The Political Economy of Capital Income Taxation with an Aging Population*

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Abstract

This paper examines the relationship between the aging of the population and tax rates on capital income, using a simple model of the political-economy determination of capital income taxation in the framework of overlapping generations. The theory predicts that tax rates on capital income could actually rise as the population ages, even though older individuals would be expected to own more capital than the young and thus vote against higher taxes. The implications of the model are shown to be consistent with panel data for Western European countries from 1970 to 1996.

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1 Introduction

In every life-cycle saving framework (for instance, the overlapping generations model) the burden of a tax on capital income falls most heavily on the shoulders of the elderly who are the primary holders of capital. Only later, when the current young grow older and accumulate savings do they become capital income taxpayers. A change in the age composition of the population therefore has potentially strong implications for the political economy of capital income taxation.

In this paper we develop a simple model of a political-economy determination of capital income taxation in the framework of overlapping generations. The tax revenues are employed to finance a uniform lump-sum transfer (demogrant), so that the combined tax-transfer system is progressive as in the modern welfare state.

Conventional wisdom suggests that a rising share of the elderly in the population should tilt the political power balance against taxes on capital income, since the old are the primary owners of capital. We first examine this hypothesis theoretically, and then confront the conclusions with data from the ten Western European countries over the period from 1970 to 1996. We show that implications of the model are consistent with the data.

The organization of the paper is as follows. Section 2 presents an overlapping generations model with an exogenous taxation of capital income. Section 3 develops a political-economy framework for endogenizing the determination of the tax on capital income. Section 4 scrutinizes the conventional wisdom concerning the effect of aging population on capital income taxation. Section 5 examines empirically the conventional wisdom about the effect of the aging population on capital income taxation. It also examines the asymmetric effect of the aging population on the taxation of capital and labor income. Section 6 concludes.

2 Equilibrium with an Exogenous Capital Income Tax

The heart of any political-economy equilibrium is some underlying distribution of income. For concreteness, our model generates an income distribution based on human capital formation framework with heterogenity in innate ability. Consider a standard overlapping-generations model in which each generation lives two periods: a working period, and a retirement period. We assume a stylized economy in which there are two types of workers: skilled workers have high productivity and provide one efficiency unit of labor per unit of labor time, while unskilled workers provide only $q < 1$ efficiency units of labor per unit of labor time. Workers have one unit of labor time during their first period of life, but are born without skills, and thus with low productivity. They have no endowment of physical capital. At the beginning of the first period, each worker chooses whether to acquire an education and become a skilled worker, or instead remain unskilled. Individuals retire after the working period, with their consumption funded by savings from the first period and a government transfer, discussed below.

There is a continuum of individuals, characterized by an innate ability parameter, e, which is the time needed to acquire an education. By investing e units of labor time in education, a worker becomes skilled, after which the remaining $(1 - e)$ units of labor time provide an equal amount of effective labor in the balance of the first period. Less capable individuals require more time to become skilled and thus find education more costly in terms of lost income (education is a full-time activity). The cumulative distribution function of innate ability is denoted by $G(\cdot)$ with the support being the interval $[0, 1]$. The density function is denoted by $g = G'$.

In a companion paper [Razin, Sadka and Swagel (forthcoming)], we demonstrate how the redistribution scheme is determined in a political-economy equilibrium when the tax instrument is the labor tax. In this paper we focus instead on capital income taxation, where the labor income tax is exogenously determined. For simplicity, we set the tax rate equal to zero.

Given these assumptions, there exists a cutoff level, e^*, such that those with education cost parameter below e^* will invest in education and become skilled, while everyone else remains unskilled. The cutoff level is determined by the equality between the return to education and the cost of education, which is foregone income:

$$w(1-e^*) = qw,$$

where w is the wage rate per efficiency unit of labor.

Rearranging terms gives the cutoff level for the education decision:

$$e^* = 1 - q. \tag{1}$$

Suppose that the government levies a flat capital income tax denoted by τ, to finance a uniform transfer or a public good, denoted by b. It is assumed that the tax revenues in each period are fully used to finance the transfer in the same period—essentially, a pay-as-you-go system. In each period, only the old have any capital income. On the other hand, the young, who own no capital yet, constitute a majority of the population, as long as the population growth rate (n) is positive. Thus, in any majority-voting system the young majority will institute a 100% tax on the income from capital which is held only by the old minority and, if feasible, will even confiscate the capital principal and not only the income from it. To eliminate such an implausible outcome from the model, we assume that any capital-income tax change must last for at least two periods and that this provision is deemed credible. In this case, the young will realize that raising the capital income tax rate will increase their tax burden as well because the tax hike applies to their capital income in the next period when they grow old.

The tax rate and the generosity of the grant are linked through the government's budget constraint. In a multi-period setting, this simple specification captures the spirit of a pay-as-you-go tax-benefit (transfer) system. The features of the transfer can include a uniform per capita grant (either in case or in-kind, such as national health care), as well as age-related benefits such as old-age social security and medicare, or free public education.

We assume a small open economy with a free capital mobility. In this case, the domestic interest rate (r) is equalized to the (fixed) world rate of interest. With a constant-returns-to-scale production technology, this means that the wage rate per efficiency unit of labor (w) is fixed too. We assume also that the residence principle of taxation is adopted by our small open economy. That is, income of residents is taxed irrespective of its origin, whether at home or abroad; income of non-residents is fully exempted from tax. This means that the capital income tax base is the capital income (interest) from domestic savings, because only these savings are taxed no matter whether they are invested domestically or abroad.

In the current period (period t), the savings of the old are already pre-determined, so that the capital income tax base is also given (and there is no efficiency cost to taxing the income from these savings). As noted, the government's budget is balanced period-by-period. The cash grant (b_t^A) that is paid to both the young (the workers) and the old (the retirees) in period t, the first period of the two-period political cycle, is given by:

$$b_t^A\, N_0[(1+n)^{t-1} + (1+n)^t] = \tau\, r\, s_{t-1}^A N_0(1+n)^{t-1},$$

where $N_0(1+n)^t$ is the size of the working-age population in period t (with N_0 the number of young individuals in period 0), and s_{t-1}^A is the average saving of the old in period t (which was pre-determined in period $t-1$). Re-arranging terms yields:

$$b_t^A = \frac{\tau r\, s_{t-1}^A}{2+n}. \tag{2}$$

We emphasize that s_{t-1}^A is exogenously given in period t since it is determined by the choices made by the now-old in the previous period.

The cash grant (b_{t+1}^B) paid in period $t+1$ (the second period of the two-period cycle) is given by:

$$b_{t+1}^B = \frac{\tau r\, s_t^B}{2+n}, \tag{3}$$

where s_t^B is the *average* (over the young population) saving made by the young in period t, that is:

$$s_t^B = \int_0^1 s_t^B(e) dG. \tag{4}$$

Unlike s_{t-1}^A, s_t^B is not given in period t; it will be determined by the utility-maximizing young individuals in period t. It is thus affected by the tax (τ) and transfer (b_t^A, b_{t+1}^B) parameters.

We denote by $W(e, \tau, b_t^A, b_{t+1}^B)$ the life-time income (wealth) of a young individual with an ability parameter e who is born in period t:

$$W(e,\,\tau,\,b_t^A,\,b_{t+1}^B) = \begin{cases} w(1-e) + b_t^A + \frac{b_{t+1}^B}{1+(1-\tau)r} & for\ e \leqq e^* \\ wq + b_t^A + \frac{b_{t+1}^B}{1+(1-\tau)r} & for\ e \geqq e^*. \end{cases} \tag{5}$$

The utility function, $u(c_{1t},\,c_{2t})$, is maximized over first-period consumption (c_{1t}) and second-period consumption (c_{2t}), subject to the life-time budget constraint:

$$c_{1t} + \frac{c_{2t}}{1+(1-\tau)r} = W(e,\,\tau,\,b_t^A,\,b_{t+1}^B), \tag{6}$$

This yields the indirect utility function:

$$V\{W(e,\,\tau,\,b_t^A,\,b_{t+1}^B), \quad [1+(1-\tau)r]^{-1}\}. \tag{7}$$

The saving of a young individual in period t, $S\{W(e,\,\tau,\,b_t^A,\,b_{t+1}^B),\ \ [1+(1-\tau)r]^{-1}\}$, equals the present value of second-period consumption:

$$S(\cdot) = C_2(\cdot)[1+(1-\tau)r]^{-1}, \tag{8}$$

where $C_2(\cdot)$ is the demand function of second-period consumption. Substituting (4) into (3) yields:

$$b_{t+1}^B = \frac{\tau r}{2+n}\int_0^1 S\{W(e,\,\tau,\,b_t^A,\,b_{t+1}^B),\ \ [1+(1-\tau)r]^{-1}\}dG. \tag{9}$$

One can see from (5) that all individuals with an ability parameter e above e^* (the unskilled individuals) have the same wealth, and, consequently the same saving (and utility). Using equation (5), we can therefore rewrite equation (9) as follows:

$$b^B = \frac{\tau r}{2+n}\int_0^{e^*} S\{w(1-e)+b^A+b^B[1+(1-\tau)r]^{-1},\ \ [1+(1-\tau)r]^{-1}\}dG$$
$$+\frac{\tau r}{2+n}S\{wq+b^A+b^B[1+(1-\tau)r]^{-1},[1+(1-\tau)r]^{-1}\}[1-G(e^*)], \tag{10}$$

Since w and r are fixed, the economy reaches the two-period, political-economy, steady-state cycle at once. We therefore drop the time subscripts t and $t+1$ in equation (10) and henceforth. Note also that there is a proportion of $1-G(e^*)$ of unskilled individual among the working-age population.

Given the capital income tax rate τ, we now have a complete description of the equilibrium. Equation (2) determines b^A as a function of n and τ (note that s^A is exogenous), while equation (10) determines b^B as a function of the same variables:

$$b^A = B^A(t,n) \tag{2'}$$

$$b^B = B^B(\tau,n). \tag{10'}$$

3 Political-Economy Determination of the Capital Income Tax

We now return to describe how the capital income tax is determined in a political-economy setting. We assume that the political process is of a direct democracy. That is, people directly vote for the tax rate, taking into account the budget-balancing benefits, b^A and b^B, as determined in (2') and (10').

Consider first an old individual with ability parameter e. Her saving, denoted by $s^A(e)$, has already been pre-determined. Note that s^A in equation (2) or (2') is the average of the saving of the old, $s^A(e)$ for each old individual. Her net gain from the tax-transfer system (β) is given by:

$$\beta(\tau, n, e) = B^A(\tau, n) - \tau r s^A(e). \tag{11}$$

Note that $s^A(e)$ is strictly declining in e for all $e \leqq e^*$ (assuming normality), and then becomes flat. Thus, if a certain tax hike benefits an old person with ability parameter e_0, it must also benefit all old people with ability parameter above e_0 (that is, all less able individuals). Conversely, if an e_0-person favors a certain tax cut, then all persons with a lower e (more able) will also favor such a tax cut. To see this formally, note from (11) that $\partial(\partial\beta/\partial\tau)/\partial e = \partial^2\beta/\partial\tau\partial e = -r ds^A/de \leqq 0$.

Consider next a young individual of type e. Rewrite her indirect utility as:

$$\hat{V}(\tau, n, e) = \begin{cases} V\{w(1-e) + B^A(\tau, n) + B^B(\tau, n)[1+(1-\tau)r]^{-1}, [1+\tau)r]^{-1}\} & for \quad e \leqq e^* \\ V\{wq + B^A(\tau, n) + B^B(\tau, n)[1+(1-\tau)r]^{-1}, [1+(1-\tau)r]^{-1}\} & for \quad e \geqq e^* \end{cases} \tag{12}$$

As with the old, we can calculate how the net gain from a tax change varies with e:

$$\frac{\partial^2 \hat{V}}{\partial \tau \partial e}(\tau, n, e) = \begin{cases} -w_1(V_{11}(\cdot)\{\frac{\partial B^A}{\partial \tau}(\cdot) + \frac{\partial B^B}{\partial \tau}(\cdot)[1+(1-\tau)r]^{-1} \\ +rB^B(\cdot)[1+(1-\tau)r\}^{-2}\} + rV_{12}(\cdot)[1+(1-\tau)r]^{-2}) \;\; for \; e < e^* \\ 0 \quad for\, e > e^* \end{cases} \tag{13}$$

where subscripts stand for partial derivatives. We assume that $\partial^2 \hat{V}/\partial \tau \partial e \geqq 0$. This is a plausible assumption. For instance, with a log-linear utility function, $V_{11} < 0$; $V_{12} = 0$; and because raising the tax rate must raise revenue at the equilibrium range of tax rates (that is, $\partial W/\partial \tau = \partial B^A/\partial \tau + \partial B^B/\partial \tau[1+(1-\tau)r]^{-1} + rB^B[1+(1-\tau)r]^{-2} > 0$, it follows that $\partial^2 \hat{V}/\partial \tau \partial e$ is indeed non-negative. In this case, if a certain tax hike benefits a young individual of type e_1, it must benefit all individuals with $e > e_1$; conversely, if a tax cut is beneficial for an e_1-individual, it must also be beneficial for all individuals with $e < e_1$.

A political-economy equilibrium is achieved when there is a triplet (τ^*, e_0, e_Y) such that:

$$\tau^* = \underset{\tau}{\operatorname{argmax}}\, \beta(\tau, n, e_O); \tag{14}$$

$$\tau^* = \underset{\tau}{\operatorname{argmax}} \hat{V}(\tau, n, e_Y); \quad \text{and} \tag{15}$$

$$G(e_O) + G(e_Y)(1+n) = (2+n)/2. \tag{16}$$

That is, there is a pair of individuals, one old (with an ability parameter e_O) and one young (with an ability parameter e_Y), who each plays the role of a "pivot" for her respective generation. These pivots' preferred choice is the *same* tax rate τ^*; see equations (14) and (15). Together, these pivots divide the total population (of the old and the young) evenly, so that the tax rate τ^* is the equilibrium with democratic voting. All old individuals with ability parameters above e_O and all young individuals with ability parameters above e_Y would prefer a higher tax rate than (or, at least, the same tax rate as) τ^*. All old individuals with ability parameters below e_O and all young individuals with ability parameters below e_Y would prefer a lower tax rate than (or the same tax rate as) τ^*. To see that these pivots divide the total population (of the old and the young) evenly, note that the number of old people with ability parameters below e_O is $G(e_O)N_0(1+n)^{t-1}$. Similarly, the number of young individuals with ability parameters below e_Y is $G(e_Y)N_0(1+n)^t$. The rest of the population (who favor a higher tax rate than τ^*) is $[(1-G(e_O)]N_0(1+n)^{t-1} + [1-G(e_Y)]N_0(1+n)^t$. Equating the latter expression with $G(e_O)N_0(1+n)^{t-1} + G(e_Y)N_0(1+n)^t$ yields equation (16).

Given the structure of the model, the determination of the political-economy equilibrium can be simplified a great deal. Differentiate β with respect to τ to get:

$$\frac{d\beta}{d\tau}(\tau, n, e) = \frac{\partial B^A}{\partial \tau}(\tau, n) - rs^A(e) = \frac{rs^A}{2+n} - rs^A(e), \tag{17}$$

where use is made of equation (2). Recall that s^A is the average saving of the old, whereas $s^A(e)$ is the saving of an old individual of type e. Because $s^A(e)$ is declining in e, then the ability parameter of the old pivot is determined by:

$$\frac{s^A}{2+n} = s^A(e_O). \tag{18}$$

This e_O depends on the population growth rate, n; denote it by $E_O(n)$. All old individuals with ability parameter above $E_O(n)$ [and hence individual saving, $s^A(e)$, below the total saving of the old per the total population, $s^A/(2+n)$] would (weakly) benefit from a tax hike up to a maximum of 100%, whereas all the rest would (weakly) benefit from a tax cut all the way down to zero. The pivot among the old, however, is indifferent to any level of the tax rate, and therefore will not play an effective role in setting the tax rate. Note that it may be possible that $s^A/(2+n) < s^A(e)$ for all e, in which case the old pivot is $E_O(n) = 1$. In this case, all old individuals object to any tax on capital income.[1]

Thus, condition (14) becomes redundant as the old pivot is determined by (18), and she is indifferent among all tax rates. Substituting $E_O(n)$ into equation (16) determines the ability parameter of the young pivot; denote this by $e_Y = E_Y(n)$. The political-economy equilibrium tax rate is then derived by substituting $E_Y(n)$ for e_Y into equation (12) and setting the derivative

[1] The opposite case of $s^A/(2+n) > s^A(e)$ for all e is not possible, because s^A is the average of $s^A(e)$ over all e, and $s^A/(2+n) < s^A$.

of $\hat{V}$ with respect to τ equal to zero. That is, the political-economy equilibrium is determined by one equation:

$$\hat{V}_1[\tau, n, E_Y(n)] = 0. \tag{19}$$

The solution to this equation is the political-economy equilibrium tax rate, denoted by $\tau^*(n)$.

4 The Dependency Ratio and the Capital Income Tax

In a life-cycle saving framework such as the overlapping generations model employed here, a tax on capital applies immediately to the current old, whose income is primarily from capital. Only one period later, when the current young grow older, do they bear the tax burden as well. Therefore, at any point in time, one would expect the anti-tax coalition to draw heavily on the current old generation. Thus, one would expect that as the share of the elderly in the population rises, the anti-tax coalition increases its influence and the ensuing political-economy equilibrium will involve lower taxes on capital.

In this section we turn to address this issue. In our setting, the share of the elderly in the population is $No(1+n)^{t-1}/[No(1+n)^{t-1}+No(1+n)^t] = 1/(2+n)$. Thus, when the population growth rate (n) falls, the share of the elderly in the population rises. We therefore address the question of whether $d\tau^*/dn$ is indeed positive, so that when n declines (and the share of the elderly in the population rises), the political-economy capital income tax rate falls.

For this purpose we totally differentiate equation (19) (the single equation which determines the political-economy equilibrium tax rate on capital income) with respect to n to get:

$$\frac{d\tau^*}{dn} = \frac{\hat{V}_{12} + \hat{V}_{13} dE_Y/dn}{-\hat{V}_{11}}. \tag{20}$$

Subscripts denote partial derivatives, and the arguments of the functions were dropped for ease of notation. Because τ^* maximizes $\hat{V}$, it follows from the second-order condition for maximization that $\hat{V}_{11} \leqq 0$, so that:

$$\text{Sign } (\frac{d\tau^*}{dn}) = \text{Sign } (\hat{V}_{12} + \hat{V}_{13} dE_Y/dn). \tag{21}$$

Thus, the sign of the effect of n on τ^* is decomposed into two components. First, $\hat{V}_{12}$ represents the effect of a change in n on the preferred tax by the existing young pivot. Second, a change in n changes the identify of the young pivot and, correspondingly, the equilibrium tax rate; this is represented by $\hat{V}_{13} dE_Y/dn$. (As was already mentioned, the old pivot does not play an effective role in the determination of the tax rate.)

We are now equipped to address the question of whether a rise in the elderly share in the population (namely, a decline in n) does indeed lower the capital income tax rate in a political-economy equilibrium. Formally, is $d\tau^*/dn$ indeed positive? We show, contrary to the aforementioned common wisdom, that the latter derivative may plausibly be negative rather than positive.

To see this, we first investigate to sign of $\hat{V}_{12}$ which represents the attitude toward the capital income tax of the existing young pivot. Note from equation (12) that

$$\hat{V}_1 = V_1 \frac{\partial W}{\partial \tau} + V_2 \frac{\partial}{\partial \tau} [\frac{1}{1 + (1-\tau) r}]. \tag{22}$$

The net gain to the young pivot from raising the tax rate consists of two components: an income effect [the first term on the right-hand side of equation (22)] and a price (interest rate) effect [the second term on the right-hand side of equation (22)] which is related to the efficiency cost of taxation. To see how this incentive to raise the tax (which is zero at the existing n) changes when n rises, differentiate the expression in (22) with respect to n to get:

$$\hat{V}_{12} = \frac{\partial}{\partial n}(V_1 \frac{\partial W}{\partial \tau} + \frac{\partial}{\partial n}\left\{V_2 \frac{\partial}{\partial \tau}[1 + \frac{1}{(1-\tau)r}]\right\}. \tag{23}$$

The first term on the right-hand side of equation (23) is plausibly negative on two mutually enforcing groups. First, when n rises, the taxes collected from the old in the current period is shared (via the transfer b^A) by more young people, thereby reducing the transfer b^A to everyone, including the young pivot. This reduces the net gain to the young pivot from raising the tax rate. Second, when n rises, the taxes collected in the second period, when the current young become old, is now shared by more newly born young individuals. Therefore the transfer b^B that the current young pivot will receive in the second period of her life, when she turns old, is also reduced. Put differently, when n rises and the share of the elderly in the population declines, the first term on the right-hand side of (23) may be negative because of a "fiscal leakage" from the young pivot to others (namely, the other current-period young and all of the next-period young). The second term on the right-hand side of equation (23) has to do with how an increase in n changes the price (and efficiency cost) component of $\hat{V}_1$, the net gain to the young pivot from raising the tax on capital. We cannot a priori sign this term. Nevertheless, because of the first term (the "fiscal leakage"), $\hat{V}_{12}$ may plausibly be negative, so that the net gain to the existing young from raising the tax diminishes.

In order to complete the determination of the sign of $d\tau^*/dn$, we must also examine the sign of $\hat{V}_{13} dE_Y/dn$, which represents the effect of a change in the identify of the young pivot on the equilibrium tax rate. This term tends to be rather low and may even altogether vanish. For instance, it does indeed vanish when the young pivot is an unskilled individual, because $\hat{V}_{13} = 0$ in this case; see equation (13). That is, the new and the existing young pivot, being both unskilled, have identical attitudes towards taxation.

Thus, we have demonstrated how $d\tau^*/dn$ may plausibly be negative. That is, as the share of the elderly in the population rises (namely, n declines), the capital income tax rate in the political-equilibrium may plausibly rise. The main driving force for this result is the fiscal leakage effect.

We demonstrate in a companion paper [Razin, Sadka and Swagel (forthcoming)] with a similar model that as the dependency (elderly) ratio rises, the political-economy tax rate on labor income plausibly falls. This result is again somewhat in contrast to conventional wisdom which goes as follows: the elderly do not work and hence benefit from raising the tax rate on labor income since a tax hike enables the government to increase transfer payments. A rising share of the elderly in the population would be expected to tilt political-economy equilibrium in favor of a higher tax on labor income. However, we found in this case too a fiscal leakage effect which turns conventional wisdom on its head. The median voter, who is a young working individual in all of the advanced economies, has an incentive to lower rather than raise taxes, since a greater share of the tax revenues will be allocated to the rising number of elderly.

5 Empirical Evidence

We next examine whether data for ten European countries over the period 1970 to 1996 are consistent with the predictions of the theory regarding the relationship between the aging of the population and the tax rate on capital income.[2] We estimate regressions in which the capital tax rate depends on the share of the old as suggested by our theory and additional control variables. Of course, capital tax rates are set in conjunction with taxes on other forms of income, notably taxes on labor income, which is the largest source of revenue in the advanced economies. We thus present results for specifications in which equations for the capital tax rate are estimated jointly with those for labor taxes, allowing for the interaction of the two. Among other things, we use the differing prediction of our theories on the implications of aging for the political economy equilibrium to identify the two tax rates. As noted above, the capital income tax depends on the balance of interests between the old and the young, while the equilibrium for labor income tax depends on that between the working and the dependent—these are overlapping but not identical populations. In addition, we make use of the notion that capital crosses borders relatively more easily than labor, so that capital tax rates in open economies are more likely to be subject to international tax competition than is the case for labor tax rates.

The control variables for capital tax rates can be thought of as comprising several groups. First, we include two measures of exposure to international flows of capital to take into account the impact of capital mobility on governments' setting of tax rates through international tax competition.[3] The measures are the ratio of the stock of international portfolio capital to GDP

[2] The countries included are Austria, Belgium, Finland, France, Germany, the Netherlands, Norway, Spain, Sweden, and the United Kingdom.

[3] See Frenkel, Razin and Sadka (1991) and Razin and Sadka (1995) for principles of international taxation and the effects of globalization on capital income taxation.

and the ratio of the stock of direct international investment to GDP. These are both measured as the total stock of international investment, not the flow in a single year, and as the gross stock, meaning the sum of inflows and outflows, both in absolute value. This usage is meant to capture a country's overall integration with international capital, both inward and outward investment, though of course domestic capital can be potentially rather than actually mobile and thus affected by international tax competition in ways not captured by our data.

The next set of variables is meant to control for factors that affect the size of the welfare state, both the government's need for revenue and citizens' demands for social services. The controls here are the share of government employment out of total employment to indicate the breadth of government involvement in the economy, and a measure of openness to trade to capture exposure to external real sector shocks. Openness is included to address the hypothesis of Rodrik (1998) that a function of the welfare state is to provide social insurance against the adverse effects of external shocks, so that larger governments would be expected to be found in more open economies. Alternately, Alesina and Wacziarg (1998) suggest that the connection between openness and the size of government comes about indirectly through a size effect, with small countries being both more open than large countries and having larger government spending as a share of national income (and thus higher taxes). We further include a measure of income inequality–the ratio of the income share of the top quintile to the combined share of the middle three quartiles ("rich versus middle"). This variable—denoted as the "skewness of income distribution"—is suggested by previous theories that seek to explain the size of the welfare state [e.g., Meltzer and Richard (1981), Persson and Tabellini (forthcoming)]. Finally, real GDP growth is included to control for business cycle effects which might affect revenue requirements.

The specification for the labor tax rate regressions is taken from our earlier work [Razin, Sadka and Swagel (forthcoming)]. The explanatory variables include the dependency ratio as discussed above, along with openness to trade flows, the share of government jobs in total employment, GDP growth, and the income distribution variable.

5.1 Data Sources and Description

Data on capital and labor tax rates are from Mendoza, Razin, and Tesar (1994) as extended by Mendoza, Milesi-Ferretti, and Asea (1997), and Daveri and Tabellini (2000); these are derived by using revenue statistics to calculate average tax rates. Data on the share of the old in the population are from the World Bank's World Development Indicators. The regression results use the share of those aged 64 and older out of the total population, though the results are not affected by taking the share of the old out of only the population of individuals 14 years and older, which might correspond to the working-age population.

Data on the the stock of international capital investment are from Lane and Milesi-Ferretti (2001). These are the estimated stock of inward and outward direct investment assets adjusted for relative price variations, and the stock of portfolio equity assets and liabilities adjusted for stock market price variations.

The OECD Analytical Database is used to calculate measures of per capita GDP, government employment as a share of total employment, and openness to trade defined as the sum of the imports plus exports as a share of GDP. The dependency ratio is defined as one minus the labor force as a share of the population (rather than as the number of dependent per working individual). The measures of income skewedness are derived from the updated inequality database of Deininger and Squire (1996), which provides measures of income shares by quintile over time, though data are not available for every year. Only the high quality measures in the database are used, and the missing observations are then obtained through linear interpolation (the shares do not vary all that much over time, though in most countries there is a general trend toward increased inequality).

As shown in Table 1, the data encompass slightly different periods for some of the countries, so that an unbalanced panel is used in the regressions. Tax rates on capital income vary across countries, from a low of under 14 percent in Spain to over 50 percent in Sweden and the United Kingdom (the latter of which has the lowest tax rate on labor income on average over the sample period). The importance of international investment varies substantially across countries, with a great deal of inward and outward investment in the Netherlands and United Kingdom and relatively little in others. This is even more true of portfolio investment, though of course the data end for many countries before important steps forward in European capital market integration were taken in 1992 and following.

5.2 Estimation Results

Table 2 provides results from regressions for the determinants of the capital and labor tax rates. The focus here is of course on the capital tax, but we include both equations since in reality capital taxes are determined in conjunction with labor taxes. All specifications include a complete set of country fixed effects (not shown in the tables); the regressions thus take into account the fact that richer countries tend to have higher tax rates and provide more generous welfare benefits than poor ones.

The first two columns show single equation results estimated using OLS (this is a panel fixed effect specification). We then provide results in which the two taxes depend on one another, first estimating regressions for each variable separately using two stage least squares, and then with the two estimated jointly by three stage least squares. Both estimators allow for the endogeneity of the two tax rates with respect to each other, with the latter estimates further allowing for common shocks to both. We discuss the estimates for each technique in turn, focusing first on the equations for the influences of the capital tax rates.

In the capital tax equations, the coefficient on the share of the old in the population is positive and statistically significant with all three estimation techniques. The results indicate that the tax rate on capital income goes up by 2 to 3 percentage points for each one percentage point increase in the share of the old in the population. This seemingly counterintuitive result is quite consistent with the implication of our theory. The old are less than a majority of voters in all countries in our sample, so that the young will naturally want to levy taxes on capital and thus shift the burden of taxation to older individuals who tend to be owners of capital. Further, the young will be more inclined to do so as there are more old people to pay the capital income tax and fewer young people to share the tax revenues that finance the transfers. The coefficient becomes larger in magnitude with the system estimates but the results are qualitatively the same.

The coefficients on the other variables in the capital tax rate regression likewise provide sensible results with all three estimation techniques. The negative coefficient on the stock of international portfolio assets (again, the gross total of assets and liabilities) aligns with the notion that there is international tax competition for relatively mobile portfolio investments, so that a country with more of these will have lower capital tax rates. In contrast, a larger share of foreign direct investment has a positive rather than negative effect on capital tax rates, though the effect is not statistically significant once labor tax rates are taken into account. The greater "fixity" of direct investment compared to portfolio investment likely lessens the importance of international tax competition, accounting for the finding of little effect of direct investment on the setting of capital tax rates. Also, foreign direct investment may qualify for a foreign tax credit in the source country, so that the tax rate in the host country is only relevant for the allocation of tax revenues between the two countries. Openness to trade flows has a negative but not statistically significant effect on capital tax rates in the OLS estimation, and negative but only marginally significant in the systems equations. As with the portfolio investment, this result might indicate that countries that are open along other dimensions such as trade face more tax competition on capital, though this is not a firm conclusion.

The coefficient on the share of government workers out of total employment has a significant positive effect in the OLS regression but a negative though not statistically significant negative coefficient in the two stage least squares and three stage least squares results. The difference again is of course including labor taxes in the latter two equations. Since government jobs has a strongly positive coefficient in the labor tax equations, this variable by itself in the OLS capital tax regressions appears to be picking up some of the effect of the omitted labor tax variable.

The coefficients on GDP growth and income distribution are again consistent across the three estimators. Stronger growth is associated with lower tax rates—a feature shared with labor taxes as well. This likely reflects the stronger tax base allowing for lower rates. In addition, there may be a reverse causality from the tax rates to growth: lower tax rates (and fewer distortions) may promote growth. A distribution of income more skewed to the richest quintile is associated with a statistically significant lower tax rate, on capital, but higher tax rate on labor. This is a somewhat puzzling result; one possibility is that it stems from a different lobbying intensity on the part of the two groups.

The labor tax rate has a positive coefficient in the latter two capital tax regressions, though this is significant at only the 11 percent confidence level. While not conclusive, this suggests that the capital tax rate is set as complement to the labor tax rather than a substitute (in addition to the other influences). In contrast, the coefficient on the capital tax rate is far from statistically significant in the two specifications where it appears as an influence on the labor tax.

The results for the influences on the tax rate on labor income are in line with our previous work (despite a slightly different sample of countries owing to data limitations on the capital tax rates and international capital stocks). This is the case in both the single equation and system estimators. The dependency ratio has a statistically negative coefficient. As noted above, this is along the lines of the relationship between the capital tax and the share of the old in the population—the dependent are a minority of voters, so the majority of working individuals naturally favors lower taxes and transfers as the number of dependents rises. Openness to trade flows is associated with a statistically significant higher tax rate, in accordance with the theories of Rodrick or Alesina and Wacziarg, while more unequal income distribution leads to higher labor tax rates as in Meltzer and Richards.

6 Conclusion

The empirical results for the relationship between capital tax rates and the aging of the population are thus in close alignment with the predictions of the theory. The central mechanism in the political-economy equibilibrium that causes the capital income tax to rise when the share of the old in the population rises is a "fiscal leakage." The old are less than a majority of the population, so that the young will naturally want to levy taxes on capital and thus shift the burden of taxation to older individuals who tend to be owners of capital. As there are more old people to pay the tax and fewer young people to share the tax revenues that finance transfers, the young will be inclined to further increase the tax.

Table 1. Summary Statistics
(169 observations)

Country	Years	Old/ Pop	Labor Tax	Capital Tax	Govt Job Share	Dependents/ Population
Spain	80-86	11.5	32.6	13.8	11.1	63.5
Austria	70-92	14.8	37.4	21.1	17.7	56.1
France	82-96	14.0	46.5	26.2	23.2	56.2
Germany	70-96	14.9	39.1	27.5	14.6	54.0
Netherlands	85-92	12.6	52.0	30.5	13.7	60.4
Belgium	70-91	14.2	42.6	34.7	18.0	59.6
Norway	81-91	15.8	39.2	40.5	26.5	50.0
Finland	86-92	13.2	34.0	45.3	21.1	48.8
Sweden	71-92	16.5	46.5	52.0	29.7	48.6
UK	70-96	14.9	25.7	56.5	19.7	52.2

Country	Years	Trade Openness	FDI/ GDP	Intl Portfolio Stock/GDP	GDP Grow
Spain	80-86	39.7	8.6	0.9	1.7
Austria	70-92	69.7	6.6	1.8	3.0
France	82-96	44.4	17.5	7.9	1.9
Germany	70-96	50.1	9.6	5.2	2.7
Netherlands	85-92	103.2	65.7	32.7	2.8
Belgium	70-91	121.8	19.6	3.5	2.7
Norway	81-91	74.5	13.3	2.3	2.4
Finland	86-92	49.8	10.8	0.6	0.8
Sweden	71-92	59.6	13.8	1.9	1.7
UK	70-96	52.1	41.1	23.1	2.1

Table 2: Determinants of Capital and Labor Tax Rates
(169 observations)

	OLS		2SLS		3SLS	
	Capital	Labor	Capital	Labor	Capital	Labor
Old/population	2.033 (2.23)		3.532 (2.58)		2.820 (2.27)	
Dependency ratio		-0.438 (-3.59)		-0.443 (-3.43)		-0.443 (-3.61)
Capital tax rate				-0.054 (-0.68)		0.030 (0.41)
Labor tax rate			2.493 (1.60)		2.295 (1.63)	
FDI stock	0.199 (1.90)		0.001 (0.00)		0.116 (0.77)	
Portfolio stock	-0.335 (-3.84)		-0.418 (-3.83)		-0.440 (-4.41)	
Trade openness	-0.026 (-0.38)	0.117 (5.19)	-0.285 (-1.60)	0.113 (4.63)	-0.282 (-1.74)	0.113 (4.87)
Govt job share	0.876 (3.26)	0.827 (10.94)	-1.805 (-1.06)	0.907 (6.36)	-1.512 (-0.98)	0.907 (6.68)
GDP growth	-0.711 (-4.18)	-0.073 (-1.25)	-0.603 (-3.04)	-0.116 (-1.31)	-0.594 (-3.25)	-0.116 (-1.38)
Income skewness	-0.152 (-3.04)	0.077 (4.12)	-0.313 (-2.73)	0.069 (3.64)	-0.309 (-2.95)	0.070 (3.82)
R^2	0.432	0.204	0.178	0.241	0.897	0.960

All specifications include country fixed effects (coefficients not shown).

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