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Quantifying the risk-sharing welfare gains of social security

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ABSTRACT

The welfare effects of intergenerational risk sharing through a pay-as-you-go social security system that is efficiently indexed to wages or interest rates are quantified. Comparing steady states, there are large welfare gains of being born into an economy with efficient risk sharing as compared to the current U.S. system. Efficient policy involves an increasingly risky net of tax income over the life cycle. When adjustment to steady state is taken into account, the welfare gains largely turn negative. The results are also compared and contrasted to the first best allocation.

1. Introduction

How should aggregate productivity risk be allocated between taxpayers and retirees in a pay-as-you-go (PAYGO) social security system? This question is motivated by the fact that overlapping generations (OLG) models are known to be inefficient in an *ex ante* sense, stemming from the inability of the unborn to insure themselves.[1] With standard CRRA preferences and Cobb–Douglas technology, the laissez-faire allocation of risk is inefficient by imposing too little productivity risk on retirees and too much on future generations.[2]

A PAYGO system has the potential of correcting these inefficiencies, due to the inherent intergenerational link found by current pension payments being immediately transferred to retirees. More precisely, productivity risk can be transferred between taxpayers and retirees by allowing benefits to respond to macroeconomic shocks. When the economy is hit by a shock, the government can keep the social security budget in balance by adjusting benefits or contributions (or, naturally, by a combination thereof). In the former case, exposure to productivity risk is amplified for retirees and, in the latter case, for taxpayers. Using the PAYGO system to transfer productivity risk between these two groups is thus straightforward.[3]

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[1] The issue of *ex ante* versus *interim* efficiency is somewhat controversial (Peled, 1982; Wright, 1987). Under an *interim* perspective, agents born in different states of nature are considered to be distinct agents. A Pareto improvement then requires that no agent in any birth-state is made worse off. This makes any analysis of intergenerational risk sharing involving future generations impossible. Since this question constitutes the focus of this paper, the appropriate efficiency benchmark here is the concept of *ex ante* efficiency.

[2] This is a very general result that will be true when the intertemporal elasticity of substitution for consumption is <1, and/or the depreciation rate $<100\%$; see Bohn (2009).

[3] The suboptimality of the risk allocation in the existing U.S. social security system has been discussed in several papers, including Shiller (1998) and Ball and Mankiw (2007).

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In the current U.S. social security system, an element of intergenerational risk sharing is found in the mechanism of wage-indexed benefits, implying that benefits respond to younger generations' income.[4]

In this paper, a three-period overlapping generations model is used to analyze the importance of intergenerational risk sharing in social security. Specifically, the model features Epstein and Zin preferences, aggregate uncertainty, endogenous production and a PAYGO system characterized by simple schemes, where benefits are indexed to the aggregate wage rate or the return to capital.[5] A search algorithm then searches for the coefficients of the schemes that maximize the expected lifetime utility of a newborn agent. Finally, outcomes are compared to the current U.S. system and the social optimum.

The allocation of risk in social security is found to have a large influence on the economy. The first section of the analysis abstracts from transitions and finds welfare gains of being born into an economy with efficient wage indexation of up to 15% of the per-period consumption, as compared to the U.S. system. The efficient risk policy, which features highly volatile benefits in combination with highly procyclical taxes, ensures that agents are well insured when they enter the economy (as young). Highly volatile benefits then imply that agents' risk exposure is increasing over the life cycle. Given this structure, workers hold more capital to hedge their coming volatile benefits, which significantly reduces the crowding out effect of the unfunded system.[6] The main point from the analysis in the first section is that the risk structure should be predictable, known in advance and that agents should be given time to prepare. The efficient policy then has important general equilibrium effects and, in fact, the major part of the welfare gains associated with improved risk sharing in the first section is found to be general equilibrium effects.[7]

Unexpected transitions are taken into account in the second part of the analysis. Here, the net present values of the welfare gains are computed and mostly found to be largely negative.[8] Even though all generations but the first two are better off, the loss for particularly the first generation (the middle-aged) is so large that it outweighs the positive gains for future generations. To determine the economic causes for these losses, the welfare effects for the first two generations are decomposed into three components. The first concerns the level and volatility of agents' consumption at the beginning of the transition. Procyclical taxes stabilize current income, implying a positive effect, but future income also becomes more volatile. This leads agents (endogenously) to increase their precautionary savings, which reduces the level of current consumption. The net effect is negative for the middle-aged, implying that the level effect outweighs the volatility effect. The second effect comes from the interest rate. The higher capital stock associated with the new risk allocation implies a lower rate of return in the model, which also contributes negatively to the welfare gains. Third, policy affects the level and volatility of future consumption. However, which of these two effects that dominates depends on whether agents can short-sell assets.

Finally, the transitions to the command optimum constitute Pareto improvements. However, since the simple schemes considered in the paper fail to produce Pareto improvements, a question for further research is to analyze whether the schemes can be improved in a simple way to yield Pareto improvements.

2. The economic model

There are three sectors in the model: a household sector (i.e., the consumers), a production sector and a government sector. These sectors are now described in detail below, starting with the first.

2.1. The consumers

A simple three-period overlapping generations model where each generation is modeled as a representative consumer is considered.[9] There is one consumption good in each period and it perishes at the end of the period. The index $i=0$, 1 and 2 is used to denote the young, the middle-aged and the old, respectively. An agent inelastically supplies labor for two periods and retires in the third period when old. During their working years, agents are endowed with a level of productivity e_i and they receive wage W. When retired, they collect the social security benefit, $\tilde{\varphi}_t$.

There are two types of securities in the economy, bonds and capital denoted by b and k, respectively. Bonds are assumed to be in zero net supply, while the supply of capital is endogenous. A consumer born in period t has zero endowment of assets. This consumer makes a portfolio decision $a_{t+1,0}=(b_{t+1,0},k_{t+1,0})$ in period t, when young; adjusts this decision to $a_{t+2,1}=(b_{t+2,1},k_{t+2,1})$ in period $t+1$, when middle-aged; and sells the portfolio in period $t+2$, when old. As usual, a negative

[4] An individual's earnings are indexed to the average wage level two years prior to the year of eligibility, i.e., when the agent reaches the age of 62.

[5] The production function is assumed to be of the Cobb–Douglas form, implying that the arrangement with wage-indexed benefits is identical to one where benefits are indexed to aggregate income.

[6] See also Smetters (2002) who shows that the government can use negative capital taxes (implying pro-cyclical wage taxes) to correct the "biological trading constraint" preventing agents from trading with the unborn. The fact that social security may be used to change national saving and investment is also discussed in Abel (2003).

[7] The importance of general equilibrium effects when determining the welfare gains associated with different social security arrangements is documented by Krueger and Kubler (2005) and Storesletten et al. (1999).

[8] Transition paths are stochastic, so that the results are averaged over a large number of initial allocations. Future utilities are discounted with the welfare weights of the social planner, which are derived from the market allocation.

[9] The three-period model is appealing, since it captures the heterogeneity of consumers across age groups that are of interest in the paper: the uninsured young, the saving middle-aged and the retired old.