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Improving the Equity-Efficiency Trade-Off: Mandatory Savings Accounts for Social Insurance

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Abstract

In the modern welfare state a substantial part of an individual's tax bill is transferred back to the same individual taxpayer in the form of social transfers. This provides a rationale for financing part of social insurance through mandatory savings accounts. We analyze the behavioral and welfare effects of compulsory savings accounts in an intertemporal model with uncertainty, involuntary unemployment, endogenous retirement decisions, credit constraints, and heterogeneous agents. We show that the introduction of (early) retirement and unemployment accounts generates a Pareto improvement by enabling the government to provide lifetime income insurance and liquidity insurance in a more efficient manner.

Keywords: social insurance reform, mandatory savings accounts

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1. Introduction

The prospect of population ageing in the OECD economies has generated an intense debate on the need for pension reform. Much of the academic controversy has focussed on the question whether moving from Pay-As-You-Go (PAYG) pensions to fully funded systems based on individual savings accounts can produce a Pareto improvement. The literature has concluded that the government cannot improve the welfare of all generations through such a switch (see e.g. Breyer, 1989; Sinn, 2000). If the current social security tax is replaced by public debt to finance the continued payment of pensions to the older generation during the transition to funding, the future taxes servicing the higher public debt exactly offset the gains of future generations from the higher return on pension saving offered by a funded system.

Homburg (1990) has argued, however, that funded individual accounts could make all generations better off if the initial transfer system distorts endogenous labor supply. The reason is that a closer individual link between contributions and benefits boosts labor supply, thereby alleviating labor-market distortions. The resulting efficiency gains can be distributed in such a way that all generations benefit. In the presence of intragenerational heterogeneity,[1]

however, one has to ensure that not only all generations but also all households within a generation benefit (see also Fenge, 1995; Brunner, 1996; Belan and Pestieau, 1999). Whereas a switch to a pension system in which all agents fund their own pensions eliminates the labor-market distortion from a 'Beveridgean' PAYG system with a flat pension benefit, such a reform also does away with the intragenerational redistribution achieved by such a PAYG system. The reform, therefore, is likely to hurt low-income households. In fact, if the initial Beveridgean pension benefit has been optimized by trading off the marginal equity gain against the marginal efficiency cost, a switch to individual funding cannot be Pareto-improving.

This analysis thus confirms the major lesson of the literature on the transition from PAYG to funding: namely, that a Pareto improvement, which protects all agents, is feasible only if pension reform is accompanied by a reduction of a distortion somewhere in the economy. Examples of such possible distortions are the corporate income tax, inefficient redistribution, labor-market distortions due to incentives to retire early, the inability of the political process to commit to promises, capital-market imperfections, and knowledge externalities. The associated efficiency gains should be ascribed to reductions in these distortions rather than the transition to funding. Indeed, the gains could be reaped also without funding the pension system.

This paper shows that funding through compulsory savings accounts can be Pareto-improving, even if (in contrast to most of the literature on the transition to funding) one allows for intragenerational heterogeneity. Hence, all agents gain from the reform, irrespective of the shocks they experience during their lifetimes. The key to this result is that the savings accounts protect households who suffer from low lifetime incomes. In particular, individual funding and the associated self insurance applies only to high-income earners and the middle class. Low-income earners still benefit from tax-financed transfers. As another extension of the literature on the role of savings accounts in old-age social security, we show that compulsory savings accounts can more efficiently finance social insurance for individuals of *working age*.[2]

When analyzing the scope for Pareto improvement through social insurance reform, one should ensure that welfare gains accruing to young and future generations are not achieved at the expense of older generations. We carry out this check by focusing on the *generational account* of each generation (i.e., the present value of its net payments to the public sector). As explained in detail in Section 2.6, a grandfathering scheme ensures that our reform experiments preserve the generational accounts of the current old generations. Since our policy experiments are thus designed to avoid intergenerational redistribution, we need not introduce an explicit overlapping generations framework.[3]

The analysis in this paper extends and generalizes the work of Sørensen (2003). In particular, we allow for a richer set of fiscal instruments and for more individual heterogeneity by introducing job search and uncertainty about involuntary unemployment as well as uncertainty about future wages. We show that even if the government has access to more fiscal instruments before the introduction of savings accounts, and even if additional shocks yield more ex-post heterogeneity in lifetime incomes, compulsory savings accounts can still make everybody better off. We also clearly separate the sources of the welfare gains from retirement accounts, early retirement accounts and unemployment accounts, respectively.

The recent contribution by Stiglitz and Yun (2002) explores the optimal design of unemployment accounts. Evaluating policy on the basis of ex ante expected utility, Stiglitz and Yun investigate how the optimal design of unemployment accounts is affected by the degree of risk aversion, the length of unemployment spells, and the sensitivity of job search intensity to economic incentives. The present paper does not seek to characterize the optimal design of unemployment accounts. Instead, we demonstrate that a marginal policy *reform* involving the introduction of compulsory saving accounts can make everybody better off ex post—even after some individuals have experienced adverse shocks.[4]

The rest of this paper is structured as follows. Section 2 describes the formal model underlying our analysis. Section 3 demonstrates that introducing (early) retirement accounts or unemployment accounts can yield a Pareto improvement. The final Section 4 summarizes and discusses our results and makes suggestions for future research.

2. The Model Framework

2.1. Basic Assumptions

Agents live for two periods. At the start of period 1, agents are young and have no prior labor market experience. As they are imperfectly informed about job opportunities, young workers face some risk of being unable to find employment during period 1. At the start of period 2, all workers have previous job search experience and are thus able to find a job. However, an exogenous fraction of the previously unemployed lose human capital as a result of being out of work. Due to this scarring effect of unemployment, these individuals earn a lower wage rate in period 2.

At some time before the end of period 2, workers decide (endogenously) to retire. Subsequently, they collect public pensions and annuities from their mandatory savings accounts. Workers who are employed in both periods smooth their consumption through life-cycle saving. Unemployed workers, in contrast, face liquidity constraints and hence consume all their unemployment benefits during period 1.[5] Consequently, they enter period 2 without any financial wealth.[6]

Our framework includes both voluntary and involuntary non-employment. On the one hand, a young worker who fails to find a job in period 1 is involuntarily out of work. On the other hand, an old worker may voluntarily opt for non-employment by retiring early. The model also includes two sources of uncertainty. In particular, agents must decide on their job search without knowing whether that search will be successful and whether they will lose human capital if they should fail to find a job in the first period. This feature of the model allows us to explore the importance of the correlation between unemployment shocks and negative wage shocks during the life cycle (see Section 4).

For the sake of simplicity, pre-tax factor prices are fixed. The exogeneity of factor prices may be rationalized by the assumption of a small open economy. Using a constant-returns technology and facing perfect capital mobility, such an economy produces and consumes a single good that is a perfect substitute for foreign goods. We allow wages to differ across the two periods, possibly reflecting different period lengths or varying labor productivities across the two periods.

Only linear taxes are assumed to be available. Real-world tax systems are piece-wise linear, so our simplifying assumption of linear taxes is not necessarily less realistic than the alternative assumption of non-linear tax schedules. Indeed, in recent decades, many OECD countries have reduced the number of income tax brackets in order to simplify administration and make their tax systems more transparent. The assumption of linear taxes can also be rationalized by assuming that the government does not observe individual incomes and can thus levy only impersonal, proportional taxes on labor income. The proportional income tax rate therefore cannot depend on age.[7]

We abstract from taxes on capital income because the government cannot observe individual savings.[8] Otherwise, the model allows for a rich set of fiscal instruments, as the government can observe both age and employment status (i.e. unemployed, employed, or retired). Hence, our model includes categorical social insurance benefits for employment, early retirement and ordinary old age. These benefits can be set independently of each other. The government can thus differentiate lump-sum transfers according to employment status and age.

2.2. The System of Individual Accounts

The savings accounts considered in this paper are inspired by Fölster (1994, 1997) and work as follows. For each taxpayer an individual account is established. Part of the taxpayer's annual tax bill is replaced by a mandatory social security contribution, which is credited to his individual account. The contribution is computed as a percentage of the taxpayer's income. Whenever the taxpayer receives a social benefit payment from one of the transfer programs included in the individual account scheme (e.g. unemployment insurance, early retirement benefits), a fraction of this benefit is debited to the account. A (risk-free) market interest rate is added to or subtracted from the balance on the account each year. When one has reached the statutory retirement age, the government settles the account. In particular, part of the balance on the compulsory savings account is used to buy an annuity covering a fraction of the ordinary public pension. The balance that remains after buying this annuity can be used to supplement the public pension. In this way, the individual accounts are in fact integrated with the pension system. If the account balance at the statutory retirement age is not sufficient to buy an annuity for the part of the ordinary public pension benefit that should be financed out of individual accounts, the government supplements the funds in the savings account so that the individual receives the full ordinary public pension during old age. In this way, the government effectively bails out households with low lifetime incomes.

We distinguish three types of compulsory savings accounts, depending on which transfer program is included in the accounts, namely unemployment accounts (UA), early retirement accounts (ERA) and retirement accounts (RA). These accounts provide *lifetime income insurance* by guaranteeing a minimum public pension benefit that does not depend on the funds in the account at statutory retirement. This provision ensures that unlucky individuals who draw large amounts from social insurance programs relative to their contributions have their benefits, just like today, financed out of general tax revenue contributed by all taxpayers without any negative consequences for their minimum old-age pensions. Moreover, the UA

system also provides *liquidity insurance* by allowing the worker to collect unemployment benefits under eligibility rules identical to those existing at present, regardless of the size of the balance on his account. We show that, by adding unemployment accounts to the existing tax-financed system of social insurance, the government can provide liquidity insurance more efficiently.

2.3. Preferences

As noted, the economy includes three groups of individuals. Those who are fully employed in period 1 are termed *high-income earners* and are indicated by the superscript h. Those who are unemployed during period 1 but do not lose any human capital are called *medium-income earners* and are marked by the superscript m, while those who do lose human capital as a result of the scarring effect of unemployment are referred to as *low-income earners* and are denoted by superscript l. We employ the superscript u to refer to all workers who were unemployed in period 1.

Before the start of period 1, the expected lifetime utility U^L of an agent exerting job search effort a is

$$\begin{aligned} U^L &= aU^h + (1-a)\,U^u + f\,(G) - F\,(a)\,, \\ f' > 0, \quad f'' \leq 0, \quad F' > 0, \quad F'' > 0, \quad 0 < a < 1, \end{aligned} \tag{1}$$

where G is a public good that may be provided in either period of life, $F(a)$ represents disutility of job search effort, while U^h and U^u are, respectively, the expected lifetime utilities attainable by employed and unemployed workers, *excluding* the disutility of search effort and the utility $f(G)$ from public consumption. Equation (1) assumes that a worker's probability of finding a job in period 1 simply equals his search intensity a. The disutility function $F(a)$ displays increasing marginal disutility of search effort.

Once the initial job search has been completed, the resulting disutility is a sunk cost. The private utility attainable by an employed worker during the remainder of his life (excluding the utility from public consumption) amounts to

$$U^h = u\big(C_1^h, 1 - e_1^h\big) + \beta u\big(C_2^h, 1 - e_2^h\big), \quad 0 < \beta < 1, \tag{2}$$

where β is a discount factor, C_i^h stands for the high-income earner's consumption during period i ($i = 1, 2$), and e_i^h denotes the fraction of period i during which the high-income individual is working. $u(.,.)$ is a strictly quasi-concave felicity function defined over material consumption C_i^h and leisure $1 - e_i^h$, with the time endowment in each period being normalized to unity.

Unemployed individuals collect an unemployment benefit b_1 during period 1. This benefit is so low that all unemployed workers face a binding credit constraint and thus prefer to consume all of their benefit during period 1. In period 2 all workers are able

to find a job. Hence the *ex-post* lifetime utility of a worker who was unemployed in period 1 is

$$U^{ui} = u(b_1, 1) + \beta u\big(C_2^i, 1 - e_2^i\big), \quad i = l, m. \tag{3}$$

An unemployed worker faces an exogenous probability ρ of losing human capital as a result of joblessness in period 1. If he experiences such a scarring effect of unemployment, he has to accept a lower wage in period 2, in which case he consumes goods C_2^l and leisure $1 - e_2^l$ during period 2. If he does not lose human capital, he earns the normal wage in period 2 and consumes the amounts C_2^m and $1 - e_2^m$ of goods and leisure, respectively. Right after the start of period 1, when the disutility of prior job search has been sunk but the unemployed agent does not yet know whether he will lose human capital, the expected private utility of an unemployed worker over his remaining lifetime is thus given by

$$U^u = u\,(b_1, 1) + \beta\big[\rho u\big(C_2^l, 1 - e_2^l\big) + (1 - \rho)u\big(C_2^m, 1 - e_2^m\big)\big], \quad 0 < \rho < 1. \tag{4}$$

To simplify the exposition, the rest of the paper assumes that employed workers fully participate in the first period (with full-time participation being normalized at unity, $e_1^h = 1$), so that first-period working hours are exogenously given. The appendix to Bovenberg and Sørensen (2003) considers the case with endogenous labor supply in the first period and shows that under weak conditions the major results derived below continue to hold. In the following $1 - e_2^i$ $(i = h, m, l)$ is interpreted as the fraction of the second period spent in retirement.[9] Endogenous second-period labor supply thus reflects an endogenous retirement decision.

2.4. Budget Constraints

During period 1, an employed worker earns the standard wage rate w_1, which is subject to the labor-income tax rate t. He also pays a mandatory social security contribution, which is levied at the rate s and is credited to his individual account. In addition to the mandatory saving in his individual account, the employed worker undertakes voluntary saving S^h. Remembering that $e_1^h = 1$, we can thus write the high-income earner's budget constraint for period 1 as

$$C_1^h = w_1(1 - t - s) - S^h + y_1, \tag{5}$$

where y_1 denotes transfers collected by employed, young individuals.[10] As a result of adverse selection in private capital markets, workers cannot borrow against their expected future labor and retirement income, so that $S^h \geq 0$. This constraint is assumed not to be binding for high-income earners.

In the second period, the worker faces the same labor-income tax rate t and the same social security contribution rate s as in the first period. He also collects a lump-sum public transfer

y_2, which can be interpreted as an ordinary old-age pension granted from the date the worker reaches the exogenous statutory retirement age. In addition, the worker receives a benefit granted at the rate b_2 during that fraction $1 - e_2^h$ of the second period in which the worker is actually retired. At the margin, the transfer b_2 may be interpreted as an early retirement benefit,[11] since it is paid out from the time the worker chooses to actually retire.[12] Finally, the retired high-income earner may consume the positive balance A^h on his compulsory individual savings account plus the balance $(1 + r) S^h$ on his voluntary savings (where r is the real rate of interest). Thus, the high-income earner's budget constraint for period 2 becomes

$$C_2^h = w_2 (1 - t - s) e_2^h + b_2\left(1 - e_2^h\right) + y_2 + (1 + r) S^h + A^h, \tag{6}$$

where w_2 denotes the wage in period 2. This wage may differ from the wage in period 1 because of different wage rates per hour or different period lengths.

The balance on the high-income earner's individual account equals the contributions paid into the account during period 1 (with interest added) $(1 + r) s w_1$, plus the contributions during period 2, $s w_2 e_2^h$, minus an exogenous fraction α_2 of the early retirement benefit and an exogenous fraction α_y of the retirement benefit received in the second period. We thus have

$$A^h = (1 + r) s w_1 + s w_2 e_2^h - \alpha_2 b_2\left(1 - e_2^h\right) - \alpha_y y_2, \quad 0 \leq \alpha_2, \quad \alpha_y \leq 1, \quad A^h \geq 0. \tag{7}$$

The parameter $(\alpha_2)\, \alpha_y$ is a policy instrument reflecting the extent to which (early) retirement benefits must be financed by withdrawals from the recipient's individual account. Under a conventional tax-transfer system without mandatory individual savings accounts, we have $\alpha_y = \alpha_2 = s = 0$. The constraint $A^h \geq 0$ reflects the lifetime income guarantee built into the account system: if the account balance is negative at the official retirement age, the account is simply canceled. We assume that this constraint is not binding for high-income and medium-income earners.

Consolidating (5), (6) and (7) to eliminate S^h and A^h, we obtain the lifetime budget constraint of a high-income earner, where p^h represents the relative price of second-period leisure, and I^h is potential lifetime income (i.e., the present value of the income the high-income individual could earn if he worked all the time):

$$C_1^h(1 + r) + C_2^h + p^h\left(1 - e_2^h\right) = I^h, \tag{8}$$

$$\begin{aligned} p^h &\equiv w_2(1 - t) - b_2(1 - \alpha_2), \\ I^h &\equiv [w_1(1 - t) + y_1](1 + r) + w_2(1 - t) + (1 - \alpha_y) y_2. \end{aligned} \tag{9}$$

The social security contribution rate s has dropped out of (8) and (9). This contribution rate thus does not distort work effort. Indeed, marginal contributions to the individual account are in effect returned to the worker in the form of higher retirement benefits. (9) reveals that for the high-income worker the individual account system for retirement benefits boils

down to a cut in the effective rate of ordinary retirement benefit $(1-\alpha_y)y_2$ and/or a cut in the effective early retirement benefit $b_2(1-\alpha_2)$.

During period 1 unemployed workers collect the unemployment benefit b_1 which is so low that the credit constraint $S^j \geq 0$ ($j = l, m$) is binding for all unemployed persons. Since a medium-income worker earns the standard wage w_2 in period 2, he accumulates a positive balance A^m in his individual account. The surplus occurs even though a fraction α_1 of his unemployment benefit is debited to his account in period 1 and carried forward with interest. The budget constraints for a medium-income worker in period 2 are thus

$$C_2^m = w_2 e_2^m (1-t-s) + b_2\left(1-e_2^m\right) + y_2 + A^m, \tag{10}$$

$$\begin{aligned} A^m &= s w_2 e_2^m - \alpha_2 b_2\left(1-e_2^m\right) - \alpha_y y_2 - \alpha_1 b_1 (1+r), \\ &\quad 0 \leq \alpha_2, \alpha_y, \alpha_1 \leq 1, \quad A^m \geq 0. \end{aligned} \tag{11}$$

If the policy parameter α_1 is zero, we have a conventional tax-financed system of unemployment insurance. Substituting (11) into (10) to eliminate A^m, we obtain

$$C_2^m + p^m\left(1-e_2^m\right) = I^m, \tag{12}$$

$$p^m \equiv w_2(1-t) - b_2(1-\alpha_2), \quad I^m \equiv w_2(1-t) + (1-\alpha_y)y_2 - \alpha_1 b_1(1+r), \tag{13}$$

where I^m stands for the medium-income earner's potential income during period 2, and p^m represents the price of his second-period leisure. Equation (13) reveals that, just as for the high-income earner, (early) retirement accounts imply a cut in the effective rate of (early) retirement benefit for the medium-income earner. Unemployment accounts in effect reduce the present value of unemployment benefits: collecting unemployment benefits in period 1 reduces the account balance by $\alpha_1 b_1(1+r)$ in period 2.

A low-income worker loses human capital as a result of first-period unemployment. Hence, his productivity in period 2 is only a fraction θ of the productivity of other workers, so he earns only a fraction θ of the standard wage w_2. With this worker being hit by adverse shocks in both periods, social security contributions during period 2 are assumed not to be sufficient to cover the social security benefits that are to be financed from the accounts, i.e. $s w \theta e_2^l - \alpha_2 b_2(1-e_2^l) - \alpha_y y_2 - \alpha_1 b_1(1+r) < 0$. The lifetime income insurance built into the individual account system ensures that the low-income earner still receives the full retirement benefits. The government bail-out in effect means that the government makes no deduction from the low-income earner's account for the retirement benefits but also does not return any of the previously paid social security contributions. The second-period budget constraint for a low-income earner thus amounts to

$$C_2^l + p^l\left(1-e_2^l\right) = I^l, \tag{14}$$

$$p^l \equiv \theta w_2(1-t-s) - b_2, \quad I^l \equiv \theta w_2(1-t-s) + y_2, \quad 0 < \theta < 1. \tag{15}$$

Accordingly, for a low-income worker the social security contribution s works exactly the same way as the ordinary tax t. Indeed, this contribution s distorts second-period labor

supply, as it is not returned to the low-income earner in the form of higher retirement benefits.

2.5. Consumer Behavior and Welfare

A high-income earner planning his lifetime consumption and labor supply after completing the initial job search maximizes lifetime utility (2) with respect to C_1^h, C_2^h and e_2^h, subject to (8). The credit-constrained medium- and low-income earners choose $C_1^i = b_1$ $(i = l, m)$ and maximize their second-period utilities $u(C_2^i, 1 - e_2^i)$ with respect to C_2^i and e_2^i, subject to (12) and (14), respectively. The solutions to these optimization problems yield indirect utility functions of the form

$$V^i = V^i(p^i, I^i), \quad i = h, m, l \tag{16}$$

$$\partial V^i/\partial I^i = \lambda^i, \quad \partial V^i/\partial p^i = -\lambda^i\left(1 - e_2^i\right), \quad i = h, m, l \tag{17}$$

where λ^i is the marginal utility of exogenous income in period 2. Substituting $V^i(p^i, I^i)$ for $u(C_2^i, 1-e_2^i), i = l, m$, in (4), we obtain the maximum ex-ante expected utility V^u attainable by an unemployed worker. Thus, utility can be compared to the maximum attainable lifetime utility V^h of a fully employed worker. Having determined V^h and V^u, we find optimal search effort by maximizing expected lifetime utility U^L (see (1)) with respect to a. The first-order condition implies

$$F'(a) = V^h - V^u. \tag{18}$$

Workers thus search up to the point where the expected marginal gain $V^h - V^u$ in lifetime utility from an additional unit of search effort exactly offsets the marginal disutility from search $F'(a)$. With $F''(a) > 0$, search effort (and hence the first-period employment rate) rises with the expected utility differential between fully employed and unemployed workers.

2.6. Generational Accounts

As noted in the introduction, our two-period model of household behaviour can be embedded in an economy with overlapping generations. In such a setting, we wish to rule out intergenerational redistribution to ensure that the welfare gains from social insurance reform accruing to current and future generations are not achieved at the expense of older generations. To achieve this, we construct a *generational account* for each group of workers that measures the present value of the group's net payments to the public sector over the entire life cycle. We assume that when the individual account system is introduced, the new rules apply only to those entering the labour market *after* the reform. Hence, the generational accounts of the existing old generations are left unaffected, as the government grandfathers the initial arrangements for the older generations who already lived through

the first period when the reform is announced and implemented.[13] We thus need to consider only the generational accounts of each of our three categories of workers denoted by g^j, $j = h, m, l$. Normalizing the total labor force at unity, we may then denote the present value g of each generation's total net payments to the public sector as

$$g = ag^h + (1-a)\left[\rho g^l + (1-\rho)\, g^m\right], \tag{19}$$

where we recall that a is the employment rate for young workers and that a fraction ρ of those who are unemployed in period 1 end up in the low-income category. The reform experiments analyzed below imply that the private lifetime utilities of all workers are kept constant and that the value of g for all generations entering the labour market after the reform increases by the same amount. By using this increase in g to finance a permanent rise in public consumption, the government may thus generate an identical increase in the total utility of all future generations without transferring resources away from older generations who are already on the labor market when the individual accounts are introduced.[14]

To calculate g, we need to determine g^i, $i = h, m, l$. Treating the system of mandatory individual accounts as a part of the public sector, and using (7) to eliminate A^h, we find for the generational account of a high-income earner,

$$\begin{aligned} g^h &= (t+s)\, w_1 - y_1 + \frac{(t+s)\, w_2 e_2^h - b_2\left(1-e_2^h\right) - y_2 - A^h}{1+r} \\ &= t w_1 - y_1 + \frac{t w_2 e_2^h - b_2\,(1-\alpha_2)\left(1-e_2^h\right) - (1-\alpha_y) y_2}{1+r}. \end{aligned} \tag{20}$$

Recalling that a medium-income earner receives unemployment benefits during period 1, and using (11) to eliminate A^m, we write the generational account of a medium-income earner as

$$\begin{aligned} g^m &= -b_1 + \frac{(t+s) w_2 e_2^m - b_2\left(1-e_2^m\right) - y_2 - A^m}{1+r} \\ &= -b_1\,(1-\alpha_1) + \frac{t w_2 e_2^m - b_2\,(1-\alpha_2)\left(1-e_2^m\right) - (1-\alpha_y) y_2}{1+r}. \end{aligned} \tag{21}$$

Finally, since the low-income earner is bailed out at the end of his active life, his generational account is given by

$$g^l = -b_1 + \frac{(t+s)\theta w_2 e_2^l - b_2\left(1-e_2^l\right) - y_2}{1+r}. \tag{22}$$

3. Pareto-Improving Social Insurance Reform Through Individual Accounts

This section starts out by demonstrating the potential for a Pareto improvement through the introduction of *retirement accounts* and *early retirement accounts*, relying on the more

efficient *lifetime income insurance* offered by such accounts. It then illustrates the Pareto improvement made possible by the *lifetime income insurance* and *liquidity insurance* provided by *unemployment accounts*.

We employ a procedure inspired by Kaplow (1996). Under this procedure, we design a policy reform that keeps the (private) utility of all agents constant. We then analyze whether the reform raises (the present value of) net government revenue. If it does, the government can make everybody better off by spending the additional revenues on public goods, which (given the additive separability of utility functions in (1)) do not affect private sector behavior.

3.1. Retirement Accounts

The economy starts out without individual accounts, so that $s = \alpha_1 = \alpha_2 = \alpha_y = 0$ in the initial equilibrium. Suppose now that policy makers want to rely more on private saving for retirement. They might then cut back on y_2 and at the same time reduce taxes on labor income to encourage life-cycle saving. However, if the initial linear tax system is efficient (given the constraint $s = \alpha_1 = \alpha_2 = \alpha_y = 0$), such a reform could not make everybody better off, as it redistributes resources away from low-income households.

Whereas funding thus cannot accomplish a Pareto-improving reform, the introduction of individual accounts will. We will show that, starting from any initial equilibrium—including one in which the initial linear tax system is efficient—the government can obtain a Pareto improvement by introducing retirement accounts (RAs).

Consider a fiscal reform involving a cut in the tax rate t along with changes in the instruments y_1, s and α_y that are calibrated so as to keep the private utilities of all agents constant. The partial derivatives of the indirect utility functions stated in (17), the definitions of p^i and I^i given in (9), (13), and (15) imply that

$$dV^l = 0 \Rightarrow ds = -dt, \tag{23}$$

$$dV^m = 0 \Rightarrow d\alpha_y = -\frac{w_2 e_2^m}{y_2} \cdot dt, \tag{24}$$

$$dV^h = 0 \Rightarrow dy_1 = \left[w_1 + \frac{w_2}{1+r} \left(e_2^h - e_2^m \right) \right] \cdot dt, \tag{25}$$

where (24) is used in the derivation of (25). Since $dt < 0$, we have $ds > 0$ and $d\alpha_y > 0$. Hence, starting from the initial equilibrium where $\alpha_y = s = 0$, the reform does indeed involve the introduction of retirement accounts.[15]

Consider now the effects of the fiscal reform on the present value of net government revenue (19). Since the reform keeps private expected utilities of both high-income, employed workers and unemployed workers constant ($db_1 = dV^l = dV^m = 0$ so that $dU^u = 0$ from (4)), the first-order condition for search (18) implies that the reform affects neither search nor the unemployment rate. The impact on the public budget therefore depends solely on the effects on the generational accounts of the three groups of workers. Using (9), (20), (24) and (25), and recalling that $\alpha_2 = 0$ initially, we arrive at the following effect of the policy

reform on the generational account of a high-income earner:

$$dg^h = w_1 dt - dy_1 + \left(\frac{w_2 e_2^h}{1+r}\right) dt + \left(\frac{y_2}{1+r}\right) d\alpha_y + \left(\frac{t w_2 + b_2}{1+r}\right)\left(\frac{\partial e_2^h}{\partial p^h}\right)_c \left(\frac{\partial p^h}{\partial t}\right) dt$$
$$= \left(\frac{t w_2 + b_2}{(1+r)}\right)\left(\frac{w_2 e_2^h \varepsilon_p^h}{p^h}\right)(-dt), \quad \varepsilon_p^h \equiv \left(\frac{\partial e_2^h}{\partial p^h}\right)_c \frac{p^h}{e_2^h} > 0, \tag{26}$$

where $(\frac{\partial e_2^h}{\partial p^h})_c$ denotes the *compensated* effect of a change in the price of leisure on second-period labor supply, so that ε_p^h represents the compensated price elasticity of a high-income earner's labor supply. The compensated effect is relevant because the reform keeps the worker's lifetime utility constant. Since the tax rate falls ($dt < 0$), we observe from (26) that $dg^h > 0$. This positive impact on net public revenue measures the gain in welfare as a result of less distorted labor-supply behavior of the high-income earner. In particular, the non-distortionary social security contribution s replaces part of the distortionary tax rate t. Hence, the high-income earner can raise his individual account balance by retiring later. The welfare gain depends on both the initial distortion of second-period labor supply, $t w_2 + b_2$, and the sensitivity of labor supply with respect to the marginal reward to labor. In Bovenberg and Sørensen (2003), we show that the compensated labor supply elasticity ε_p^h in (26) reflects intertemporal substitution from second-period leisure to first-period material consumption as well as intratemporal substitution from leisure to consumption in the second period.

In a similar way, we employ (13), (21) and (24) to find the impact on the generational account of the medium-income earners:

$$dg^m = \left(\frac{t w_2 + b_2}{1+r}\right)\left(\frac{w_2 e_2^m \varepsilon_p^m}{p^m}\right)(-dt), \quad \varepsilon_p^m \equiv \left(\frac{\partial e_2^m}{\partial p^m}\right)_c \frac{p^m}{e_2^m} > 0. \tag{27}$$

This generational-account impact is quite similar to the corresponding impact for the high-income earner. Also the medium-income earner faces more incentives to delay retirement, because such a delay increases the balance in his RA.[16] The additional labor supply expands the tax base and thereby benefits the generational account. The main difference with the high-income earner is that the elasticity ε_p^m does not include intertemporal substitution effects on labor supply; only intratemporal substitution away from second-period leisure to second-period consumption is relevant. The reason is that the medium-income household faces liquidity constraints and thus does not adjust its saving behavior.[17]

For low-income earners, the reform affects neither incentives nor net incomes, since (23) implies that a low-income earner's total tax rate $t + s$ is kept constant. Hence, g^l is also unaffected. We therefore conclude that retirement accounts can be introduced in a manner preserving the private utilities of all agents, while at the same time improving the public budget through an increase in the (present value of the) net tax payments of medium-income and high-income earners. The additional public resources enable the government to raise

everybody's total utility by offering more public goods. These additional public resources are especially substantial if second-period labor supply is taxed heavily at the margin (i.e. t and b_2 are large), the intratemporal substitution elasticities between second-period consumption and second-period leisure are substantial, and the intertemporal substitution elasticity in the labor supply of high-income earners is large (see also Bovenberg and Sørensen, 2003). Intuitively, improved labor-supply incentives are especially important in the presence of substantial initial distortions and elastic behavior.

The efficiency gain associated with the Pareto improvement arises because the RAs establish an efficiency-enhancing actuarial link between contributions and resources in retirement for high-income and middle-income workers whose social benefits are currently paid by distortionary taxes. Improved incentives are obtained without cutting benefits paid to low-income workers. The reason is that the lifetime income guarantee protects these latter households, who continue to receive the same positive net transfers from those with higher lifetime incomes. The RA system effectively enables the government to implement a selective benefit cut for high-income and middle-income groups without having to cut net benefits at the bottom of the (lifetime) income ladder. In this way, the RAs improve the equity-efficiency trade-off.

3.2. Early Retirement Accounts

With the introduction of early retirement accounts (ERAs), we use the same instruments as with the introduction of retirement accounts—except that we employ α_2 rather than α_y to keep utilities of the medium-income and high-income households constant. Hence, (23) continues to hold, but (24) and (25) are replaced by the following relationships (derived from (9), (13), and (17)):

$$dV^m = 0 \Rightarrow d\alpha_2 = -\frac{w_2 e_2^m}{b_2\left(1 - e_2^m\right)} \cdot dt, \tag{28}$$

$$dV^h = 0 \Rightarrow dy_1 = \left[w_1 + \frac{w_2}{1+r}\left(\frac{e_2^h - e_2^m}{1 - e_2^m}\right)\right] dt. \tag{29}$$

Using these relationships along with (23), we find the impacts on the generational accounts:

$$dg^h = \left(\frac{tw_2 + b_2}{(1+r)}\right)\left(\frac{w_2 e_2^h \varepsilon_p^h}{p^h\left(1 - e_2^m\right)}\right)(-dt), \tag{30}$$

$$dg^m = \left(\frac{tw_2 + b_2}{1+r}\right)\left(\frac{w_2 e_2^m \varepsilon_p^m}{p^m\left(1 - e_2^m\right)}\right)(-dt), \tag{31}$$

$$dg^l = 0. \tag{32}$$

Comparing (30) to (26) and (31) to (27), we observe that ERAs generate a stronger positive welfare effect than RAs (given the same dt). Whereas a cut in the effective old-age retirement benefit $(1 - \alpha_y)y_2$ generates only income effects because households cannot

affect their use of this benefit, the cut in the effective *early* retirement benefit $b_2\,(1-\alpha_2)$ exerts a positive substitution effect on second-period labor supplies of the medium-income and high-income households. Indeed, households can determine their own use of the early retirement benefit by selecting their date of retirement. Since medium-income and high-income households now pay part of their own early retirement benefit, they face an incentive to limit the use of this benefit by retiring later. The net contributions of the medium-income and high-income earners to the public budget thus increase through two channels: first, the lower marginal tax rate t expanding second-period labor supply (the so-called *tax base* effect), and second, the lower effective rate of early retirement benefit $(1-\alpha_2)b_2$ reducing the attractiveness of early retirement (the so-called *moral hazard* effect). Through these two channels, ERAs produce a double dividend for the government in the form of both higher labor income tax revenue and lower expenditure on early retirement benefits.

After the reform, low-income earners continue to receive their early retirement benefits from the government and thus do not face a direct link between their social security contribution s and retirement incomes. Hence, just as a RA, an ERA impacts neither incentives nor net incomes of these households, so that g^l is unaffected.

The Pareto improvement associated with the introduction of ERAs reflects more efficient lifetime income insurance.[18] This more efficient insurance produces not only a positive tax base effect on account of less distortionary finance (i.e. through the cut in the marginal tax rate t), but also less expenditure on insurance benefits as moral hazard is reduced; agents face fewer incentives to draw on the social insurance benefits, as they in fact finance part of these benefits themselves.

3.3. Unemployment Accounts

Unemployment accounts (UAs) provide both lifetime income insurance and liquidity insurance. We deal with both these aspects of unemployment accounts in turn.

3.3.1. Lifetime Income Insurance Through UAs The case for unemployment accounts as an efficient instrument for lifetime income insurance can be made by using the same instruments as with the introduction of retirement accounts, except that we employ α_1 rather than α_y to keep utilities constant. This implies that (24) and (25) are replaced by

$$dV^m = 0 \Rightarrow d\alpha_1 = -\frac{w_2 e_2^m}{(1+r)b_1} \cdot dt, \tag{33}$$

$$dV^h = 0 \Rightarrow dy_1 = \left[w_1 + \frac{w_2 e_2^h}{1+r} \right] dt, \tag{34}$$

while (23) continues to hold. This experiment amounts to a cut in the effective unemployment benefit for medium-income households $(1-\alpha_1)b_1$ and a cut in the first-period work benefit of the high-income household y_1 in return for a lower labor-income tax rate.

It turns out that the effects on the generational accounts of the high-income and medium-income households are given by, respectively, (26) and (27), while the low-income households do not alter their behavior so that $dg^l = 0$. Medium-income households postpone

their retirement because by working longer their social security contributions pay not only for the unemployment benefits they enjoyed during the first period of their life but also for higher incomes during retirement. Also high-income households expand their second-period labor supply, as part of the levies they pay on that labor income now result in higher retirement incomes for themselves.

3.3.2. Liquidity Insurance Through UAs Unemployment benefits offer liquidity insurance by alleviating the liquidity constraints facing unemployed agents. We will show that UAs offer this liquidity insurance more efficiently than regular unemployment benefits do. To demonstrate this, we first look at the case in which higher unemployment benefits offering liquidity insurance are tax financed. This reform is designed to keep the *ex-post* welfare of the low-income household constant.[19] Using (3), (15) and (17), and recalling that $\alpha_1 = \alpha_2 = \alpha_y = s = 0$ in the initial equilibrium, we find that such a reform satisfies

$$dU^{ul} = du\,(b_1, 1) + \beta dV^l(p^l, I^l) = 0 \quad \Rightarrow \quad dt = \frac{\lambda^u}{\beta\lambda^l\theta w_2 e_2^l} \cdot db_1, \tag{35}$$

where λ^u stands for the marginal utility of consumption for an unemployed agent in period 1, and λ^l denotes the marginal utility of consumption for a low-income worker in period 2.

From (3), (13) and (17), the impact of the reform (35) on the ex-post welfare of the medium-income household can be shown to be

$$\begin{aligned} dU^{um} &= du\,(b_1, 1) + \beta dV^m(p^m, I^m) = \lambda^u db_1 - \beta\lambda^m w_2 e_2^m dt \\ &= \left(1 - \frac{\lambda^m e_2^m}{\lambda^l \theta e_2^l}\right)\lambda^u \cdot db_1, \end{aligned} \tag{36}$$

where λ^m denotes marginal utility of consumption for a medium-income worker in period 2. The welfare of the high-income earner is kept constant by increasing y_1.

The policy change (35) generates the following impact on the generational account of the low-income worker (with $s = 0$):

$$\begin{aligned} dg^l &= -db_1 + \frac{\theta w_2 e_2^l dt}{1+r} + \left(\frac{t\theta w_2 + b_2}{1+r}\right)\left(\frac{\partial e_2^l}{\partial p^l}\right)\left(\frac{\partial p^l}{\partial t}\right)dt \\ &= \left[\left(\frac{\lambda^u}{\beta(1+r)\lambda^l} - 1\right) - \left(\frac{\lambda^u}{\beta\lambda^l}\right)\left(\frac{t\theta w_2 + b_2}{1+r}\right)\left(\frac{e_2^l \varepsilon_I^l}{I^l} + \frac{\varepsilon_p^l}{p^l}\right)\right] db_1, \\ \varepsilon_I^l &\equiv \frac{\partial e_2^l}{\partial I^l}\frac{I^l}{e_2^l} < 0, \quad \varepsilon_p^l \equiv \left(\frac{\partial e_2^l}{\partial p^l}\right)_c \frac{p^l}{e_2^l} > 0. \end{aligned} \tag{37}$$

Here, ε_I^l and ε_p^l are the income elasticity and the compensated price elasticity of the low-income earner's second-period labor supply, respectively. In contrast to our previous policy experiments, the present reform involves a change in the second-period utility level of previously unemployed workers, thereby generating income as well as substitution effects on their second-period labor supply. Indeed, (37) employs the Slutsky composition to disentangle income and substitution effects.

The term $(\frac{\lambda^u}{\beta(1+r)\lambda^l} - 1)$ in (37) represents the welfare gain from additional liquidity insurance. In a perfect capital market, an unemployed worker would borrow until the marginal utility gain from higher current consumption (λ^u) equals the marginal utility loss from lower future consumption, $\beta\,(1+r)\,\lambda^l$. In the present setting with credit constraints, however, we have $\lambda^u > \beta\,(1+r)\,\lambda^l$, so that the first term in the square bracket in (37) is positive. This reflects the pure *liquidity insurance effect* of tax-financed unemployment benefits. Since the reform shifts disposable income to a period with higher marginal utility of consumption, it enables the government to extract more net revenue from unemployed workers over their lifetimes without harming their welfare.

The term involving the elasticity ε_I^l in (37) shows that the low-earner's generational account also improves due to a negative income effect in the second period. Since the policy change shifts resources from the second to the first period of life, agents enter the second period with fewer resources. This induces them to retire later. The implicit loan the government provides to liquidity-constrained households in effect allows them to dissave more, and these dissavings boost labor supply at the end of the working life.

In contrast to the other terms, the term including the elasticity ε_p^l in (37) is negative. It captures the negative substitution effect on labor supply associated with a higher tax rate t financing the unemployment benefits. This term implies that liquidity insurance implies some efficiency costs (assuming that $t\theta w_2 + b_2 > 0$).

The generational account (21) of the medium-income earner is affected in the following way (with $\alpha_1 = \alpha_2 = \alpha_y = 0$ and using (35)):

$$dg^m = \left(\frac{e_2^m}{\theta e_2^l}\right)\left[\left(\frac{\lambda^u}{\beta(1+r)\lambda^l} - \frac{\theta e_2^l}{e_2^m}\right) - \left(\frac{\lambda^u}{\beta\lambda^l}\right)\left(\frac{tw_2 + b_2}{1+r}\right)\left(\frac{e_2^m \varepsilon_I^m}{I^m} + \frac{\varepsilon_p^m}{p^m}\right)\right] db_1, \tag{38}$$

where $\varepsilon_I^m < 0$ and $\varepsilon_p^m > 0$ denote the income elasticity and the compensated price elasticity of the medium-earner's second-period labor supply, respectively. Non-negativity of the *un*compensated labor supply elasticity is sufficient (but not necessary) to ensure that $\theta e_2^l / e_2^m < 1$, since a low-income earner's net wage is lower than a medium-income earner's wage and $\theta < 1$. It then follows that the liquidity insurance term $(\frac{\lambda^u}{\beta(1+r)\lambda^l} - \frac{\theta e_2^l}{e_2^m})$ in (38) is positive. The remaining terms capture the offsetting income and substitution effects generated by the tax financing of the higher unemployment benefits.

The policy changes impact the generational account for the high-income earners through changes in y_1 and t, and the overall impact on this generational account can be shown to be equal to expression (26), with dt given by (35). The compensated increase in the labor tax rate t thus reduces a high-income worker's net contribution to the public budget by motivating that worker to retire earlier.

We now compare these effects of tax-financed unemployment benefits on the generational accounts with the corresponding impacts if the government provides liquidity insurance through an UA. In that case, ex-post utility of the low-income earner is maintained by setting (using the derivatives of the indirect utility function)

$$dU^{ul} = 0 \Rightarrow ds = \frac{\lambda^u}{\beta\lambda^l \theta w_2 e_2^l} \cdot db_1. \tag{39}$$

Not surprisingly, this generates exactly the same impact on the low-earner's generational account as in (37), since the change in the social security tax rate in (39) is identical to the change in the ordinary tax rate in (35). We therefore again face a trade-off between providing liquidity insurance and containing labor-supply distortions. Raising unemployment benefits through UAs does distort labor supply of low-income households because the additional social security contributions are not returned to these agents in terms of higher retirement benefits. Hence, the financing of the additional unemployment benefits remains distortionary, even if provided through UA. Relieving capital-market distortions thus does not come free.

With the UA financing the additional unemployment benefits, we may use (13), (17) and (36) to derive the change in the parameter α_1 that ensures that the ex-post utility of the medium-income household is affected in exactly the same way as with a rise in regular tax-financed unemployment benefits:[20]

$$dU^{um} = \lambda^u db_1 - \beta\lambda^m b_1 (1+r)\, d\alpha_1 = \left(1 - \frac{\lambda^m e_2^m}{\lambda^l \theta e_2^l}\right) \lambda^u db_1 \Longleftrightarrow$$

$$d\alpha_1 = \frac{\lambda^u e_2^m}{\beta (1+r) \lambda^l \theta e_2^l b_1} \cdot db_1 > 0. \tag{40}$$

The impact of the reform (40) on the medium earner's generational account can be shown to be the same as (38), except that the negative final term (with ε_p^m) drops out. The financing of unemployment benefits is thus no longer distortionary, as the social security contributions paid by the medium-income earner raise individual retirement incomes.

Since the employed policy instruments b_1, α_1, and s do not affect the welfare of the high-income earner, the government does not need to change any other policy instruments. Also, since the high earner is thus not affected at all, his generational account is not changed. Hence, just as the generational account of the medium-income earner, the generational account of the high-income earner improves compared to the case in which additional unemployment benefits are tax financed. Additional unemployment benefits provided through UA therefore alleviate capital-market distortions at lower efficiency costs than regular tax-financed unemployment benefits do.[21]

Raising unemployment benefits paid out of UA thus increases the scope for intertemporal reallocation of disposable income towards the beginning of the working life. Essentially, unemployment accounts allow unemployed, medium-income workers to borrow against their own future labor income; part of the unemployment benefits collected in the first period is debited to the worker's individual account, reducing his consumption possibilities in the second period. In this way, UAs allow the government to increase the consumption possibilities of an unemployed, medium-income worker during the period in which marginal utility of consumption is the highest, without increasing the present value of tax-financed unemployment benefits (discounted at the government's borrowing rate of interest), and without undermining incentives for these agents.

4. Conclusions

We have explored whether financing part of social insurance through mandatory contributions to individual savings accounts can produce a Pareto-improving welfare gain. Through these accounts, the middle class would engage in self insurance by saving for their own social insurance benefits. The system would continue to provide lifetime income insurance by offering a public pension guarantee to low-income workers with a deficit on their savings accounts at the time of statutory retirement. Moreover, the account system would allow unemployed workers to borrow against their future labor income by drawing unemployment benefits from their accounts, thereby alleviating credit constraints.

We demonstrated that the introduction of these compulsory savings accounts would produce efficiency gains in credit markets (in the case of unemployment accounts) and labor markets. These efficiency gains allow the government to generate an ex-post Pareto improvement so that all agents benefit. The gains arise because the savings accounts establish an efficiency-enhancing actuarial link between taxes and benefits for high-income and middle-income workers—who currently pay distortionary taxes partly to finance distortionary social benefits to themselves—without reducing net transfers paid to the low-income workers who remain protected by the lifetime income guarantee. The savings accounts thus effectively enable the government to implement a selective benefit cut for high-income and middle-income groups, without having to reduce benefits at the bottom of the income ladder. Savings accounts enrich the fiscal armory of the government by adding a non-linear element to an otherwise linear fiscal system. Indeed, individual accounts increase the information available to the government, since the individual account balances at the official retirement age provide information about each individual's net lifetime income. Individual accounts thus enable the government to base its redistribution policy on lifetime incomes (which determine long-run welfare) rather than on annual incomes. In this way, compulsory savings accounts improve the equity-efficiency trade-off, enabling the government to engineer a Pareto welfare improvement, even if it has optimized the pre-existing tax-transfer system.

Another issue is whether our results depend on our particular assumptions about who is able to accumulate non-negative individual account balances. If not only the low-income but also the medium-income workers ended up with negative account balances, unemployment accounts would not generate a Pareto welfare improvement in our model economy. However, retirement accounts and early retirement accounts still allow for more efficient lifetime income insurance as long as at least one group of high-income earners manages to accumulate a surplus on their individual accounts.

In general, the scope for welfare gains via individual accounts depends on the parameter ρ indicating the proportion of unemployed workers who lose human capital as a result of joblessness. This parameter measures the correlation between adverse shocks. The stronger this correlation, the smaller are the aggregate efficiency gains from the compulsory savings accounts, since a larger value of ρ implies that more households are unable to accumulate a positive account balance. The government then needs to bail out more agents, who thus do not face improved labor-supply incentives and therefore do not enhance their generational accounts. Indeed, compulsory savings accounts, providing more efficient lifetime income

insurance, benefit the generational accounts of high-income and medium-income earners only. Similarly, as far as liquidity insurance is concerned, compared to tax-financed benefits, funded unemployment benefits produce a stronger impact on the generational accounts of only these latter households. Hence, the larger the proportion of low-income households (which is determined by ρ and the unemployment rate $1 - a$), the less substantial the efficiency gains are.

Loosely speaking, higher values for ρ and lower values for a imply a smaller middle class and thus—in the context of a European welfare state—a smaller number of taxpayers whose taxes can serve to finance part of their own benefits. Within a more polarized society, the fiscal system to a larger degree redistributes resources from high lifetime-income earners to low lifetime-income earners, rather than reallocating resources over the life cycle of the same individuals. Indeed, more correlation between adverse shocks (a higher value of ρ) reduces the scope for improving incentives through self insurance on the basis of individual savings.

Another related factor in determining the scope for self insurance is the relative length of the two periods. A longer period of unemployment raises the likelihood that unemployment produces a scarring effect on human capital (thus raising ρ). In addition, it increases the number of individuals that need be bailed out through the public pension guarantee; the longer the period of unemployment, the larger the fraction of individuals who have not accumulated enough funds in their accounts at their statutory retirement age to be able to finance their own public pension. Moreover, with longer unemployment spells, liquidity constraints are also likely to become less serious, as unemployed young individuals scale down their planned future consumption in anticipation of low lifetime incomes. Hence, long unemployment durations in slow-moving labor markets make individual accounts less attractive as an instrument to provide lifetime income insurance and liquidity insurance. Long unemployment spells in effect imply that adverse shocks are strongly correlated over time so that self insurance is less efficient. To protect agents hit by correlated shocks against poverty, while at the same time enhancing their labor-supply incentives, the government must rely on other instruments than self insurance.[22] In particular, the government may collect additional information by closely monitoring job search and imposing penalties on less active search. In this connection, workfare may play a useful role because the mere threat of being put on workfare is likely to boost job search.

Setting up and enforcing compulsory individual accounts and registering the individual balances would obviously involve some costs. We have not analyzed these costs, but the benefits of improved lifetime income and liquidity insurance identified in this paper can be used to compute an upper bound for the costs of a welfare-improving individual savings system. For expositional convenience, we assumed that the individual accounts are administered by the public sector. However, as demonstrated by Sørensen (2003), the effects of the individual account system will be the same if the accounts are administered by private financial institutions, provided administration costs are the same in the public and private sectors.

The present paper is only a first step towards a full analysis of the economic costs and benefits of basing transfers on lifetime incomes. We see a number of related issues for

future research.[23] First, in future work, we plan to allow for more heterogeneity among agents—for example, by distinguishing a continuum of workers with different skills and by allowing for more periods with involuntary unemployment.

A second issue, closely related to the first, is to allow for non-linear income taxes. Such a rich tax schedule allows us to offset the redistributional effects of the compulsory saving scheme in order to generate a Pareto-improving reform for a continuum of agents.[24] Moreover, we can then investigate what the benefits would be of basing a person's net fiscal contribution on his individual *lifetime* income, as reflected in the balance on his individual account at the time of retirement, as opposed to his individual *annual* income. In this connection, one may also want to explore the optimal mix between self insurance, compulsory insurance of verifiable events (e.g. disability), and active labor-market policies, including workfare, in enhancing labor-market incentives facing various skill levels.

Finally, whereas the present paper has considered only marginal reforms, which involve only one particular formulation of lifetime income insurance and which start from an initial situation without any compulsory savings accounts, we intend to characterize an optimal savings account system producing efficient lifetime income and liquidity insurance. In this context, we should explore how far the government can go in setting a non-linear tax schedule based on lifetime income and in offering liquidity insurance without violating self-selection constraints that must be respected in order to protect incentives for job search and work.

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Notes

1. Without intragenerational heterogeneity, the optimal tax-transfer system would not need to distort labor supply, as lump-sum taxes would be optimal.
2. Orszag and Snower (1997a, 1997b), Feldstein and Altman (1998) Orszag et al. (1999) and Fölster et al. (2002) propose savings accounts to finance social insurance for the working population.
3. Sørensen (2003) explores an individual account system of the type considered here in an explicit OLG setting.
4. Compared to Stiglitz and Yun (2002), we also consider a richer set of shocks, including involuntary unemployment and wage shocks, and we include incentive effects on the labor supply of employed agents in addition to the moral hazard effects on job search considered by Stiglitz and Yun. Moreover, in contrast to Stiglitz and Yun, we analyze the case for early retirement accounts and retirement accounts.
5. The assumption that all unemployed workers are subject to liquidity constraints is made solely for expositional convenience. The case for UA as an efficient way to offer lifetime income insurance does not depend on the existence of credit constraints.
6. The liquidity constraints may be due to adverse selection arising from asymmetric information about a person's risk of human capital loss: unemployed workers may well learn relatively early in period 1 whether they will

lose human capital, while this information remains private until a person's wage rate in period 2 is revealed. Hence, banks do not know whether an unemployed worker asking for a loan in period 1 will earn a normal or a subnormal wage in period 2.

7. Section 4 argues that the potential for a Pareto improvement via individual accounts does not rest on our assumption that non-linear taxes on static incomes are unavailable.
8. In the face of this lack of information, the government cannot impose a residence-based tax on voluntary saving. Under the small-open-economy assumption, the government does not want to levy a source-based tax on capital. Indeed, with infinitely elastic capital supply from abroad, such a source-based tax would be shifted onto labor. It is thus more efficient to tax labor directly through a labor income tax rather than indirectly through a source-based capital tax, which distorts not only labor supply but also the capital-labor ratio. Note that whereas the government cannot observe voluntary saving, it can observe the funds in the compulsory saving accounts.
9. The benchmark considered here can thus be considered as the case in which labor supply is elastic on the extensive rather than the intensive margin. Recent empirical evidence suggests that labor supply is substantially more elastic on the extensive margin than the intensive margin (see Heckman, 1993).
10. These transfers differ from transfers received by unemployed agents. For example, the government can provide day-care subsidies to working families with children.
11. b_2 can alternatively be interpreted as an unemployment benefit with a lax work test, or as a disability benefit without strict medical tests.
12. Actual retirement is assumed to occur above the age entitling a worker to early retirement benefits.
13. Using an explicit overlapping generations framework, Sørensen (2003) shows how policy makers can employ public debt to implement such a grandfathering scheme during the transition to a system of individual accounts.
14. This contrasts with studies that employ a steady-state version of the government budget constraint.
15. Given (23) and (24), the reader may verify that a low-income earner will end up with a negative IA balance if $\theta < (\frac{e_2^m}{e_2^l})(\frac{1-e_2^l}{1-e_2^m})$. A sufficient (but not necessary) condition for this, and hence for our assumption $A^l < 0$ to be valid, is that the uncompensated wage elasticity of labor supply is non-negative, since we then have $(\frac{e_2^m}{e_2^l})(\frac{1-e_2^l}{1-e_2^m}) \geq 1$.
16. One can check from (11) that, starting from a situation without retirement accounts, the introduction of a marginal retirement account causes the medium-income household to accumulate exactly zero funds in its account if the household keeps second-period labor supply constant. By reducing second-period labor supply, the household could run a deficit in its account and draw on the government bail-out. The household does not find this optimal, however, because doing so would reduce utility compared to the initial equilibrium. Indeed, at a negative account balance, households find it optimal not to change their behavior compared to the situation without retirement accounts (since nothing changes compared to the initial situation; see also the behavior of the low-income household below). By raising labor supply (compared to the initial equilibrium) in response to the improved incentives (at a non-negative account balance), the medium-income household accumulates a positive balance and enjoys a second-order gain in utility. The household finds it optimal to raise labor supply because in this way it can raise net retirement benefits. Intuitively, the individual account system implies a kink in the budget constraint at the initial equilibrium, with lower marginal tax rates for higher labor supplies. This induces households to move away from the kink by raising labor supply.
17. Without liquidity constraints (and with exogenous first-period labor supply), the reform would unambiguously depress saving because medium-income households would increase first-period consumption in anticipation of higher second-period labor income.
18. Just as with retirement benefits, simply cutting early retirement benefits b_2 and tax rates t at the same time is unlikely to produce a Pareto improvement (as such a reform would induce redistribution away from low-income households).
19. The government could alleviate the liquidity constraints completely by raising b_1 and y_1 and simultaneously cutting y_2. This could be done in such a way as to keep everybody's ex-post utility unaffected. We assume, however, that the government wants to fight old-age poverty by keeping y_2 at a minimum level (which could be zero), and cannot commit to reduce old-age pensions below this minimum. Indeed, this lack of commitment can be one of the rationales behind the government guaranteeing a minimum pension level y_2, even if agents do not have sufficient funds in their individual accounts to finance an annuity paying out this minimum pension.

The higher the minimum pension level y_2 is, the more severe liquidity constraints are likely to be. The reason is that agents may then want to bring forward their higher second-period incomes to the first period. This holds true especially for medium-income households (as opposed to low-income households), who earn relatively high wages in the second period.

20. One can verify that the medium-income household accumulates exactly zero funds in its account. The household can slightly improve its welfare by reducing its labor supply so that it is bailed out by the government. To prevent this from happening, the government has to marginally reduce the asset level below which the government tops up the individual accounts of agents at retirement. This reduces the scope for bailing out the low-income household. When UAs are introduced, however, this effect is only second order.
21. To establish this, one should note that both ways of raising unemployment benefits change V^l, V^m, V^h, and U^u in the same way and thus alter search effort a in the same fashion. Hence, as unemployment changes, both reforms modify the composition of taxpayers in the same way. Through this channel, they thus generate the same impact on the government budget (19).
22. The model assumes that labor is homogeneous. If low-skilled labor is complementary to high-skilled labor in production, the improved labor supply incentives of high-skilled workers may raise the low-skilled wage. Through these indirect general equilibrium effects, also low-skilled labor supply may be boosted.
23. Another political-economy issue is how more individual funding accompanied by targeted redistribution affects the political economy of the welfare state and its associated political risks. In particular, individual funding may produce a stronger ownership of social insurance. This may make it more difficult for the government to change benefit rules, thereby reducing political risks but also decreasing the flexibility to adjust the benefit rules in response to unanticipated shocks. Whereas individual funding may increase the political support of the middle class for social insurance, targeted redistribution to the underclass may undermine the support for this redistribution.
24. Kaplow (1996) employs a non-linear income tax to neutralize the income effects of a higher public good supply on a continuum of agents.

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