AEA Session H5—Social Security Reform

THE WAGE GAP AND PUBLIC SUPPORT FOR SOCIAL SECURITY

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Tax rates on labor income rose in most industrial countries in the the 1970's and 1980's, in large part to fund burgeoning social security systems. The growth of the welfare state coincided with increased returns to education, and thus broader wage differentials between workers with relatively high levels of skills or education and those without. This paper provides a theoretical framework which connects these phenomena. We show that the aging of the population and the return to education both affect the political-economy determination of tax rates and the generosity of transfers in a democratic framework. Using panel data on the United States and nine European countries, we provide supportive empirical evidence.

1 Analytical Framework

The analytical framework is similar to that used in our previous work [Razin, Sadka, and Swagel (2001)]. Consider a standard overlapping-generations model in which each generation lives two periods: a working period and a retirement period. There are two types of workers: skilled workers provide one efficiency unit of labor per unit of labor time during their first period of life, while unskilled workers provide only $q < 1$ efficiency units of labor per unit of labor time in this

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period. Workers are born without skills and thus with low productivity. At the beginning of the first period of life, each worker chooses whether to use part of the period to acquire an education and become skilled, or instead remain unskilled. The value $1 - q$ thus reflects the return to education. After the working period, individuals retire, with second period consumption funded by savings and a government transfer. This grant, denoted as b, captures Social Security benefits.

Individuals are characterized by an innate ability parameter, e, which is the time needed to acquire education. The distribution of innate ability is assumed uniform over the interval $[0, 1]$. 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). In addition to the time involved, we also assume a positive pecuniary cost of acquiring skills, γ, which is not tax deductible. Wage earnings are taxed at the rate, τ.

Given these assumptions, there exists a cutoff level, e^*, such that only those with education-cost parameter below e^* will become skilled. The cutoff level is determined by the equality between the return to education and the cost of education (including lost income): $(1-\tau)w(1-e^*) + b = (1-\tau)qw + \gamma + b$.

Rearranging terms gives the cutoff level for the education decision:

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

Gross output (Y) is produced by labor (L) and capital (K), according to a production function which is assumed linear for analytical tractability:

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

where $\delta + r$ is the gross rental price of capital, δ is the rate of depreciation; and where the marginal productivity conditions for factor prices ($w = \partial Y/\partial L$ and $\delta + r = \partial Y/\partial K$) are already substituted into the production function.

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—retirees 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 in effective labor units equals:

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

where $N_0(1 + n)^t$ is the size of the working age population. 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.

Finally, the government's budget is balanced period by period. The wage bill, wL_t, constitutes the base for the payroll tax. The cash grant is paid to both workers and retirees, so that the government budget constraint implies:

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

For any payroll tax rate τ and an unskilled-skilled earning ratio, q, equations (1) and (4) determine $e_t^* = e^*(\tau_t, q)$ and $b_t = b(\tau_t, q)$ as functions of τ_t and q.

Denote by $W(e, \tau_t, \tau_{t+1}, q)$ 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:

$$W(e, \tau_t, \tau_{t+1}, q) = \begin{cases} (1-\tau)w(1-e) - \gamma + b(\tau_t, q) + \dfrac{b(\tau_{t+1}, q)}{(1+r)} \\ \quad \text{for} \quad e \leqq e^*(\tau_t, q) \quad \text{“skilled”} \\ \\ (1-\tau)wq + b(\tau_t, q) + \dfrac{b(\tau_{t+1}, q)}{(1+r)} \\ \quad \text{for} \quad e \geqq e^*(\tau_t, q) \quad \text{“unskilled”} \end{cases} \tag{5}$$

Since the government's budget constraint is balanced period by period, it follows that the transfer in period $t+1$, $b(\tau_{t+1}, q)$, is independent of the tax rate in period t, τ_t. Therefore, in voting on the tax rate τ_t, individuals living in period t take $b(\tau_{t+1}, q)$ as exogenous. 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.

The structure of this model implies that if an increase in the income tax rate benefits a particular young (working) individual (because the higher tax rate supports a higher transfer), then all young individuals who are less able 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. Razin, Sadka and Swagel (2002) provide elaboration.

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. As long as $n > 0$, 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 the median voter who is a young (working) individual.

Denote the innate ability parameter of this median voter by $e_M = (2+n)/2(1+n)$. As noted, the political equilibrium tax rate, τ, in period t [denoted by $\tau_o(q)$] maximizes the lifetime income of the median voter: $\tau_o(q) = \arg\max_\tau \ W(e_M, \tau, q)$. For a given q, 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, $\tau_o(q)$ is implicitly defined by the first-order condition:

$$\frac{\partial W[e_M, \tau_0(q), q]}{\partial \tau} = B[\tau_0(q), q] = 0. \tag{6}$$

The second-order condition is:

$$\frac{\partial^2 W[e_M, \tau_o(q), q]}{\partial \tau^2} = B_\tau[\tau_o(q), q] \leqq 0, \tag{7}$$

where $B_\tau = \partial B/\partial \tau$ and

$$B(\tau,q)=\begin{cases} -w(1-e_M)+\dfrac{w(1+n)}{(2+n)}\left[e^*-\frac{1}{2}(e^*)^2+(1-e^*)q\right]-\dfrac{\gamma^2\tau(1+n)}{(2+n)(1-\tau)^3w} \\ \text{if } \ e_M<e^* \\ -wq+\dfrac{w(1+n)}{(2+n)}\left[e^*-\frac{1}{2}(e^*)^2+(1-e^*)q\right]-\dfrac{\gamma^2\tau(1+n)}{(2+n)(1-\tau)^3w} \\ \text{if } \ e_M>e^*. \end{cases} \tag{8}$$

We next examine the effect of a change in the return to education on the political economy equilibrium; that is, we wish to sign $d\tau_0(q)/dq$. Total differentiation of (6) with respect to q implies:

$$\frac{d\tau_0(q)}{dq}=-\frac{B_q[\tau_0(q),q]}{B_\tau[\tau_0(q),q]}. \tag{9}$$

Since $B_\tau \leqq 0$, it follows that the sign of $d\tau_0/dq$ is equal to the sign of $B_q[\tau_0(q),q]$. This derivative is found from (8):

$$B_q[\tau_0(q),q]=\begin{cases} \dfrac{wq(1+n)}{2+n}>0 \ \text{ if } \ e_M<e^* \\ -w\dfrac{2-q+n(1-q)}{2+n}<0 \ \text{ if } \ e_M>e^*. \end{cases}$$

Hence:

$$\frac{d\tau_0(q)}{dq}\begin{cases} >0 \ \text{ if } \ e_M<e^* \\ <0 \ \text{ if } \ e_M>e^*. \end{cases} \tag{10}$$

We can see from (10) that the effect of a rise in the return to education (that is, a decline in q) on the equilibrium tax rate and transfer depends on the nature of the median voter. When

the median voter is a skilled individual, a larger return to education lowers the equilibrium tax and the benefit; conversely taxes and transfers are higher with a larger return to education in the case of an unskilled median voter.

The rationale for this result is straightforward. A decline in q lowers the effective labor supply—e^* falls with q so that it becomes more worthwhile to gain an education and thus the share of skilled workers grows, but this is more than offset by the smaller effective labor supply of the remaining unskilled workers (dL/dq equals $qN_0(1+n)^t$, which is positive). With wages fixed, the payroll tax base falls with the labor supply. If the median voter is skilled, the individual who was previously indifferent between raising or lowering the tax rate will now find it beneficial to lower the tax rate. This is because with a skilled median voter, all changes in the labor supply occur only in individuals less able than the median. With a smaller supply of labor coming from the "bottom" half of the population, the burden of funding the transfers falls more heavily on individuals at and above the median. The skilled median voter will thus now find it preferable to lower the tax rate and receive a smaller transfer. The situation is reversed if the median voter is unskilled. As before, a decline in q lowers the tax burden imposed on the unskilled (since they supply less labor); the shift in the composition of the tax base dominates the decline in tax revenues to fund transfers. The unskilled median voter will thus vote for higher taxes. Since B_q is negative with an unskilled median voter, benefits likewise rise as the tax is raised by enough to more offset the lower tax base.

2 Empirical Evidence

We next use data for the United States and nine European countries over the period 1965 to 1996 to examine the relationship between tax rates, the aging of the population, and returns to education.[4] We estimate regressions in which the dependent variables of the labor tax rate and real per capita transfers are functions of the return to education and the share of the population with high education, along with additional control variables. These include the dependency ratio as suggested by our theory, a measure of income distribution suggested by previous theories that seek to explain the size of the welfare state [e.g., Meltzer and Richard (1981), Persson and Tabellini (forthcoming)], 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 against which the welfare state might provide social insurance [as in Rodrik (1998)].

2.1 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 skewedness are derived from the updated inequality database of Deininger and Squire (1996), which provides measures of income shares by quintile over time, with missing observations obtained through linear interpolation. The measure of income skewedness is the ratio of the income share of the top quintile to the combined share of the middle three quartiles

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

("rich versus middle")–this is the "skewedness" of income distribution in the terminology of Meltzer and Richard.

Data on the return to higher education are from OECD (1998), and are for women completing the upper level of secondary school in 1995 (results for men are similar). These are calculated as the internal rate of return which equates the present value of higher lifetime income as a result of more education to the present value of the opportunity cost of attaining it. The share of the population by educational attainment is from Barro and Lee (2000), with valuess between their five-year benchmarks obtained through linear interpolation. Note that our theory indicates that the effect of the wage gap on the equilibrium tax rate depends on the interaction between the return to education and the share of individuals with high education. The interaction of these variables is thus used in the regressions–this is useful in the empirical specification since our measure of the return to education does not vary over time but only across countries.

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 one minus the labor force as a share of the population (rather than 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 provides a summary of the data, with the countries sorted by average labor tax rate.

Note that in all countries that a majority of the population is in the group corresponding to "less educated" in our regressions.

2.2 Estimation Results

Table 2 provides results from regressions for the determinants of the labor tax rate and (log) real transfers per capita. The equations are estimated with ordinary least squares (that is, panel fixed effects)—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 which controls for the fact that richer countries tend to have higher tax rates and provide more generous welfare benefits.

Columns 1 and 2 show results for the labor tax rate, and columns 3 and 4 those for per capita real transfers. In both cases, the interaction of the return to education and the share of the highly educated in the population has a positive and strongly significant coefficient. This is consistent with our theoretical model: the less educated are the majority in all countries and thus would be expected to favor higher taxes and transfers the larger is the return to education. As in the model, the dependency ratio has a statistically significant negative effect on the labor tax rate and transfers. The young are the majority of the populations and thus would naturally vote for lower taxes and transfers as the number of dependents goes up in order to limit the "fiscal leakage" from the welfare state.

The results for the other variables are sensible and are qualitatively unchanged in adding the interacted education variable (that is, going from column 1 to 2 and from column 3 to 4). A larger share of government employment is associated with a higher labor tax rate and more transfers,

while countries more open to trade likewise have larger welfare states, in accord with the theory of Rodrik (1998). The significant negative coefficient for per capita real GDP growth is in line with the use of automatic stabilizers providing countercyclical fiscal policy. The coefficient on the income skewedness variable is not statistically significant for tax rates, but is positive and significant for transfers. This matches the prediction of previous theories that inequality leads to pressure for redistribution.

3 Conclusion

We show that the aging of the population and changes in returns to education and the composition of the population both affect the political-economy equilibrium which determines the generosity of the welfare state. Moreover, the theory and empirical results are in line with some broad developments in the advanced economies over the past 30 years. In the 1970's and 1980's, increased returns to skill and education occurred along with rising tax rates–under our theory, this association reflects the fact that the "low-skilled" remained the majority of the population. More recently, however, the welfare state has been in retreat. This coincides with the aging of the populations in the advanced economies, as the majority prefers a smaller tax burden and less generous transfers to the growing dependent population. But our theory predicts that this latter feature would would reverse once the dependent become the majority of the population.

Table 1: Data Summary

Country	Years	Labor Tax	Unemp Rate	Per capita Transfers	Govt Job Share	Openness
UK	65-96	25.1	6.3	1,568	19.3	50.2
USA	65-96	25.5	6.2	2,143	15.7	16.8
Finland	65-92	29.0	4.3	2,965	16.3	52.9
Italy	65-95	34.9	6.8	3,428	15.2	37.7
Norway	65-91	36.9	2.3	2,450	22.4	75.1
Germany	65-96	37.7	4.8	2,335	14.0	49.4
France	65-96	38.6	6.7	3,690	20.8	39.3
Denmark	81-92	42.6	9.4	4,013	29.9	69.2
Sweden	65-92	43.9	2.3	4,505	27.2	56.4
Netherlands	70-92	48.2	5.4	3,604	13.5	99.3

Country	Years	Depend Ratio	Share of High Education	Return to Education
UK	65-96	52.4	15.6	19.1
USA	65-96	54.3	48.8	22.9
Finland	65-92	50.3	25.6	8.1
Italy	65-95	61.2	12.8	9.5
Norway	65-91	53.4	30.5	17.3
Germany	65-96	54.2	30.4	5.5
France	65-96	56.9	19.8	14.1
Denmark	81-92	45.4	47.5	11.8
Sweden	65-92	49.2	36.7	9.9
Netherlands	70-92	61.3	18.8	24.4

Table 2: Determinants of Labor Tax Rate and Social Transfers
(274 observations)

	(1)	(2)	(3)	(4)
	Labor Tax rate		Social Transfers	
Return to education		0.895		9.098
* higher education share		(3.41)		(4.54)
Dependency ratio	-0.466	-0.159	-8.409	-5.290
	(-4.61)	(-1.19)	(-10.73)	(-5.18)
Govt jobs/employment	0.838	0.816	3.519	3.294
	(10.18)	(10.08)	(5.52)	(5.34)
Trade openness	0.225	0.210	0.533	0.378
	(6.49)	(6.12)	(1.98)	(1.44)
Per capita GDP growth	-0.292	-0.236	-2.814	-2.251
	(-3.23)	(-2.62)	(-4.02)	(-3.28)
Income skewness	-0.006	-0.015	0.423	0.326
	(-0.33)	(-0.87)	(3.06)	(2.42)
R^2	0.684	0.698	0.623	0.651

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

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