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INDIVIDUAL ACCOUNTS AND THE LIFE-CYCLE APPROACH TO SOCIAL INSURANCE

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Abstract: We explore the rationales for financing part of social insurance via mandatory individual accounts. An account system that offers liquidity insurance and a lifetime income guarantee helps to alleviate the dilemma between insurance and incentives. To illustrate this,] We analyse a specific proposal for reform of the Danish system of social insurance, involving the use of individual accounts. We estimate how the reform would affect the distribution of lifetime incomes, the public budget, and economic efficiency. Our analysis suggests that, even with conservative assumptions regarding labour supply elasticities, the proposed reform would generate a Pareto improvement and would imply only a minor increase in the inequality of lifetime income distribution.

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THE LIFE-CYCLE APPROACH TO SOCIAL INSURANCE

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1. Introduction

Many welfare states are under strain as a result of globalization, aging, and technological change biased against low-skilled workers. While these trends have received much attention, it is less frequently recognized that the changing nature of social risks also puts the welfare state under pressure. As the economy shifts from blue-collar work in industrial sectors to white-collar work in service sectors and knowledge-intensive activities, mental causes of sickness and disability become more prominent. These types of sickness and disability are less easy to diagnose and verify than those with physical causes, thereby increasing the danger of moral hazard. Moreover, changes in technology and in the organisation of work have made many segments of the labour market more 'fluid', as people move more frequently between employers and as they enter and exit the labour force more often. In such a transitional labour market it becomes more difficult to verify whether a person is voluntarily or involuntarily out of work, again exacerbating the problem of moral hazard in social insurance. Thus, whereas the dynamic world economy confronts many people with increasing economic risks, the ability of the welfare state to offer security is weakened, as globalization increases the mobility of tax bases and as the changing nature of human-capital risks raises the costs of insuring these risks. The age-old trade-off between equity and efficiency as well as the related dilemma between insurance and incentives are therefore more relevant than ever before.

Against this background, we analyse the merits of mandatory individual saving accounts that are supplemented by public liquidity insurance and public lifetime income insurance. Mandatory payments in personal saving accounts that finance social insurance payments replace taxes that are currently financing social-insurance benefits. At retirement, the remaining balances in the accounts are converted into an annuity which

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is added to the ordinary public retirement benefit. If the account balance is negative at that time, the account is set to zero and the account holder simply receives the ordinary retirement benefit. We explore to what extent such accounts can improve incentives without substantially increasing lifetime inequality and lifetime risk. The motivation behind these accounts is that they facilitate consumption smoothing throughout the life cycle without creating substantial disincentives to work. These accounts therefore limit the inescapable labour-market distortions that are associated with lifetime redistribution, lifetime income insurance and liquidity insurance. In particular, the accounts establish an efficiency-enhancing actuarial link between contributions and benefits for high-income and middle-income workers (who currently pay distortionary taxes partly to finance distortionary social benefits to themselves) without harming low-income workers who remain protected by the lifetime income guarantee. This actuarial link reduces the tax character of social security contributions and thus enhances incentives to work. The accounts also help to improve the trade-off between insurance and incentives by facilitating self-insurance over the life course. Specifically, they allow people to shift the payment of deductibles in social insurance to the periods in which these costs can be more easily afforded. In this way, individuals can self-insure themselves over their life course and thus do not have to rely on insurance that gives rise to moral hazard.

The empirical background for our proposal for a social insurance reform is provided by Bovenberg, Hansen and Sørensen (2007) who document that most social insurance transfers are much less redistributive when income is measured on a lifetime basis than when it is measured on an annual basis. The present paper starts by explaining the theoretical rationale for mandatory saving accounts for social insurance. To illustrate how an account system might work in practice, we proceed to lay out a specific proposal for a reform of the Danish system of social insurance, involving the use of individual accounts. We then estimate how this reform would affect the distribution of lifetime incomes, the public budget and economic efficiency. Our analysis suggests that, even with conservative assumptions regarding labour-supply elasticities, the proposed reform would imply a Pareto improvement not only from an ex-ante but also from an ex-post point of view (i.e. in terms of realized utility in all contingencies) and would involve only a minor increase in the inequality of lifetime income distribution.

Fölster (1997, 1999), Orszag and Snower (1997, 2002), Feldstein and Altman (1998), Brown et al. (2006), Fölster et al. (2002), Stiglitz and Yun (2002), Sørensen (2003), Bovenberg and Sørensen (2004) and Bovenberg, Hansen and Sørensen (2007) analyse the merits of various types of individual saving accounts. Some of these studies investigate how individual accounts for the financing of unemployment benefits could improve labour-market incentives compared to a tax-financed system of unemployment insurance. Fölster (1997, 1999) estimates how individual accounts financing a broader set of social-insurance programs would affect the distribution of lifetime incomes in Sweden, given that the account system includes lifetime income insurance as well as liquidity insurance. We conduct a similar exercise for Denmark in this paper, but in addition, we extend the existing literature in two directions. First, we quantify how the system of individual accounts affects work incentives, allowing us to compute the efficiency gains and the consequences for the government budget. Second, we design our proposal for individual accounts in such a way that it is Pareto improving.

The rest of the paper is structured as follows. Section 2 investigates how individual accounts with a lifetime-income guarantee can enhance labour-market incentives without harming the lifetime poor. Section 3 presents a specific proposal to reform the Danish system of social insurance through mandatory savings accounts and estimates how this reform would affect the distribution of lifetime incomes, the labour market, the public budget and economic efficiency. Our conclusions are summarized in Section 4.

2. The theoretical rationale for social insurance based on individual savings accounts

As an alternative or supplement to tax-financed transfers, the consumption-smoothing function of the welfare state can be accomplished also through saving schemes that link taxes and benefits at the individual level. In such a scheme, workers contribute a fraction of their earnings to an individual saving account that is debited when the owner draws social-insurance benefits. At the time of retirement, any surplus on the account is used to supplement retirement benefits. By linking benefits to contributions in an actuarially fair way, the saving accounts reduce the tax wedge on labour income. Social security contributions essentially become benefit taxes.

To illustrate in the simplest possible manner how individual accounts (IAs) allow the government to redistribute lifetime income in a more efficient manner, consider an economy inhabited by a high-income earner (indicated by superscript h) and a low-income earner (indicated by superscript l). Both individuals live for two periods. In the second period they are retired, and in the first period they are unemployed part of the time and work for the rest of the time. By increasing their job search effort (denoted by a), both persons can reduce their rate of unemployment ($u(a)$) in the first period. Whereas the marginal returns to search efforts (in terms of a lower risk of unemployment) are declining with the level of this effort a, the marginal utility costs are rising in search effort. With C_1 and C_2 denoting consumption in the two periods, and setting the interest rate and the utility discount rate equal to zero to simplify exposition (this assumption is quite innocent), the lifetime utility of the high-income earner is

$$U^h = v\left(C_1^h\right) + v\left(C_2^h\right) - f\left(a^h\right), \qquad v' > 0, \quad v'' < 0, \qquad f' > 0, \quad f'' > 0, \tag{2.1}$$

where $f(a)$ is the disutility of search effort. Assuming a perfect capital market for the moment, denoting saving by S, and recalling that the interest rate is zero, we can write consumption in the two periods as

$$C_1^h = W(1-\tau-s)\left[1-u\left(a^h\right)\right] + u\left(a^h\right)B - S^h, \qquad u' < 0, \quad u'' \geq 0, \tag{2.2}$$

$$C_2^h = S^h + y + A^h. \tag{2.3}$$

The variable W is the wage rate of the high-income earner, τ is the labour income tax rate, B is the rate of unemployment benefit, y is a public retirement benefit, s is the rate of mandatory social security contribution to the individual account, and A^h is the balance on the account that is paid out at the time of retirement. If a fraction α of unemployment benefits received is debited to the individual account, the account balance at retirement amounts to

$$A^h = sW\left[1-u\left(a^h\right)\right] - \alpha u\left(a^h\right)B, \qquad 0 \leq \alpha \leq 1, \qquad A^h \geq 0. \tag{2.4}$$

The constraint $A^h \geq 0$ reflects the lifetime income insurance built into the IA system: if the balance on the IA is negative at the time of retirement, the account is set at zero, and the individual still receives his ordinary retirement benefit y. Using (2.2) through

(2.4) and assuming that the constraint $A^h \geq 0$ is not violated, we obtain the consolidated lifetime budget constraint

$$C_1^h + C_2^h = W(1-\tau)\left[1-u\left(a^h\right)\right] + (1-\alpha)\,u(a^h)B + y. \tag{2.5}$$

The social security contribution rate s has dropped out of (2.5), since contributions to the IA are effectively remitted to the consumer when the account balance is paid out. Equation (2.5) also shows that, for a consumer with a surplus on the IA, the account system reduces the effective rate of unemployment benefit by the fraction α.

The high-income earner chooses his search effort a^h so as to maximize lifetime utility (2.1) subject to the budget constraint (2.5). It is easy to show that this behaviour implies

$$\frac{\partial a^h}{\partial \tau} < 0, \qquad \frac{\partial a^h}{\partial B} < 0, \qquad \frac{\partial a^h}{\partial \alpha} > 0, \tag{2.6}$$

given our assumptions of increasing marginal disutility of search ($f'' > 0$) and non-increasing marginal returns to search effort ($u'' \geq 0$). The solution to the high-income earner's problem yields an indirect utility function of the form $V^h(\tau, B, \alpha, y)$ with partial derivatives

$$V_\tau^h = -\lambda^h W\left(1-u^h\right), \qquad V_B^h = \lambda^h(1-\alpha)\,u^h, \qquad V_\alpha^h = -\lambda^h B u^h, \tag{2.7}$$

where λ^h is the high-income earner's marginal utility of (exogenous) income, and $u^h \equiv u\left(a^h\right)$. Finally, we may write the generational account of a high-income earner (i.e., the present value of the net taxes paid over his life cycle) as

$$\begin{aligned} G^h &= (\tau+s)\,W\left[1-u\left(a^h\right)\right] - Bu\left(a^h\right) - y - A^h \\ &= \tau W\left[1-u\left(a^h\right)\right] - (1-\alpha)\,Bu\left(a^h\right) - y. \end{aligned} \tag{2.8}$$

The low-income earner has a utility function analogous to (2.1), but his income is assumed to be so low relative to the unemployment benefits he receives that he ends up with a deficit on his IA. Hence, his account is set to zero at retirement, so that the mandatory contributions paid into the account of the low-income earner are not remitted to him. Instead, these contributions will work like the ordinary labour income tax, as seen from the following lifetime budget constraint of the low-income earner;

$$C_1^l + C_2^l = w(1-\tau-s)\left[1-u\left(a^l\right)\right] + u\left(a^l\right)B + y, \tag{2.9}$$

where $w < W$ is the low-income earner's wage rate. With optimal search effort, the low-income earner's indirect utility function can be shown to take the form $V^l(\tau, s, B, y)$ with derivatives

$$V_\tau^l = V_s^l = -\lambda^l w\left(1 - u^l\right), \qquad V_B^l = \lambda^l u^l, \tag{2.10}$$

where $u^l \equiv u\left(a^l\right)$. The generational account of the low-income earner is

$$G^l = (\tau + s)\, w\left[1 - u\left(a^l\right)\right] - Bu\left(a^l\right) - y. \tag{2.11}$$

We now show that, starting from a situation without individual accounts where $s = \alpha = 0$, the introduction of IAs (i.e., the introduction of positive values of s and α) for a particular cohort enables the government to generate a Pareto improvement (the older cohorts are not affected since the original tax-tranfer system remains in place for them). To see this, note from (2.7) and (2.10) that the policy reform

$$d\tau = -ds < 0, \qquad\qquad d\alpha = \frac{W\left(1 - u^h\right)}{Bu^h} \cdot ds > 0, \tag{2.12}$$

will ensure that $dV^l = dV^h = 0$; that is, it will keep the (ex-ante) lifetime utilities of both individuals constant. If at the same time the policy reform (2.12) increases net public revenue (by increasing G^h and/or G^l), it must be possible for the government to make everybody better off – say, by using the extra revenue to raise the retirement benefit y. It is immediately clear from (2.9) and (2.11) that the policy $d\tau = -ds$ affects neither the behaviour nor the generational account of the low-income earner, since it leaves his total effective tax rate $\tau + s$ unchanged. For the high-income earner, however, we find from (2.8) and (2.12) that

$$dG^h = (\tau W + B)\left[\overbrace{\left(\frac{\partial u^h}{\partial \tau}\right)}^{>0} ds - \overbrace{\left(\frac{\partial u^h}{\partial \alpha}\right)}^{<0} d\alpha\right] > 0, \tag{2.13}$$

where we have used (2.6) and $\partial u^h / \partial x = u'(a^h) \cdot \left(\partial a^h / \partial x\right)$. The introduction of IAs thus improves the public budget through two channels. First, the closer actuarial link between contributions and benefits reduces the effective labour-income tax rate facing the high-income earner, thereby raising search effort. Second, the individual accounts reduce the effective rate of unemployment benefit that the high-income earner enjoys. This induces him to reduce the risk of unemployment by searching more intensely for a job. Less moral hazard in unemployment insurance thus results in a lower unemployment rate.

The accounts combine a number of risks that occur during different periods of an individual's life in a single insurance contract with a deductible that is conditioned on the aggregate loss during the life course. The model above shows that the government can insure individuals more efficiently against unemployment and lack of skills by basing the deductible in lifetime income insurance on aggregate income losses during the life course instead of separate deductibles for unemployment in a single period. This is an application of the insight of Gollier and Schlesinger (1995) to the insurance of human capital. Drawing on Arrow (1971), Gollier and Schlesinger show that an umbrella insurance contract with a deductible on the aggregate loss dominates separate insurance contracts with separate deductibles for each type of loss if these individual losses are imperfectly correlated. Intuitively, insurance protection is most valuable for the states in which several losses occur simultaneously. An umbrella insurance policy that adjusts the deductible on each separate loss to the outcome of the other risks in the form of a straight deductible based on the aggregate loss provides the best protection against large aggregate losses for a given insurance budget. Hence, an individual account that insures aggregate lifetime risk with a single deductible conditioned on aggregate lifetime losses dominates separate insurance contracts with their own deductibles for risks faced in different periods of an individual's life time. For a given level of insurance cover, separate policies for risk experienced in each period underindemnify risk-averse individuals for high levels of aggregate losses during the life course and overindemnify them for losses that are experienced only in a single period. Compared to separate insurance policies, the umbrella insurance contract provides better protection in the worst case scenario of a succession of adverse shocks during the life course in exchange for less protection in other cases.[2]

[2] We are indebted to Christian Gollier for pointing out this link to the literature on optimal insurance.

3. Individual accounts in a Western European welfare state: how would they work?

Having laid out the theoretical rationale for social insurance based on individual accounts combined with a lifetime income guarantee, we will now discuss in more detail how individual accounts (IAs) might be designed in practice, and how they are likely to affect the distribution of income, the public finances, and economic efficiency. As indicated by the discussion in the previous section, a system of IAs with a lifetime income guarantee could potentially generate an ex-ante Pareto improvement, because it represents an additional policy instrument that helps to alleviate the equity-efficiency trade-off. Section 3.1 presents a simple method of estimating whether a specific IA system would in fact be Pareto-improving in an ex-post sense (i.e. not only in an expected utility sense before people know which shocks will hit them during their lives but also in terms of realized utility in each contingency). To illustrate the policy choices involved in the design of an IA system, section 3.2 then considers a concrete proposal for a system of individual accounts in Denmark, discussing its impact on the distribution of lifetime incomes, and section 3.3 uses the method developed in section 3.1 to explore how the proposed reform would affect the labour market, the public budget and economic efficiency.

3.1. Estimating the revenue and welfare effects of individual accounts

Under the proposed system of individual accounts a part of the individual taxpayer's current tax bill is converted into a mandatory social security contribution that is credited to his IA, while transfers from the programs included in the system are debited to his IA. The individual account balance A_t accumulates at the (after-tax) market interest rate r_t, so if a fraction s of labour income Y_t is contributed to the account during period t, the account balance at the start of time $t+1$ is

$$A_{t+1} = (1 + r_t) A_t + sY_t - \alpha B_t, \tag{3.1}$$

where B_t is a column vector representing the amounts of the various public transfers received by the account holder during period t, and α is a row vector indicating the fractions of the various transfer payments that are debited to the IA.

To receive the transfers included in the IA system, the proposal considered here requires that the account holder must satisfy the same eligibility criteria as under the present transfer programs. If the account holder has a negative account balance when he/she reaches the official retirement age, the balance is simply set to zero, and the holder receives the normal public pension in accordance with the current rules. If the account balance is positive, it is converted into an annuity which is added to the owner's ordinary public pension. Thus, the IA system has a lifetime income guarantee ensuring that no person can be worse off in any realized contingency than under the existing tax-transfer system, while individuals with positive account balances will be better off.[3] If the introduction of such a system can be shown to be self-financing (or even to improve the public budget), then it implies a Pareto improvement in terms of realized utilities if non-fiscal external effects are absent.[4]

This section develops a formula that can be used to estimate the budgetary effect of an IA system of the type just described under the assumption that all cohorts born later than some specific year would be subject to the IA system, whereas all earlier cohorts would be subject the current tax-transfer system. The system would thus be phased in gradually without any intergenerational redistribution effects. The formula derives the impact of the reform on net public revenue from the cohorts that fall under the new system.

The formula rests on the simplifying assumption that the interest rate paid on account balances roughly equals the rate of income growth so that the growth-adjusted interest rate is zero. Note that the interest rate applied to the IA balances should be the *after-tax* rate of interest to ensure that saving via the IAs is treated in the same manner as ordinary saving via the capital market. In Denmark (to which we shall apply our formula) the average after-tax interest rate on long-term government bonds has in fact been quite close

[3] This procedure is different from that used in section 2 where we set the parameters of the account system in such a way that agents are indifferent between the account system and the initial tax-transfer system in terms of *expected* utilities. In the present section, we allow individuals with a surplus on their accounts to be better off than under the initial tax-transfer system. Thus section 2 explores the effects on *ex-ante* utility (i.e. before people know what shocks will hit them) whereas the present section studies the impact on *ex-post* utilities after shocks have in fact materialized.

[4] The complications arising when these latter external effects are present will be discussed below.

to the trend growth rate of GDP in recent years.[5]

When the after-tax real interest rate equals the economy's real growth rate, we may measure all magnitudes in current income levels and add up net public revenues in different time periods to arrive at net revenue measured in growth-adjusted present-value terms. Since persons who end up with a deficit on their IA pay the same taxes and receive the same transfers as under the current system, we may focus on those individuals who manage to accumulate a surplus on their IA at the date of retirement. With a zero growth-adjusted real interest rate, and with the total time available up until the official retirement age normalized at unity, the balance (A) on the IA at that date will be

$$A = sewh - \alpha_e b_e(1-e) - \alpha_m b_m m, \qquad 0 \leq \alpha_e; \quad \alpha_m \leq 1, \tag{3.2}$$

where s is the rate of mandatory contribution to the IA; w is the wage rate of the representative wage earner with an IA surplus, and e and h are his average labour-force participation rate and working hours, respectively (so that ewh is his total labour income); b_e is his average after-tax public transfer received in periods of non-employment, and α_e is the fraction of out-of-work benefits during working age that is debited to the IAs for this person. The variable b_m is another public benefit that is not directly tied to non-employment (e.g. child benefits; education benefits) but to another variable m (e.g. the number of children, time spent on education). The parameter α_m is the fraction of these benefits that is debited to the IAs (again, for those with positive balances), and we allow for the possibility that the variable m (e.g. education) may affect employment (i.e. $de/dm \neq 0$). With T denoting the average tax payment over the active career of a

[5] If the net interest rate would be larger (smaller) than the growth rate, the various terms in the formula (3.7) derived below would be scaled up or down by an additional factor, depending on when the various revenue effects identified in the formula occur. This additional factor is the same for all terms in the formula if the average duration between contributions to the accounts and the time of retirement coincides with the corresponding average duration for withdrawals. This condition is probably not a bad approximation for social insurance benefits collected during the working life. If this condition holds, all terms in the formula would be scaled up (if the net interest rate exceeds the growth rate) or down (if the after-tax interest rate is lower than the growth rate) by the same factor. Hence, the overall revenue effect would have the same sign as with a zero growth-adjusted interest rate. The absolute size of the effect, however, would be larger or smaller with a percentage equal to the growth-adjusted interest rate times the average duration.

person with an IA surplus, the growth-adjusted present value of the net public revenue collected from the representative person with an IA surplus is

$$\begin{aligned} R &= eT + sewh - (1-e)\, b_e - b_m m - y - A \\ &= eT - (1-\alpha_e)(1-e)\, b_e - (1-\alpha_m)\, b_m m - y, \end{aligned} \tag{3.3}$$

where y is the ordinary retirement benefit granted to people above the official retirement age (assumed not to be included in the IA system). All variables in (3.3) are measured after indirect taxes, so the revenue effects of indirect consumption taxes are implicitly included (see the specification of effective tax rates in section 3.3).

Since real-world tax systems are piecewise linear, we assume a linear system of labour income taxation where the tax bill of a person participating in the labour market is

$$T = \tau wh - I. \tag{3.4}$$

Here, τ is the marginal tax rate on labour income, including social security taxes as well as indirect taxes; w is the wage rate; h is the number of hours worked; and I is 'virtual' income, i.e. a parameter that may be calibrated to obtain a realistic value of the total average effective tax rate on labour income.

The introduction of IAs means that part of the labour income tax is replaced by a mandatory IA contribution and that part of the transfers received is debited to the IA. In formal terms, such a reform thus implies a cut in τ combined with a rise in the variables s, α_e and α_m. We wish to estimate the revenue effect of introducing a system of IAs, starting from an initial situation without such a system where $A = s = \alpha_e = \alpha_m = 0$. Using this initial condition, we show in the appendix that the revenue effect of introducing IAs amounts to

$$\begin{aligned} \frac{dR}{ewh} &= \overbrace{d\tau + c_e\left(\frac{1-e}{e}\right) d\alpha_e + c_m\left(\frac{m}{e}\right) d\alpha_m}^{\text{static effect}} \\ &\quad \overbrace{-\underbrace{\varepsilon\left(\frac{\phi_h\tau}{1-\phi_h\tau}\right)\bar{\phi}_h d\tau}_{\text{hours-of-work effect}} - \underbrace{\eta\left(\frac{\phi_e t + c_e}{1-\phi_e t - c_e}\right)\bar{\phi}_e d\tau}_{\text{participation effect}}}^{\text{dynamic effect}} \\ &\quad \overbrace{+\underbrace{(\phi_e t + c_e)\left\{\left(\frac{c_e\eta}{1-\phi_e t - c_e}\right) d\alpha_e + \varphi\chi d\alpha_m\right\}}_{\text{co-insurance participation effect}} + \underbrace{\chi c_m\left(\frac{m}{e}\right) d\alpha_m}_{\text{co-insurance moral hazard effect}}}^{\text{dynamic effect}} \end{aligned} \tag{3.5}$$

where $c_e \equiv b_e/wh$ and $c_m \equiv b_m/wh$ are, respectively, replacement rates and normalized benefit rates in the transfer programs included in the IA system for those who end up with an IA surplus, $t \equiv T/wh$ denotes the average labour income tax rate, ε is an hours-of-work elasticity indicating how hours worked respond to a change in the marginal after-tax wage rate, η is a participation elasticity reflecting how labour-force participation reacts to a change in the difference between net income from employment and net income from non-employment, $\varphi \equiv -\frac{de}{e}/\frac{dm}{m}$ is the (negative) elasticity of employment with respect to our variable m (e.g., the elasticity of employment with respect to education), and χ is a 'benefit dependency elasticity' reflecting how the eligibility criterion m responds to a change in the net benefit rate $b_m(1-\alpha_m)$. The parameters ϕ_h and ϕ_e measure the extent to which the (marginal) labour income tax τ is a 'genuine' tax rather than an insurance premium which entitles the taxpayer to additional social insurance benefits. Under a pure Bismarckian social insurance system with an actuarially fair link between social security taxes paid and benefits received, we would have $\phi_h = \phi_e = 0$. At the opposite end of the spectrum, under a pure Beveridgean social insurance system with no link between taxes and benefits at the individual taxpayer level, we have $\phi_h = \phi_e = 1$. The parameters $\bar{\phi}_h$ and $\bar{\phi}_e$ in (3.5) are defined as $\bar{\phi}_h \equiv d(\phi_h\tau)/d\tau$ and $\bar{\phi}_e \equiv d(\phi_e\tau)/d\tau$, thus measuring the degree to which the marginal effective tax rates $\phi_h\tau$ and $\phi_e\tau$ vary with the statutory marginal labour-income tax rate τ. These parameters may depend on the programs that are included in the individual accounts.

The 'static' effect indicated in (3.5) measures the immediate impact on net public revenue of introducing IAs, abstracting from any change in individual behaviour. However, the introduction of IAs and the associated cut in the labour income tax will affect labour-force participation, hours worked, and the take-up of social benefits, and these behavioural responses will generate the 'dynamic' budgetary effects indicated in (3.5). The 'co-insurance participation effect' reflects that, via the IA system, consumers partly self-finance the social benefits they receive during periods of non-employment. This induces them to reduce their periods of non-employment, thereby strengthening the public finances. Similarly, the (partial) self-financing of benefits via the IAs may reduce the extent to which citizens take up certain benefits that are not directly related to non-employment, as reflected in the 'co-insurance moral hazard effect' in equation (3.5).

Following the proposal presented in the next section, suppose that the rate of social security contribution s is set so as to ensure that the aggregate contributions to the IAs are equal to the aggregate payments of transfers from the accounts, given the labour income tax base and the expenditure on transfers prevailing before the reform. Recalling that $ds = -d\tau = s$ and $d\alpha_i = \alpha_i$ for $i = e, m$ (since s and α are initially zero), we then have

$$s \cdot e^* w^* h^* = \alpha_e^* \cdot b_e^* (1 - e^*) + \alpha_m^* \cdot b_m^* m^* \Longrightarrow$$
$$-d\tau = \left(\frac{1-e^*}{e^*}\right) c_e^* \alpha_e^* + \left(\frac{m^*}{e^*}\right) c_m^* \alpha_m^*, \qquad c_e^* \equiv \frac{b_e^*}{w^* h^*}, \quad c_m^* = \frac{b_m^*}{w^* h^*}, \tag{3.6}$$

where the asterisks indicate averages across the entire working population (including those who end up with negative IA balances); c_e^* therefore represents the average replacement rate across the entire labour force. Using (3.6) to eliminate $d\tau$ from (3.5), we obtain

$$\frac{dR}{ewh} = \overbrace{\left(\frac{1-e}{e}\right) c_e \alpha_e - \left(\frac{1-e^*}{e^*}\right) c_e^* \alpha_e^* + \left(\frac{m}{e}\right) c_m \alpha_m - \left(\frac{m^*}{e^*}\right) c_m^* \alpha_m^*}^{\text{static effect}}$$

$$+ \overbrace{\left[\underbrace{\left(\frac{\phi_h \tau}{1 - \phi_h \tau}\right) \varepsilon \bar{\phi}_h}_{\text{hours-of-work effect}} + \underbrace{\left(\frac{(\phi_e t + c_e)}{1 - \phi_e t - c_e}\right) \eta \bar{\phi}_e}_{\text{participation effect}}\right] \underbrace{\left[\left(\frac{1-e^*}{e^*}\right) c_e^* \alpha_e^* + \left(\frac{m^*}{e^*}\right) c_m^* \alpha_m^*\right]}_{\text{cut in labour income tax rate}}}^{\text{dynamic effect from lower tax rate}}$$

$$+ \overbrace{\underbrace{(\phi_e t + c_e) \left\{\left(\frac{c_e}{1 - \phi_e t - c_e}\right) \eta \alpha_e + \varphi \chi \alpha_m\right\}}_{\text{co-insurance participation effect}} + \underbrace{\left(\frac{m}{e}\right) c_m \chi \alpha_m}_{\text{co-insurance moral hazard effect}}}^{\text{dynamic effect from lower effective benefits}} \tag{3.7}$$

The static effect indicated in (3.7) is simply the sum total of the positive IA balances that the government would have to transfer to the account holders if they would not change their behaviour. Since these resources were previously part of general government revenue, they measure the deterioration of the public budget in the hypothetical situation where no taxpayer responds to the change in incentives brought about by the IA system. In the absence of behavioral changes, the individual accounts would thus not be Pareto improving in an ex-post sense since individuals without positive account balances would lose as the government would have to raise taxes to make up for its revenue loss. Formula (3.7) reveals that the static revenue loss is larger, the more heterogeneous is the population. In particular, the larger is the employment rate and the smaller are the average replacement rate and the call on non-employment benefits (m) for individuals with positive IA balances relative to the population as a whole, the larger will be the positive IA balance accruing to an average person within the group with positive balances, and so the larger will be the revenue loss that occurs in the absence of behavioural responses. Intuitively, with a more heterogeneous population, a conventional tax-transfer system tends to imply more interpersonal redistribution across the life cycle, so the larger is the static budgetary cost of reducing net revenue collection from those individuals who are net taxpayers over the life cycle under the current system. One can also interpret the static revenue loss as the distributional loss from the introduction of individual accounts. This distributional loss is translated into a revenue loss, as the government compensates those who end up losing from the accounts.

The dynamic effect on net public revenue, which consists of the product of behavioural responses and tax and benefit wedges, can be decomposed into two separate effects corresponding to the two channels identified in (2.13). One is the impact of a closer actuarial link between contributions and benefits, captured by the terms in the second line of (3.7). This produces lower effective marginal and average tax rates, resulting in more hours worked and more labour-force participation.

The second component of the dynamic effect is the revenue impact of less benefit dependency on account of more self insurance, as individuals finance their own benefits out of their individual accounts (see the terms in the third line of (3.7)). If the benefit is triggered by non-employment (and thus insures against periods of inactivity), labour-market inactivity will drop. How much this 'co-insurance participation effect' then improves the budget depends on the initial overall tax and benefit wedge on employment ($\phi_e t + c_e$) and the sensitivity of inactivity with respect to a higher value of α_e, as indicated by the participation elasticity η in formula (3.7).[6]

[6] We have included only labour-supply effects of lower effective replacement rates in our elasticity η. However, a lower effective replacement rate on account of a higher value for α_e is also likely to reduce wage pressure, thereby boosting labour demand and thus reducing the natural rate of employment and benefit dependency. Also lower effective tax rates produced by a closer actuarial link between contributions and

If the benefit is not employment-related (e.g. child benefits), the co-insurance effect does not directly affect employment. However, co-insurance may combat moral hazard in other domains. In the case of child benefits, for example, fertility may decline if parents have to pay the child benefits out of their own accounts. This 'co-insurance moral hazard effect' depends on the product of a behavioural elasticity χ and a 'benefit wedge' $\left(\frac{m}{e}\right) c_m$ indicating to what extent one less child saves the government money at the margin. Similarly, if people have to pay their education benefits out of their own accounts, they may take less education. The direct budgetary implications of less education are also captured by the term $\left(\frac{m}{e}\right) c_m \chi \alpha_m$ in formula (3.7).

In addition, education benefits may generate an indirect budgetary effect since people may move earlier to employment when they spend less time on education and/or since they may retire earlier when lower education reduces their earnings potential. In these cases we would have $\varphi \equiv -\frac{de}{e}/\frac{dm}{m} \neq 0$. To the extent that child benefits affect fertility, they may also have an indirect effect on employment as parents temporarily withdraw from the labour market to rear their children (implying $\varphi > 0$). The net revenue implications of these cross effects on participation are picked up by the term $\varphi \chi \alpha_m \left(\phi_e t + c_e\right)$ included in the 'co-insurance participation effect' in (3.7).

The decomposition of the budgetary impact in formula (3.7) in a static and a dynamic revenue effect allows a quantification of (some of) the efficiency gains from the introduction of IAs. The dynamic revenue effect generated by the labour-supply response to the reform is roughly equal to the increase in labour supply times the tax and benefit wedge between the marginal productivity of labour and the marginal disutility of work. To a first-order approximation, this dynamic revenue gain reflects the efficiency gain from the increase in labour supply. It is given by the sum of the terms involving the labour-supply elasticities ε, η and φ in formula (3.7). The further revenue gain from reduced moral hazard – represented by the term $\left(\frac{m}{e}\right) c_m \chi \alpha_m$ in (3.7) – also implies a welfare gain, since the higher revenue allows the government to make (some) citizens better off.

benefits may reduce unemployment and thus stimulate employment through this channel. To illustrate, Daveri and Tabellini (2000) find that the rise of 10 percentage points in the rate of effective labour tax in continental Europe in the seventies and eighties can explain about 3 percentage points of the increase in European unemployment during this period. Nickell and Layard (1999) estimate an unemployment effect of about 2 percentage points of such a tax increase.

In the presence of non-fiscal external effects, the overall welfare effect is comprised of more terms than the dynamic revenue effects alone. To illustrate, if (higher) education produces a positive non-fiscal externaly amounting to ψ per student, the fiscal external effects of a fall in the volume of education should be amended by the non-fiscal external effect $-\left(\frac{m}{e}\right)\psi\chi\alpha_m$ to capture the overall welfare effect. If education benefits are Pigovian so that the benefit rate is set equal to the non-fiscal and fiscal external effect of education, we would have $\left(\frac{m}{e}\right)c_m = \left(\frac{m}{e}\right)\psi - \varphi\left(\phi_e t + c_e\right)$. In that case the terms involving the benefit dependency elasticity χ in (3.7) would drop out from the expression for the welfare effect of including education benefits in the IA system. Similarly, if fertility produces positive non-fiscal external effects and child benefits are Pigovian, the terms including the elasticity χ should be neglected in the evaluation of the welfare effect of including child benefits in the IA reform.

3.2. Illustration: An IA reform proposal for Denmark

To illustrate how formula (3.7) may be used to evaluate the likelihood that a switch to individual accounts will generate a Pareto improvement, we now consider a specific IA reform proposal for Denmark. There are four reasons why the introduction of IAs is likely to improve the equity-efficiency trade-off in a country like Denmark. First, the Danish system of social insurance is of the Beveridgean type, with a very weak link between taxes paid and benefits received. The bulk of social-insurance benefits is financed out of general tax revenues, and most benefits are paid out in flat rates unrelated to previous wages. Hence, the existing labour income taxes financing intrapersonal redistribution over the life cycle incorporate a large distortionary element. Second, by international standards the effective tax and benefit rates tend to be high in Denmark, so the efficiency gains from cuts in these effective rates are potentially large. Third, as documented in Bovenberg, Hansen and Sørensen (2007), the current Danish welfare state arrangements involve a large element of intrapersonal redistribution over the individual taxpayer's life cycle. Finally, compared to other countries, heterogeneity in gross (i.e. before-tax) lifetime incomes is only limited in Denmark.

Against this background, the Danish Economic Council[7] (2005, ch. VI) has proposed

[7]Established by the Danish parliament in 1962, the Economic Council is an independent think tank

that part of the existing social-insurance benefits be financed via mandatory individual savings accounts. According to this reform proposal (henceforth the DEC proposal), the IA system would have the following features. Each citizen in the age group from 18 years until the official retirement age of 65 years would be required to deposit a certain percentage of his/her labour income in an individual account every year. For employees, this social security contribution would be calculated as a percentage of gross wage income. For the self-employed, it would be calculated on the basis of an imputed labour income that is computed every year as an integral part of the Danish tax code. Whenever a person receives certain social-insurance benefits according to the current eligibility rules (which are assumed to be unchanged), his/her individual account would be debited by the corresponding amount, and the balance on the IA would be carried forward with the after-tax interest rate on government bonds. If the IA balance is positive at the time of retirement, the account holder may choose to have it converted into an annuity that is added to the ordinary public retirement benefit, or he/she may choose to have the balance paid out as a lump sum. If the IA balance is negative when the individual reaches the official retirement age, the account is simply set to zero. Accordingly, the owner of the account still receives the ordinary flat retirement benefit as a consequence of the lifetime income insurance built into the system. For married couples, any benefit paid to one of the spouses is debited by half the amount on the IA of each spouse, and for unmarried parents any child-related benefits are likewise debited by half the amount on the IA of each parent. These rules are intended to ensure a reasonably equal distribution of IA balances between men and women.

When selecting the transfer programs to be included in the IA system, the DEC focused on those programs that involve the lowest degree of interpersonal redistribution in order to minimize the potential negative impacts on lifetime income distribution. Specifically, the DEC proposed inclusion of the following transfers in the IA system:

1. Early retirement benefits
2. Grants to students in higher education

advising the Danish government and parliament on issues of economic policy. The council is headed by three academic economists who prepare two reports on the state of the Danish economy every year, assisted by the professional economists in the council secretariat.

3. Short-term unemployment benefits
   (for unemployment spells up to a length of three months)
4. Sickness benefits (up to a limited number of sickness days)
5. Child benefits
6. Parental leave benefits

Table 1 compares the distributional characteristics of these programs to those of some other important transfer programs.

(Table 1 about here)

The last column in Table 1 uses the most recent estimates of the impact of the tax-transfer system on the distribution of lifetime incomes in Denmark, presented in the report from the Danish Economic Council (2005, ch. VI). These estimates are based on a comprehensive micro panel data set covering the period 1994-2002 and comprising a sample of 10 percent of the Danish population above the age of 18.[8] The calculation of the redistribution index stated in the last column of Table 1 starts from a standard Lorenz-curve diagram. In addition to the Lorenz curve, such a diagram may include a *concentration curve* measuring the fraction of total spending on some social-insurance benefit accruing to the poorest X percent of the population (see Shorrocks (1982)). If people in poorer deciles receive a larger share of total spending on the transfer considered, the concentration curve will lie above the 45-degree line; in the hypothetical case of an identical lump-sum transfer to all citizens, the concentration curve will coincide with the 45-degree line. The redistribution index is defined as the area between the concentration curve and the Lorenz curve, measured in proportion to the total area below the 45-degree line. The greater the value of this index, the more redistributive is the transfer in question. Table 1 normalizes the redistribution index by reporting the *excess* value of the index above the value of the redistribution index for an identical lump-sum transfer to all individuals. The numbers in the last column in Table 1 thus indicate how much more redistributive the various transfers are compared to a uniform lump-sum transfer.

[8] The estimates were produced for the Danish Economic Council by Martin Ino Hansen working under the supervision of Anne Kristine Høj and Peter Birch Sørensen. A detailed description of the method used and an evaluation of the quality of the estimates is provided in a technical appendix available at www.econ.ku.dk/pbs/default.htm#Recent%20working%20papers.

The table shows that early retirement benefits, grants to students in higher education, parental leave benefits and child benefits imply a low degree of lifetime income redistribution from rich to poor. The Danish government grants to students in higher education are offered to *all* students without any means testing. This explains why this program is not very redistributive. Programs such as disability benefits and housing benefits were excluded from the IA system since they involve a high degree of redistribution of lifetime incomes, as indicated in the last column of Table 1. Furthermore, the degree of lifetime income redistribution implied by benefits paid to workers suffering long unemployment spells (exceeding three months) is more than twice as large as the interpersonal redistribution generated by short-term unemployment benefits (for spells shorter than three months). For this reason the DEC proposal includes only short-term unemployment benefits in the IA system. Similarly, benefits paid during long sickness spells tend to be more redistributive than those paid during short spells. Moreover, short-term sickness spells tend to involve a greater moral hazard problem of verifiability. The DEC therefore proposed that only benefits paid during a limited number of sickness days should be included in the IA system. However, data limitations compelled us to include all sickness benefits in the calculations presented below.

The data on disposable lifetime incomes reported by the Danish Economic Council (2005) include estimates of the various transfers received by individuals over their working lives. From these estimates we have calculated the magnitudes $\alpha_e c_e \left(\frac{1-e}{e}\right)$ and $\alpha_e^* c_e^* \left(\frac{1-e^*}{e^*}\right)$ (or $\alpha_m c_m \left(\frac{m}{e}\right)$ and $\alpha_m^* c_m^* \left(\frac{m^*}{e^*}\right)$, depending on the type of transfer program) appearing in our formula (3.7) – that is, the average amount of benefits withdrawn from the IA relative to average pre-tax income for individuals with an IA surplus and for the population as a whole, respectively. As explained in section 3.1, the difference between these magnitudes determines the size of the static revenue loss from an IA system, before accounting for the budgetary impact of behavioural changes. The first two columns in Table 1 show our estimates of $\alpha_e c_e \left(\frac{1-e}{e}\right)$ and $\alpha_e^* c_e^* \left(\frac{1-e^*}{e^*}\right)$ (and $\alpha_m c_m \left(\frac{m}{e}\right)$ and $\alpha_m^* c_m^* \left(\frac{m^*}{e^*}\right)$). The differences in these magnitudes between people with an IA surplus and the population as a whole depend in part on the size of the transfer program and partly on the skewness of the distribution of the benefits from the program. The differences between the numbers in the first and second columns in Table 1 also depend on the specific transfers included in the IA system, because this will determine the separation between people with and without an IA surplus. Furthermore, recall from equation (3.6) that the magnitudes $\alpha_e^* c_e^* \left(\frac{1-e^*}{e^*}\right)$ and $\alpha_m^* c_m^* \left(\frac{m^*}{e^*}\right)$ in the second column of Table 1 indicate the proportional cut in the labour income tax rate made possible by including the relevant transfer program in the IA system.

To estimate the co-insurance participation effects captured by the bottom line of formula (3.7), we also need estimates for α_e and α_m, i.e. the fraction of total transfers to people of working age accounted for by the various transfer programs included in the IA system. These estimates are reported in the third column of Table 1. They were derived from the figures in the first column of the table. For example, in the case of early retirement benefits, the value of α_e was calculated by dividing the number in the top row of the first column by the number in the seventh row of that column (i.e., $\alpha_e = 0.0209/0.0509 = 0.4106$).[9]

The DEC proposed that the mandatory contributions to the IAs should be a fixed percentage of the base for the proportional Danish payroll tax ('arbejdsmarkedsbidrag'). This tax is levied on gross wage income and on the imputed labour income of the self-employed (with no cap for any of these groups); for wage earners, the tax is collected at the employee level. The revenue collected by this tax supplements general government revenues and is not earmarked for financing social insurance benefits to the individual taxpayer. According to the DEC proposal, the percentage IA contribution would be set such that total contributions would correspond to total expenditure on the transfers included in the IA system, and the payroll tax rate would be cut by a corresponding amount, in accordance with the assumption underlying our formula (3.7). On the basis of this formula plus the figures in the second column of Table 1, we estimate that the proposed IA system covering the six transfer programs mentioned above would imply an

[9] Combined with our assumption in section 3.1 that the replacement rate c_e is roughly the same for the various out-of-work benefits, this procedure implies that the non-employment rate $1-e$ is assumed to be the same for the different benefit programs. This short-cut was necessitated by the fact that the data set presented by the Danish Economic Council (2005) does not allow separate program-specific estimates of c_e and e (or of c_m and m). Although our rough assumption that $1-e$ is the same across transfer programs undoubtedly implies some inaccuracy in our estimates of the *program-specific* co-insurance participation effects of IAs, it does not yield a systematic bias in our estimate of the *total* co-insurance effect of the entire IA system, given that the replacement rate is roughly the same across programs.

8.17 percentage point cut in the payroll tax rate (and the introduction of a corresponding IA contribution). This is very close to the 7.9 percentage points payroll tax cut estimated by the DEC.[10]

The account system could be administered directly by the government, or it could be administered by private sector financial institutions. In Denmark, all taxpayers below 65 years of age already contribute to a mandatory supplementary pension scheme (denoted ATP), so it would seem natural to build on this existing administrative infrastructure.

Table 2 shows the DEC's estimate of the impact of the proposed IA system on the distribution of lifetime incomes, assuming a zero growth-adjusted real interest rate. Importantly, the table abstracts from any behavioural effects of the IA system. The numbers thus reflect only the static impact effect. Although the very purpose of the IA system is to influence labour-market behaviour, the distribution of positive IA balances in Table 2 should provide a good proxy for the effect of the reform on the distribution of individual welfare. The reason is that, by the Envelope Theorem, changes in employment caused by the IA system yield no first-order effects on individual welfare if individuals have optimized their behaviour in the initial equilibrium and are not rationed on the labour market.[11]

(Table 2 about here)

The second row in Table 2 shows the accumulated contributions to the IA relative to the accumulated withdrawals from the account for each of the deciles in the lifetime income distribution. Not surprisingly, this ratio is systematically rising with lifetime

[10] The slight difference between the two estimates may be explained by the fact that the DEC would allow the IA contribution to be deducted against the base for the personal income tax, as is the case for the current Danish payroll tax. For symmetry reasons, the positive balance on the IA would then be included in the personal income tax base when it is paid out. If the marginal tax rate at the time of contribution to the IA differs from the marginal tax rate on payments from the account, these tax rules imply a slight modification of our formulas (3.5) and (3.7). However, as shown in the appendix, these modifications will only be of second-order magnitude if there is no IA system from the outset. This explains why our estimate of the payroll tax cut is so close to the estimate produced by the DEC.

[11] The IAs do not have first-order implications for the welfare impact of capital-market imperfections such as liquidity constraints. The reason is that the IAs allow individuals to enjoy the same insurance benefits as under the current system – even if their account balance is negative. In this respect, the accounts provide the same liquidity insurance as current public benefits.

income. Moreover, the ratio of the average positive IA balance to lifetime income is also rising with the income level, as shown in the third row in Table 2. Furthermore, whereas only 7.2 percent of individuals in the lowest decile end up with a positive IA balance at the time of retirement (assuming unchanged behaviour), almost 80 percent of people in the top decile will accumulate a positive balance, as indicated in the fourth row of the table.

This distributional pattern reflects the fact that the contributions to the IA are proportional to labour income, whereas most of the benefits included in the IA system are paid out in flat rates. It also reflects that people who are less active in the labour market and more dependent on the transfer system tend to end up in the lower lifetime income brackets. There is thus no doubt that the proposed IA system will make the lifetime income distribution more unequal. The distributional impact will be limited, however. Specifically, while the Gini coefficient for the distribution of disposable lifetime income is 0.127 under the current Danish tax-transfer system, it would only rise to 0.133 if the proposed IA system were introduced (Danish Economic Council, 2005, ch. VI). The Gini coefficient for the distribution of lifetime factor income is currently 0.253. While the redistribution of lifetime income implied by the current tax-transfer system amounts to (0.253-0.127)/0.253 = 49.8 percent, the redistribution under the DEC proposal would thus still amount to a substantial (0.253-0.133)/0.253 = 47.4 percent.[12] Moreover, as we shall argue in the next section, the proposed IA system would generate a Pareto improvement even under rather conservative assumptions regarding behavioural responses.

3.3. Effects on the public budget and on economic efficiency

We will now employ formula (3.7) to estimate the revenue and welfare effects of the DEC proposal. When applying the formula, it must be recalled that the effective tax rates on labour income include indirect taxes; therefore, prior to the adjustment for a possible link between taxes and benefits, the effective marginal and average tax rates on labour income are given as

$$\tau = \frac{\tau^d + t^c}{1 + t^c}, \qquad t = \frac{t^d + t^c}{1 + t^c}, \tag{3.8}$$

[12] These mechanical calculations are based on the heroic assumption that factor incomes are unaffected by the tax-transfer system.

where τ^d and t^d denote the marginal and average direct tax rates (before taking into account the additional benefit rights that might be generated by more employment and hours worked), respectively, and t^c stands for the overall effective indirect tax rate on consumption. In Denmark, realistic values of these tax parameters for an average worker would be[13]

$$\tau^d = 0.54, \quad t^d = 0.42, \quad t^c = 0.26 \quad \Longrightarrow \quad \tau = 0.63, \quad t = 0.54.$$

Application of formula (3.7) requires an estimate of our parameters ϕ_e and ϕ_h quantifying the degree to which increases in employment and hours worked generate additional benefit rights. Suppose the benefit rate obtainable in some transfer program depends on previous earnings. In that case a unit increase in earnings today will increase the future benefit rate by the replacement rate c_e, defined as the *after-tax* benefit rate relative to the *pre-tax* wage rate. Suppose further that on average the wage earner expects to be eligible for the benefit during some fraction u of his remaining labour-market career. With a zero growth-adjusted discount rate, this person's effective tax rate on labour income should then be reduced by the amount uc_e to reflect the fact that additional earnings generate additional future benefits. However, it may be that for some people eligible for the benefit, the benefit rate is unrelated to previous earnings, for example, because benefits are capped. Hence, we estimate our parameters ϕ_h and ϕ_e by the simple formulas

$$\tau\phi_h = \tau - a_h u c_e, \qquad t\phi_e = t - a_e u c_e, \tag{3.9}$$

where a_h is the fraction of workers who are in a position to raise their future benefits by increasing their current working hours, and a_e is the fraction of people in the workforce who can increase their future benefit rights by moving from non-employment into employment. Note that the parameters a_h, a_e, u and c_e are averages across all transfer programs for those individuals of working age who (expect to) end up with a surplus on their IA. In an appendix available at www.econ.ku.dk/pbs/default.htm#Recent%20working%20papers

[13] The estimate for t^d is taken from the OECD Taxing Wages report (OECD (2005)) and refers to the average Danish production worker. The estimate for the average value of the marginal direct tax rate on labour income (τ^d) is taken from the Danish Ministry of Finance (2004), and the estimate for t^c is based on Carey and Rabesona (2004, Table 7.B2) and is an average figure for Denmark for the period 1990-2000.

we explain in detail how we have estimated these parameters to find

$$\phi_h = 0.987, \qquad \phi_e = 0.985.$$

These estimates reflect the very low degree of actuarial fairness of the Danish system of social insurance.

Although estimates of the average (uncompensated) wage elasticity of hours worked for Denmark tend to centre around 0.1 (a little higher for females and a little lower for males; see Frederiksen et al. (2001)), we select $\varepsilon = 0.05$ to be on the conservative side. The participation elasticity η was recently estimated by Le Maire and Scheuer (2005) to be in the range 0.2-0.4 for Danish recipients of social assistance benefits. However, the authors argue that these estimates may have an upward bias, so we conservatively set $\eta = 0.1$. By selecting low values for the labour-supply elasticities, we account for the possibility that some agents may be myopic or liquidity constrained and therefore do not fully account for the intertemporal links between withdrawals from the accounts and future retirement benefits.

Finally, formula (3.7) requires a distinction between those benefits in the IA system that are directly related to the recipient's employment status and those that are not. In the latter category we include education benefits and child benefits, whereas unemployment benefits, sickness benefits, early retirement benefits and parental leave benefits are clearly paid out only during periods of non-employment.

For the latter four transfer programs, we can now estimate the effects of introducing IAs on the basis of the assumptions and information stated above, since the parameters χ and φ in formula (3.7) are not relevant for these programs (in terms of the formula, $\alpha_m = 0$ for these programs). Inserting our assumptions on parameter values plus the relevant estimates from the three first columns of Table 1 into formula (3.7), we obtain the estimated budgetary effects stated in the five top rows of Table 3.

(Table 3 about here)

Given our assumed parameter values, including these four programs in an IA system would improve the public budget by more than three percent of the initial labour income tax base for those people who end up with an IA surplus. According to the data underlying Table 3, ewh amounts to almost 60 percent of the total labour income tax base, so the estimated gain in net revenue is almost two percent of the total tax base. Table 3 shows that the bulk of the dynamic net revenue gain comes from the participation response to the cut in effective benefit rates implied by the IA system (see column 4 in the table). This is not surprising, considering that the IA system effectively cuts the replacement rate by 100 percent in those transfer programs that are included in the system.

To illustrate the workings of the account system and to explain how the numbers in Table 3 were calculated, it may be instructive to consider the first row in Table 3 which shows the various effects of including short-term unemployment benefits in the IA system. The inclusion of this program in the account system allows a cut in the marginal labour income tax rate of about 2.12 percentage points, as indicated in the fourth row and second column of Table 1. Multiplying this tax rate cut by the factor $\varepsilon\left(\frac{\phi_h\tau}{1-\phi_h\tau}\right)\bar{\phi}_h$ appearing in formula (3.7), we can estimate the rise in tax revenue generated by the increase in working hours resulting from including short-term unemployment benefits in the IA system. Clearly, this effect depends on the hours-of-work elasticity ε and the initial level of the marginal effective labour income tax rate, $\phi\tau$. Using the parameter values mentioned above, we estimate an increase in tax revenue amounting to 0.18 percent of the labour income tax base (for individuals with an IA surplus), as shown in the first row and second column of Table 3.[14] The *average* tax rate on labour income will also drop by 2.12 percentage points when short-term unemployment benefits are included in the IA system because the Danish payroll tax is purely proportional. This will stimulate labour supply at the *extensive* margin, as the lower average tax burden on labour income induces the unemployed to increase their search efforts in order to move faster into employment. The resulting effect on the public budget is captured by the term $\left(\frac{\eta(\phi_e t+c_e)}{1-\phi_e t-c_e}\right)\bar{\phi}_e$ in formula (3.7). This term includes the 'participation elasticity' η (in this case picking up the effect of more intensive job search) and the initial effective 'participation tax rate' $\phi_e t + c_e$, which reflects the increased tax burden and the loss of benefit income experienced by an individual who moves from unemployment into employment. Given our assumptions on parameter values, we estimate that the cut in the average effective labour income tax rate increases the employment rate by about 0.78 percent. This will in turn improve the budget by 0.57 percent of the labour income tax base, as reported in the first row and

[14]In applying formula (3.7), we use the facts that $\overline{\phi}_h \equiv d(\phi_h\tau)/d\tau = \phi_h$ and $\overline{\phi}_e \equiv d(\phi_e\tau)/d\tau = \phi_e$.

third column of Table 3.

Finally, since collection of short-term unemployment benefits reduces a worker's IA balance by a similar amount in present value terms, the inclusion of these benefits in the IA system effectively reduces the replacement rate to zero. This provides a further strong incentive for forward-looking individuals to raise their labour supply at the extensive margin through increased search effort. The resulting effect on the budget is reflected in the term $(\phi_e t + c_e)\left(\frac{c_e \eta}{1-\phi_e t - c_e}\right)\alpha_e$ in formula (3.7), where the estimate for α_e is given in the fourth row and third column of Table 1. On this basis, we obtain a budgetary improvement of 1 percent of the labour income tax base, as stated in the first row and fourth column of Table 3. The total dynamic effect on the budget is the sum of the three effects just mentioned, adding up to 1.75 percent of the labour income tax base of individuals with a positive IA balance (who account for 60 percent of the total labour income tax base).

In the absence of non-fiscal external effects, the dynamic revenue gain is a proxy for the welfare gain from the introduction of IAs, as we explained in section 3.1. From column 5 in Table 3, this efficiency gain can estimated to be a respectable 3.5 percent of the *total* labour income tax base ($0.6 \cdot 5.81 \approx 3.5$), despite our rather cautious assumptions on labour-supply elasticities. Note that since the proposed IA system ensures that nobody can be financially worse off than under the existing tax-transfer system, the estimated efficiency gain represents a genuine ex-post Pareto improvement, provided the four transfer programs do not serve to correct for non-fiscal externalities. One might argue that the parental leave scheme has a positive external effect in so far as parental care in the early stage of childhood improves the social skills of the child. If there are negative non-fiscal externalities associated with non-employment (e.g., increased crime rates and loss of self-respect and social skills), however, the increase in employment obtained through the IA system would have positive external effects that are not included in Table 3. Thus it is not at all obvious that an allowance for non-fiscal externalities would reduce the estimated total welfare gain. At any rate, the estimate in the fifth row of Table 3 shows how large the possible loss in non-fiscal externalities would have to be to eliminate the total net welfare gain from the IA system.

Estimating the revenue and welfare effects of incorporating education benefits and child benefits in the IA system is a more complex matter, in principle requiring an estimate of the parameters χ and φ in formula (3.7). However, in the benchmark Pigovian case where the initial benefit rates roughly match the non-fiscal and fiscal externalities from changes in the number of children or students, one may as a first approximation ignore the contributions of the terms $\chi\varphi\left(\phi_e t + c_e\right)$ and $\chi c_m\left(\frac{m}{e}\right)$ to the welfare effect of the IAs, as we explained in section 3.1. In this case the welfare effect can be evaluated from the first three columns in the two bottom rows of Table 3. According to the estimates presented there, the inclusion of education benefits and child benefits would be roughly revenue neutral, ensuring that the net taxes on people with an IA deficit would not have to be raised. At the same time, persons with an IA surplus would gain, implying a Pareto improvement. In this scenario the size of the aggregate efficiency gain may be approximated by the sum of the figures in columns 2 and 3.

The numerical exercises in this section seem to support our earlier conjecture that the introduction of IAs for those transfer programs that involve relatively little interpersonal redistribution could be Pareto-improving, provided the IA system includes a 'lifetime income guarantee' (a bail-out clause) for those who end up with a negative account balance.

4. Concluding remarks

Our analysis suggests that individual accounts can play a useful role in financing social benefits that have only little redistributive power in a life-cycle perspective and give rise to serious moral hazard. For such benefits, saving accounts can enhance labour-market incentives at a relatively low cost in terms of a more unequal distribution of lifetime incomes. As the changing nature of social risks makes social insurance more expensive in terms of distorted labour-market incentives, individual accounts with a lifetime income guarantee seem to be an attractive alternative to simple cuts in taxes and benefits. Indeed, such accounts can continue to provide substantial income security at a time when a dynamic world economy confronts many people with substantial risks.

Apart from the changing nature of social risks and the continued demand for income security, several factors have made individual accounts in social insurance more attractive. First of all, modern information and communication technologies enable governments to keep systematic records of the contribution and withdrawal histories of their citizens. Second, more efficient capital markets allow individuals to smooth their consumption over their life courses. By thus allowing individuals to decouple annual consumption from annual disposable incomes, better functioning capital markets make lifetime- rather than annual incomes better indicators of overall welfare. Moreover, financial innovation allows private financial institutions to administer the compulsory saving accounts. A further reason for the increased attractiveness of individual accounts is that they are fully portable between jobs. Hence, social insurance does not tie workers to their initial employer. This facilitates labour mobility and the flexibility of the labour market. Finally, many social-insurance programs suffer from the problem that it is hard to separate the truly needy from other individuals who do not really need help from the government. If social norms regarding the take-up of benefits are endogenous and the take-up rate depends positively on how many people already receive benefits (as argued by Lindbeck (2006)), individual accounts may improve the sustainability of the welfare state by inducing people not to take up social benefits unless they really need them. This helps to halt an erosion of social norms. With individual accounts reducing moral hazard for middle- and higher incomes, the government can focus its active labour-market policies more on the lifetime poor, thereby also protecting the social norms of this group.

We have explored whether the introduction of individual accounts for certain public transfers can yield a Pareto improvement. The optimal size of individual accounts is a more complicated issue that we leave for future research. Individual accounts also have implications that have not yet been included in our formal analysis. By separating lifetime redistribution from consumption-smoothing and insurance, individual accounts increase the transparency of lifetime redistribution. This may weaken the political support for this redistribution. Another factor that may work in the same direction is that the middle class no longer benefits from redistribution, which is now more closely targeted at the lifetime poor (see, e.g., Casamatta, Cremer, and Pestieau (2000)). At the same time, however, individual accounts give individuals a stronger sense of ownership and personal responsibility. This may strengthen popular support for the welfare state and the liquidity and lifetime insurance it provides. Stronger personal ownership may also make it more difficult for the government to change benefit rules, thereby reducing political risks.

However, the proposed system of individual accounts also has some potential drawbacks. The lifetime income insurance built into the system limits the cuts in effective social benefits to high- and middle incomes in order to contain the possible adverse effects on the incomes of the lifetime poor. This may encourage the middle and higher income earners to lobby for stronger employment protection, thereby harming the flexibility of the labour market. The lifetime income guarantee implies also that, while marginal rates are cut for others, marginal tax rates tend to remain large only for the lifetime poor.[15] The employment gap between low-skilled and high-skilled workers may thus increase unless the government focuses active labour-market policies on the bottom of the labour market and employs instruments other than financial incentives to activate the lifetime poor.

APPENDIX

This appendix shows how to derive formula (3.7) presented in section 3.1 and used in section 3.3 to estimate the effects on the public budget of introducing individual accounts.

The introduction of IAs involves a cut in τ combined with a rise in the variables s, α_e and α_m from zero to some positive numbers. Using equations (3.3) and (3.4) in section 3.1;[16] remembering that $s = \alpha_e = \alpha_m = 0$ initially; and recalling that the proposed IA

[15] A related drawback is that, although the lifetime poor may not become worse off in absolute terms, they may become poorer compared to the lifetime rich. This is a serious drawback if people care more about relative incomes than absolute incomes. In the presence of such standard-of-living utilities, optimal marginal tax rates at the top of the income distribution would be positive.

[16] Equation (3.3) assumes that contributions to the IA are not deductible, that IA balances are not taxed, and that only net (after-tax) benefits are debited to the IA. Alternatively, one may assume that *pre*-tax benefits are debited to the IA and that IA contributions are deductible from the personal income tax base whereas IA balances are subject to tax. In this case, by using $T = \tau wh - I$, one can show that (3.3) modifies to

$$\begin{aligned} R &= eT - (1-\alpha_e)(1-e)\, b_e - (1-\alpha_m)\, b_m m - y \\ &+ \left(\tau^A - \tau\right) sewh + \left(\frac{t^b - \tau^A}{1-t^b}\right)\left[\alpha_e (1-e)\, b_e + \alpha_m b_m m\right], \end{aligned} \tag{i}$$

where τ^A is the average tax rate on IA balances, and t^b is the average tax rate on benefit income. However, in the initial pre-reform equilibrium we have $s = \alpha_e = \alpha_m = 0$, so to a first-order approximation, changes in e and h will have no impact on R via the last two terms on the right-hand side of (i). Hence, an analysis based on (3.3) still approximates the revenue effect of the reform.

system does not involve any change in ordinary retirement benefits (i.e., $dy = 0$), we find that the revenue effect of introducing IAs amounts to

$$dR = \overbrace{ewh \cdot d\tau + b_e (1-e) \cdot d\alpha_e + b_m m \cdot d\alpha_m}^{\text{static effect}} + \overbrace{(\phi_e T + b_e) \cdot de - b_m \cdot dm + \phi_h \tau ew \cdot dh}^{\text{dynamic effect}} \tag{A.1}$$

The parameter ϕ_e indicates to what extent the additional tax payments generated by additional labour force participation yields additional benefit rights. If the tax payments are actuarially fair, we have $\phi_e = 0$. Similarly, the parameter ϕ_h indicates to what extent the additional tax payments generated by additional hours worked yields entitles the taxpayer to additional benefits.

In modelling behavioural impacts, we abstract from income effects on labour supply, since most recent empirical studies find that these effects are quite small. Income effects will be absent if utility functions take the quasi-linear form

$$U = C - D \cdot [f(h) + q], \qquad f' > 0, \quad f'' > 0, \tag{A.2}$$

where C is consumption, $f(h)$ is the disutility of working h hours, q is a fixed (pecuniary and/or psychological) cost of labour force participation, and D is a dummy variable taking the value of unity when the individual participates in the labour market and the value of zero when he does not participate. Following Immervoll et al. (2007), suppose q varies in a smooth continuous manner within a group of workers earning the same wage rate w. The participation rate of that group will then vary continuously with changes in the variable

$$Y \equiv wh_o (1 - \phi_e \tau) + \phi_e I - b_e (1 - \alpha_e), \tag{A.3}$$

representing the difference between net income when working and net income when not working, measured at the initial level of working hours, h_o. A marginal change in h induced by a policy reform does not affect the utility of an employed worker, since the resulting change in consumption is offset by a change in the disutility of work when the initial working hours h_o have been optimized (i.e., $f'(h_o)\, dh = dC = w(1 - \phi_h \tau)\, dh$ in the initial optimum). Hence, a change in h does not affect the incentive to participate in the labour market. This is why the variable Y in (A.3) is measured at the given initial level of working hours. At the intensive margin of labour supply, the absence of income effects means that the working hours of an employed worker depend exclusively on the marginal after-tax wage rate, $w(1-\phi_h\tau)$. Hence we define the labour supply elasticities

$$\eta \equiv \frac{de/e}{dY/Y}, \qquad \text{(participation elasticity)}\ , \tag{A.4a}$$

$$\varepsilon \equiv \frac{dh/h}{dw(1-\phi_h\tau)/w(1-\phi_h\tau)}, \qquad \text{(hours-of-work elasticity)}. \tag{A.4b}$$

Moreover, the number of persons applying for a certain benefit (and hence our variable m) may depend on the benefit level, and employment may in part be affected by the variable m (e.g., the employment rate may depend on the number of people collecting education benefits). We therefore also define the elasticities

$$\chi \equiv \frac{dm/m}{db_m(1-\alpha_m)/b_m(1-\alpha_m)}, \qquad \text{(benefit dependency elasticity)}, \tag{A.4c}$$

$$\varphi \equiv -\frac{de}{dm}\frac{m}{e}, \tag{A.4d}$$

where χ could reflect a moral hazard effect. Using the elasticities in (A.4), we may write (A.1) as

$$\begin{aligned} dR &= ewh \cdot d\tau + b_e(1-e) \cdot d\alpha_e + b_m m \cdot d\alpha_m \\ &+ (\phi_e T + b_e)\left(\eta e \cdot \frac{dy}{y} - \varphi\chi e \cdot \frac{db_m(1-\alpha_m)}{b_m(1-\alpha_m)}\right) \\ &-\chi b_m m \cdot \frac{db_m(1-\alpha_m)}{b_m(1-\alpha_m)} + \varepsilon\phi_h\tau ewh \cdot \frac{dw(1-\phi_h\tau)}{w(1-\phi_h\tau)}. \end{aligned} \tag{A.5}$$

Defining

$$t \equiv \frac{T}{wh_o}, \qquad \text{(average labour income tax rate)},$$

$$c_e \equiv \frac{b_e}{wh_o}, \qquad \text{(replacement rate)},$$

$$c_m \equiv \frac{b_m}{wh_o}, \qquad \text{(relative benefit rate)},$$

$$\bar{\phi}_h \equiv \frac{d(\phi_h\tau)}{d\tau}, \qquad \bar{\phi}_e \equiv \frac{d(\phi_e t)}{d\tau},$$

and using

$$dw(1-\phi_h\tau) = -w \cdot d(\phi_h\tau) = -w\bar{\phi}_h d\tau,$$

$$Y = wh_o - (\phi_e T + b_e)\,,$$

$$dY = -wh_o\bar{\phi}_e \cdot d\tau + b_e \cdot d\alpha_e,$$

we can rewrite equation (A.5) as equation (3.5) in section 3.1. From that we obtain (3.7) by inserting (3.6).

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