# Capital Income Taxation under Majority Voting with Aging Population

**Assaf Razin, Efraim Sadka,** and **Phillip Swagel**

*Tel Aviv University; Tel Aviv University;*
*Council of Economic Advisers, Washington, D.C.*

**Abstract:** An old person typically has a mixed attitude toward the welfare-state benefits, when they are financed by capital taxes, because her income derives mostly from capital. We develop a majority-voting model which focuses on the effect of aging on this dilemma. Surprisingly, 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. We then confront the key prediction of the model with panel data for ten European Union countries, over the period 1970–1996. We investigate the asymmetric effect of aging on the taxation of capital and labor. The implications of the model are shown to be consistent with panel data. JEL no. H0, H5, P1
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## 1 Introduction

The modern welfare state typically redistributes income from the rich to the poor, or from the young to the old, either by cash or in-kind transfers. With the aging of the population, the proportion of voters receiving social security has increased, and these pensions are by far the largest component of transfers in all industrial economies. Oeppen and Vaupel (2002: 1030) pose the question that lies at the heart of the aging process: "Is life expectancy approaching its limit?" Their answer: "Many... believe it is. The evidence suggests otherwise... . For 160 years, best-performance life expectancy has steadily increased by a quarter of a year per annum, an extraordinary constancy of human achievement."

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Indeed, the median age in Europe is forecasted to rise from 37.7 now to 52.7 in 2050 (*The Economist*, August 24th, 2002: 22). Similarly, the ratio of the elderly (aged 60 years and over) to the working-age population (aged 15–59 years) in Western Europe is expected to double from 20 percent in the year 2000 to 40 percent in the year 2050 (*The Economist*, August 24th, 2002: 22). These demographic trends are driven by declining fertility rates:[1]

> At present, West European countries are following what seems to be a normal demographic path: As they became richer after the 1950s, so their fertility rates fell sharply. The average number of children born by each woman during her lifetime fell from well above the "replacement rate" of 2.1—the rate at which the population remains stable—to less than 1.4 now. (*The Economist*, August 24th, 2002: 11)

This aging process put a heavy burden on the welfare state that provides generously for old-age security. As vividly put by *The Economist* (August 3rd, 2002: 23):

> Seven-tenths of German pensions come from a state scheme with roots in Bismarck's day. It is financed mainly by a levy on wages, 19.1% this year, half paid by workers and half by employers. But, as all over Europe, the demographics are grim. Today, there are 2.8 Germans aged 20–59 to support each pensioner. By 2030 there could be half as many. And the state can't just fork out money to fill the gap.

The benefits provided by the welfare state are financed to a large extent (but not entirely) by payroll (labor) taxes. Typically the (nonworking) old are beneficiaries of the welfare state. Therefore, when their share in the population rises through the country's aging process, one may expect the political power balance to shift toward higher taxes, and benefits. This argument was scrutinized in Razin et al. (2002). We uncovered a counter effect (termed "fiscal-leakage effect"). The median voter, who is among the working young, becomes more reluctant to pay taxes that go increasingly to the old during the aging process.[2]

Will capital taxes rise in a political-economy equilibrium, so as to supplement labor taxes when the country ages? This issue is the main focus of

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[1] The U.S. has experienced a similar trend until recently, but the fertility rate started to rise sharply.

[2] See Razin and Sadka (forthcoming) for a comprehensive analysis of the implications of aging and globalization for the welfare state.

this paper. We note that with respect to capital taxes, an old person typically must have a mixed attitude, because she does not only receive benefits from higher taxes. But, rather, her income which is mostly from capital (as she is already retired from work) is made subject to heavier taxes. The young, on the other hand, may be favorable toward capital taxation, as they typically draw less of their income from capital. Also, the poor, regardless of age, are naturally in favor of taxes; especially on capital. In this paper we develop a simple political-economy model to analyze these conflicts. We then confront the main prediction of the model, concerning the effect of aging on capital taxes, with panel data for ten European Union countries over the period 1970–1996. We investigate the asymmetric effect of aging on the taxation of capital and labor.

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 heterogeneity 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 consump-

tion 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 Razin et al. (2002), 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 $\tau$, 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 percent 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.[3] 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 multiperiod 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.[4] That is, income of residents is taxed irrespective of its origin, whether at home or abroad; income of nonresidents 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 predetermined, 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 $b_t^A$, which 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

[3] Of course, there might be other factors that prevent confiscatory taxes on capital. For instance, the young voters themselves may care about the old and refrain from confiscating their capital. There are also other political-economy mechanisms, such as special interest group influence (see Grossman and Helpman 1994), and probabalistic voting, which stop short of 100 percent tax on capital.

[4] In the empirical part of this paper (Section 5) we allow for capital flight (see, for instance, Kehoe 1989), which brings about deviations from a pure residence principle of taxation (see also Razin and Sadka forthcoming).

saving of the old in period $t$ (which was predetermined in period $t-1$). Rearranging 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 $t+1$, 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 ($\tau$) 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 $t$:

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

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:

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

This yields the indirect utility function:

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

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:

$$b^B_{t+1} = \frac{\tau r}{2+n} \int_0^1 S\left\{W\left(e,\ \tau,\ b^A_t,\ b^B_{t+1}\right), [1+(1-\tau)r]^{-1}\right\} dG. \quad (9)$$

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 (5), we can therefore rewrite (9) as follows:

$$\begin{aligned} b^B = \frac{\tau r}{2+n} \int_0^{e^*} & S\left\{w(1-e) + b^A + b^B[1+(1-\tau)r]^{-1},\right. \\ & \left. [1+(1-\tau)r]^{-1}\right\} dG \\ + \frac{\tau r}{2+n} & S\left\{wq + b^A + b^B[1+(1-\tau)r]^{-1},\right. \\ & \left. [1+(1-\tau)r]^{-1}\right\} [1-G(e^*)]. \end{aligned} \quad (10)$$

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 (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 $\tau$, we now have a complete description of the equilibrium. Equation (2) determines $b^A$ as a function of $n$ and $\tau$ (note that $s^A$ is exogenous), while (10) determines $b^B$ as a function of the same variables:

$$b^A = B^A(t, n) \quad (2')$$

$$b^B = B^B(\tau, n). \quad (10')$$

## 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 predetermined. Note that $s^A$ in (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, $\beta$, 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 $\partial(\partial\beta/\partial\tau)/\partial e = \partial^2\beta/\partial\tau\partial e = -rds^A/de \leqq 0$.

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

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

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

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

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, $V_{11} < 0$ and $V_{12} = 0$; 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 nonnegative. 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 $(\tau^*, e_O, e_Y)$ such that:

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

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

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

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 $\tau^*$; see (14) and (15). Together, these pivots divide the total population (of the old and the young) evenly, so that the tax rate $\tau^*$ 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) $\tau^*$. 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) $\tau^*$. 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 $\tau^*$) 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 (16).

Given the structure of the model, the determination of the political-economy equilibrium can be simplified a great deal. Differentiate $\beta$ with respect to $\tau$ 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 (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 $e$, 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 percent, 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.[5]

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 (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 (12) and setting the derivative of $\hat{V}$ with respect to $\tau$ 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 antitax 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 antitax 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 $N_0(1+n)^{t-1}/[N_0(1+n)^{t-1} + N_0(1+n)^t] = 1/(2+n)$. Thus, when the population growth rate, $n$, falls, the share of the elderly in the population rises. We therefore address the question of

[5] 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 $s^A/(2+n) < s^A$.

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 (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 $\tau^*$ maximizes $\hat{V}$, it follows from the second-order condition for maximization that $\hat{V}_{11} \leqq 0$, so that:

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

Thus, the sign of the effect of $n$ on $\tau^*$ 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 identity 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 the sign of $\hat{V}_{12}$, which represents the attitude toward the capital income tax of the existing young pivot. Note from (12) that

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

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 (22)) and a price (interest rate) effect (the second term on the right-hand side of (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:

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

The first term on the right-hand side of (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 (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 identity 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 (13)); and, by continuity, the term is rather small when the young pivot is not highly skilled. That is, the new and the existing young pivot, being both unskilled, have identical attitudes toward 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-economy equilibrium may plausibly rise. This result is consistent with the empirical finding of the next section.

## 5 Empirical Evidence

We next examine whether data for ten European countries over the period 1970–1996 are consistent with the predictions of the theory regarding the relationship between the aging of the population and the tax rate on capital income.[6] We estimate regressions in which the capital income tax rate depends on the share of the old as suggested by our theory and additional control variables. Of course, capital income 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 income tax rate are estimated jointly with those for labor income 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 income tax rates in open economies are more likely to be subject to international tax competition than is the case for labor income tax rates.

The control variables for capital income 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.[7] The measures are the ratio of the stock of international portfolio capital to GDP 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

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

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

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 quintiles (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 1999). Finally, real GDP growth is included to control for business cycle effects which might affect revenue requirements.

The specification for the labor income tax rate regressions is taken from Razin et al. (2002). 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 income tax rates are from Mendoza et al. (1994) as extended by Mendoza et al. (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 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 individuals). The measures of income skewness are derived from

Table 1: *Summary Statistics (169 observations)*

| Country | Years | Old/ pop | Labor tax | Capital tax | Govt job share | Dependents/ pop |
|---|---|---|---|---|---|---|
| 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 |
| United Kingdom | 70–96 | 14.9 | 25.7 | 56.5 | 19.7 | 52.2 |

| | | Trade openness | FDI/ GDP | Intl portfolio stock/GDP | GDP growth |
|---|---|---|---|---|---|
| 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 |
| United Kingdom | 70–96 | 52.1 | 41.1 | 23.1 | 2.1 |

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 the 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 income tax rates. The focus here is of course on the capital income tax, but we include both equations since in reality capital income taxes are determined in conjunction with labor income 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 each other, 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 income tax rates.

In the capital income tax equations, the coefficient on the share of the old in the population is positive and statistically significant with all three es-

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

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

*Note:* All specifications include country fixed effects (coefficients not shown). t-values in parentheses.

timation 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 income 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 income tax rate regression likewise provide sensible results with all three estimation tech-

niques. 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 income tax rates. In contrast, a larger share of foreign direct investment has a positive rather than negative effect on capital income tax rates, though the effect is not statistically significant once labor income 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 income 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 coefficient in the two-stage least square and three-stage least square results. The difference again is of course including labor income taxes in the latter two equations. Since government jobs have a strongly positive coefficient in the labor income tax equations, this variable by itself in the OLS capital income tax regressions appears to be picking up some of the effect of the omitted labor income 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 income 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 income. 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 income tax rate has a positive coefficient in the latter two capital income tax regressions, though this is significant at only the 11 percent confidence level. While not conclusive, this suggests that the capital income tax rate is set as complement to the labor income tax rather than a substitute (in addition to the other influences). In contrast, the coefficient on the capital income tax rate is far from statistically significant in the two specifications where it appears as an influence on the labor income 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 income 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 income 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 Rodrik (1998) or Alesina and Wacziarg (1998), while more unequal income distribution leads to higher labor income tax rates as in Meltzer and Richard (1981).

## 6 Conclusion

We develop a simple political-economy model to analyze the capital-tax dilemma: An old person is, at the same time, a higher-than-average recipient of the welfare-state benefits, financed by taxes, and a higher-than-average payer of capital income taxes. The young, on the other hand, may be favorable toward capital income taxation, as they typically draw less of their income from capital income. Also, the poor, regardless of age, are, naturally, more well disposed in favor of taxes, especially on capital income. We employ an overlapping-generations model to analyze the effect of aging on the equilibrium that is based on these conflicting interests. Our analysis suggests that as the share of the elderly in the population rises, the equilibrium capital income tax rate may, plausibly, rise. A support of this prediction is found in a panel data of ten European Union countries, over the period from 1970 to 1996. Interestingly, aging has an opposite effect on labor income taxes.

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