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On the role of labor supply for the optimal size of Social Security

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ABSTRACT

The paper studies the welfare effects of a Social Security system in a stylized overlapping generations economy with random production and capital accumulation. Different welfare concepts including long run optimality, social optimality, and time consistency are employed to determine the optimal size of the system. When labor supply is exogenous, a unique contribution level can be identified which is optimal according to all three concepts. When labor supply is endogenous, however, this result generically fails to hold and the long-run optimal solution is only constrained socially optimal while the time-consistent policy may even lead to an inefficient equilibrium.
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0. Introduction

What is the optimal size of a Social Security system? This question is at the very core of any discussion about the design or reform of Social Security. From a theoretical point of view, it is well-known that the presence of a Social Security system crowds out private investment and that a reduction in retirement benefits increases private savings and fosters the accumulation of capital. While at first sight this effect seems favorable, it is also known that dynamic inefficiencies corresponding to an overaccumulation of capital may occur in overlapping generations (OLG) models. In such cases, the introduction of Social Security can lead to a welfare-improvement by implementing a dynamically efficient allocation which in fact makes each generation better off. If the goal is to determine the optimal size of the system, however, stronger concepts than dynamic efficiency are needed. Typically, such concepts cannot be based on the requirement to make each generation better off but instead need to incorporate the trade-off between the welfare of different generations. Determining the optimal size of Social Security based on suitable welfare criteria is the primary objective of the present paper.

A large body of the existing literature studies the welfare properties of allocations in OLG models and their implementation as equilibria through intergenerational transfer schemes. In this regard, many contributions focus on

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OLG models with aggregate risk such as random shocks to the production process. Models that fall into this category are, among many others, Chattopadhyay and Gottardi (1999), (Demange and Laroque, 1999; Demange, 2002) or Peled (1984) and Sakai (1988). The employed welfare criteria are usually ex ante optimality and interim or conditional Pareto optimality which extend the classical Pareto criterion to stochastic OLG economies. A detailed account of these concepts and their relation may be found in Demange (2002). While these criteria can identify Pareto-inefficient allocations and failures of the first welfare theorem, they are in general not suitable to determine a unique optimal allocation. Hence, their application seems inappropriate for the purpose of determining the optimal size of a Social Security system. In addition, a large class of models focuses on pure exchange economies taking production or consumer incomes as an exogenously determined stochastic process which is independent of the Social Security system. This assumption abstracts from the adverse affect of Social Security on capital accumulation as exhibited above.

An alternative approach which incorporates the production process and capital accumulation into a stochastic OLG model was developed in Wang (1993) and further generalized in Wang (1994). His framework was extended by Hauenschild (2002) to include a simple Social Security system with a constant contribution rate levied as a proportional tax on labor income. As a central result, he shows that the adverse effect of Social Security on capital accumulation first established by Feldstein (1974) for deterministic models extends to a general class of stochastic OLG economies. He leaves open, however, whether this effect is also desirable from a welfare perspective which, as exhibited above, may fail to be the case in the presence of dynamic inefficiencies.

Common to the aforementioned approaches is that labor supply is taken as exogenous and assumed not to respond to changes in the Social Security policy. Several contributions in the literature, however, stress the sensitivity of labor supply to changes in the prevailing tax-transfer scheme, see, e.g., Birkeland and Prescott (2007), Prescott (2005), or Rogerson and Wallenius (2009). Despite these insights, most of the existing studies on Social Security neglect this interdependence by taking labor supply as exogenous. Exceptions may be found, e.g., in Breyer and Straub (1993) and Homburg (1990). Using a deterministic overlapping generations model they investigate the welfare effects of Social Security based on the Pareto criterion for a closed and open economy, respectively.

Against this background, the goal of the present paper is to contribute to the discussion by analyzing the welfare effects of Social Security in a stylized OLG model with a particular focus on the role of labor supply. The approach extends the existing studies by incorporating the role of risk through random production shocks as well as the interactions between Social Security, capital accumulation, and labor supply. Conceptually, the employed setup is similar to Wang (1993) and Hauenschild (2002) which is extended to the case with endogenous labor supply. To ensure analytical tractability, however, the assumptions on preferences and technologies are much less general than in Wang (1994) and Hauenschild (2002). Instead, the paper focuses on a parametrization that is well-known to admit analytical solutions. Using the framework developed, different normative criteria are applied and compared and the optimal size of a Social Security system corresponding to an optimal contribution rate is determined under each criterion. While an extension towards more general settings marks a challenging task for future research, the model developed in this paper suffices to illustrate the crucial role of labor supply for the welfare effects of Social Security and its optimal size.

The paper is organized as follows. Section 1 introduces the underlying model and establishes the existence and form of an equilibrium. Sections 2–4 analyze the welfare effects of Social Security using the concepts of long run, social, and constrained social optimality. Finally, Section 5 introduces time consistency as another welfare criterion and summarizes the previous results. Section 6 draws some conclusions, proofs for all results are placed in the mathematical appendix.

1. The model

The economy is populated by overlapping generations of homogeneous consumers who live for two time periods. The index $j \in \{y,o\}$ identifies the young and old generation in each period. The number of young consumers born in period $t \geq 0$ is denoted $N_t > 0$ and grows at constant rate $\eta > -1$ such that $N_t = (1+\eta)N_{t-1}$, $t > 0$. Each young consumer is endowed with one unit of time which she divides up between working time and leisure. Let $\ell_t \in [0,1]$ be the amount of labor supplied by each young consumer at time t. Old consumers are retired and do not work implying that $L_t^S = \ell_t N_t$ is the aggregate labor supply at time t.

Labor is employed by a competitive firm which produces consumption good output Y_t using labor L_t and capital K_t as inputs in period t. In addition, the production process is subjected to random shocks modeled as an exogenous random variable ε_t with values in $[\varepsilon_{min},\varepsilon_{max}] \subset \mathbb{R}_{++}$. The production technology is represented by the function $F : \mathbb{R}_+^2 \times [\varepsilon_{min},\varepsilon_{max}] \longrightarrow \mathbb{R}_+$

$$Y_t = F(K_t,L_t;\varepsilon_t) := \varepsilon_t K_t^{\alpha} L_t^{1-\alpha}, \quad 0 < \alpha < 1. \tag{1}$$

The noise process $\{\varepsilon_t\}_{t \geq 0}$ consists of independent, identically distributed random variables defined on a common probability space $(\Omega,\mathcal{F},\mathbb{P})$. Each ε_t is distributed according to the probability measure ν_ε supported on $[\varepsilon_{min},\varepsilon_{max}]$. The process is adapted to a suitable filtration $\{\mathcal{F}_t\}_{t \geq 0}$ of increasing sub-σ-algebras of $\mathcal{F}$ such that each $\varepsilon_t : \Omega \longrightarrow [\varepsilon_{min},\varepsilon_{max}]$ is Borel-measurable with respect to $\mathcal{F}_t$.[1] In the sequel the notion of an adapted stochastic process $\{\xi_t\}_{t \geq 0}$ taking values in some set $\Xi \subset \mathbb{R}^M$ throughout

[1] The underlying probability space may be constructed by defining $\Omega := \prod_{t=0}^{\infty}[\varepsilon_{min},\varepsilon_{max}]$ which may be endowed with the product topology to become a topological space on which the Borel-σ-algebra $\mathcal{F} := \mathcal{B}(\Omega)$ may be defined. The measure $\mathbb{P}$ corresponds to the product measure $\mathbb{P} := \otimes_{t \geq 0} \nu_\varepsilon$ while the sub-σ-algebra $\mathcal{F}_t$ is generated by the class of measurable rectangular sets $A = \prod_{n=1}^{\infty} A_n$ where each A_n is a Borel-measurable subset of $[\varepsilon_{min},\varepsilon_{max}]$ and $A_n = [\varepsilon_{min},\varepsilon_{max}]$ for $n > t$.

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