σ_c is at least 5 and possibly much higher, while the estimates by Attanasio and Weber (1995) suggest that σ_c lies in the interval between 1.5 and 4.7. Hence tax coordination may be welfare-improving even when it generates rents (recall from Proposition 6 that a coordinated rise in taxation will almost surely create rents when the recruitment constraint ceases to bind). The reason for this result is that public goods are still underprovided in the initial equilibrium, so if politicians spend part of the extra tax revenue on an increase in public goods supply - as indeed they will, given the parameter values assumed in the numerical example above - the resulting positive welfare effect may outweigh the loss from the distortions caused by the introduction of rents.[18]

[18] To see that public goods are underprovided initially, note from (A.29) in Appendix 3 that the political equilibrium condition $MPB = MPC$ implies $g'/u' > F_L$. The fact that a coordinated rise in τ will increase public goods provision (and not just induce a rise in rents) follows from (A.18) in Appendix 2 by inserting the assumed parameter values.

Introducing positive rents causes a rise in the private consumption of public sector workers (if their wage rate rises by more than their tax bill) which may increase the ratio $\frac{g'(G)/u'_g}{F_L(\alpha)}$. In that case the pre-existing distortion to public goods supply will *increase* from the perspective of public sector workers so that no unambiguous conclusion on the overall welfare effect can be drawn, even though the distortion to public goods supply will certainly be reduced from the viewpoint of private sector workers.

5. Conclusions and suggestions for further research

In this paper we have set up a probabilistic voting model to explore the hypothesis that tax competition improves public sector efficiency and social welfare when a political distortion favours public sector employees. In our model the political distortion induces politicians to create rents through high wages to public sector workers in the absence of tax base mobility. If tax competition is introduced via the lifting of capital controls, it will reduce the rents to public sector workers and may well destroy them completely when the number of competing jurisdictions becomes sufficiently large. However, tax competition will also cause an underprovision of public goods by increasing the marginal cost of public funds. Our analysis indicated that, in the presence of a political distortion favouring public sector workers, a modest degree of tax competition involving a relatively low tax base elasticity is likely to be welfare-improving, whereas unfettered tax competition among small jurisdictions is likely to be welfare-reducing, compared to a hypothetical situation without tax base mobility. In particular, if tax competition is sufficiently strong to eliminate all rents, a coordinated rise in capital taxation will always be welfare-improving by offsetting the underprovision of public goods. We also found that it may be welfare-enhancing to carry tax coordination beyond the point where rents to public sector workers start to emerge.

Overall our analysis suggests that while the advocates of tax competition are right in claiming that tax base mobility serves to reduce rent-seeking, it is a double-edged sword that also tends to distort the supply of public goods, as argued by supporters of tax coordination. Up to a certain point tax competition may play a useful efficiency-enhancing role, but if it becomes too intense it is likely to be welfare-reducing. Indeed, in a calibrated version of our model we were able to identify an optimal intensity of tax competition, measured by the elasticity of the tax base with respect to the tax rate. Our quantitative analysis suggested that even very large political distortions can only justify a modest intensity of tax competition. In our model tax competition thus seems a poorly targeted means of curbing rents, compared to domestic institutional reform.

A natural extension of our analysis would be to allow for taxes on immobile factors. One could then study whether tax competition for mobile factors will reduce rents even if politicians can compensate for a lower revenue from the mobile tax base by raising taxes on the immobile base. We believe the answer to this

question will be 'yes', as long as politicians have an incentive to rely to some extent on taxation of a mobile factor, say, because it earns location-specific rents accruing partly to foreign owners, as in Huizinga and Nielsen (1997) and Sørensen (2004). In that case politicians will equate the marginal political costs of taxing the mobile and the immobile factor, so tax competition that raises the marginal cost of taxing the mobile factor will also raise the overall marginal cost of taxation and force some reduction in public goods provision. Since optimising politicians equate the marginal political benefits from rent creation and public goods provision, they will then also want to curb rents. The simulation results reported by Sørensen (2004) indicate that even in a setting with taxes on immobile as well as mobile factors, tax competition can have significant quantitative effects on the marginal cost of public funds. On this basis one would expect tax competition to have non-negligible effects on rent-seeking in a political economy setting with multiple tax instruments.

An interesting empirical exercise would be to investigate if there is any systematic link between proxies for the intensity of tax competition and relative public/private sector wage rates for comparable skill groups, as suggested by the present study. Finally, although we followed the Leviathan literature in assuming a political bias in favour of 'bureaucrats', one can think of alternative settings where the political proces generates rents to other groups, e.g., in the form of selective (tax) subsidies or regulations in favour of certain well-organized private sector interest groups. In such an environment one could still use the general political economy approach suggested in this paper to study the effects of tax competition on rent creation and resource allocation.

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Appendices

Appendix 1. The probabilistic voting model with a public sector lobby

In this appendix we derive equation (2.19) giving the optimal lobby campaign efforts and equation (2.20) determining the probability that political party A will win the election.

According to (2.16) the lobby swing voter who is indifferent between the two parties has the ideological bias

$$\rho_i = U_i^A - U_i^B - \widetilde{\omega}. \tag{A.1}$$

All lobby members with a value of ρ_i^j less than ρ_i will prefer party A to party B. If ρ_i^j is uniformly distributed on the interval $\left[-\frac{1}{2\phi_i}, \frac{1}{2\phi_i}\right]$ with length $1/\phi_i$, the fraction π_i^A of lobby members with a value of ρ_i^j less than ρ_i is

$$\pi_i^A = \frac{\rho_i - \left(-\frac{1}{2\phi_i}\right)}{1/\phi_i} = \phi_i\left(\rho_i + \frac{1}{2\phi_i}\right) = \phi_i\left(U_i^A - U_i^B - \widetilde{\omega} + \frac{1}{2\phi_i}\right). \tag{A.2}$$

Using (2.17) to eliminate $\widetilde{\omega}$ from (A.2), we may thus write the probability that a lobby member will vote for party A as

$$\pi_i^A = \frac{1}{2} + \phi_i\left[U_i^A - U_i^B - \omega + \alpha_i h\left(Z_A - Z_B\right)\right]. \tag{A.3}$$

In a similar way, if the individual ideological preference of an outsider (ρ_o^v) follows a uniform distribution on the interval $\left[-\frac{1}{2\phi_o}, \frac{1}{2\phi_o}\right]$, the probability π_o^A that an outsider will vote for party A can be shown to be

$$\pi_o^A = \frac{1}{2} + \phi_o\left[U_o^A - U_o^B - \omega + \alpha_i h\left(Z_A - Z_B\right)\right]. \tag{A.4}$$

Thus the expected fraction of total votes that will be cast in favour of party is

$$\pi^A = \alpha_i \pi_i^A + \left(1 - \alpha_i\right)\pi_o^A. \tag{A.5}$$

The probability p_A that party A will win the election equals the probability that π^A is at least one half. Using (A.3) through (A.5), this condition may be written as

$$\begin{aligned} p_A &\equiv \Pr_{\omega}\left[\pi^A \geq 1/2\right] \qquad (A.6) \\ &= \Pr_{\omega}\left[\frac{\alpha_i\phi_i}{\phi}\left(U_i^A - U_i^B\right) + \frac{(1-\alpha_i)\,\phi_o}{\phi}\left(U_o^A - U_o^B\right) + \alpha_i h\left(Z_A - Z_B\right) \geq \omega\right], \end{aligned}$$

where $\phi \equiv \alpha_i\phi_i + (1-\alpha_i)\,\phi_o$ is the average dispersion of ideological preferences across the two groups of voters. As the general ideological preference ω is uniformly distributed on the interval $\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right]$, the probability in (A.6) is

$$\begin{aligned} p_A &= \frac{\frac{\alpha_i\phi_i}{\phi}\left(U_i^A - U_i^B\right) + \frac{(1-\alpha_i)\phi_o}{\phi}\left(U_o^A - U_o^B\right) + \alpha_i h\left(Z_A - Z_B\right) - \left(-\frac{1}{2\psi}\right)}{1/\psi} \\ &= \frac{1}{2} + \frac{\psi}{\phi}\left[\alpha_i\phi_i\left(U_i^A - U_i^B\right) + (1-\alpha_i)\,\phi_o\left(U_o^A - U_o^B\right) + \phi\alpha_i h\left(Z_A - Z_B\right)\right] \end{aligned} \qquad (A.7)$$

Lobby officials choose their campaign efforts to maximise the objective function (2.18), subject to the constraint that efforts cannot be negative. Since (A.7) implies $\partial p_A/\partial Z_A = \alpha_i h\psi$ and $\partial p_A/\partial Z_B = -\alpha_i h\psi$, the first-order conditions for the solution to the lobby problem may be written as follows, where μ_A and μ_B are the Kuhn-Tucker multipliers associated with the non-negativity constraints on Z_A and Z_B, respectively:

$$\alpha_i h\psi\left(U_i^A - U_i^B\right) - Z_A - \mu_A = 0, \qquad -\alpha_i h\psi\left(U_i^A - U_i^B\right) - Z_B - \mu_B = 0, \quad (A.8a)$$

$$Z_A \geq 0, \qquad Z_B \geq 0, \qquad \mu_A \geq 0, \qquad \mu_B \geq 0, \qquad \mu_A Z_A = 0, \qquad \mu_B Z_B = 0. \quad (A.8b)$$

From (A.8) we get the results stated in (2.19) which in turn imply that

$$Z_A - Z_B = \alpha_i h\psi\left(U_i^A - U_i^B\right). \qquad (A.9)$$

Substituting (A.9) into (A.7), we find

$$p_A = \frac{1}{2} + \frac{\psi}{\phi}\left[\alpha_i\left(\phi_i + \phi\alpha_i\psi h^2\right)\left(U_i^A - U_i^B\right) + (1-\alpha_i)\,\phi_o\left(U_o^A - U_o^B\right)\right]. \qquad (A.10)$$

If ϕ_o is sufficiently large, reflecting a small dispersion of the ideological preferences of outsiders, we may have $\phi_o > \phi_i + \phi\alpha_i\psi h^2$. In that case it follows from (A.10) that the individual outsider is politically more influential than the individual insider, as noted in section 2.4. However, in the benchmark case where $\phi_o = \phi_i = \phi$, (A.10) simplifies to equation (2.20) in the text, representing the situation where lobby members have greater political power.

Appendix 2. The political equilibrium

This appendix explains the derivation of the political equilibrium presented in section 3.1 and reports some comparative-static results which are used in the proofs of the propositions stated in Appendix 3.

Using (2.20), (2.21) plus the facts that $U_i = U_g = u\left(W + r\overline{k}\right) + g\left(G\right)$ and $G = \alpha$, we construct the Lagrangian £ corresponding to the maximisation problem specified at the start of section 3.1,

$$\pounds = \frac{1}{2} + \alpha_i p_i \left[u\left(W + r\overline{k}\right) + g\left(\alpha\right) - U_i^B\right]$$

$$+ \left(1 - \alpha_i\right) p_o \left[\left(\frac{\alpha - \alpha_i}{1 - \alpha_i}\right) u\left(W + r\overline{k}\right) + \left(\frac{1 - \alpha}{1 - \alpha_i}\right) u\left(w\left(r + \tau\right) + r\overline{k}\right) + g\left(\alpha\right) - U_o^B\right]$$

$$+ \lambda\left[\tau\left(1 - \alpha\right)k\left(r + \tau\right) - \alpha W\right] + \eta\left[W - w\left(r + \tau\right)\right],$$

where η is the Kuhn-Tucker multiplier associated with the recruitment constraint $W \geq w$. Exploiting (2.13), (2.14) and the fact that $\left(1 - \alpha\right)k = \overline{k}$ in symmetric capital market equilibrium, we find the first-order conditions for maximisation with respect to W, α and τ to be

$$\partial\pounds/\partial W = 0 \quad \Longrightarrow \quad \left[\alpha_i p_i + \left(\alpha - \alpha_i\right) p_o\right] u_g' - \alpha\lambda + \eta = 0, \tag{A.11}$$

$$\partial\pounds/\partial\alpha = 0 \quad \Longrightarrow \quad \left[\alpha_i p_i + \left(1 - \alpha_i\right) p_o\right] g' + p_o\left(u_g - u_p\right) - \lambda\left(\tau k + W\right)$$

$$+ \frac{k}{n\left(1 - \alpha\right)k'}\left[\overline{k}\alpha_i u_g'\left(p_i - p_o\right) + \overline{k}\alpha p_o\left(u_g' - u_p'\right) + \lambda\tau\left(1 - \alpha\right)k' + \eta k\right] = 0, \tag{A.12}$$

$$\partial\pounds/\partial\tau = 0 \quad \Longrightarrow \quad \lambda\left(1 - \alpha\right)\left(k + \tau k'\right) + \eta k - \left(1 - \alpha\right)k p_o u_p'$$

$$-\frac{1}{n}\left[\overline{k}\alpha_i u_g'\left(p_i-p_o\right)+\overline{k}\alpha p_o\left(u_g'-u_p'\right)+\lambda\tau\left(1-\alpha\right)k'+\eta k\right]=0. \tag{A.13}$$

When the recruitment constraint is not strictly binding, we have $\eta=0$. Using the government budget constraint $\tau k=\left(\frac{\alpha}{1-\alpha}\right)W$ to eliminate τk, the reader may verify that (A.11) through (A.13) then lead to (3.1) and (3.2) in section 3.1.[19]

Consider now the case of autarky and suppose that $W>w$ so that $\eta=0$. Setting $n=1$ and noting from the government budget constraint that $W=\tau\overline{k}/\alpha$ under autarky, we may then write (3.1) and (3.2) in the form

$$\alpha u'\left(w\left(r\left(\alpha,\tau\right)+\tau\right)+r\left(\alpha,\tau\right)\overline{k}\right)-\left(\alpha+\delta\right)u'\left(\frac{\tau\overline{k}}{\alpha}+r\left(\alpha,\tau\right)\overline{k}\right)=0, \tag{A.14}$$

$$\begin{aligned}\alpha^2 g'\left(\alpha\right)\left(1+\delta\right)+\alpha^2\left[u\left(\frac{\tau\overline{k}}{\alpha}+r\left(\alpha,\tau\right)\overline{k}\right)-u\left(w\left(r\left(\alpha,\tau\right)+\tau\right)+r\left(\alpha,\tau\right)\overline{k}\right)\right]\\ -\left(\alpha+\delta\right)\tau\overline{k}u'\left(\frac{\tau\overline{k}}{\alpha}+r\left(\alpha,\tau\right)\overline{k}\right)=0,\end{aligned} \tag{A.15}$$

where the derivatives of the function $r\left(\alpha,\tau\right)$ are given by (2.13) and (2.14). Taking total differentials of (A.14) and (A.15), evaluating the derivatives in an initial equilibrium where $\delta=0$ (so that $W=w$, $u_g=u_p$ and $u_g'=u_p'$ initially), and defining $\widehat{\varepsilon}\equiv-\tau k'/k$, we get (using (2.13) and (2.14) with $n=1$ plus the facts that $\tau\overline{k}=\alpha w$ and $g'=u'w$ in the initial undistorted equilibrium):

$$\begin{bmatrix} wu''\left[1+\frac{1}{\widehat{\varepsilon}}\left(\frac{\alpha}{1-\alpha}\right)^2\right] & -\overline{k}u'' \\ \alpha g''-\frac{wu'}{\widehat{\varepsilon}}\left(\frac{\alpha}{1-\alpha}\right)^2+w^2u''\left[1+\frac{\alpha}{\widehat{\varepsilon}}\left(\frac{\alpha}{1-\alpha}\right)\right] & -wu''\overline{k}\left(1-\alpha\right)\end{bmatrix}\begin{bmatrix}d\alpha\\ d\tau\end{bmatrix}=\\ \begin{bmatrix}u'\cdot d\delta\\ wu'\left(1-\alpha\right)\cdot d\delta\end{bmatrix}$$

Applying Cramer's rule to this system, we find that

$$\frac{\partial\alpha}{\partial\delta}=0, \tag{A.16}$$

$$\frac{\partial\tau}{\partial\delta}=\frac{\frac{u'g'}{\widehat{\varepsilon}}\left(\frac{\alpha}{1-\alpha}\right)^2-\alpha u'\left(g''+w^2u''\right)}{u''\overline{k}\left[\alpha\left(g''+w^2u''\right)-\frac{g'}{\widehat{\varepsilon}}\right]}>0. \tag{A.17}$$

Thus the introduction of a small political distortion will drive up the tax rate but leave public sector employment unchanged, as reported in section 3.1.

[19] A detailed derivation of (3.1) and (3.2) from (A.11) through (A.13) is provided in a supplementary appendix available from the authors.

We turn next to the effects of tax coordination with rent creation discussed in section 4.2. Assume that the equilibrium value of W implied by (2.22), (4.6) and (4.7) will indeed satisfy the recruitment constraint $W \geq w$. From these equations and the assumption made in section 4.2 that $W = w$ initially, one can then show that

$$\frac{d\alpha}{d\tau} = \frac{(\varepsilon/\tau)(1-\alpha)\{(\alpha+\delta)[1-\gamma\sigma_c(1-\alpha)]-\alpha(1-\alpha)\}}{\Delta}, \tag{A.18}$$

$$\frac{dW}{d\tau} = \left(\frac{\overline{k}\varepsilon(1-\alpha)}{\alpha\Delta}\right)\left\{\left(\frac{\alpha+\delta}{\alpha}\right)\left(1-\frac{\sigma_g}{1+\delta}\right)-\left(\frac{1+\delta}{1-\alpha}\right)-\gamma\sigma_c(\alpha+\delta)\right\} - \left(\frac{\overline{k}}{\Delta}\right)[\alpha+\gamma\sigma_c(\alpha+\delta)], \tag{A.19}$$

$$\frac{dr}{d\tau} = \left(\frac{\varepsilon(1-\alpha)}{\Delta}\right)\left\{2-\alpha+\left(\frac{\alpha+\delta}{\alpha}\right)\left[\frac{\alpha}{1-\alpha}+\gamma\sigma_c+\frac{\sigma_g}{1+\delta}\right]\right\} + \left(\frac{1}{\Delta}\right)[\gamma\sigma_c(\alpha+\delta)-\delta], \tag{A.20}$$

$$\Delta \equiv -\varepsilon\overline{k}(1-\alpha)\left\{2-\alpha+\left(\frac{\alpha+\delta}{\alpha}\right)\left[\frac{\alpha}{1-\alpha}+\gamma\sigma_c+\frac{\sigma_g}{1+\delta}\right]\right\} - \alpha[\alpha+\gamma\sigma_c(\alpha+\delta)] < 0, \tag{A.21}$$

$$\gamma \equiv \frac{W}{W+r\overline{k}}, \qquad \sigma_c \equiv -C\frac{u''}{u'}, \qquad \sigma_g \equiv -\alpha\frac{g''}{g'},$$

where σ_c is the coefficient of relative risk aversion in private consumption (which is identical for private and public sector workers in the initial equilibrium) and σ_g is the coefficient of relative risk aversion in public consumption. As mentioned, these results hold provided $W \geq w$. If this condition is satisfied initially, it will continue to be met if $dW \geq dw$. Noting from (2.11) that $dw/d\tau = -k\left(1+\frac{dr}{d\tau}\right)$ and using (A.19) and (A.20), we find

$$\frac{dW}{d\tau} - \frac{dw}{d\tau} = \left(\frac{-k}{\Delta}\right)\{\delta+\alpha[1+\alpha+\gamma\sigma_c(\alpha+\delta)]\} - \left(\frac{\varepsilon k(1-\alpha)}{\alpha\Delta}\right)\left[\frac{1+\delta}{1-\alpha}+\gamma\sigma_c(\alpha+\delta)+\left(\frac{\alpha+\delta}{\alpha}\right)\left(\frac{\sigma_g}{1+\delta}-1\right)\right]. \tag{A.22}$$

The proof of Proposition 6 given in Appendix 3 utilises (A.21) and (A.22).

Appendix 3. Proofs of propositions

Proof of Proposition 1: From (3.1) it follows that for $n = 1$ a positive value of δ will drive $u'_g \equiv u'\left(W + r\overline{k}\right)$ below $u'_p \equiv u'\left(w + r\overline{k}\right)$. Since $u'' < 0$, this requires $W > w$. Moreover, according to equations (A.16) and (A.17) in Appendix 2 we have

$$\frac{\partial \tau}{\partial \delta} > 0, \qquad \frac{\partial \alpha}{\partial \delta} = 0 \qquad \text{for} \quad n = 1 \text{ and } \delta = 0 \text{ initially.} \qquad \blacksquare$$

Proof of Proposition 2: Condition (3.3) in Proposition 2 is equivalent to

$$\left(\frac{\alpha}{\alpha + \delta}\right)\left(\frac{1 - \frac{\alpha}{n}}{1 - \frac{\alpha}{n} - \varepsilon}\right) > 1. \tag{A.23}$$

Consider equation (3.1) which was derived from the politician's first-order conditions on the assumption that the recruitment constraint $W \geq w$ is not binding. According to (3.1) the inequality in (A.23) would imply $u'_g \equiv u'\left(W + r\overline{k}\right) > u'_p \equiv u'\left(w + r\overline{k}\right)$, but since this would require $W < w$, it would violate the recruitment constraint. Hence this constraint must be binding when (3.3) holds, implying the absence of rents. $\blacksquare$

Proof of Proposition 3: The proposition considers a case with many small jurisdictions ($n \to \infty$) where tax competition has eliminated rents so that $W = w$, $u_g = u_p$ and $u'_g = u'_p = u'$. The first-order conditions (A.11) through (A.13) in Appendix 2 then simplify to

$$p_o\left(\alpha + \delta\right)u' - \alpha\lambda + \eta = 0, \tag{A.24}$$

$$p_o\left(1 + \delta\right)g' - \lambda\left(\tau k + W\right) = 0, \tag{A.25}$$

$$\lambda\left(1 - \alpha\right)\left(k + \tau k'\right) + \eta k - \left(1 - \alpha\right)k p_o u' = 0, \tag{A.26}$$

where we have used the definition $\delta \equiv \alpha_i\left(p_i - p_o\right)/p_o$. Inserting (A.24) into (A.26) and noting from (3.1) that $\varepsilon = -\tau k'/k$ when $n \to \infty$, we get

$$\eta \equiv p_o u'\left(1 - \alpha\right)\left(\frac{\varepsilon\left(\alpha + \delta\right) - \delta}{1 - \varepsilon\left(1 - \alpha\right)}\right). \tag{A.27}$$

Substituting the government budget constraint $\tau k = \left(\frac{\alpha}{1-\alpha}\right) W$ into (A.25) and solving for λ, we obtain

$$\lambda = p_o \left(1-\alpha\right)\left(1+\delta\right)\left(\frac{g'}{F_L}\right), \tag{A.28}$$

where we have used the fact that the absence of rents implies $W = w = F_L$. Equation (3.4) in Proposition 3 is found by substituting (A.27) and (A.28) into (A.24) and rearranging. The fraction g'/u' in (3.4) is the marginal rate of substitution between private and public goods, and F_L is the marginal rate of transformation. Since $\left(\frac{1}{1-\alpha}\right)\left(\frac{1}{1-\varepsilon(1-\alpha)}\right) > 1$, it follows immediately from (3.4) that $g'/u' > F_L$, implying that public goods are underprovided relative to the first-best allocation. ■

Proof of Proposition 4: The proposition assumes that tax coordination starts out from a tax competition equilibrium without rents where $W = w = F_L$, $u'_g = u'_p = u'$ and $u_g = u_p$. Further, when the individual country takes τ as well as r as given, it follows from the government budget constraint (2.22) that $dW/\left|d\alpha\right| = W/\alpha\left(1-\alpha\right)$. Inserting these relationships into (4.2) and dividing the resulting expression by (4.1), we get

$$\frac{MPC}{MPB} = \left(\frac{g'\left(\alpha\right)}{u'F_L}\right)\left(\frac{\alpha\left(1-\alpha\right)\left(1+\delta\right)}{\alpha+\delta}\right). \tag{A.29}$$

By Proposition 3 the initial tax competition equilibrium satisfies (3.4) which may be substituted into (A.29) to give

$$\frac{MPC}{MPB} = \frac{\alpha+\alpha\delta}{\alpha+\delta-\varepsilon\left(\alpha+\delta\right)\left(1-\alpha\right)}. \tag{A.30}$$

From Proposition 2 and the assumption $n \to \infty$ it follows that $\varepsilon > \delta/\left(\alpha+\delta\right)$ in the initial tax competition equilibrium without rents. The expression on the right-hand side of (A.30) must therefore be greater than one, implying $MPC > MPB$. Since MPC is the marginal political cost of reducing public sector employment and MPB is the marginal political gain from spending the freed-up resources on higher public sector wages, an unconstrained politician would thus want to *cut* the public sector wage rate in order to *expand* public employment, but the binding recruitment constraint $W \geq w$ prevents him from doing so. When tax

coordination allows individual countries to raise more revenue, politicians will therefore want to spend *all* of the increased revenue on expanding public sector employment, apart from any revenue that may be needed to continue satisfying the recruitment constraint. ■

Proof of Proposition 5: Using (2.11) and (2.15), the social welfare function (2.5) may be written as

$$SW = \alpha u\left(W + r\overline{k}\right) + (1-\alpha)\, u\left(w\left(r+\tau\right) + r\overline{k}\right) + g\left(\alpha\right),$$

which may be differentiated to give (using $w' = -k$ and the fact that $(1-\alpha)\, k = \overline{k}$ in symmetric equilibrium):

$$\frac{dSW}{d\tau} = \left(g' + \overbrace{u_g - u_p}^{=0 \text{ initially}}\right) \cdot \frac{d\alpha}{d\tau} + \alpha u_g' \cdot \frac{dW}{d\tau} + \alpha\overline{k}\left(\overbrace{u_g' - u_p'}^{=0 \text{ initially}}\right)\frac{dr}{d\tau} - \overline{k}u_p'. \quad \text{(A.31)}$$

Inserting (4.3) through (4.5) into (A.31) and remembering that $u_g = u_p$, $u_g' = u_p'$ and $dW = dw$ initially, we find by using $w = F_L$ that

$$\begin{aligned}\frac{dSW}{d\tau} &= \left(\frac{u'\overline{k}}{\alpha + \varepsilon\alpha^{-1}\left(1-\alpha\right)^2}\right)\left[\left(\frac{g'}{u'}\right)\left(\frac{\varepsilon\left(1-\alpha\right)^2}{w\alpha}\right) + \alpha - \left[\alpha + \varepsilon\alpha^{-1}\left(1-\alpha\right)^2\right]\right] \\ &= \left(\frac{u'\overline{k}\varepsilon\left(1-\alpha\right)^2}{\alpha^2 + \varepsilon\left(1-\alpha\right)^2}\right)\left(\frac{g'/u'}{F_L} - 1\right). \qquad \text{(A.32)}\end{aligned}$$

Equation (A.32) shows that the welfare gain from tax coordination is proportional to the initial degree of underprovision of public goods, $\left(\frac{g'/u'}{F_L} - 1\right)$, as measured by the deviation from the Samuelson condition which requires $\frac{g'/u'}{F_L} = 1$. From Proposition 3 we know that equation (3.4) must hold in the initial tax competition equilibrium. Inserting this expression for $\frac{g'/u'}{F_L}$ into (A.32), we finally obtain

$$\frac{dSW}{d\tau} = \left(\frac{u'\overline{k}\varepsilon\left(1-\alpha\right)^2}{\alpha^2 + \varepsilon\left(1-\alpha\right)^2}\right)\left[\left(\frac{1}{1-\alpha}\right)\left(\frac{1}{1-\varepsilon\left(1-\alpha\right)}\right) - 1\right] > 0. \quad ■ \qquad \text{(A.33)}$$

Proof of Proposition 6: Since we know from (A.21) that $\Delta < 0$, it follows directly from (A.22) that condition (4.8) in Proposition 6 is necessary and sufficient to ensure that $\frac{dW}{d\tau} - \frac{dw}{d\tau} > 0$. ■

Proof of Proposition 7: Inserting (A.18) and (A.19) into (A.31), one finds the following welfare effect of a further coordinated increase in the capital tax rate at the point where the recruitment constraint just ceases to bind (so that we still have $u_g = u_p$ and $u'_g = u'_p = u'$ initially):

$$\left(\frac{-\alpha\Delta}{u'\varepsilon\,(1-\alpha)}\right)\left(\frac{dSW}{d\tau}\right) = \gamma\sigma_c\,(\alpha+\delta)\left[\frac{\alpha+\delta}{\alpha+\alpha\delta} - (1-\alpha)\right]$$

$$-\left[\delta + \alpha\,(2-\alpha) + \left(\frac{\alpha+\delta}{1+\delta}\right)\left(\frac{\alpha^2+\delta}{\alpha\,(1-\alpha)}\right)\right] \tag{A.34}$$

Since $\Delta < 0$ according to (A.21), it follows directly from (A.34) that the condition (4.9) stated in Proposition 7 is necessary and sufficient to guarantee that $dSW/d\tau > 0$. ■

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