Journal of Public Economics 87 (2003) 2571–2588
JOURNAL OF PUBLIC ECONOMICS
www.elsevier.com/locate/econbase

Fiscal competition in space and time

David E. Wildasin *

Martin School of Public Policy, University of Kentucky, Lexington, KY 40506-0027, USA

Received 28 September 2000; received in revised form 27 September 2001; accepted 13 November 2001

Abstract

This paper analyzes fiscal competition among numerous spatially-separated jurisdictions in an explicitly dynamic framework. The degree of factor mobility between jurisdictions is imperfect because it is costly and time-consuming to adjust factor stocks. Even if it is harmful in the long run, taxation of mobile factors redistributes income in favor of the owners of immobile resources in the short run. The locally-optimal tax on mobile factors is lower, the faster the speed with which factors adjust to fiscal policy. Anticipated taxes are less beneficial than those that can be imposed unexpectedly.

1. Introduction

The ability of governments to redistribute income is often constrained by private-sector behavioral adjustments. Classic examples of such behavior are labor/leisure substitution by taxpayers and by the beneficiaries of redistributive transfers. Another constraint, which has been emphasized in the now-large literature on fiscal competition, stems from the fact that governments cannot or may choose not to control the movement of economic resources, especially labor and capital, across jurisdictional boundaries (see, e.g. Cremer et al., 1996; Wildasin, 1998; Wellisch, 2000, and references therein.) When the government attempts to capture resources from some in order to finance benefits for others, the "contributors" may be able to move themselves, or the resources that they own, beyond the reach of the taxing authority. When a government attempts to pursue a policy that benefits one group, other potential beneficiaries may move into the locality, state/province, or country in order to gain access to those benefits. Governments may of course attempt to

*Tel.: +1-859-257-2456; fax: +1-859-323-1037
E-mail address: login@icpc.ie (D.E. Wildasin).

0047-2727/$ - see front matter
doi:10.1016/S0047-2727(02)00055-5

limit these sorts of behavioral adjustments, for example through restrictions on population or capital movements. And, quite aside from government restrictions, these adjustments are not costless. Indeed, limited mobility of resources is of critical importance for the analysis of redistribution; if all resources were costlessly mobile, then, as recognized long ago by Stigler (1957), redistribution would be essentially infeasible. This realization has led many authors to argue, as a normative matter, that redistribution should be undertaken by central governments; lower-level governments, it is argued, are "too open" to engage effectively redistribution.

Whether normatively desirable or not, it is certainly true empirically that national governments (in OECD countries, for example) are responsible for the vast bulk of government redistribution, both on the tax and on the expenditure sides of the government budget. From the viewpoint of political economy, this is perhaps not surprising: because mobility of resources constrains the abilities of lower-level governments to confer benefits to some at the expense of others, the return to political action at the local level may be relatively modest, and the equilibrium level of local redistribution may be correspondingly small in comparison with higher-level governments. If redistributive politics is about rent transfers, the geographic mobility of resources is important for political economy because the "degree" of mobility affects the amount rents to be gained or lost through policy change.

Although the theoretical literature on fiscal competition has drawn considerable attention to the importance of resource mobility, it has generally done so by drawing sharp and not always consistent distinctions between those resources that are assumed to be costlessly mobile and those that are perfectly immobile. For example, capital is sometimes viewed as freely mobile while labor is regarded as immobile; in other cases, labor is treated as mobile while capital is immobile. Finer-grained distinctions are not uncommon in the literature. Depending on the context and desired applications, mobility may be postulated for the young, the old, the poor, the unskilled, the rich, the skilled, or for portfolio capital, for capital used in direct investment, for capital in certain sectors or industries, and so forth. Natural resources such as land, minerals, or natural harbors are of course intrinsically immobile (although ownership rights in these resources may be tradeable), but the public infrastructure that makes them accessible is sometimes viewed as fixed, sometimes as variable. The literature also varies in the assumptions made about the geographic scope of factor markets. Sometimes, capital is assumed to be mobile among a group of localities within a given metropolitan area but fixed in supply to the area as a whole; sometimes, capital mobility is postulated among regions within a country but not among countries; sometimes, it is postulated among countries within the EU but not worldwide; and sometimes, capital is assumed to be mobile throughout the entire world.

The widely-differing modeling approaches found in the theoretical literature highlight the need for more systematic identification of the degree of mobility of different resources. The goal of the present analysis is to present an analytical framework within which the degree of mobility of resources is determined endogenously as a result of rational economic behavior by resource owners, and to show how this behavior can be taken into account in the study of fiscal competition. This is done by recognizing that the resources that are the targets of fiscal policy, including especially redistributive fiscal policy, are *stocks*, like the stock of capital or the stock of labor, that adjust gradually over time as a result of *flows*, like the flow of investment or the flow of migration. The *rates* of these flows are determined, in response to economic incentives, by the owners of these resources. Stock adjustment behavior is intrinsically dynamic in nature: the movement of resources among jurisdictions, that is, across *space*, is a process that occurs gradually, that is, over *time*. The analysis builds on standard models of costly dynamic adjustment that have been heavily exploited in empirical models of investment (see Turnovsky, 2000).[1]

The next section of the paper presents the basic model, solves for the comparative-dynamic response of a small and open economy to permanent and unanticipated perturbations of fiscal policy, and shows how a competitive jurisdiction chooses its optimal policy, given the nature of the dynamic adjustment process. Section 3 explores what happens when local policies do not take economic agents by surprise but are, at least to some degree, anticipated by them. This analysis amounts, technically speaking, to a generalization of the case of unanticipated policy changes, and the results differ from those of the preceding case in ways that can be easily interpreted in relation to them. For the purposes of Sections 2 and 3, the owners of immobile resources within the small economy are treated as a single representative agent and the imperfectly mobile resources that adjust dynamically are interpreted as capital controlled by firms that are owned in part by non-residents. Fiscal policy, under this interpretation, allows for redistribution between residents and non-resident owners of firms. Section 4, however, discusses extensions of the analysis, emphasizing that the key findings are applicable to any redistribution between immobile and partially-mobile resources. Section 4 also discusses the application of the analysis to competition within a system of jurisdictions, and among jurisdictions of different geographical scales. Section 5 concludes briefly.

2. Tax competition with adjustment costs

2.1. The model

The focus of attention is a single small jurisdiction, assumed for most of the analysis to be inhabited by identical, infinitely-lived immobile households who can be treated as a

[1] Several previous studies have examined some aspects of intertemporal fiscal competition, though none have explicitly addressed dynamic adjustment. Jensen and Toma (1991) develop a two-period model of tax competition in which a pair of governments use debt policy to manipulate the intertemporal structure of taxation. Dynamic models of fiscal competition with imperfectly mobile households are discussed by Hercowitz and Pines (1991) and Wildasin and Wilson (1996). Lee (1997) analyzes a two-period model in which capital in the second period is imperfectly mobile. Huizinga and Nielsen (1997) examine a two-period model and show that taxation of perfectly-mobile resources may enable a jurisdiction to capture rents from non-resident owners of local immobile resources. Kehoe (1989) discusses the problem of time-consistent taxation of mobile capital. It is not uncommon for game-theoretic models of strategic fiscal competition to be formulated as “stage games” with sequential decision structures e.g. Walz and Wellisch (1996), though these typically focus on the determination of a single equilibrium constellation of private and public choices rather than on the evolution of these choices over time.

representative agent. The model assumes no uncertainty, perfect capital markets, and continuous time.

2.1.1. Households

Preferences are described by a lifetime utility function $\int_0^\infty u(x_t, G_t, t)\,\mathrm{d}t$ where $u(x_t, G_t, t)$ is the discounted instantaneous utility derived from consumption of a single composite numeraire commodity x_t and local public expenditures G_t. In order to focus on the structure of local tax policy, the time path of local public good provision is treated as exogenously fixed throughout. Preferences are monotonic in x_t.

The household supplies one unit of a non-traded input called "labor" at each moment; this can be viewed as an aggregate of all local fixed inputs. The return to labor is determined in a perfectly competitive local market, and its return at time t is denoted w_t. Capital earns an exogenously-fixed and time-invariant rate of return r on the world market, and the households can borrow or lend as desired at this interest rate. Let π_t denote the profits accruing to local firms at time t, and assume that the local household owns a share θ of these firms, with $0 \leq \theta \leq 1$. The present value of this ownership share is thus $\theta \int_0^\infty \pi_t\,\mathrm{e}^{-rt}\,\mathrm{d}t$. The household may also own a share of the profits of firms outside of the locality, the present value of which is $\bar{\Pi} \geq 0$, an endowment of capital $\bar{k} \geq 0$, and an endowment of the numeraire commodity $\bar{x} \geq 0$. Let $\bar{E} \equiv \bar{x} + \bar{k} + \bar{\Pi}$.

Since labor is supplied inelastically, it may be taxed or subsidized in a lump-sum fashion. Letting T denote the net present-value of lump-sum taxes imposed by the local government on the household, the lifetime budget constraint can now be written as

$$\int_0^\infty x_t\,\mathrm{e}^{-rt}\,\mathrm{d}t = \bar{E} - T + \int_0^\infty w_t\,\mathrm{e}^{-rt}\,\mathrm{d}t + \theta \int_0^\infty \pi_t\,\mathrm{e}^{-rt}\,\mathrm{d}t \equiv Y. \tag{1}$$

Note that household welfare is monotonic in Y. Note also that T can be negative, corresponding to public expenditures on transfer payments or their equivalent.

2.1.2. Firms

Local production is undertaken by competitive firms using capital and local labor to produce the numeraire output according to the time-invariant production function $f(k_t)$ with $f'(k_t) > 0 > f''(k_t)$, where k_t is the amount of capital used in the local production process at time t; f is strictly concave because of the presence of the fixed amount of local labor. Competition for labor implies that $w_t = f(k_t) - k_t f'(k_t)$.

While firms can hire labor services in the local spot market, their capital inputs can only be altered by incurring adjustment costs, given by $c(i_t)k_t$, with $c' > 0 < c''$, where i_t is the rate of gross investment within the locality at time t, i.e. the amount of expenditures on capital goods expressed as a proportion of the amount of capital in the locality, k_t. This adjustment cost is assumed to take the form of lost output and is expressed in units of numéraire. Note that since $c(\cdot)$ is homogeneous of degree zero in the level of investment and the total stock of capital, total adjustment costs are homogeneous of degree one in these variables. Assuming that capital depreciates at a constant exponential rate of δ, the evolution of the local capital stock takes the usual form:

$$\dot{k} = (i_t - \delta)k_t. \tag{2}$$

The local government imposes a per-unit tax on capital at a rate τ which, for now, is assumed to be time-invariant. The cash flow of local firms at time t is thus the value of their output net of adjustment costs, less investment expenditures, less tax payments, less payments for local labor:

$$\pi_t = f(k_t) - c(i_t)k_t - \tau k_t - i_t k_t - w_t. \tag{3}$$

Firms choose the paths of investment i_t and capital k_t to maximize the present value of profits:

$$\max \quad \Pi \equiv \int_0^\infty \pi_t \, \mathrm{e}^{-rt} \, \mathrm{d}t. \tag{P}$$

subject to Eq. (2), with an initially-given stock of capital $k_0 = K_0$.

2.1.3. Government

The government must choose its policies to satisfy its intertemporal budget constraint,

$$\int_0^\infty G_t \, \mathrm{e}^{-rt} \, \mathrm{d}t = T + \int_0^\infty \tau k_t \, \mathrm{e}^{-rt} \, \mathrm{d}t. \tag{4}$$

Because the time path of G_t is treated as exogenous, the government has to choose just the two tax instruments, T and τ. Using Eq. (4), however, T can be determined in terms of τ. The government is assumed to act so as to maximize the welfare of the local representative agent. As noted, welfare is monotonic in Y; the government's policy problem, then, is to choose τ to maximize Y, given that T adjusts to satisfy Eq. (4). Since profits accrue in part to non-residents, these fiscal instruments allow for redistribution of income between non-resident households and the representative agent within the locality. As discussed further below, the model can be interpreted much more generally to provide an analysis of redistribution not only between local residents and owners of foreign firms, but between generic imperfectly mobile resources (e.g. different types of labor—young, skilled, etc.) and a generic immobile resource (e.g. old workers, unskilled, etc.).

2.2. Comparative dynamics

The present section investigates the effects of time-invariant local policies. The first task is to understand how a once-and-for-all unanticipated and permanent change in the local tax on capital affects the evolution of the local capital stock. This is studied under the assumption that the local economy is initially in a long-run equilibrium. It is then possible to determine how the local tax policy affects local welfare. Issues relating to time-varying and anticipated policy changes are deferred until the next section.

Assuming that the local economy is initially in a steady-state equilibrium with a capital stock of k_∞, one can characterize the impact of a change in local policy on the local capital stock in terms of a linear second-order differential equation with two distinct real roots, denoted ρ_1 and ρ_2, where (see Appendix A for details)

$$\rho_1, \rho_2 = \frac{r}{2} \pm \frac{\sqrt{r^2 - 4k_\infty f''(k_\infty)/c''(\delta)}}{2}; \tag{5}$$

note that $\rho_1 > r$ and $\rho_2 < 0$, where these inequalities depend on the concavity of f and the convexity of c. Let $\epsilon_\infty \equiv f'(k_\infty)/(k_\infty f''(k_\infty))$ denote the steady-state value of the elasticity of demand for capital. The comparative-dynamic response of the capital stock to the tax rate is given by

$$\frac{\mathrm{d}k_t}{\mathrm{d}\tau} = \frac{k_\infty}{f'(k_\infty)} \epsilon_\infty (1 - \mathrm{e}^{\rho_2 t}), \tag{6}$$

from which it follows that

$$\frac{\mathrm{d}k_t}{\mathrm{d}\tau} < 0 \quad \text{for all} \, t > 0, \tag{7}$$

that is, although an increase in the local tax on capital has no instantaneous ("short-run") impact on the local capital stock, it reduces the capital stock at all subsequent times. The reduction in the capital stock is monotonic, and the magnitude of ρ_2 determines the rate at which the capital stock falls to its new, lower, steady-state value. In the "long run", that is, asymptotically, an increase in the tax rate on capital by an amount equal to one percent of the gross return to capital reduces the capital stock by ϵ_∞ percent. Except insofar as the elasticity of demand for the capital may vary, the speed of adjustment therefore has *no* impact on the the long-run response of the capital stock to a change in tax policy.[2]

Note from Eq. (5) that the rate of adjustment of the capital stock depends critically on $c''(\delta)$, that is, the second derivative of the adjustment cost function. If the adjustment cost function is only mildly convex, so that c'' is close to zero, then $|\rho_2|$ is large and the adjustment to the new steady state occurs very quickly. If c'' is large, however, $|\rho_2|$ is small, and the adjustment to the steady state is slow.

The principal conclusions of this analysis can be summarized as follows:

Proposition 1. *Starting from an initial steady-state equilibrium, a permanent unanticipated increase in the capital tax rate lowers the new steady-state equilibrium capital stock in proportion to the elasticity of demand for capital. The capital stock falls monotonically to its new steady-state value at a rate that depends positively on the*

[2] For example, with a Cobb–Douglas production function, ϵ_∞ is a constant, and therefore $\mathrm{d}k_\infty/\mathrm{d}\tau$ is the same, no matter what the specification of the adjustment cost technology.

convexity of the adjustment cost function. In particular, with linear adjustment costs, the adjustment is instantaneous.

2.3. The welfare analysis of fiscal policy with imperfect capital mobility

Having characterized the comparative-dynamic effects of local capital taxes on the evolution of the capital stock, it is now possible to consider the welfare implications of capital taxation. Substituting from Eq. (4) into (1) and noting the dependence of w_t and π_t on k_t, one can show (see Appendix A for further details) that

$$\frac{\mathrm{d}Y}{\mathrm{d}\tau} = (1-\theta)\int_0^\infty \left\{\tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau} - k_\infty f''(k_\infty)\frac{\mathrm{d}k_t}{\mathrm{d}\tau} + k_\infty\right\}\mathrm{e}^{-rt}\,\mathrm{d}t + \theta\int_0^\infty \tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau}\mathrm{e}^{-rt}\,\mathrm{d}t. \tag{8}$$

Using Eq. (6), it is clear that $\mathrm{d}Y/\mathrm{d}\tau \geq 0$ when $\tau = 0$, with strict inequality if the local share of ownership in local firms is less than 100%. This means that the optimal local tax rate is positive whenever $\theta < 1$. Setting the derivative in Eq. (8) equal to zero and using Eq. (6), one can solve (implicitly) for the (locally) optimal rate of capital taxation, expressed as a proportion of the gross return on capital:

$$\frac{\tau}{f'(k_\infty)} = \frac{(1-\theta)r}{\epsilon_\infty \rho_2}. \tag{9}$$

Hence:

Proposition 2. *The optimal steady-state rate of taxation of local capital is directly proportional to the share of foreign ownership of firms and inversely proportional to the elasticity of demand for capital. It is inversely proportional to the speed with which the local capital stock adjusts in response to changes in the local rate of return on capital. In particular, if adjustment is instantaneous, the optimal local tax rate is zero.*

This key result has a number of implications. First, note that $\tau = 0$ if local firms are owned entirely by local residents, that is, if $\theta = 1$. Second, the optimal tax rate is strictly positive if the local ownership share is less than 1. Third, the optimal tax rate is inversely proportional to the elasticity of demand for capital. Finally, the optimal tax rate is inversely proportional to ρ_2, the speed of adjustment of the local capital stock. It is important to note that while the speed of adjustment depends on the fundamental data of the model (as shown in Eq. (5)), it is *endogenously determined*, and the optimal tax formula (9) is therefore an implicit characterization of the policy that a competitive government would select.

In standard static tax competition models with costlessly-mobile capital, the optimal local tax on capital for a small open jurisdiction is always *zero* if lump-sum revenue instruments are available. (This familiar result is just an application of the theory of the optimal tariff to taxation of a traded factor of production.) Here, that result is no longer valid, provided that: (i) local firms are owned in part by non-residents ($\theta < 1$), (ii) the local demand for capital is less than perfectly elastic, and (iii) the speed of adjustment of the capital stock is not instantaneous (ρ_2 finite). What accounts for these differences?

A critical distinction between the static and dynamic models is that the imperfect immobility of capital gives rise to quasi-rents. These rents are greater, the slower the speed of adjustment of the local capital stock. If these rents accrue to non-residents, at least in part, i.e. if $\theta < 1$, then taxation of capital enables the transfer of some of these rents to the local resident household. If the capital stock could be adjusted instantaneously (i.e. when $\rho_2 \rightarrow \infty$), there are no quasi-rents to capture and the optimal local tax is zero. If capital is completely immobile (i.e. when $\rho_2 = 0$), the optimal local policy is complete expropriation of the capital stock through confiscatory taxation.

The net rate of return on capital must be equal to r in the long run, so that the incidence of the local tax on capital thus must fall entirely on the immobile factor in the long run, no matter what the speed of adjustment may be. During the transition following a tax increase, the net rate of return is below the level that can be obtained on external markets, and the local capital tax transfers quasi-rents from capital owners to local residents. Thus, a small open locality, whose policies have no perceptible effect on the net rate of return to capital on external markets, can nonetheless achieve some redistribution at the expense of the owners of *imperfectly* mobile resources.

While a locality's residents can benefit from taxing imperfectly-mobile capital when firms are owned at least in part by non-residents, the reduction in the stock of local capital reduces the productivity of local labor, and the steady-state level of wage income is reduced by the taxation of mobile capital. Taxing imperfectly-mobile capital thus involves an intertemporal tradeoff for local residents: they can enjoy the benefits of reduced taxes for local public services, but gradually their wage income erodes, ultimately by an amount greater than the tax savings that they obtain by taxing capital. The preceding analysis has shown that the taxation of local capital is in their interest *in present value terms*, when discounted at the market rate of return. However, if the effects of local policy are (socially) discounted at a lower rate, this intertemporal tradeoff becomes less favorable. Indeed, if they are not discounted at all, so that policies are judged only by their long-run effects, the local capital tax is necessarily harmful to local residents, even if firms are entirely owned by outsiders, and thus should be avoided.

These findings contrast with those in static or two-period models. Perhaps most importantly, explicit modeling of dynamics emphasizes empirical magnitudes (speeds of adjustment) and their relevance for intertemporal tradeoffs (short-run vs. long-run effects of policy). In a two-period model such as Lee (1997), for example, costly adjustment of the capital stock gives rise to a wedge, in equilibrium, between internal and external net rates of return. Furthermore, it limits the magnitude of the adjustment of the equilibrium capital stock in response to tax policy: the higher the adjustment costs, the smaller the magnitude of equilibrium factor flows. By contrast, the explicit modeling of dynamic adjustment highlights the fact that taxation of mobile resources can still redistribute income, even though the long-run return on mobile resources is unaffected by local policies and even though the incidence of taxes on these resources are shifted entirely to immobile resources in the long run. Furthermore, higher adjustment costs affect the *speed* with which mobile resources move across jurisdictional boundaries, not the magnitude of the long-run equilibrium resource flow. The present analysis is similar to that in Huizinga and Nielsen (1997) in that the taxation of capital is only attractive to a locality because of the possibility of capturing rents accruing to foreigners. In the H–N model, however, capital is costlessly mobile, but there is (in effect) an immobile resource owned, in part, by foreigners; by taxing perfectly mobile capital, the rents accruing to the immobile factor are reduced.[3] In the present analysis, capital itself earns quasi-rents which gradually (and endogenously) erode over time, and the desired degree of taxation depends critically on the speed of adjustment of the capital stock.

3. Time-varying (anticipated) local tax policy

The analysis in the preceding section has shown how the introduction of imperfect capital mobility, in the form of adjustment costs, leads to significant changes in the incentives for a locality to impose a tax on capital. The analysis of tax policy in a dynamic setting, however, naturally raises questions about how policies might vary over time, about expectations, and about time consistency. Many of these issues have been thoroughly discussed in previous literature (see, e.g. Turnovsky, 2000), and do not necessarily warrant detailed analysis here. However, as has been seen noted above, the difference between the results from the static and dynamic models derive from the quasi-rents accruing to non-resident owners of local capital that, in the short run, can be captured by local residents through an unanticipated permanent increase in the local tax rate. Wouldn't capital owners foresee their vulnerability and act to shield themselves from fiscal exploitation in this manner?

There are several ways in which the ability of a locality to extract rents from outside owners of partially (or wholly) immobile resources may, in practice, be limited. First, if ownership of these resources is transferable, they may be sold by non-residents to residents, or never acquired by non-residents to begin with. When $\theta = 0$, as shown by Eq. (9), the optimal local tax rate is zero. This is because there are no rents to extract from outsiders, and therefore no local benefit that can offset the cost of distorting the local capital stock. Second, non-resident owners might attempt to influence the local policy-making process so as to protect their quasi-rents. In principle, they would be willing to pay up to the full amount of these rents in bribes, campaign contributions, or other rent-preserving activities. If local policymakers are perfect rent extractors, then the attempt to influence the local political process will, in effect, absorb the wealth of non-residents within the locality in much the same fashion as local taxes. On the other hand, it is conceivable that influence over the local political process can be achieved by non-resident capital owners at very low cost. In this case, the equilibrium local policy choice would involve a negligible net fiscal burden on capital. A third restraint on the use of local taxation to extract rents from non-resident capital owners is the anticipation by investors

[3] The return to the "immobile resource" in H–N is called "profit". Since there is no dynamic adjustment in that model, the local net rate of profit can diverge permanently from that in the rest of the world.

that their capital will be subject to taxation in the future, leading them to remove some or all of their capital from the locality before the local tax is actually imposed.

To explore this third possibility more formally, suppose, in contrast to the model of Section 2, that all agents anticipate an increase in the local tax rate at some date $t_1 \geq 0$. Specifically, the tax rate at time $3t$ is τ for $0 \leq t \leq t_1$ and $\tau + \alpha$ for $t \geq t_1$. Note that the anticipation of the change in policy at time t_1 is equivalent, technically speaking, to the unanticipated announcement, at $t = 0$, of a time-varying policy—specifically, one that maintains the initial tax rate until $t = t_1$ and then jumps to a higher level thereafter. (The discussion in the remainder of this section is limited to the case of a once-and-for-all change in policy at a specified future date t_1; more complex time-varying policies, with any number of changes at any specified points of time, can be built up from combinations of this simple one-time jump). With an anticipated jump in the tax rate, firms must plan their investments both before and after t_1 in a profit-maximizing fashion. One can show (details available on request) that

$$\frac{dk_t}{d\alpha} = \frac{k_\infty}{f'(k_\infty)} \epsilon_\infty \frac{-\rho_2}{(\rho_1 - \rho_2)e^{\rho_1 t_1}} (e^{\rho_1 t} - e^{\rho_2 t}) \quad \text{for } 0 \leq t \leq t_1 \tag{6a$'$}$$

$$= \frac{k_\infty}{f'(k_\infty)} \epsilon_\infty \left(1 - \left[\frac{\rho_1 e^{\rho_1 t_1} - \rho_2 e^{\rho_2 t_1}}{e^{\rho_1 t_1} e^{\rho_2 t_1} (\rho_1 - \rho_2)}\right] e^{\rho_2 t}\right) \quad \text{for } t > t_1 \tag{6b$'$}$$

where ρ_1 and ρ_2 are given in Eq. (5). Note that this solution satisfies

$$\frac{dk_t}{d\tau} < 0 \quad \text{for all } t > 0, \tag{7$'$}$$

and, in particular,

$$\frac{dk_{t_1}}{d\alpha} = \frac{k_\infty}{f'(k_\infty)} \epsilon_\infty \frac{-\rho_2}{(\rho_1 - \rho_2)e^{\rho_1 t_1}} (e^{\rho_1 t_1} - e^{\rho_2 t_1}) < 0. \tag{10}$$

Comparing Eq. (7) with (7$'$), it is clear that the qualitative impact of an increase in the local tax rate is the same, whether the tax increase is unanticipated or anticipated. This means, of course, that the mere anticipation of a tax increase is sufficient to cause the capital stock to start shrinking right away, even though the actual policy change may lie far in the future. However, the pre-implementation impact of an anticipated policy change is more limited, the more distant in time the policy change is.[4] Differentiating Eq. (10) with respect to t_1, one can see that more of the long-run adjustment will have been completed by the time that the higher tax rate takes effect, the longer the time between the announcement of the policy change and its implementation (i.e. the larger the value of t_1). The long-run effects of the tax increase are exactly the same regardless of whether or not the tax increase is anticipated.[5] Although the qualitative effects of anticipated policy changes are identical

[4] From Eq. (6a$'$), a higher value of t_1 implies a smaller change in k_t for any given $t < t_1$.

[5] The last term in brackets in (6b$'$) depends on time, and it approaches zero as time increases, so that (6b$'$) and (6) are identical in the limit.

to those of unanticipated ones, the two differ in degree because the rate of decline of the capital stock in the pre-implementation stage of adjustment ($0 \le t \le t_1$) is slower than would be true if the policy were implemented immediately. Thus:

Proposition 3.

(a) *Starting from an initial steady-state equilibrium, a permanent anticipated increase in the capital tax rate lowers the new steady-state equilibrium capital stock in proportion to the elasticity of demand for capital. The capital stock falls monotonically to its new steady-state value at a rate that depends positively on the convexity of the adjustment cost function. In particular, with linear adjustment costs, the adjustment is instantaneous.*

(b) *The anticipation of a tax increase causes the capital stock to begin falling immediately. The more in advance the tax change is anticipated (or announced), the more the capital stock will have adjusted by the time the tax increase takes place.*

Part (a) of Proposition 3 merely recapitulates the results stated in Proposition 1, thus emphasizing the qualitative similarity of the two cases. The second part, which is unique to the analysis of anticipated changes, reflects that fact that the *anticipation* of a tax increase causes adjustment to begin right away. Since the anticipation of a policy change does not affect the desired long-run adjustment, we see that the main effect of anticipation of a policy change is to lengthen and slow down the adjustment process.

Optimal local policy is characterized (details available on request) by calculating

$$\frac{\mathrm{d}Y}{\mathrm{d}\alpha} = \frac{k_\infty}{r - \rho_2}\left([1-\theta] - \frac{\tau}{f'}\epsilon_\infty\left[\frac{\rho_2}{r}\mathrm{e}^{-rt_1} + \mathrm{e}^{-\rho_1 t_1} - \mathrm{e}^{-rt_1}\right]\right). \tag{8'}$$

This expression is a generalization of Eq. (8), reducing to it when $t_1 = 0$. Since the terms on the right-hand-side of Eq. (8′) depend negatively on t_1, the anticipation of a tax increase reduces its benefit to local residents. Setting the derivative in Eq. (8′) equal to zero and solving for the optimal tax rate,

$$\frac{\tau}{f'\,(k_\infty)} = \frac{(1-\theta)}{\epsilon_\infty}\,\frac{r}{\rho_2 + \rho_1[1 - \mathrm{e}^{\rho_2 t_1}]}, \tag{9'}$$

a generalization of Eq. (9) that allows for $t_1 > 0$ that yields:

Proposition 4.

(a) *The optimal steady-state rate of taxation of local capital is directly proportional to the share of foreign ownership of firms and inversely proportional to the elasticity of demand for capital. It is lower, the greater the speed with which the local capital stock adjusts in response to changes in the local rate of return on capital. In particular, if adjustment is instantaneous, the optimal local tax rate is zero.*

(b) To the extent that an increase in the local tax rate is anticipated, the optimal local tax rate is reduced; the more in advance the tax change is anticipated (or announced), the lower is the optimal local tax rate. As $t_1 \to \infty$, the optimal local tax rate approaches zero.

The first part of this proposition is almost identical to Proposition 2. The second part follows intuitively from Proposition 3: since the anticipation of a tax increase causes an outflow of capital to begin even before the higher tax takes effect, and since this outflow reduces the benefits to local residents from higher taxes, it makes sense that the optimal tax rate is lower when the owners of local capital are not taken completely by surprise by changes in local tax policy.

The formula for the optimal tax rate in Eq. (9′) lends itself to empirical estimation. Note from Eqs. (6) and (6b′) that ρ_2 is the proportionate rate of decline of the local capital stock in response to a higher local tax (whether anticipated or unanticipated). This means that the half-life of the post-implementation adjustment process is $\ln(0.5)/\rho_2$. An estimate of the speed of adjustment (see Hamermesh and Pfann, 1996, for a survey) can thus be used to determine the value of ρ_2 and $\rho_1 = r - \rho_2$, which, along with estimates of the other parameters in Eq. (9′), determine the optimal tax rate. As one illustration, the findings of Decressin and Fatás (1995), who estimate that interregional labor flows in the EU respond to market demand fluctuations about half as rapidly as among US regions of comparable size, suggest that one would likely observe higher net fiscal burdens on workers in the EU context. Estimates of the speed of adjustment for regions or jurisdictions of different sizes within countries and at the international level and for labor and capital of different types could be used to test the degree to which greater factor mobility constrains governments in using fiscal policy to impose net burdens or offer net subsidies.

As observed at the beginning of this section, the desire of governments to capture quasi-rents from non-resident owners of imperfectly mobile resources may discourage cross-ownership of such resources. For example, it is frequently noted (e.g. Baxter and Jermann, 1997) that international cross-ownership of capital is insufficient to achieve full diversification of risks on financial assets. An intriguing question is whether political-economy considerations (essentially, risk of expropriation through fiscal or other policies) plays a role in explaining this fact.[6] One might anticipate that low degrees of factor mobility (the ρ_i's) would be associated empirically with a high degree of local ownership (θ). These issues warrant further theoretical and empirical investigation.

4. Further implications and extensions

4.1. Competition for types of labor and capital

Following much of the literature on fiscal competition and on dynamic adjustment, the imperfectly mobile factor of production k has been called "capital". There is nothing intrinsic to the model, however, that precludes alternative interpretations of the immobile

[6] See Wildasin and Wilson (1998) for a formal model that addresses the implications of local rent-capture for risk pooling and welfare, as well as for references to related literature.

and imperfectly mobile resources. For example, one could interpret the immobile resource as ‘‘unskilled labor’’, while k could be interpreted as ‘‘skilled labor’’ or ‘‘managers and entrepreneurs’’.[7]

It is straightforward to allow for multiple types of imperfectly-mobile resources, at least for some simple cases. Suppose that there are many local production sectors, each with a production function $f_i(k_i)$ utilizing distinct types of sector-specific immobile and imperfectly mobile resources k_i to produce traded goods (whose prices are taken as fixed on external markets and normalized to unity). Suppose that all of the immobile resources are owned by the representative immobile household and that each imperfectly-mobile resource can be taxed at a different rate τ_i. Under these assumptions, the formulae (9) and (9′) can be applied separately for each of the mobile resources, thus characterizing the *structure* of taxation for different types of resources. For example, if intangible financial assets can be adjusted very quickly, whereas manufacturing facilities can only be adjusted slowly, the former would optimally be taxed very lightly while the latter would be taxed relatively heavily, other things the same. Similarly, the analysis implies that jurisdictions would optimally impose smaller net fiscal burdens on highly-mobile workers (for example, ‘‘temporary’’ workers such as non-resident business travelers).

4.2. Equilibrium for a system of jurisdictions

In focusing on optimal policy for a single jurisdiction, the analysis has not explicitly addressed the welfare properties of fiscal competition among a *system* of jurisdictions. From an overall efficiency perspective, there are two principal issues: first, do local tax policies affect the spatial misallocation of resources, and second, how do they affect the adjustment of factor stocks? If all jurisdictions are perfectly symmetric, imposition of identical net burdens on a mobile resource causes no spatial factor misallocations. Extractions of rents from initial factor stocks coupled with competition for new resources may, however, result in excessive ‘‘churning’’ of factor allocations among jurisdictions (as in Wildasin and Wilson (1996)). Jurisdiction with differing production or adjustment-cost technologies or different degrees of local ownership of mobile resources will impose unequal fiscal burdens on imperfectly-mobile factors, resulting in an inefficient spatial allocation of resources for the system as a whole. This is in contrast to the standard atemporal models with costless factor mobility, where, no small jurisdiction would impose a non-zero fiscal burden on mobile factors which are thus, in equilibrium, allocated efficiently over space. In addition, of course, competition for mobile resources can affect the mix of local taxes. It is first-best efficient to tax only the immobile local resources if, as assumed above, they are perfectly inelastically supplied. As is well known, however, this conclusion can easily be reversed if one assumes instead that the world-wide stock of mobile resources is fixed and the immobile resources are elastically supplied; in this case,

[7] Of course, firms cannot ‘‘own’’ skilled workers or managers in the same way that they own capital. Provided that the cost of adjusting the stock of skilled workers/managers is an increasing function of the *rate of adjustment*, however, the foregoing analysis is equally applicable to competition for human as well as non-human resources.

the first-best policy would be to tax only the former, but competition would shift the tax burden toward the latter.

4.3. Fiscal competition, redistribution, and geographical scale

How quickly capital or labor can flow from one real-world jurisdiction to another is an empirical question. The adjustment-cost model does not insist that factor mobility is more costly on large rather than small geographical scales, and some resources (e.g. world-class athletes, musicians, scientists, or entrepreneurs) can move more freely over large distances than others may be able to move even over small distances. In general, however, the mobility of resources is undoubtedly greater at small geographical scales. One way to capture this stylized fact within the formal model would be to suppose that a country consists of many identical small jurisdictions, and that the speed of adjustment for mobile resources is higher within the country, i.e. among the small jurisdictions, than it is between the country and the rest of the world. The simplest way to do this is to suppose that adjustment costs are quadratic so that c'' in Eq. (5) is a constant which can then parameterize the speed of adjustment: a high value of c'', and a low speed of adjustment, would apply to international factor movements, as compared with movement of factors among localities. Other things the same, local governments would then optimally choose low rates of taxation on mobile resources while a central government would choose a higher rate. This result supports the traditional notion that higher-level governments face weaker constraints on their ability to engage in redistributive tax/transfer policies, even for countries (presumably including almost all countries) which are sufficiently small that they cannot affect the worldwide rate of return on capital or labor. It also suggests an operationally-meaningful basis on which one could examine whether the localities within a state, province, metropolitan area, or other relatively small region compete "more intensely" with one another than with the rest of the world. Empirical analyses of tax competition among localities within small regions (Brueckner, 2001; Buettner, 2001; Brueckner and Saavedra, 2001) find that the amount of capital and the choice of capital tax policy for any one local government depends on the fiscal policies of nearby localities. If capital were as freely mobile across the nation or the entire world as within a metropolitan area, the policies of neighboring jurisdictions would have no effect on amount of capital within a given locality and thus, presumably, no effect on its tax policy. These empirical findings are thus perhaps most easily explained by faster speeds of capital-stock adjustment on smaller geographic scales.

5. Conclusion

The preceding sections have presented an explicitly dynamic analysis of fiscal competition built on a standard model of costly adjustment of the stock of a factor of production. This analysis has shown how an endogenously-determined level of factor mobility affects the response to changes in fiscal policy and how this in turn alters the desirability of alternative policies. Broadly speaking, the analysis indicates that governments may have incentives to impose net fiscal burdens on imperfectly-mobile factors of production, even though this is harmful in the long run, because there are short-run rents that can be captured from the non-resident owners of these factors. The short-run gains can offset the long-run losses, at least for modest rates of net taxation. However, the ability of a government to capture these rents depends in part on being able to ‘‘surprise’’ owners of the imperfectly mobile resources, and the magnitude of the rents themselves depend on the speed with which factor supplies adjust.

The analysis here has focused on the case of a jurisdiction that is sufficiently small that its policies do not affect equilibrium factor prices in external markets. As in the theory of the firm in a perfectly competitive industry, this obviates the need to be concerned with strategic interactions among governments. If, however, two or more jurisdictions are sufficiently large relative to external factor markets that their policies have non-negligible impacts on factor prices, the choice of fiscal policy by one will affect the optimal choices of others, and conversely. The analysis of strategic fiscal interactions in a dynamic setting such as that presented above may offer useful new insights.

While it is possible to extend the model in a straightforward fashion to allow for several mobile factors of production in distinct sectors, it would be of considerable interest to analyze the simultaneous dynamic adjustment of two or more factors of production used in the same production process. An explicit analysis of the joint stock-adjustment problem with complementary inputs would shed light on the optimal structure of fiscal treatment for different factors of production, an issue of considerable empirical and policy relevance.

Acknowledgements

Earlier versions of some of the analysis and results in this paper were presented at a conference on ‘‘Fiscal Competition and Federalism in Europe’’ at the Zentrum für Europäische Wirtschaftsforschung (Mannheim), at the University of Kentucky, at a meeting of the Economic Policy Panel (Lisbon) (Wildasin, 2000), and at the ISPE conference on ‘‘Public Finance and Redistribution’’ at CORE. (A longer version, containing additional discussion and technical details, appears as CESifo Working Paper No. 370). I am grateful to participants, to two anonymous referees, and to the editors for helpful comments. I also thank R. Chirinko for very helpful correspondence. The author retains sole responsibility for errors, however.

Appendix A

This appendix presents the derivations of some of the results in the text.

Derivation of Eq. (6)

The key to most of the results is to understand how local tax policy affects the local capital stock, which requires analysis of the profit-maximization problem (P). Forming the current-value Hamiltonian

$$H_t \equiv \pi_t + \lambda_t (i_t - \delta) k_t,$$

the necessary conditions for a solution to (P) are

$$\frac{\partial H}{\partial i_t} = 0 \leftrightarrow \lambda_t = 1 + c'(i_t) \tag{A.1}$$

$$-\dot{\lambda} + r\lambda_t = \frac{\partial H}{\partial k_t} \leftrightarrow -\dot{\lambda} = f'(k_t) - c(i_t) + (\lambda_t - 1)i_t - \tau - \lambda_t(r+\delta). \tag{A.2}$$

By Eq. (A.1), the profit-maximizing rate of investment is determined implicitly as a function $i_t = \phi(\lambda_t)$ with $\phi'(\cdot) = c''(\cdot)^{-1} > 0$. Substituting into Eq. (A.2) and defining $\Psi(\lambda_t) \equiv c(\phi[\lambda_t]) - c'(\phi[\lambda_t])\phi(\lambda_t)$ yields

$$-\dot{\lambda} = f'(k_t) - \Psi(\lambda_t) - \tau - \lambda_t(r+\delta). \tag{A.3}$$

Eqs. (2) and (A.3) define a dynamical system in the two variables k_t and λ_t. Letting λ_∞, k_∞, and i_∞ denote steady state values, Eqs. (2) and (A.3) imply that

$$i_\infty \equiv \phi(\lambda_\infty) = \delta \tag{A.4}$$

$$f'(k_\infty) = \Psi(\lambda_\infty) + \tau + \lambda_\infty(r+\delta) \tag{A.5}$$

which uniquely determine the steady state of the system.

To see how the local capital stock depends on local taxation, first derive the variational equations (Hartman, 1964, Theorem 3.1, pp. 95–96; Boadway, 1979)

$$\frac{\mathrm{d}\dot{k}}{\mathrm{d}\tau} = (\phi(\lambda_t) - \delta)\frac{\mathrm{d}k}{\mathrm{d}\tau} + k_t\phi'(\lambda_t)\frac{\mathrm{d}\lambda_t}{\mathrm{d}\tau} \tag{A.6}$$

$$\frac{\mathrm{d}\dot{\lambda}}{\mathrm{d}\tau} = -f''(k_t)\frac{\mathrm{d}k}{\mathrm{d}\tau} + (r + \delta + \Psi'(\lambda_t))\frac{\mathrm{d}\lambda_t}{\mathrm{d}\tau} + 1 \tag{A.7}$$

from Eqs. (2) and (A.3). These equations, together with the boundary conditions $k_0 = K_0$ and $\lim_{t\to\infty}\lambda_t = \lambda_\infty = \phi^{-1}(\delta)$, provide two linear differential equations in $\mathrm{d}\lambda_t/\mathrm{d}\tau$ and $\mathrm{d}k_t/\mathrm{d}\tau$; assuming an initial steady-state, the coefficients in these equations are constant. To reduce the dimensionality of this system, use Eq. (A.4) in (A.6) and note that $\phi'(\lambda_\infty) = 1/c''(\delta)$. Then Eq. (A.6) implies

$$\frac{\mathrm{d}\lambda_t}{\mathrm{d}\tau} = \frac{c''(\delta)}{k_\infty}\frac{\mathrm{d}\dot{k}_t}{\mathrm{d}\tau} \tag{A.8}$$

and hence

$$\frac{\mathrm{d}\dot{\lambda}_t}{\mathrm{d}\tau} = \frac{c''(\delta)}{k_\infty}\frac{\mathrm{d}\ddot{k}_t}{\mathrm{d}\tau}. \tag{A.9}$$

Noting that $\Psi'(\lambda_\infty) = -\delta$, substitution from Eqs. (A.8) and (A.9) into (A.7) yields a second-order differential equation

$$\mathrm{d}\frac{\ddot{k}_t}{\mathrm{d}\tau} = r\frac{\mathrm{d}\dot{k}_t}{\mathrm{d}\tau} - \frac{k_\infty f''}{c''(\delta)}\frac{\mathrm{d}k_t}{\mathrm{d}\tau} + \frac{k_\infty}{c''(\delta)} \tag{A.10}$$

with boundary conditions $\mathrm{d}k_0/\mathrm{d}\tau = 0$ and $\lim_{t\to\infty} \mathrm{d}k_t/\mathrm{d}\tau = \mathrm{d}k_\infty/\mathrm{d}\tau = 1/f''(k_\infty)$; the characteristic polynomial of this equation has the roots stated in Eq. (5) and direct calculation confirms that Eq. (6) is the solution to it.

Derivation of Eqs. (8) and (9)

To obtain Eq. (8), note first that

$$\begin{aligned}\frac{\mathrm{d}\Pi}{\mathrm{d}\tau} &= \int_0^\infty \frac{\mathrm{d}\pi_t}{\mathrm{d}\tau}\,\mathrm{e}^{-rt}\,\mathrm{d}t \\ &= \int_0^\infty \left\{(f' - [c+i])\frac{\mathrm{d}k_t}{\mathrm{d}\tau} - k_\infty(1 + c'(\delta))\frac{\mathrm{d}i_t}{\mathrm{d}\tau}\right\}\mathrm{e}^{-rt}\,\mathrm{d}t \\ &\quad - \int_0^\infty \left\{\tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau} + k_\infty - \frac{\mathrm{d}w_t}{\mathrm{d}\tau}\right\}\mathrm{e}^{-rt}\,\mathrm{d}t.\end{aligned} \tag{A.11}$$

Substituting from Eqs. (A.1) and (A.2),

$$\int_0^\infty \left\{(f' - [c+i])\frac{\mathrm{d}k_t}{\mathrm{d}\tau} - k_\infty\frac{\mathrm{d}i_t}{\mathrm{d}\tau}\right\}\mathrm{e}^{-rt}\,\mathrm{d}t \tag{A.12}$$

$$= \lambda\int_0^\infty \left\{r\frac{\mathrm{d}k_t}{\mathrm{d}\tau} - k_\infty\frac{\mathrm{d}i_t}{\mathrm{d}\tau}\right\}\mathrm{e}^{-rt}\,\mathrm{d}t + \int_0^\infty \tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau}\mathrm{e}^{-rt}\,\mathrm{d}t$$

$$= \int_0^\infty \tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau}\mathrm{e}^{-rt}\,\mathrm{d}t$$

where the second equality is obtained by noting first that $k_\infty \mathrm{d}i_t/\mathrm{d}\tau = \mathrm{d}\dot{k}_t/\mathrm{d}\tau$ in a steady state and then by integrating by parts.

Use Eq. (4) in (1) to eliminate T; noting the dependence of w_t on k_t, differentiation of Y yields

$$\frac{\mathrm{d}Y}{\mathrm{d}\tau} = \int_0^\infty \left(-k_\infty f''(k_\infty)\frac{\mathrm{d}k_t}{\mathrm{d}\tau} + \tau\frac{\mathrm{d}k_t}{\mathrm{d}\tau} + k_\infty\right)\mathrm{e}^{-rt}\mathrm{d}t + \theta\frac{\mathrm{d}\Pi}{\mathrm{d}\tau}, \tag{A.13}$$

from which Eq. (8) follows after substituting from Eqs. (A.11) and (A.12).

Using Eq. (6) and setting the derivative equal to zero produces Eq. (9).

References

Baxter, M., Jermann, U., 1997. The international diversification puzzle is worse than you think. American Economic Review 87, 170–191.

Boadway, R., 1979. Long-run tax incidence: A comparative dynamic approach. Review of Economic Studies 46, 505–511.

Brueckner, J.K., 2001. Strategic Interaction Among Governments: An Overview of Empirical Studies, unpublished.

Brueckner, J.K., Saavedra, L.A., forthcoming. Do Local Governments Engage in Strategic Tax Competition? National Tax Journal.

Buettner, T., 2001. Local business taxation and competition for capital: The choice of the tax rate. Regional Science and Urban Economics 31, 215–245.

Cremer, H., Fourgeaud, V., Leite-Monteiro, M., Marchand, M., Pestieau, P., 1996. Mobility and redistribution: A survey. Public Finance 51, 325–352.

Decressin, J., Fatás, A., 1995. Regional labor market dynamics in Europe. European Economic Review 39, 1627–1655.

Hamermesh, D.S., Pfann, G.A., 1996. Adjustment costs in factor demand. Journal of Economic Literature 34, 1264–1292.

Hartman, P., 1964. Ordinary Differential Equations. Wiley, New York.

Hercowitz, Z., Pines, D., 1991. Migration with fiscal externalities. Journal of Public Economics 46, 163–180.

Huizinga, H., Nielsen, S.B., 1997. Capital income and profit taxation with foreign ownership of firms. Journal of International Economics 42, 149–165.

Jensen, R., Toma, E.F., 1991. Debt in a model of tax competition. Regional Science and Urban Economics 21, 371–392.

Kehoe, P.J., 1989. Policy cooperation among benevolent governments may be undesirable. Review of Economic Studies 56, 289–296.

Lee, K., 1997. Tax competition with imperfectly mobile capital. Journal of Urban Economics 42, 222–242.

Stigler, G.J., 1957. The Tenable Range of Functions of Local Government, Joint Economic Committee, Federal Expenditure Policy for Economic Growth and Stability, reprinted in Phelps, E.S. (Ed.). Private Wants and Public Needs, Rev. ed., 1965, New York: Norton, pp. 167–176.

Turnovsky, S.J., 2000. Methods of Macroeconomic Dynamics, 2nd Edition MIT Press, Cambridge.

Walz, U., Wellisch, D., 1996. Strategic provision of local public inputs for oligopolistic firms in the presence of endogenous location choice. International Tax and Public Finance 3, 175–189.

Wellisch, D., 2000. Theory of Public Finance in a Federal State. Cambridge University Press, Cambridge.

Wildasin, D., 1998. Factor mobility and redistributive policy: local and international perspectives. In: Sorensen, P.B. (Ed.), Public Finance in a Changing World. MacMillan Press Ltd, London, pp. 151–192.

Wildasin, D., 2000. Factor Mobility and Fiscal Policy in the EU: Policy Issues and Analytical Approaches, Economic Policy.

Wildasin, D.E., Wilson, J.D., 1996. Imperfect mobility and local government behavior in an overlapping-generations model. Journal of Public Economics 60 (2), 177–198.

Wildasin, D.E., Wilson, J.D., 1998. Risky local tax bases: Risk-pooling vs. rent capture. Journal of Public Economics 69, 229–247.