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Social security, growth, and welfare in overlapping generations economies with or without annuities ☆

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ABSTRACT

We examine the impact of a stylized pay-as-you-go (PAYGO) Social Security program in an economy of overlapping generations with equilibrium growth. We adopt realistic mortality and other demographic assumptions and allow for the presence or absence of life annuities. In all cases steady-state economies with PAYGO Social Security programs grow more slowly than those without. Also, we find that lifetime expected utilities are lower for existing and future households in steady-state economies with Social Security. We also report the effect of Social Security on the age profile of consumption and explore the effects of longer life expectancy, compensating Social Security program changes, and capital subsidies.

1. Introduction

The impact of pay-as-you-go (PAYGO) Social Security programs on growth and welfare, as well as on the program structure necessary to maintain their solvency, is of perennial policy interest. Because such programs substitute intergenerational tax-transfers for saving and investment in productive capital, they are presumed to be detrimental to long-term productivity growth, barring other impacts they may have, such as on fertility and retirement decisions. At the same time, by providing a life annuity of fixed purchasing power, Social Security programs provide consumption insurance to elderly households, and should therefore be expected to enhance lifetime welfare in economies with annuities market failure.

By their nature, the terms of PAYGO Social Insurance programs depend on demographic aspects, such as life expectancy and fertility, as well as labor market characteristics, such as retirement plans and Social Security claiming ages. Changes in these structural features have important implications for the impact of PAYGO Social Security programs and their sustainability. In this paper we examine the impacts of a stylized PAYGO Social Security program in a model of equilibrium growth with overlapping generations and realistic household mortality. We derive quantitative estimates of the effects of such programs on long-term growth and welfare, and numerically simulate the effects of different demographic and labor supply conditions on the terms required for the long-run solvency of PAYGO Social Security.

The use of overlapping generations (OLG) models to analyze the effects of PAYGO Social Security has a long history dating back to the pioneering work of Samuelson (1958) and Diamond (1965). The discrete time, two-period canonical models they employed have been extended to include many periods, and other generalizations. In addition, there is a literature analyzing PAYGO Social Security using the continuous time models of Blanchard (1985) and Weil (1989). Assuming a constant mortality hazard rate (an exponential survival function), these models have proven to be highly tractable and informative. In an important paper in this literature, Saint-Paul (1992) derives analytical results describing the impact of Social Security and other government policies for the Blanchard–Weil model. But the Blanchard–Weil model suffers from a serious shortcoming, in that it has an unrealistic demographic structure, implying the existence of an excessively long tail of very old households. In order to provide a realistic assessment of the impact of Social Security on the performance of an economy, it is critical to embed within the OLG model a realistic demographic structure. To do so is our main objective in this paper.

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During the last several years, substantial progress has been made in incorporating more realistic demographic structures in OLG macroeconomic models, and in particular in generalizing the Blanchard–Weil framework. For example, Bommier and Lee (2003), d'Albis (2007), Lau (2009), Gan and Lau (2010) employ very general mortality structures to study the existence and uniqueness of the steady-state equilibrium of a macro-dynamic model with finite-lived agents. Boucekkine et al. (2002), Faruqee (2003), Heijdra and Romp (2008), Heijdra and Mierau (2012), Mierau and Turnovsky (2012), and Bruce and Turnovsky (in press) specify and calibrate empirically plausible mortality functions in their macro-dynamic models.[1]

Regardless of the models used, the consensus is that the direct effect of a PAYGO Social Security system is to reduce the economic growth rate; see e.g. Gertler (1999), Ehrlich and Kim (2005), and Wigger (1999), a result that can be dated back to the early two-period overlapping generations model by Samuelson (1975).[2] However, some authors, such as Zhang (1995), have shown that once one introduces the effects of Social Security on fertility and family size, it is possible for an unfunded social security system to increase the growth rate through indirect effects.

In this paper we introduce a PAYGO Social Security system into the computational demographic endogenous growth model developed by Bruce and Turnovsky (in press). We utilize the survival function introduced by Boucekkine et al. (2002), henceforth denoted as the BCL survival function.[3] Because closed-form analytical results are intractable, we conduct our analysis numerically, with preference and production parameters assigned values consistent with those characterizing the US and other Western economies. The Blanchard–Weil exponential survival function employed by Saint-Paul (1992) is a special case of the BCL function, so we also compute values for this specification for comparison purposes.

In order to focus attention on the demographic aspects, we assume output is produced using a Romer (1986) technology augmented with government infrastructure spending as in Barro (1990). The production technology we adopt ensures that the economy is always on its balanced growth path. We do not address transitional dynamics, such as would arise when a Social Security program is introduced or modified in an economy. Such events have differential effects on different cohorts, depending upon their ages, and generate a transitory period of dynamic adjustment. For this reason, the comparisons we undertake with regard to the effects of Social Security should be viewed as pertaining to two steady-state economies after any transitional effects have been fully completed.

A key element of the mortality structure introduced in the Blanchard model is the existence of actually-fair life annuities, which provide a mechanism whereby the financial wealth of decedents is recycled to the survivors in the economy. To preserve comparability with the existing literature, we begin by maintaining this assumption. However, it is useful, particularly in assessing the welfare impact of Social Security, to consider a more realistic situation of annuities market failure.[4] We consider an economy that lacks annuities markets entirely, so households fully invest their financial wealth in capital, and when they die they leave accumulated financial capital as unintended bequests that are recycled as lump-sum transfers across the surviving population.

Using this framework we obtain the following results. We emphasize that while they are obtained for a plausible calibration, we have conducted extensive sensitivity analysis and find them to be robust across substantial variations in key parameters. We begin by comparing a benchmark steady-state economy having full actuarially-fair life annuities and a Social Security program comparable to that in the United States, to a steady-state economy with no Social Security. We find that labor productivity in the latter economy grows about .72 percentage points (pps) faster than in the economy with Social Security, at 1.91% rather than 1.19%. Although this agrees qualitatively with other studies that adopt less comprehensive demographic structures, and is not surprising because the PAYGO system reduces saving in productive capital, the magnitude of the effect is much greater – about 2.5 times greater – than we find in the Blanchard–Weil model, underscoring the need to analyze Social Security within a more plausible demographic framework. We also find that the lifetime expected utilities of existing and future households are higher in steady-state economies without Social Security, with the welfare of a newborn household (that is, a household entering the economy) at least 11.2% higher without Social Security.

In economies lacking annuities markets, the equilibrium depends upon how unintended bequests are recycled across the surviving population. We consider a natural scheme in which survivors receive, at each age, lump-sum transfers equal to the mortality interest payment they would have received if life annuities existed. In this case, the growth rate is significantly lower than in an economy with annuities, but Social Security reduces the growth rate by about the same amount.[5] We also find that welfare is reduced by the presence of Social Security despite the absence of life annuities.[6] While this welfare result could seemingly be attributed to the capital production externality incorporated in the Romer technology, we find the result continues to apply, even when "corrective" capital subsidies are applied.

The absence of annuities does, however, have important consequences for the lifetime consumption profile of households. In contrast to the annuities economy, which implies that consumption grows indefinitely with age, an economy without annuities exhibits a more empirically plausible hump-shaped longitudinal consumption-age profile. Agents increase consumption during the early phase of their life cycle and reduce it later, consistent with the previous findings of Bütler (2001), Hansen and İmrohoroğlu (2008) and Heijdra and

[1] Boucekkine et al. (2002) adopt a generalization of the Blanchard mortality function, thereby embedding the latter as a special case. This formulation is also adopted by Heijdra and Mierau (2012) and Mierau and Turnovsky (2012). Heijdra and Romp (2008) use the Gompertz (1825) exponential mortality hazard function in a small open-economy overlapping generations model. Faruqee (2003) approximates the Gompertz function with an estimated hyperbolic function, which he introduces into the Blanchard (1985) model. Finally, Bruce and Turnovsky (in press) compute growth rates using a survival function based on de Moivre's Law, which has the advantage of including the Samuelson-Diamond and the Blanchard models as polar cases. However, this survival function does not track the data as well as does the Boucekkine et al function.

[2] In an important contribution, Gertler (1999) modifies the Blanchard-Weil approach by introducing two stages of life, work and retirement, with constant probabilities of transitioning from work to retirement and from retirement to death. To render this analytically tractable he employs a class of non-expected utility preferences. In a similar model, Bruce and Turnovsky (2007) introduce a decomposition of lifetime into work and retirement and preserve tractability by adopting a CARA utility function. However, this specification does not sustain an equilibrium of constant exponential growth.

[3] The BCL function is not only tractable but also matches well the empirical data on survival across age. The reason for this, as we show later, is that the BCL function is a first-order approximation to the Gompertz (1825) survival function, which is known to fit the human mortality data very well.

[4] Several authors have addressed the role of annuities markets in addressing issues pertaining to life-cycle consumption and growth, though focusing on different aspects. For example, Bütler (2001) develops a stylized partial-equilibrium model of life cycle consumption and shows how the absence of annuities generates hump-saved consumption behavior. Hansen and İmrohoroğlu (2008) analyze the consequences of the absence of an annuities market for life-cycle consumption behavior in a general equilibrium framework. While they incorporate a simple unfunded Social Security system, their equilibrium is one of exogenous growth. Heijdra and Mierau (2012) introduce annuity market imperfections in an endogenous growth framework, but do not incorporate Social Security. The latter two papers also demonstrate how the lack of annuities markets can generate hump-shaped consumption behavior over the life-cycle.

[5] In an earlier version of the paper we also considered an alternative allocation scheme, where the wealth of decedents is distributed to newborn households as initial financial wealth, as a proxy for unintended bequests, with generally similar results being obtained.

[6] The result that the growth rate is reduced in the absence of annuities is consistent with that of Heijdra and Mierau (2012), who reach the same conclusion with their specification of annuity market imperfections.