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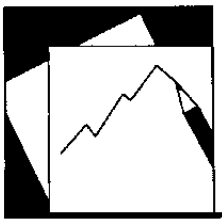

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The Aging of the Population and the Size of the Welfare State

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The Aging of the Population and the Size of the Welfare State

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Abstract

Data for the United States and countries in Western Europe indicate a negative correlation between the dependency ratio and both labor tax rates and the generosity of social transfers, after controlling for other factors that influence the size of the welfare state. This is the case despite the increased political clout of the dependent population implied by the aging of the population. This paper develops a model of intra-and inter-generational transfers and human capital formation which addresses this seeming puzzle. We show that with democratic voting, a higher dependency ratio can lead to lower taxes or less generous social transfers.

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Contents Page

I. Introduction

With the aging of the population, the proportion of voters eligible to receive old-age social security has increased, and these pensions are by far the largest component of transfers in all industrial economies. Indeed, in the rich countries, the ratio of people of working age to those over 65, currently about four to one, is expected to fall in half by the year 2030. This paper examines the implication of changes in the composition of the population for the generosity of the social security and transfer system, focusing particularly on the relationship between aging of the population and the tax rates and benefits involved in the welfare state.

Data for the United States and 12 Western European countries from 1965 to 1992 show a negative correlation between the dependency ratio and two measures of the size of the welfare state, namely the tax rate on labor income and the generosity of social transfers, after controlling for other factors that would be expected to influence the size of the welfare state. This is a puzzle, as it might have been expected that countries with larger shares of dependent populations would have higher taxes and more generous social transfers reflecting the increased political power of the retired population.

We provide an explanation using a simple theoretical model in which the extent of taxes and social transfers between the working age population and the retired is endogenously determined by voting. The political economy equilibrium is determined as a balance between those who gain and those who lose from a more extensive tax-transfer policy. The aging of the population and the consequent increase in the dependency ratio affects the political economy balance in two directions: the greater number of retirees increases demand for benefits, but at the same time reduces the willingness of the working-age population to accede to higher taxes and transfers, since current workers are net losers from the welfare state. We show that the outcome of the model in which both workers and retirees vote on the level of taxes and social benefits is that a higher dependency rate may well lead to an equilibrium with lower taxes and transfers.

Our conclusions are consistent with the standard theory of the determinants of the size of government in a direct democracy, in which the size of government or the scope of redistribution depends on pre-tax income inequality. Two economic interpretations have been used to explain this dependence. Lovell (1975) emphasizes the size of the government as a provider of public goods, while others, notably Meltzer and Richard (1981), consider the role of the government in redistributing income; see Persson and Tabellini (1999) for a recent survey. In both applications, the size of government or the scope of redistribution depends on a particular measure of the skewness of the income distribution: the ratio of the *pre-tax* median income to the *pre-tax* average income; this ratio represents the "price" of collectively supplied goods in terms of private goods for the median voter. Our model adds a new channel through which the size of government is determined, namely the effect of the "fiscal

leakage" that occurs in a pay-as-you go social security system, in which current workers are net contributors while the retired are net beneficiaries.[2]

The results of this paper may shed light on the current debate over privatization of the Social Security systems in the industrial countries. Privatization of social security is typically conceived of as providing for individual-specific balances between total discounted contributions and total discounted benefits. That is, the privatized system does not redistribute income, but instead simply provides a publicly-run (and in some cases, mandatory) mechanism for savings. Privatization would eliminate the payroll tax/transfer element of national Social Security systems, cutting both the payroll tax burden and the size of public transfers. Our model can thus explain the rising calls for privatization in light of the aging of the population.

The paper is organized as follows. Section II develops an overlapping-generations model of human capital formation and derives the political-economy equilibrium tax-transfer policy. Section III studies the effects of changes in the dependency ratio on the equilibrium. Section IV presents empirical evidence, while Section V concludes.

II. Tax-Transfer Policy in a Political-Economy Equilibrium

Consider a standard overlapping-generations model in which each generation lives two periods: a working period and a retirement period. Following Saint-Paul (1994) and Razin and Sadka (1995), we assume a stylized economy in which there are two types of workers: skilled workers who have high productivity and provide one efficiency unit of labor per unit of labor time, and unskilled workers who 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 and an endowment of K units of capital, but are born without skills and thus with low productivity. Each worker chooses whether to acquire an education and become a skilled worker, or instead remain unskilled. After the working period, individuals retire, with their consumption funded by savings from their earnings 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). We assume a positive pecuniary cost of acquiring skills, γ, which is not tax deductible. The cumulative distribution function of innate ability is denoted by $G(\bullet)$ with the support being the interval $[0,1]$. The density function is denoted by $g = G'$.

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[2] In a different context (subsidies for farmers), Becker (1983) suggests a negative relationship between group size and transfers per group member.

Suppose that the government levies a flat payroll tax to finance a flat grant, b. The literature [e.g., Mirrlees (1971)] suggests that the best egalitarian income tax can be approximated by a linear tax which consists of a flat rate, τ and a lump-sum grant, b. The tax rate and 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 cash 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.

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 (including lost income):

$$(1-\tau)\, w\, (1-e^*) = qw + \gamma,$$

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

Rearranging terms gives the cutoff level for the education decision:

$$e^* = 1 - q - \frac{\gamma}{(1-\tau)w} \tag{1}$$

To obtain analytical results, we must use a specification in which factor prices are not variable.[3] Thus, for analytical tractability, we assume a linear production function in which gross output, Y is produced using labor, L and capital, K:

$$Y = wL + (1+r)\, K, \tag{2}$$

The wage rate, w, and the gross rental price of capital, $1+r$, are determined by the marginal productivity conditions for factor prices ($w = \partial Y/\partial L$ and $1+ r = \partial Y/\partial K$) and already substituted into the production function.[4] The linearity of the production function can arise as an equilibrium outcome through either international capital mobility or factor price equaliza-tion in the presence of goods trade. For simplicity, the two types of labor are assumed to be

[3] Razin, Sadka, and Swagel (1998) considers a related model with variable factor returns, but the solution requires numerical simulations.

[4] The fixed factor price assumption and the period-by-period budget balancing in the pay-as-you-go tax-transfer system break the links between generations that do not overlap. In this way, our intertemporal model becomes essentially isomorphic to a static atemporal model. This enables us to focus in a simple way on the effect of the dependency ratio on the tax-transfer system.

perfect substitutes in production in terms of efficiency units of labor input, and capital is assumed to fully depreciate at the end of the production process.

We assume that the population grows at a rate of n. Since individuals work only in the first period, the ratio of retirees to workers is $1/(1+n)$, and the dependency ratio—retired as a share of the total population—equals $1/(2+n)$. Each individual's labor supply is assumed to be fixed, so that the income tax does not distort individual labor supply decisions at the margin. The total labor supply does, however, depend on the income tax rate, as this affects the cut-off ability parameter e^* and thus the mix of skilled and unskilled in the economy. In period t, the total labor supply is given by:

$$\begin{aligned} L_t &= \{\int_0^{e_t^*} (1-e)dG + q[1-G(e_t^*)]\} N_0(1+n)^t \\ &= l(e_t^*) N_0(1+n)^t \end{aligned} \tag{3}$$

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 $l(e_t^*) = \int_0^{e_t^*} (1-e)dG + q[1-G(e_t^*)]$ is the average (per worker) labor supply in period t. This specification implies that for each e and t, the number of individuals in period t with an innate ability parameter less than or equal to e is $(1+n)^t$ times the number of such individuals in period 0.

The government's budget is balanced period by period. Since the income tax is levied on labor income, the wage bill, wL_t, constitutes the tax base. The cash grant is paid to both workers and retirees, so that the government budget constraint implies:

$$\begin{aligned} b_t N_0[(1+n)^{t-1} + (1+n)^t] &= \tau_t w L_t \\ &= \tau_t w l(e_t^*) N_0(1+n)^t \end{aligned}$$

Therefore, the lump-sum grant equals:

$$b_t = \tau_t w l(e_t^*)(1+n)/(2+n) \tag{4}$$

Note that if the transfer is paid only to the old, then in the political economy equilibrium, the young who outnumber the old in a growing economy will drive the tax and transfer down to zero. We may thus conjecture that "bundling" together benefits to the young and old is essential for establishing an incentive-compatible social contract or norm in which the current young engage in redistribution to the old with the anticipation that the future young will honor the "contract." However, as this is not guaranteed, the current young would like to receive some of the benefits up front. In reality, some bundling indeed occurs. For example, the payroll social security tax serves to finance both old-age transfers and unemployment benefits (and national health care in many countries).

For any tax rate, τ, and population growth rate, n, equations (1) and (4) determine $e_t^* = e^*(\tau_t)$ and $b_t = b(\tau_t, n)$ as functions of τ and n. The population growth rate, n, is exogenous, but we nevertheless write b as a function of n because we wish to explore the effect of changes in the rate of population growth, since changes in n translate directly (and inversely) into changes in the dependency ratio.

Denote by $W(e,\tau_t,\tau_{t+1},n)$ the lifetime income of an individual born at period t with ability parameter e. This is a strictly decreasing function of the innate ability parameter, e, for the skilled worker; and constant for the unskilled worker. This function is given by:

$$W(e,\tau_t,\tau_{t+1},n) = \begin{cases} (1-\tau)w(1-e) - \gamma + b(\tau_t,n) + \dfrac{b(\tau_{t+1},n)}{(1+r)} \\ \text{for } e \le e^*(\tau_t) \\ (1-\tau)wq + b(\tau_t,n) + \dfrac{b(\tau_{t+1},n)}{(1+r)} \\ \text{for } e \ge e^*(\tau_t) \end{cases} \tag{5}$$

A young individual born in period t chooses her first- and second-period consumption (c_{1t} and c_{2t}, respectively) to maximize lifetime utility, $u(c_{1t},c_{2t})$, subject to the lifetime budget constraint, $c_{1t} + c_{2t}/(1+r) = W(e,\tau_t,\tau_{t+1},n)$.

Second-period consumption of a retiree born in period t-1 (that is, consumption of a retiree in period t) is given by:

$$c_{2,t-1}(e) = S_{t-1}(e)(1+r) + b(\tau_t,n) \tag{6}$$

where $S_{t-1}(e)$ denotes this individual's savings in period t-1.

Since the government's budget constraint is balanced period by period, it follows that the transfer in period t+1, $b(\tau_{t+1},n)$, is independent of the tax rate τ_t in period t. In voting on the tax rate τ_t, individuals living in period t therefore take $b(\tau_{t+1},n)$ as exogenous, because there is no serial correlation between $b(\tau_t,n)$ and $b(\tau_{t+1},n)$. The political economy equilibrium for the tax rate, τ_t, is then determined by majority voting of individuals alive in period t, without being affected by preceding or future generations.

We therefore calculate the effect of taxes on the income of any young individual in order to find how she will vote on a proposed change in the tax rate. Differentiating $W(e,\tau_t,\tau_{t+1},n)$ with respect to e and τ_t we find that:

$$\frac{\partial^2 W(e,\tau_t,\tau_{t+1},n)}{\partial e \partial \tau_t} = \begin{cases} w \text{ for } 0 \le e < e^*(\tau_t) \\ 0 \text{ for } e^*(\tau_t) < e < 1 \end{cases}$$

Therefore, if $\partial W/\partial \tau > 0$ for some e_o, then $\partial W/\partial \tau > 0$ for all $e > e_o$. And, similarly if $\partial W/\partial \tau < 0$ for some e_o, then $\partial W/\partial \tau < 0$ for all $e < e_o$. This implies that if an increase in the income tax rate benefits a particular young (working) individual (because the higher tax rate can support a higher transfer), then all young individuals who are less able (that is, those who have a higher innate ability parameter, e), must also gain from this tax increase. Similarly, if an income tax increase hurts a certain young individual (because the increased transfer does not fully compensate for the tax hike), then it must also hurt all young individuals who are more able.

So long as raising the tax rate in period t (that is, τ_t) generates more revenues and, consequently, a higher grant in that period, $b(\tau_t,n)$, it follows from (6) that the old (retirees) in period t always opt for a higher tax rate in that period. As long as $n > 0$, it follows that there are always more young (working) people than old (retired) people. These considerations imply that the median voter—the pivot in determining the outcome of majority voting—is a young (working) individual. That is, the political equilibrium tax rate maximizes the lifetime income of a young (working) individual and thus the lifetime income of the median voter.

Denote the innate ability parameter of this median voter by e_M. There are $N_0(1+n)^t G(e_M)$ young individuals with innate ability parameter $e \leq e_M$ (more able than the median voter), and $N_0(1+n)^t[1-G(e_M)]$ young individuals with innate ability parameter $e \geq e_M$ (less able than the median). There are also $N_0(1+n)^{t-1}$ retired individuals in period t who always join the pro-tax coalition. Hence, e_M is defined implicitly by:

$$N_0(1+n)^t G(e_M) = N_0(1+n)^t (1 - G(e_M)) + N_0(1+n)^{t-1}$$

Dividing this equation by $N_0(1+n)^{t-1}$ and rearranging terms yields the innate ability parameter for the median voter:

$$e_M(n) = G^{-1}\left[\frac{2+n}{2(1+n)}\right].$$

As noted, the political equilibrium tax rate in period t, denoted by $\tau_o(n)$, maximizes the lifetime income of the median voter:

$$\tau_o(n) = \arg\max_{\tau} W[e_M(n), \tau, n] \quad (8)$$

For a given n, the political equilibrium τ is constant over time, so that the time subscript is suppressed. As τ_{t+1} is exogenous in period t, we likewise drop it from the arguments of W.

As indicated, $\tau_o(n)$ is implicitly defined by the first-order condition:

$$\frac{\partial W[e_M(n), \tau_o(n), n]}{\partial \tau} = B[\tau_0(n), n] = 0, \tag{9}$$

and the second-order condition is:

$$\frac{\partial^2 W[e_M(n), \tau_o, n]}{\partial \tau^2} = B_\tau[\tau_0(n), n] \leq 0, \tag{10}$$

where the subscript indicates a partial derivative.

Recalling equation (5), we can see that $B(\tau, n)$ depends on whether the median voter is skilled or unskilled:

$$B(\tau, n) = \begin{cases} -w[1 - e_M(n)] + \dfrac{w(1+n)}{(2+n)} l[e^*(\tau)] + \dfrac{\gamma\tau(1+\mathrm{n})\mathrm{g}[\mathrm{e}^*(t)]}{(2+n)(1-\tau)} \dfrac{de^*}{d\tau} \\ \textit{if } e_M(n) < e^*(\tau) \\ -\mathrm{wq} + \dfrac{w(1+n)}{(2+n)} l[e^*(\tau)] + \dfrac{\gamma\tau(1+\mathrm{n})\mathrm{g}[\mathrm{e}^*(t)]}{(2+n)(1-\tau)} \dfrac{de^*}{d\tau} \\ \textit{if } 1 > e_M(n) > e^*(\tau), \end{cases} \tag{11}$$

where

$$l[e^*(\tau)] = \int_0^{\mathrm{e}^*(\tau)} (1 - \mathrm{e}) \mathrm{dG} + \mathrm{q}[1 - \mathrm{G}(\mathrm{e}^*)],$$

and by equation (1):

$$\frac{de^*}{d\tau} = -\frac{\gamma}{(1-\tau)^2 w} < 0.$$

In addition to the effect of the population growth rate (and thus the dependency ratio) on the political-economy equilibrium, the tax rate $\tau_o(n)$ also depends on the median income (I_M) versus the average income (I_A), as predicted by the standard models of the determinants of the size of government. For example, when the median voter is unskilled, $B(\tau, n) = 0$ in the second part of equation (11) implies:

$$I_M = \frac{\partial(\tau I_A)}{\partial \tau}$$

or

$$\tau \frac{\partial I_A}{\partial \tau} = I_M - I_A[e^*(\tau)], \tag{12}$$

where $I_M = wq$ is the pre-tax median wage and $I_A[e^*(\tau)] = l[e^*(\tau)]/(2+n)$ is the pre-tax average income. When there is no income inequality—the limiting case with no old and G concentrated around its mean and hence $I_M = I_A$—the equilibrium tax rate is zero since there can be no pro-tax coalition. As the median income is typically smaller than the average income ($I_M - I_A < 0$), and since a labor tax lowers labor supply and pre-tax labor income ($\partial I_A/\partial\tau < 0$), it follows that the equilibrium tax rate is positive [see also Meltzer and Richard (1981)].

III. The Dependency Ratio and the Tax Burden in the Political-Economy Equilibrium

We next examine the effect of changes in the population growth rate and thus the dependency ratio on the equilibrium.

Total differentiation of (9) with respect to n implies:

$$\frac{d\tau_o(n)}{dn} = -\frac{B_n[\tau_o(n),n]}{B_\tau[\tau_o(n),n]}. \tag{13}$$

Since $B_\tau[\tau_o(n),n] \leq 0$ from equation (10), it follows that the direction of the effect of changes in n on the equilibrium tax rate, τ_o, is determined by the sign of $B_n[\tau_o(n),n]$.

By differentiating equation (11) with respect to n, we conclude that:

$$B_n[\tau_o(n),n] = \begin{cases} w\dfrac{de_M}{dn} + wl\{e^*[\tau_0(n)]\}\dfrac{1}{(2+n)^2} + \tau\dfrac{\gamma}{(1-\tau)}\dfrac{g\{e^*[\tau_0(n)]\}}{(2+n)^2}\dfrac{de^*}{d\tau} \\ \text{if } e_M < e^*[\tau_0(n)] \\ wl\{e^*[\tau_0(n)]\}\dfrac{1}{(2+n)^2} + \tau\dfrac{\gamma}{(1-\tau)}\dfrac{g\{e^*[\tau_0(n)]\}}{(2+n)^2}\dfrac{de^*}{d\tau} \\ \text{if } 1 > e_M > e^*[\tau_0(n)] \end{cases} \tag{14}$$

where $\dfrac{de_M}{dn} = -\dfrac{1}{2g(e_M)(1+n)^2} < 0$, by equation (7).

If the sign of $B_n[\tau_o(n),n]$ is positive, then an increase in the rate of population growth, n, raises the political-economy equilibrium tax rate, τ_o and consequently, the amount of the per-

capita transfer, b.[5] Upon inspection of the right-hand side of (14), we can see that it contains one term—$wl\{e^*[\tau_0(n)]\}/(2+n)^2$—which is positive, while the other terms are negative (because de_M/dn and $de^*/d\tau$ are both negative). Thus, the sign of $B_n[\tau_o(n),n]$ cannot be determined *a priori*. When this is positive, an increase in the population growth rate (a decline in the dependency ratio) **raises** the political equilibrium tax rate and the per capita transfer. Conversely, an increase in the dependency ratio **lowers** the political equilibrium τ and b.

The rationale for this result is as follows. Consider for concreteness the case in which the median voter is a young, skilled individual ($e_M \leq e^*$), and that the population growth rate rises (the dependency ratio falls). In this case, there is a decline in the amount of tax revenue collected from the median voter that "leaks" to the retirees, who with the higher n become a smaller share of the population. This is an unambiguously pro-tax factor. However, the median voter now becomes more able (because $de_M/dn < 0$), and therefore opts for a lower tax and transfer. Moreover, the per-capita marginal efficiency cost of distortionary taxation, $\tau\frac{\gamma}{(1-\tau)}\frac{g\{e^*[\tau_0(n)]\}}{(2+n)^2}\frac{de^*}{d\tau}$, rises as well, as can be seen in the last terms on the right-hand sides of (11) and (14).[6] This is also an anti-tax factor. When the negative terms de_M/dn and $de^*/d\tau$ are sufficiently small, the pro-tax factor dominates the anti-tax factors and $d\tau_0/dn$ is positive. In this case, an increase in n (smaller dependency ratio) raises the political equilibrium tax rate and per capita transfer.

If the median voter is an unskilled worker, $B_n[\tau_o(n),n]$ does not include the anti-tax term de_M/dn, because the change in the median voter toward a less able individual is of no consequence, as all of the unskilled have the same demand for redistribution regardless of their innate ability parameter. If, furthermore, the distortionary element $\tau\frac{\gamma}{(1-\tau)}\frac{g\{e^*[\tau_0(n)]\}}{(2+n)^2}\frac{de^*}{d\tau}$ is sufficiently small and q is large enough, then $B_n[\tau_o(n),n]$ is positive.[7] It then follows that an increase in the population growth rate (a decline in the

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[5] Notice also that a higher n increases lifetime welfare of everyone in our pay-as-you-go tax-transfer system (for given tax rates), because the transfers will be higher. See also Razin and Sadka (1999).

[6] The efficiency cost of taxation arises because taxation distorts economic decisions. In our model, the payroll tax distorts the decision on whether or not to acquire skills (the cutoff e^* and reduces output. This cost exists whether or not the economy is on the "wrong" side of the Laffer curve.

[7] To see this, let γ approach zero. Then, one can see from (14) that B_n approaches a positive limit of $wl\{e^*[\tau_0, n)]\}/(2+n)^2$ if τ does not approach one. From (11) it can be verified that τ does indeed not approach one if q is sufficiently large.

dependency ratio), **raises** the political equilibrium tax rate and the per capita transfer, τ and b. Conversely, an increase in the dependency ratio **lowers** the political equilibrium tax rate and transfer.

We have so far assumed that $n > 0$, so that the median voter is a member of the working-age population. For completeness, we will also consider briefly the case in which the median voter is among the retired population. In our setup, this happens when $n < 0$. We can see from (6) that the political-economy equilibrium tax rate in this case maximizes the transfer, $b(\tau, n)$, since retirees' savings from the previous period are already determined. In contrast, when the median voter was a member of the working-age population, the political-economy equilibrium tax rate maximizes $b(\tau, n)$ plus another term—either $(1-\tau)w(1-e_M)$ or $(1-\tau)wq$—which is decreasing in τ Thus, the political-economy equilibrium tax rate "jumps" upward when the old become a majority; that is, as n switches from being positive to being negative.

This effect is along the lines of the theory of Meltzer and Richard (1981), who attribute the increase in the size of the welfare state to the spread of the right to vote (franchise), which increased the number of voters with relatively low income and thus a natural incentive to vote for higher taxes and transfers. The increase in the number of social security recipients has an expansionary effect similar to the extension of the franchise in expanding the size of the welfare state. Meltzer and Richard conclude that: "In recent years, the proportion of voters receiving social security has increased, raising the number of voters favoring taxes on wage and salary income to finance redistribution. In our analysis the increase in social security recipients has an effect similar to an extension of the franchise." However, if the median voter is not among the retirees—as is probably still the case in all western countries—then the increased size of the non-working population may well lead to lower taxes and transfers, as the median voter is adversely affected because she is a net contributor to the welfare system. These opposing effects on the equilibrium tax rate and per capita transfer are next examined empirically.

IV. Empirical Evidence

We use data for the United States and 12 European countries over the period 1965 to 1992 to examine the relationship between the dependency ratio and the tax burden and the generosity of social transfers.[8] We show that the data are broadly consistent with the main implications of the theory, but do not test the specific structural model of the theory. The empirical results must thus be seen as only suggestive, particularly since the regressions do not test against alternative mechanisms.

We estimate regressions in which the dependent variables of the labor tax rate and real per capita transfers are functions of the dependency ratio as suggested by our theory, the measure

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

of income skewness suggested by the standard theory, and additional control variables. These include government employment as a share of total employment to indicate the breadth of government involvement in the economy, real GDP growth to control for business cycle effects, and a measure of openness to trade to capture exposure to external 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). The measure of income skewness is the ratio of the income share of the top quintile to the combined share of the middle three quartiles ("rich versus middle"). This corresponds to the ratio of the mean income to the median income suggested by the standard theory. This measure of income inequality is used in empirical tests of the standard theory because the disproportionate share of income accruing to the upper quartile of the income distribution ensures that the mean income is determined in large part by the income of those at the top and thus exceeds the median income (for which consistent cross-country data are not available).

A. Data Sources and Description

Data on the labor tax rate from 1965 to 1992 are from Mendoza, Razin, and Tesar (1995) as extended by Mendoza, Milesi-Ferretti, and Asea (1996), and Daveri and Tabellini (2000); these are derived by using revenue statistics to calculate an average tax rate on labor income. The measures of income skewness 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).

The OECD Analytical Database is used to calculate the other variables, including measures of per capita GDP, per capita transfers received by households, 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 dependents per worker. Per capita transfers include both social security and other transfers such as unemployment and disability compensation, though social security payments are by far the largest component of transfers in all countries. Transfers are deflated by each country's CPI to provide real transfers in 1990 terms, translated into the common currency of U.S. dollars, and then divided by the population to provide per-capita transfers.

Table 1 summarizes the variables used in the regression analysis. The data encompass slightly different periods for some of the countries, with an unbalanced panel used in the regressions. The countries are listed in order of an increasing tax rate, so that it can be seen

that high tax countries are generally those with more generous transfers (the correlation between the two variables is 0.83). In all countries, the bottom quintile receives about 5 to 10 percent of income, the middle three quintiles around 50-60 percent, and the top quintile 35 to 40 percent (the United States is the least equal, with just under 5 percent going to the bottom quintile and just over 60 percent going to the top).

The dependency ratio varies widely across countries, with particularly high dependency rates (fewer workers per population) in Belgium, Italy, the Netherlands, and Spain. But there is little correlation with the tax rate (-0.07), and only a moderate correlation with (log) per-capita benefits (-0.26). Countries with high unemployment rates generally have high labor tax rates and high benefits, a point examined in detail by Daveri and Tabellini (2000) and discussed further below.

B. Estimation Results

Table 2 provides results from regressions for the determinants of the labor tax rate, while Table 3 contains results for analogous regressions for the determinants of (log) real transfers per capita. The equations are estimated using ordinary least squares—the regressors are the same in the two equations, so there is no efficiency gain from seemingly unrelated regressions. All specifications include a complete set of country fixed effects; the regressions thus take into account the fact that richer countries tend to have higher tax rates and provide more generous welfare benefits.

The results in Table 2 show that the dependency ratio has a statistically significant negative effect on the labor tax rate, resolving the ambiguity in the analytical model. A one percentage point increase in the dependency ratio leads to a nearly 0.4 percentage point decline in the labor tax rate. To put this in perspective, the average tax rate in the data rose from 30 percent in 1970 to 41 percent in 1991, while the average dependency ratio *fell* from 58 percent to 54 percent over this period. Given the negative coefficient, the fall in the dependency ratio resulted in higher taxes—the coefficient of -0.382 implies that the 4 percentage point decline in the dependency ratio accounted for roughly 1.5 percentage points of the 11 percentage point increase in the labor tax rate.

Not surprisingly, a larger share of government employment is associated with a higher labor tax rate, though this could reflect the need for greater revenues to support the government sector or reverse causality of higher tax rates allowing for a larger government sector. The significant negative coefficient for per capita real GDP growth indicates that tax rates are pro-cyclical, while the negative coefficient on income skewness is the opposite of the prediction of the standard theory that inequality leads to pressure for redistribution. The effect of openness on the labor tax rate is positive, in accord with the theories of Rodrik (1998) and Alesina and Wacziarg (1998).

Column 2 adds the unemployment rate, with a statistically significant positive coefficient. As suggested by Daveri and Tabellini (2000), this possibly reflects the effect of reverse causality, with high labor taxes leading to unemployment. The results for the other variables

are essentially unchanged, though the coefficient on openness is now far from statistically significant. Column 3 uses the income share of the rich relative to the poor (lower quintile); here, the positive coefficient is in line with the prediction of the standard theory, though the coefficient is significant at only the 11 percent level. In all three specifications, the coefficient for the effect of the dependency ratio on taxes remains negative and significant and broadly similar in magnitude.

Column 4 modifies the variable corresponding to the fiscal leakage, replacing the dependency ratio (share of non-active in the population) with the share of the population younger than 15 or older than 64—that is, the share of the population not of "prime working age." This is meant as a broader sensitivity check: the age-based variable corresponds to the share of population potentially in the labor force rather than those actually participating. Prime-aged adults are about 65 percent of the population compared to the 55 percent average participation rate shown in the first line of Table 1, but the correlation between the two variables is 0.42, indicating that they are similar but provide different information because participation across countries varies by age and sex. However, the estimation results in column 4 again support the theoretical model: a larger share of the potentially dependent population leads to statistically significant lower tax rates. The share of the old and young in the population fell by over 3.5 percentage points from 1970 to 1991, so the coefficient of -0.877 in column 4 of Table 2 implies that this could account for just over 3 percentage points of the 11 percent rise in the labor tax over this period.

Table 3 provides estimation results with (log) transfers per capita (in 1990 dollars) as the dependent variable. As with the results for the tax rate, a higher dependency ratio is found to lead to lower per capita transfers, with the coefficient statistically significant in all specifications. Benefits rose on average from $1,600 per person in 1970 to $4,360 in 1991 (again, in 1990 dollars); in terms of the log, this is an increase of 1.0. Recalling that the dependency ratio fell from 58 percent to 54 percent over this period, the coefficient of nearly -7.5 means that the lower dependency ratio can account for 30 percent of the higher social transfers (0.3 of the 1.0 increase in the log of per capita benefits).

The results are unchanged by adding the unemployment rate in column 2, in which a higher unemployment rate is found to be associated with lower per-capita transfers though the coefficient is not statistically significant. And if there is reverse causality as suggested by Daveri and Tabellini (2000), this would likely mean that this coefficient would be even more negative were it possible to use instrumental variables to account for the effect of benefits on unemployment. This is because more generous benefits would be expected to lead to a longer duration of unemployment and thus a higher unemployment rate; this positive correlation would mask a more negative coefficient for the effect of unemployment on transfers. The negative relationship between unemployment and transfers might reflect the same factors as that between benefits and the dependency ratio: the unemployed are net gainers from the welfare state, so that higher unemployment implies a larger fiscal leakage from the employed who are net contributors. This translates into a larger anti-tax coalition and thus lower benefits. This is particularly relevant for countries in Europe, where the prevalence of long-term unemployment means that a large segment of the unemployed are essentially dependent

(they appear in the labor force only because this is required to maintain eligibility for social benefits). The positive coefficient for the effect of the unemployment rate on the labor tax rate likely reflects the positive relationship in the other direction (high labor taxes leading to high unemployment), which could thus mask an anti-tax effect of higher unemployment along the lines of the analytical framework of this paper. The results are again broadly unchanged by using the income share of the rich relative to the poor as the measure of income skewness in column 3 or the share of the non-prime working age in the population.

In addition to using instrumental variables to disentangle the causal effects of migration, unemployment, labor market taxes, and social benefits, another extension of this paper would be to develop and test a theory that distinguishes between the factors that determine the level of taxes and benefits (or more generally, revenue and expenditure).

V. Conclusion

We explore here how the demand for redistribution by the decisive voter is affected by the growing demands on the welfare state's public finances implied by the aging of population. In a related paper [Razin, Sadka, and Swagel (2001)], we pointed out a similar relationship between low-skill migration and the size of the welfare state.[9] This shift may be larger than the increase to the pro-tax coalition brought about by the migrants who join this coalition. Both phenomena can be explained by a similar mechanism: a fiscal "leakage" from the median voter to the net beneficiaries of the welfare state. The mechanism for the determination of the tax burden and generosity of social transfers emphasizes the demand for redistribution by the median voter. A crucial factor determining the political-economy tax-transfer policy is whether this decisive voter is a net contributor or a net beneficiary of the pay-as-you-go social security system.

On the one hand, a higher dependency ratio means a larger pro-tax coalition, as the retired are net beneficiaries of transfers from those who are employed. On the other, a higher dependency ratio puts a higher tax burden on the people around the median voter, as it is necessary to finance transfers to a larger share of the population. People for whom the costs of higher taxes outweigh benefits shift to the anti-tax coalition. Hence, it may well be the

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[9] Earlier studies that emphasize a similar consideration have examined the burden imposed on the modern welfare state by low-skilled migration. For instance, Wildasin (1994) and Razin and Sadka (1995) show how all income groups of the native-born population may lose from migration with income redistribution schemes. Razin, Sadka, and Swagel (2001) examine how these schemes are shaped in the context of a political-economy equilibrium. The theory suggests that migration does not necessarily tilt the political balance in favor of heavier taxation and more intensive redistribution. The reason for this is that more native-born individuals from the middle of the income distribution (that is, the skill/ability distribution) may lose from the extra tax burden brought about by the need to finance the transfer to the migrants, and as a result shift to the side of the high-income anti-tax coalition.

case that the second factor dominates and the political-economy equilibrium tax rate declines when the dependency ratio rises. This would be the case until society ages enough so that the median voter is retired, at which point there is a discontinuous jump up in the tax rate and corresponding increase in the share of transfers.

An important consideration for our analytical result that the tax rate may be negatively related to the dependency ratio is the fact that in the model (and typically in reality), redistribution is financed by a tax on labor income rather than on capital income. If in our setup a capital income tax were available as a source of revenue to finance social security benefits, and this made retirees net contributors to the fiscal system rather than net beneficiaries, the tax rate would then be positively related to the dependency ratio (until the weight of capital owners in the population becomes large enough to shift the tax burden onto labor income).

The puzzle is why, in reality, work-related redistribution (such as old-age pensions, public medical benefits, etc.) is typically financed by payroll taxes rather capital income taxes. On this point we can only offer some conjectures:

1. In the global village, the capital income tax is subject to a "race to the bottom" erosion from international tax competition (see, for instance, Frenkel, Razin and Sadka (1991), and Razin and Sadka (1995)).[10]

2. In general, a payroll tax induces retirement in tenure-based institutions [see, for instance, Mulligan (2000)].

3. Many social security benefits are geared to replacing income or fringe benefits received while working. A foremost example is that of the social pension for the elderly, in which publicly provided retirement income replaces labor income. Another example is unemployment insurance. Also, many workers enjoy employee-provided health care insurance (in Europe, often as a supplement for the public health system); public medical insurance replaces this provision during retirement. Therefore, it may be considered "fair" to finance these benefits by payroll taxes. Extending the model and empirical work to consider the overall tax burden and the split into labor and capital income tax would be an important topic for future research.

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[10] In a full-commitment dynastic equilibrium, the optimal Chamley-Judd rate of capital income tax approaches zero in the steady state, leaving a labor tax as the only stable means of finance. This result, however, does not hold in an overlapping generations model. In a dynastic model in which both human and physical capital are endogenously accumulated, then both the optimal capital and the labor income tax rates approach zero in the steady state and all steady state government revenues derive from budget surpluses accumulated during the transition period.

Looking forward, the aging of the baby boom generation and declining fertility rates in the advanced economies both suggest future increases in the dependency ratio. The results of this paper imply that this will put downward pressure on labor tax rates, so long as the voting bloc of the retired are not the majority. This is relevant for the current debate on the privatization of social security systems. In the context of our model, the desire to have individual retirement accounts rather than a pay-as-you-go system can be seen as an attempt by current workers to lessen the fiscal leakage of transfers to the retired.

Table 1. Summary Statistics
(average for each country, in percent)

Country	Years	Labor Tax Rate	GDP Per Capita	Transfers/ GDP	Transfers Per Capita	Rich/ Middle	Rich/ Poor	Government Jobs Share	Depend Ratio	Unemploy-ment Rate	Trade Openness
Overall	1965–92	35.1	10,875	17.1	2,799	0.74	6.88	17.9	55.6	5.4	57.5
USA	1965–91	25.2	14,940	10.2	1,933	0.80	8.31	15.8	55.1	6.2	15.8
UK	1965–92	25.3	10,233	10.1	1,493	0.72	4.08	19.9	52.6	5.9	49.4
Spain	1965–91	26.4	7,134	11.8	1,319	0.65	4.91	8.7	62.5	9.8	32.9
Finland	1965–92	29.0	10,203	16.2	2,965	0.67	5.17	16.3	50.3	4.4	52.9
Italy	1965–91	33.2	9,315	18.5	3,375	0.89	7.55	14.8	61.3	6.3	37.2
France	1965–92	36.8	11,067	20.3	3,400	0.95	17.06	20.2	57.0	6.0	38.7
Norway	1965–91	36.9	11,127	11.7	2,450	0.75	7.32	22.4	53.4	2.3	75.1
Austria	1970–92	37.4	10,388	20.6	2,670	0.67	5.38	17.7	56.1	2.9	69.7
Germany	1968–92	38.1	11,641	16.1	2,254	0.74	6.52	14.1	54.3	4.6	49.9
Belgium	1965–91	40.2	10,138	23.7	3,093	0.66	4.85	17.2	59.9	6.9	115.9
Denmark	1981–92	42.6	13,006	19.5	4,013	0.66	6.64	29.9	45.4	9.4	69.2
Sweden	1965–92	43.9	12,180	18.4	4,505	0.68	6.09	27.2	49.2	2.3	56.4
Netherlands	1970–92	48.2	11,214	28.2	3,604	0.68	4.67	13.5	61.3	5.5	99.3

Notes: GDP per capita and transfers per capita are in real (1990) U.S. dollars; trade openness is defined as (exports + imports)/GDP; the two measures of income inequality are the income share for the top quintile divided by the income share for the middle three quintiles (rich/middle), and the share of the top quintile divided by the share of the bottom quintile (rich/poor).

Table 2. Determinants of Labor Tax Rates
(330 observations)

	Labor Tax Rate			
	(1)	(2)	(3)	(4)
Dependency ratio	-0.382 (-4.02)	-0.383 (-4.40)	-0.342 (-3.60)	
Share of "non-working age" (1 - aged 15–64/population)				-0.877 (-8.94)
Government jobs/total employment	0.915 (12.17)	0.729 (10.01)	0.945 (12.59)	0.963 (15.52)
Trade openness	0.198 (8.09)	0.131 (5.45)	0.212 (8.75)	0.129 (5.38)
Per capita GDP growth	-0.187 (-2.83)	-0.127 (-2.09)	-0.207 (-3.13)	-0.169 (-2.79)
Rich/middle income share	0.055 (-2.77)	-0.049 (-2.66)		-0.036 (-2.01)
Rich/poor income share			0.0003 (1.60)	
Unemployment rate		0.480 (7.82)		
R^2	0.753	0.793	0.749	0.793

T-statistics are in parentheses. All specifications include country fixed effects (coefficients not shown).

Table 3. Determinants of Per Capita Transfers
(330 observations)

	Log of Real Per Capita Social Transfers			
	(1)	(2)	(3)	(4)
Dependency ratio	-7.493 (-8.81)	-7.492 (-8.80)	-7.616 (-9.03)	
Share of "non-working age" (1 - aged 15–64/population)				-7.730 (-7.89)
Government jobs/total Employment	4.467 (6.64)	4.611 (6.47)	4.341 (6.51)	6.376 (10.28)
Trade openness	0.740 (3.37)	0.792 (3.37)	0.689 (3.20)	0.210 (0.88)
Per capita GDP growth	-2.716 (-4.59)	-2.762 (-4.63)	-2.586 (-4.41)	-2.662 (-4.41)
Rich/middle income share	0.276 (-1.55)	0.271 (-1.52)		0.554 (1.55)
Rich/poor income share			0.003 (1.65)	
Unemployment rate		-0.370 (-0.62)		
R^2	0.617	0.618	0.618	0.602

T-statistics are in parentheses. All specifications include country fixed effects (coefficients not shown).

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