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Steady-State Welfare Effects of Social Security in a Large Open Economy

By

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The previous welfare-economics literature on intergenerational transfers through unfunded public pension schemes studies either "small open" economies, which can borrow or lend abroad without restriction at constant interest rates, or "closed" economies, in which domestic capital accumulation must be equal to domestic savings. Here we analyze the more realistic "intermediate" case of an economy which is both open and large enough to have an impact on world interest rates. It turns out that even those efficiency results that hold for both "polar" cases do not carry over to large open economies: If a country is a net lender, it can successfully redistribute income away from the non-residents by increasing the public pension program above the "golden-rule" level at which interest and growth rate coincide. Thus one must be careful in interpreting the previous results on the welfare effects of social security.

1. Introduction

The literature on efficient intergenerational transfers through unfunded public pension schemes can be classified in two broad categories. The first set of models (including, among others, Samuelson 1958, Aaron 1966, Spremann 1984) studies "small open" economies, i.e. economies which can borrow or lend abroad without restriction and have to take interest rates in the world capital market as given. As a corollary, the domestic wage rate is fixed as well, if the domestic technology exhibits constant returns to scale. The second set (including Diamond 1965, Samuelson 1975) examines "closed" economies, mainly using life-cycle growth models in which

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factor prices are endogenously determined. A distinguishing feature of this second type of model is that domestic capital accumulation is constrained to be equal to domestic savings.

Despite the radical difference in the assumptions of the underlying models, the main welfare implications referring to an infinite sequence of overlapping generations are identical: Steady-state welfare is unambiguously improved by introducing (or expanding an existing) system of transfers from the young to the old as long as the interest rate falls short of the growth rate of the economy, where the latter is, of course identical to the population growth rate if there is no technical change. Furthermore, while the introduction of an unfunded pension scheme always provides a windfall benefit for the first generation of transfer recipients, it is true in both cases that the abolition or scaling down of such a pension system necessarily hurts at least one generation even if the interest rate exceeds the growth rate (see Breyer 1989)[1].

A natural question to ask is whether the same properties carry over to the "intermediate" cases of economies which are both open and large enough to have an impact on world interest rates. While the "small open" economy of the first type of model certainly has some counterparts in the real world, the "closed" economy does not, at least if interpreted literally. Several of the major industrial countries are probably not adequately represented either as closed or as small and open. Therefore the question has some empirical significance.

There are essentially two ways to model "large open" economies. One way familiar from international-trade theory is to assume that the world can be divided in two countries of roughly equal size, "home" and "abroad", and some progress has been made in examining the effects of government debt under these circumstances (see, e.g. Persson 1985, Frenkel/Razin 1987).

In this paper we shall pursue a different approach in examining a country which is supposed to be the only one in the world big enough to have an impact on the world interest rate. All others, therefore, take the interest rate as given, and thus their behavior can be summarized in a (net) demand function for capital. The model may be thought to be roughly descriptive of the United States in the decades after World War II. However, it contains both the case of a closed and of a small open

[1] This result is true under the assumption of exogenous labor supply. If labor supply is the outcome of rational choice of people who value leisure, then under certain conditions unfunded pension schemes can be phased out in a Pareto-improving fashion (see Homburg 1990 for small open economies and Breyer/Straub 1993 for closed economies).

economy as special cases. In the former case, the outside demand for capital is identically equal to zero, and in the latter case it is infinitely elastic at a given interest rate.

A supply function for external debt has been analyzed by Diamond in his seminal paper (1965, Appendix B), but his analysis differs from ours in several respects. He treats the size of external debt as a government instrument rather than as an endogenous variable, and he does not explicitly address the question of increasing social security taxes. Therefore, our main conclusion developed below cannot be found there.

The paper is organized in the following way. In Sect. 2, the assumptions of the model are laid out. In Sect. 3 our main result is derived: we assume that both the population growth rate and the external demand function for capital are constant over time, and we ask for the size of a pension system with constant benefits over time which maximizes steady-state welfare. Section 5 contains some concluding remarks.

2. Assumptions and Notation

We consider an infinite sequence of overlapping generations. Each individual lives for two periods and supplies a fixed amount (one "unit") of labor in the first period. Working-age consumption of the only good by a person born in period t is denoted by c_{1t} and retirement-age consumption by c_{2t}. As we shall be concerned exclusively with steady states, however, the time subscripts will be dropped henceforth.

The "population growth factor" G, which measures the number of workers per retiree in period t, is assumed to be given exogenously. The only instrument with which the government can influence the growth path of the economy is an unfunded pension system, in which B denotes the contributions levied from each "young" person, measured in units of corn.

Individuals are allowed to save and borrow freely at the prevailing interest factor R, so that their life-time budget constraint can be written as

$$R \cdot c_1 + c_2 = R \cdot (w - B) + G \cdot B = R \cdot w + (G - R) \cdot B \qquad (2.1)$$

Lifetime utility can be represented by the indirect utility function $v[R \cdot w + (G - R) \cdot B, R]$, where the first argument is lifetime income and can be denoted by I and the second is the price of first-period consumption. Letting v_I and v_R denote the partial derivatives,

$$\frac{v_R}{v_I} = -c_1 \qquad (2.2)$$

by Roy's identity. Furthermore, consumption in each period of life is assumed to be normal so that $\partial c_j/\partial I > 0$ $(j = 1, 2)$.

The only good ("corn") is produced according to a neoclassical constant-returns-to-scale production technology, which can be written in per-capita terms as

$$y = f(k) \qquad (f' > 0, f'' < 0)\,, \tag{2.3}$$

and factor markets are assumed to be competitive. This means that R, the (gross) rate of return to savings must be equal to the marginal productivity of capital[2], and the wage rate must be equal to the marginal productivity of labor:

$$R = f'(k) \tag{2.4}$$

$$w = f(k) - k \cdot f'(k)\,. \tag{2.5}$$

Inverting (2.4), we can write

$$k = \varphi(R) \qquad \text{with } \varphi'(R) = f''^{-1} < 0 \tag{2.6}$$

$$w = f[\varphi(R)] - \varphi(R) \cdot R =: \psi(R) \qquad \text{with } \psi'(R) = -k < 0 \tag{2.7}$$

Now equilibrium in the capital market requires that savings by the young equal the sum of domestic and foreign demand for capital, and we assume that foreign net demand for capital in each period (per capita of domestic society) is given by the function $h(R)$:

$$G \cdot k + h(R) = w - B - c_1\,, \tag{2.8}$$

and by using (2.6) and (2.7), (2.8) can be written as the excess demand function in the capital market:

$$Z(R) \equiv G \cdot \varphi(R) + h(R) - \{\psi(R) - B - c_1[I(R, B), R]\}\,. \tag{2.9}$$

As a sufficient condition for Walrasian stability of the capital market equilibrium, we assume $\partial Z/\partial R < 0$.

3. Steady-State Welfare Effects of a Change in Social Security

In this section we determine the effects of a change in the size of the old-age transfers B on steady-state utility of a representative household. To this

[2] Here we assume a depreciation rate of 100 per cent over one standard period.

end we apply the implicit function theorem to (2.9) to determine the impact of a change in B on the steady-state interest factor R:

$$\frac{dR}{dB} = -\frac{1 + (G - R)\cdot \partial c_1/\partial I}{\partial Z/\partial R} = -\frac{G\cdot \partial c_1/\partial I + \partial c_2/\partial I}{\partial Z/\partial R} > 0 \quad (3.1)$$

due to the assumed normality of first- and second-period consumption.

Now writing the household's indirect utility function as a function of B yields

$$v(B) = v[R(B)\cdot w(R(B)) + (G - R(B))\cdot B, R(B)] . \quad (3.2)$$

Differentiating this expression with respect to B, dividing by v_I, and using (2.2), (2.7), and (2.8), we obtain

$$\begin{aligned}\frac{1}{v_I}\cdot\frac{dv}{dB} &= (\psi + R\cdot\psi' - B - c_1)\cdot\frac{dR}{dB} + G - R \\ &= (w - R\cdot k - B - c_1)\cdot\frac{dR}{dB} + G - R \\ &= [(G - R)\cdot k + h(R)]\cdot\frac{dR}{dB} + G - R \\ &= (G - R)\cdot\left\{1 + k\cdot\frac{dR}{dB}\right\} + h\cdot\frac{dR}{dB} . \end{aligned} \quad (3.3)$$

This expression shows the effect of an increase in the size of the public pension program on steady-state welfare.

The first point to note about (3.3) is that it includes as special cases the results obtained by previous authors for the cases of the closed or the small open economy. In particular, if the economy is open but small, changes in B have no effect on the equilibrium interest rate, $dR/dB = 0$, and the direction of change in steady-state welfare is determined entirely by the difference between the growth rate of the economy and the (world) interest rate. Similarly, if the economy is closed, $h \equiv 0$, and thus the last term vanishes. In this case as well, we see that steady-state welfare unambiguously rises (falls) with B as long as $G > (<) R$.

What is not yet established wisdom is what are the impacts of social security on an economy that is neither closed nor small, if the reference point is a golden-rule growth path ($R = G$). As (3.2) shows, increases in the size of the public pension system raise the world interest rate. According to the last term in (3.3), this effect by itself raises steady-state utility if the country is a net exporter of capital ($h > 0$), and it lowers steady-state utility if it is a net importer ($h < 0$).

The intuitive explanation for this result is a familiar one from international trade theory. In general, policy changes that raise the world price of exported commodities, or that lower the world price of imported goods, are welfare-enhancing. Such "terms of trade" effects, familiar from the theory of the optimal tariff, are applicable as well to other types of policy in an open-economy setting. In the present case, the public pension program, which is ostensibly a "domestic" policy, can affect a large open country's terms of trade in the international capital market and thus its welfare. The introduction or expansion of an unfunded public pension program in a capital-rich country raises consumption, limits saving, reduces net capital exports, drives up the world interest rate, and raises welfare at the expense of foreign capital importers. For a capital-poor country, the same considerations indicate the desirability of limiting the size of the public pension program[3].

Compared to a golden-rule growth path, either in the closed economy or in the small open economy case, small changes in public pensions will have no first-order effect on steady state welfare, and the second-order effect unambiguously reduces welfare no matter whether B is raised or lowered. One might expect that the large open economy, as a sort of intermediate case between the closed and small open economies, to have the same property.

This is not the case, however. Let B^0 denote the level of B at which the world interest factor R is brought into equality with the domestic growth factor G. If the country is a net capital exporter in this situation ($h > 0$), then steady-state welfare is raised by increasing B to some $B^* > B^0$. Conversely, suppose that the country is a capital importer ($h < 0$) when $B = B^0$ and $R = G$. In this case, a small decrease in social security contributions to some $B^* < B^0$ enhances steady-state welfare, while reducing the interest factor to a value $R(B^*) < G$. That is, "dynamic efficiency" is sacrificed in order to take advantage of the country's monopsony power in the international capital market.

4. Concluding Remarks

The policy conclusions from the analysis above are twofold. First, a country which is in a dominating position in the international capital market

[3] The same conclusion was reached by Persson (1985) in his two-large-countries model with respect to an increase in government debt. Note that in his analysis the increased debt is used to reduce a lump-sum tax on the young and in ours to raise a lump-sum subsidy to the old.

can make its citizens better off by *expanding* the size of its unfunded public pension program beyond the "golden-rule" level. The resulting increase in the interest rate benefits the net lenders (who in the case of a net capital exporter all live in the "domestic" country) and hurts all net borrowers, some of whom live abroad. Expansion of the Social Security system in the United States in the 1950's and 60's could thus have been desirable despite (or indeed because of) the resulting fall in savings.

Second, a country which dominates the international capital market but is a net borrower, can successfully redistribute income away from the non-residents by *reducing* by some small amount the public pension program below the "golden-rule" level. However, while this increases steady-state welfare, it does not constitute an intergenerational Pareto improvement compared to the autarky case since the windfall benefit to the first generation of recipients is reduced.

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