The Aging Population and the Size of the Welfare State

Assaf Razin, Efraim Sadka, Phillip Swagel*

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Abstract

This paper develops an overlapping generations model of Social Security and human capital formation in which—somewhat against the conventional wisdom—an increase in the dependency ratio can lead to a reduced tax burden or less generous social transfers. A higher dependency ratio resulting from the aging of the population therefore reduces the extent of redistribution. Data on 12 European countries over the period 1974 to 1992 are consistent with the implications of this model: a higher dependency ratio leads to a lower tax rate on labor income, with the effects statistically significant even after controlling for income inequality as suggested by the standard theory of the tax burden, per capita GDP growth, the international exposure of the economy, and the share of government jobs out of total employment. Similarly, a higher dependency ratio leads to lower per capita transfers, again after controlling for these socio-economic factors.

1 Introduction

With the aging of the population, the proportion of voters eligible to receive Social Security has increased, and these pensions are by far the largest component of transfers in all industrial

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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 this ongoing increase in the size of the social security/transfer system for the welfare state, focusing particularly on the relationship between aging of the population and the tax rates and benefits involved in the welfare state.

A model is developed in which the scope of taxes and social transfers between the working age population and the retired is endogenously determined by voting. The extent of taxation and redistribution policy is decided by democratic voting, with the political economy equilibrium 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 representative democracy, in which the size of government or the scope of redistribution depends on pre-tax income inequality. Two economic interpretations are 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 skewedness 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 the pay-as-you-go Social Security system, in which current workers are net contributors while the retired are net beneficiaries.

Empirical evidence using panel data on 12 European countries from 1974 to 1992

provides strong support for our theory. These countries share common institutional features of their welfare states, including tax rates on labor income ranging from 40 to 50 percent, transfers constituting 20 to 30 percent of GDP, and dependency ratios approaching half of the population. While the institutions are broadly similar, the extent of taxes and transfers vary across the 12 countries, and are found to depend on demographic characteristics as proxied by the dependency ratio. The dependency ratio has a statistically significant negative effect on both the labor tax rate and the generosity of per-capita transfers, after controlling for income skewedness as suggested by the standard theory and for a number of social and demographic control variables. Since the age structure of the population is not affected by annual changes in tax or benefit rates, the econometric finding that the dependency ratio affects the parameters of the welfare state is unlikely to be sensitive to a problem of reverse causality.

The results of this paper 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 many 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 2 develops an overlapping-generations model of human capital formation and derives the political-economy equilibrium tax-transfer policy. Section 3 studies the effects of changes in the dependency ratio on the equilibrium. Section 4 presents empirical results, including a description of the data sources and discussion of the econometric findings. Section 5 concludes.

2 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 cummulative distribution function of innate ability, $G(e)$, has a uniform density over the interval $[0, 1]$.

Suppose that the government levies a flat tax on labor income in order to finance a flat grant, b. The literature (e.g., James 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 cash grant, b. The flat lump-sum grant may capture both free provision of public services such as health and education, as well as cash transfers. As will be seen, the tax rate and generosity of the grant are linked through the government's budget constraint.

Given these assumptions, there exists a cutoff level, e^*, such that those with education cost 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):

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

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.[1] Thus, for analytical tractability, we assume a linear production function:

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

where $1+r$ is the gross rental price of capital and the marginal productivity conditions for factor prices ($w = \partial Y/\partial L$ and $1 + r = \partial Y/\partial K$) are already substituted into the production function. The linearity of the production function can arise as an equilibrium outcome through either international capital mobility or factor price equalization arising from goods' trade. For simplicity, the two types of labor are assumed to be perfect substitutes in production in terms of effective 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. 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:

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

$$L_t = \{\int_0^{e_t^*} (1-e)dG + q[1-G(e_t^*)]\}N_0(1+n)^t,$$

where $N_0(1+n)^t$ is the size of the working age population 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. With uniform distribution of innate ability, the aggregate input of labor in efficiency units equals:

$$L_t = [e_t^* - \frac{1}{2}(e_t^*)^2 + (1-e_t^*)q]N_0(1+n)^t \tag{3}$$

Finally, 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:

$$\begin{aligned} & b_t N_0[(1+n)^{t-1} + (1+n)^t] = \tau_t w L_t \\ = \quad & \tau_t w[e_t^* - \frac{1}{2}(e_t^*)^2 + (1-e_t^*)q]N_0(1+n)^t \end{aligned}$$

Therefore, the lump-sum grant equals:

$$b_t = \tau_t w[e_t^* - \frac{1}{2}(e_t^*)^2 + (1-e_t^*)q](1+n)/(2+n) \tag{4}$$

For any tax rate τ and population growth rate, n, equations (1), (3), and (4) determine $e_t^* = e^*(\tau_t, n)$, $L_t = L(\tau_t, n)$, and $b_t = b(\tau_t, n)$ as functions of τ_t and n. The population growth rate, n, is exogenous, but we nevertheless write e^*, L and b as functions 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:

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

Period t consumption of a retiree born in period $t-1$ 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, since it is beyond their control. The political economy equilibrium for the tax rates, τ_t, is then determined by majority voting of individuals alive in period t, without being affected by preceding or future generations.

We next calculate the effect of taxes on the income of any given individual, and thus obtain the political economy equilibrium for taxes. Differentiating $W(e, \tau_t, \tau_{t+1}, n)$ with respect to e and τ_t, we find that:

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

Therefore, if $\partial W/\partial \tau > 0$ for some e_o, then $\partial W/\partial \tau_t > 0$ for all $e > e_o$. And, similarly if $\partial W/\partial \tau_t < 0$ 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 (namely, $b(\tau_t, n)$), it follows from (6) that the old (retirees) in period t always opt for a higher tax rate in that period. Since $n > 0$, 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. Since e is uniformly distributed, there are $N_0(1+n)^t e_M$ young individuals with innate ability parameter $e \le e_M$ (more able than the median voter), and $N_0(1+n)^t(1-e_M)$ young individuals with innate ability parameter $e \ge e_M$ (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:

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

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

$$e_M(n) = \frac{1}{2}\frac{(2+n)}{(1+n)}. \tag{7}$$

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

$$\tau_o(n) = \arg\max_{\tau} \; W(e_M(n), \tau, n). \tag{8}$$

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

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

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

and the second-order condition is:

$$\frac{\partial^2 W(e_M(n), \tau_o, n)}{\partial \tau^2} = B_\tau(\tau_o(n), n) \; 5 \; 0, \tag{10}$$

where the subscript indicates a partial derivative.

The equilibrium tax rate can be obtained implicitly, from $B(\tau, n) = 0$. Recalling equation (5), we can see that $B(\tau, n)$ depends on whether the median voter is skilled or unskilled:

$$B(\tau,n) = \begin{cases} -w(1-e_M(n)) + \dfrac{w(1+n)}{(2+n)}[e^* - \frac{1}{2}(e^*)^2 + (1-e^*)q] + \dfrac{\gamma\tau(1+n)}{(2+n)(1-\tau)}\dfrac{de^*}{d\tau} \\ \text{if } \; e_M(n) < e^*(\tau(n)) \\ -wq + \dfrac{w(1+n)}{(2+n)}[e^* - \frac{1}{2}(e^*)^2 + (1-e^*)q] + \dfrac{\gamma\tau(1+n)}{(2+n)(1-\tau)}\dfrac{de^*}{d\tau}, \\ \text{if } \; 1 > e_M(n) > e^*, \end{cases} \tag{11}$$

where

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

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, in the case where the median voter is an unskilled worker, $B(\tau,n) = 0$ in the second part of equation (11) implies:

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

or

$$\tau\frac{\partial(I_A)}{\partial\tau} = I_A - I_M, \tag{12}$$

where $I_M = wq$ is the pre-tax median wage and $I_A = w(1+n)[e^* - \frac{1}{2}(e^*)^2 + (1-e^*)q]/(2+n)$ is the pre-tax average taxable income.[2]

[2]Note that the median wage is calculated over the working-age population, but the average taxable income is total wage income divided by the size of the population, including the non-working retirees.

3 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 $B_\tau(\tau_o(n), n) \; 5 \; 0$ (see 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:

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

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. Upon inspection of the right-hand side of (14), we can see that it contains one term—$w[e^* - \frac{1}{2}(e^*)^2 + (1 - e^*)q]/(2+n)^2$—which is positive, while the other terms are negative (because de_M/d_n 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 samller share of the population. This is an unambigously pro-tax factor. However, the median voter now becomes more able (because $\frac{de_M}{dn} = -\frac{1}{2(1+n)^2} \leq 0$), and therefore opts for a lower tax and transfer. Moreover, the per-capita efficiency cost of distortionary taxation, $\tau\frac{\gamma}{(1-\tau)}\frac{de^*}{d\tau}\frac{1}{(2+n)^2}$, rises as well, as can be seen in the last terms on the right-hand sides of (11) and (14). This is also an anti-tax factor. When the negative terms $\frac{de_M}{dn}$ and $\frac{de^*}{d\tau}$ 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 $\frac{de_M}{dn}$, because the change in the median voter toward a less able individual is of no consequence in this case, as all of the unskilled have the same demand for redistribution regardless of their innate ability parameter. If, furthermore, the distortionary element $\tau\frac{\gamma}{(1-\tau)}\frac{de^*}{d\tau}\frac{1}{(2+n)^2}$ is sufficiently small and q is large enough, then $B_n(\tau_o(n), n)$ is positive.[3] It then follows that an increase in population growth rate (decline in the 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 which is decreasing in τ (either $(1-\tau)w(1-e_M)$, or $(1-\tau)wq$). Thus, the political-economy equilibrium tax rate

[3] To see this, let γ approach zero. Then, one can see from (4) that B_n approaches a positive limit of $w[e^* - \frac{1}{2}(e^*)^* - (1-e^*)q]/(1+n^*)$ if τ does not approach one. From (11) it can be verified that τ does indeed not approach one if q is sufficiently large.

"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 will 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.

4 Empirical Evidence

We apply data on 12 European countries over the period 1974 to 1992 to examine the empirical implications of the theory for the determinants of the tax burden and the generosity of per capita transfers. We use data on European countries rather than across other advanced economies such as the United States because countries in Europe share relatively similar fiscal institutions while still having fairly broad heterogeneity in demographic and economic characteristics such as tax rates, benefits, and the dependency ratio.

We estimate two sets of equations in which the dependent variables of the labor tax rate and transfers per capita are functions of the dependency ratio as suggested by our theory, the measure of income skewedness suggested by the standard theory, and additional control variables. These latter variables include government employment as a share of total employment to indicate the breadth of government involvement in the economy, a measure

of openness to trade to capture exposure to external shocks, and GDP growth to control for business cycle effects.

The measure of income skewedness in the baseline specification is the ratio of the income share of the top quartile to the combined share of the middle two 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 measure by the income of those at the top and thus exceeds the median income (for which consistent cross-country data are not available). The standard theory predicts that the extent of redistribution depends on the preferences of the median voter—those in the middle rather than those at the bottom of the income distribution—which is why rich/middle is used in the baseline instead of other measures of inequality such as the income share of the top quartile relative to the bottom ("rich versus poor").

4.1 Data Sources

Data on the labor tax rate from 1974 to 1992 are taken 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 skewedness are derived from the updated inequality database of Deininger and Squire (1996), which provides measures of income shares by quintile over time, though data are not available for every year. Only the high quality measures in the database are used, and the missing observations are then obtained through linear interpolation (the shares do not vary all that much over time, though in most countries there is a general trend toward increased inequality).

The OECD Analytical Database is used to calculate 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 usual as one minus the labor force as a

share of the population. 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 most 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.

Data on the stock of immigrants are from the OECD Migration Statistics database, supplemented for years before 1980 by various issues of the OECD Trends in International Migration Annual Report.

4.2 Description of Data

Table 1 summarizes the variables used in the regression analysis. The data encompass slightly different periods for some of the countries, so that an unbalanced panel is used in the regressions. The countries are listed in order of an increasing tax rate, so that it can easily be seen that high tax countries are generally those with more generous transfers (the correlation between the two variables is 0.68). In all countries, the bottom quintile receives about 5-10 percent of income, the middle three quintiles around 50-60 percent, and the top quintile 35-40 percent.

The dependency ratio varies widely across the 12 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 (-0.02), and only a moderate correlation with (log) per-capita benefits (-0.28). 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.

Openness to trade is included as a determinant of the labor tax rate 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).

4.3 Results

Two baseline regressions are examined, one each for the determinants of the labor tax rate and the determinants of transfers per capita; these are then supplemented with various sensitivity analyses. The explanatory variables include the dependency ratio, the share of government jobs out of total employment, openness to trade, per capita GDP growth, and the measure of income skewedness suggested by the standard theory (rich/middle). Note that inclusion of the country fixed effect means that the regressions take into account the fact that richer countries tend to have higher tax rates and provide more generous welfare benefits. The equations are estimated with 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.

Table 2 shows results for the determinants of the labor tax rate. It can be seen that the dependency ratio has a statistically significant negative effect on the labor tax rate in all specifications, resolving the ambiguity in the analytical model.

The first column provides the baseline specification. A one percentage point increase in the dependency ratio leads to a nearly 0.5 percentage point decline in the labor tax rate. To put this in perspective, the (unweighted) average tax rate in the data rose from 34 percent in 1974 to 42 percent in 1991, while the average dependency ratio fell from 57 percent to 54 percent over this period.[4] Given the negative coefficient, the fall in the dependency ratio resulted in higher taxes—the coefficient of -0.489 implies that the decline in the dependency ratio accounted for roughly 1.5 percentage points of the 8 percentage point increase in the labor tax rate. A larger share of government employment is associated with a higher labor tax rate,[5] but no significant relationship is found between the labor tax rate and income distribution, or between the tax rate and per-capita real GDP growth. The effect of openness on the labor tax rate is positive, possibly reflecting the role of the government in providing

[4]This calculation excludes Denmark, for which data start in 1981, and is done only through 1991 since data for 1992 are not available for Belgium, Italy, Norway, and Spain.

[5]This could reflect reverse causality as higher tax rates allow for a larger government share of employment.

citizens with insurance against external shocks as suggested by Rodrik, but this coefficient is significant at only the 9 percent significance level.

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. The coefficient for the effect of the dependency ratio on taxes remains negative and significant and nearly unchanged in value.

Column 3 uses the income share of the rich versus the poor (top quintile versus bottom quintile) rather than the variable for the income of the rich versus the middle (top versus middle three quintiles). This now has a statistically significant positive coefficient as predicted by the standard median voter theory (though this is somewhat different from the variable suggested by the theory). But the other results are unchanged, including the negative and significant effect of the dependency ratio on the labor tax rate.

Adding the share of migrants in the population in column 4 again does not affect the negative relationship between the dependency ratio and the labor tax rate, though the coefficient more than doubles in magnitude. The sample is smaller because data on the stock of immigrants are not available for a number of years in many of the countries. Though not statistically significant, the negative coefficient on the share of immigrants matches the finding in Razin, Sadka, and Swagel (1998) that a larger share of immigrants leads to an enlargement of the anti-tax coalition similar to the effect of the aging population—the fiscal leakage comes about in this case because immigrants are typically net beneficiaries of the welfare state.[6] The results in column 5 are for the baseline specification but estimated over the smaller sample for which immigration data are available; the results are again qualitatitively unchanged.

Table 3 provides estimation results with 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 strongly significant in all specifications.

[6]Razin, Sadka, and Swagel (1998) show that the anti-tax effect comes about through low-education migrants who are more likely to be net beneficiaries of the fiscal system than high-education immigrants.

Benefits rose on average from $2,445 per person in 1974 to $4,490 per person in 1992 (again, in 1990 dollars); in terms of the log, this is an increase of 0.61. Recalling that the dependency ratio fell from 57 percent to 54 percent over this period, the coefficient of -7.176 in column 1 of Table 3 means that the lower dependency ratio accounted for roughly one-third of the increased benefits (0.21 of the 0.61 increase in the log of per capita benefits). These results are qualitatively unchanged in the other four specifications: adding unemployment or using the alternative measure of income distribution has essentially no effect on the coefficent on the dependency ratio (columns 2 and 3). Adding the share of immigrants in the population in column 4 and using the small sample but without the share of immigrants in column 5 affects the magnitude of the coefficient on the dependency ratio, but this remains negative and statistically significant.

Although the principal focus of the paper is on robustness of the results for the effects of the dependency ratio on taxes and benefits, interesting differences can be seen in comparing the coefficients on the other variables across the various specifications. The coefficient on the share of government employment remains positive and statistically significant in Table 3 as was the case in the regressions for the labor tax rate, but openness, GDP growth, and income distribution have statistically significant effects on benefits unlike in Table 2 for the effects on the tax rate. A more open economy is associated with lower per capita benefits; the opposite of the result expected from Rodrik (1998) or Alesina and Wacziarg (1998). The generosity of social benefits has a counter-cyclical effect, as higher growth leads to lower transfers. And, at least in the specifications estimated over the full sample (columns 1 to 3, without migration data), more unequal income distribution leads to higher per-capita transfers, as predicted by the standard theory of the welfare state.

A higher unemployment rate is associated with lower per-capita transfers (column 2 of Table 3). 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 higher unemployment rate, so that this positive correlation masks a more negative coefficient for the effect of unemployment on transfers. The negative relation-

ship 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 in Table 2 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.

Finally, column 4 of Table 3 shows that a higher share of immigrants in the population is associated with higher per capita benefits, in contrast to the negative relationship between taxes and the immigrant share. This could again causation in the other direction, as immigrants might be expected to flow toward countries with the highest benefits. Again, however, none of this changes the main result of the paper that there is a robust negative relationship between the dependency ratio and the generosity of transfers and the labor tax rate.

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).

5 Conclusion

The issue explored in this paper is how the demand for redistribution by the decisive voter is affected by the growing demands on the the welfare state's public finances implied by the aging of population. 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 hand, 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 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 in the tax rate and corresponding increase in the share of transfers.[7]

An important consideration for our analytical result that the tax rate is 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 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. We can 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)).[8]

[7]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 (1998) 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. This shift may be larger than the increase to the pro-tax coalition brought about by the migrants who join this coalition.

[8]In a full-commitment dynastic equilibrium, the optimal Chamley-Judd rate of capital income tax ap-

(2) In general, a payroll tax induces retirement (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.

Our empirical results using data on 12 European countries from 1974 to 1992 are remarkably consistent with the implications of the theory. After controlling for the income skewedness as suggested by the standard theory of the size of government in a representative democracy, and for a number of additional control variables, we find that a larger dependency ratio leads to a smaller tax burden and smaller per-capita transfers.

The data for the labor tax rate are available only through 1992, precluding estimation over more recent years. Looking forward, however, the aging of the baby boom generation and declining fertility rates in the advanced economies in western Europe will together lead to future increases in the dependency ratio. The empirical results suggest that this will put downward pressure on labor tax rates, so long as the voting bloc of the retired are not the majority. In the meantime, the results of this paper are 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.

proaches 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.

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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	Govt jobs share	Depend ratio	Unemploy-ment rate	Trade openness	Migrants/ population
Overall	1974-92	39.0	11,453	19.5	3,316	0.71	6.46	19.7	54.9	6.6	65.6	4.4
UK	1974-92	26.3	11,092	11.2	1,621	0.73	4.24	20.9	51.9	7.7	53.0	3.1
Spain	1974-91	31.1	7,878	13.7	1,511	0.64	4.52	10.6	62.8	13.2	36.4	0.7
Finland	1974-92	32.0	11,441	18.1	3,538	0.64	5.08	18.6	49.1	5.3	55.8	0.5
Italy	1974-91	36.4	10,458	19.9	3,411	0.76	5.23	16.1	60.9	7.3	41.1	1.0
Austria	1974-92	38.5	10,874	21.5	3,011	0.67	5.36	18.5	55.7	3.3	71.9	5.1
Norway	1974-91	39.0	12,716	13.0	3,066	0.74	7.03	25.0	51.6	2.7	76.1	2.7
Germany	1974-92	39.8	12,339	16.8	2,646	0.73	6.79	15.0	53.8	5.7	53.1	7.2
France	1974-92	41.5	12,163	22.3	3,957	0.91	18.20	21.4	56.5	7.7	43.3	7.7
Denmark	1981-92	42.6	13,006	19.5	4,013	0.66	6.64	29.9	45.4	9.4	69.2	2.7
Belgium	1974-91	44.4	11,243	26.5	3,878	0.63	4.41	18.9	59.2	9.2	126.2	8.9
Sweden	1974-92	48.0	13,060	21.0	5,297	0.70	5.45	30.7	48.2	2.4	61.3	5.1
Netherlands	1974-92	49.7	11,553	29.8	4,028	0.66	4.47	13.8	61.3	6.3	101.7	3.7

Notes: GDP per capita and transfers per capita are in real (1990) U.S. dollars; Trade openness is defined as (exports + imports)/GDP; dependency ratio includes unemployed as dependent; 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 Tax Rate on Labor Income
(dependent variable: labor tax rate)

	(1)	(2)	(3)	(4)	(5)
Dependency ratio	-0.489	-0.464	-0.494	-1.149	-1.024
	(-3.61)	(-3.71)	(-3.67)	(-6.84)	(-7.66)
Government jobs/total employment	1.015	0.602	0.988	0.833	0.834
	(9.76)	(5.15)	(9.58)	(7.66)	(7.66)
Trade openness	0.049	0.003	0.047	0.019	0.021
	(1.68)	(0.12)	(1.62)	(0.74)	(0.80)
Per capita GDP growth	-0.013	-0.005	-0.004	-0.042	-0.021
	(-0.19)	(-0.09)	(-0.06)	(-0.68)	(-0.36)
Rich/middle income share	0.035	0.036		-0.021	-0.008
	(1.38)	(1.54)		(-0.62)	(-0.24)
Rich/poor income share			0.0003		
			(2.30)		
Unemployment rate		0.446			
		(6.13)			
Immigrants/population				-0.399	
				(-1.23)	
R^2	0.531	0.605	0.538	0.609	0.605
Observations	217	217	217	158	158

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

Table 3: Determinants of Social Transfers
(dependent variable: log of per capita benefits, 1990 dollars)

	(1)	(2)	(3)	(4)	(5)
Dependency ratio	-7.176 (-5.70)	-7.421 (-8.82)	-7.226 (-5.75)	-3.762 (-2.16)	-11.355 (-7.04)
Government jobs/total employment	2.595 (2.69)	3.854 (3.29)	2.333 (2.42)	3.038 (2.69)	2.977 (2.26)
Trade openness	-1.090 (-4.02)	-0.950 (-3.39)	-1.123 (-4.16)	-1.706 (-6.34)	-1.807 (-2.45)
Per capita GDP growth	-1.503 (-2.40)	-1.525 (-2.45)	-1.414 (-2.26)	-0.520 (-0.80)	-1.790 (-2.45)
Rich/middle income share	0.437 (1.87)	0.433 (1.87)		0.197 (0.57)	-0.585 (-1.53)
Rich/poor income share			0.003 (1.99)		
Unemployment rate		-0.014 (-1.86)			
Immigrants/population				24.090 (7.17)	
R^2	0.336	0.347	0.338	0.572	0.415
Observations	217	217	217	158	158

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