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Labor supply elasticity and social security reform ☆

Selahattin İmrohoroğlu *, Sagiri Kitao

University of Southern California, Marshall School of Business, Finance and Business Economics Department, United States

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ABSTRACT

Previous literature on social security reform has used a variety of period utility functions and calibrated values for the intertemporal elasticity of substitution (IES) in labor. In this paper, we show that the effects of social security reforms on aggregate labor supply are invariant to plausible values of the IES, but the effect of such reforms on the profile of hours over the life-cycle is highly sensitive to the IES. We first establish these results analytically in a simple partial-equilibrium setting and then demonstrate their robustness in a general equilibrium model calibrated to match key U.S. macroeconomic indicators. We find that the aggregate effects are similar regardless of the wide range of the values of IES used in calibrated economies. However, social security reform leads to a large reallocation of hours worked over the life-cycle, from early years to later working years, and the size of this reallocation significantly increases with the IES.

1. Introduction

There is a large literature on social security reform that uses different utility functions with different estimates of the intertemporal elasticity of substitution in labor supply (IES).[1] In this paper, we investigate the implications of making different choices about the period utility function and values of the IES for the policy debate on social security. We show that the effects of social security reforms on aggregate labor supply are invariant to plausible values of the IES, but the effect of such reforms on the profile of hours over the life-cycle is highly sensitive to the IES. We first establish these results analytically in a simple partial-equilibrium setting and then demonstrate their robustness in a general equilibrium model calibrated to match key U.S. macroeconomic indicators.

We start with a simplified theoretical framework. We consider a two-period, deterministic, partial-equilibrium overlapping generations model and a period utility function which is separable in consumption and leisure. Building on Chetty (2006) we show analytically that the overall impact on labor supply of a permanent increase in wage depends on the relative strengths of the substitution and income effects. In the special case of logarithmic utility over consumption, these effects cancel out and there is no effect on labor supply. Furthermore the curvature of the disutility of work has no effect either. In the more general case, when the coefficient of relative risk aversion is less (more) than unity, the substitution (income) effect dominates and the labor supply will rise (fall) with an increase in wage. The magnitude of the response will be greater if the IES is larger. In addition, a permanent decrease in the interest rate will lower the growth rate of consumption which flattens the age-hours profile and individuals supply more hours at older ages. These analytical results provide the economic intuition behind the effects of price changes (induced, for example, by social security reform) on labor supply. However, extending these analytical results to non-separable utility functions or to a general equilibrium framework proved difficult. In particular, in a general equilibrium setting, social security reform raises the capital-labor ratio and causes both an increase in the wage rate and a decrease in the interest rate. In this case, even with a separable utility function, the overall effects of reform on both the aggregate labor supply and its allocation over the life-cycle become ambiguous.

Once we demonstrate the results and intuition with the analytical framework, the next task of the paper is to conduct an extensive quantitative analysis using a general equilibrium model populated by long-lived individuals facing mortality and idiosyncratic income risks and borrowing constraints. Individuals in this economy choose consumption and hours worked until a mandatory retirement age. The benefit and taxation rules of social security are implemented according to the formulas used by the Social Security Administration (SSA). The fiscal authority taxes capital and labor income and consumption to finance an exogenous quantity of government

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* Corresponding author.
E-mail addresses: selo@marshall.usc.edu (S. İmrohoroğlu), skitao@marshall.usc.edu (S. Kitao).

[1] For example, see Feldstein (1985), Hubbard and Judd (1987), İmrohoroğlu et al. (1995), İmrohoroğlu et al. (2003), Cooley and Soares (1999), Boldrin and Rustichini (2000), Casamatta et al. (2002) Huang et al. (1997), De Nardi et al. (1999), Kotlikoff et al. (1999), Conesa and Krueger (1999), Fuster et al. (2007) and Nishiyama and Smetters (2007).

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purchases and interest payments on its debt. We calibrate the model by using both micro data and aggregate data on the U.S. economy. We then conduct counterfactual (revenue-neutral) experiments by reforming social security, either by downsizing the system by 50%, or by totally eliminating it. Our goal is to understand the long-run effect of social security reforms and we focus on how the strength of IES affects the properties of the steady state under alternative policies. Our analysis is based on the comparison of the two steady states, one implied by the current pay-as-you-go social security system and the other by a reform towards a fully-funded system.

Our main quantitative finding is that social security reform leads to similar aggregate outcomes for a wide range of the IES. For example, when we take the IES as 0.1, half privatization leads to an increase of 10.8% in the capital stock, an increase of 0.03% in the average work hours and a decrease of 5.8% in the budget-clearing labor income tax rate, whereas the changes are 9.8%, 0.11% and −5.9%, respectively, when the IES is taken as 1.0, a ten-fold increase in the intertemporal responsiveness of labor. Long-run welfare is also similar: individuals strongly prefer to be born into the reformed steady state; they are willing to give up 5.0% and 5.4% consumption, respectively, in the unfunded steady state in order to be born in the reformed one. However, these similarities at the aggregate level hide significant differences in the allocation of work hours over the life-cycle. With reform (half privatization) individuals shift work from the early years in the life-cycle to later years, regardless of the IES. However, with an IES equal to unity, this reallocation is quantitatively much more significant than that in the case of an IES of 0.1. This reallocation is even larger in the case of full privatization. Therefore, the IES used in a study of social security reform leaves the aggregate implications unchanged to a large extent in the long run, but matters significantly when analyzing the life-cycle implications of the reform.[2]

We would like to emphasize that this paper explores the sensitivity of gains from social security reform to changes in the IES, but should not be interpreted as an exercise attempting to evaluate optimal social security reform. The overall welfare consequences of social security reform depend upon transitional costs and a variety of other parameters and factors beyond the IES.

The remainder of the paper is organized as follows. We present a simple two-period model and its analytical results in Section 2. The large-scale, general equilibrium model is described in Section 3. The calibration details are given in Section 4. Section 5 presents our numerical findings. Section 6 conducts a sensitivity analysis and concluding remarks are given in Section 7.

2. Simple partial-equilibrium models and intuition

2.1. A general multi-period model

Consider an economy with a complete market, populated by J overlapping generations. Households derive utility from consumption, incur disutility from labor and maximize their life-time utility by optimally choosing the sequence of consumption, saving and labor supply over the life-cycle.

We start with preferences that are separable in consumption and labor supply and over time:

$$\sum_{j=1}^{J} \beta^{j-1}\left[u\left(c_j\right) - v\left(\ell_j\right)\right],$$

where c_j and ℓ_j denote consumption and labor supply at age j, respectively. $u(c)$ represents the utility from consumption with $u'>0$ and $u''<0$, $v(\ell)$ disutility from work with $v'>0$ and $v''>0$. β is the subjective discount factor. The maximization is subject to the life-time budget constraint:

$$\sum_{j=1}^{J}\left(\frac{1}{R}\right)^{j-1} c_j = \sum_{j=1}^{J}\left(\frac{1}{R}\right)^{j-1} w\ell_j, \tag{1}$$

where w and R are the wage and gross interest rate that are exogenously given.

First-order conditions with respect to the labor supply and consumption are given as

$$u'\left(c_j\right)w = v'\left(\ell_j\right), \tag{2}$$

$$u'\left(c_j\right) = \beta R u'\left(c_{j+1}\right). \tag{3}$$

From Eqs. (2) and (3) we can make the following general points that extend the intuition in Chetty (2006):

- When there is a permanent increase in the wage w, the effect on labor supply depends on the magnitude of the decline in $u'(c_j)$ (substitution effect) relative to the increase in the wage rate (income effect) in Eq. (2).
  A one-percent increase in the wage will raise the consumption at any given level of labor supply by 1%, which lowers the marginal utility of consumption by $\varepsilon_c = -(\partial u_c/\partial c)(c/u_c)$, that is, the coefficient of relative risk aversion (CRRA).
  - In the case of log utility, $\varepsilon_c = 1$ and the substitution and income effects exactly offset each other, resulting in no change in labor supply. Obviously, the curvature of $v(\ell)$ (IES) has no effect on aggregate labor supply in this case.
  - If $\varepsilon_c < 1$ (>1), the *substitution effect (the income effect)* dominates and the labor supply will rise (fall) upon an increase in the wage. The magnitude of the response will be larger if the labor supply elasticity is higher.
- A permanent change in the interest rate will affect the labor supply profile through the change in the marginal rate of substitution (or the optimal growth rate of consumption). Using Eqs. (2) and (3), we obtain

$$\frac{v'\left(\ell_j\right)}{v'\left(\ell_{j+1}\right)} = \frac{u'\left(c_j\right)}{u'\left(c_{j+1}\right)} = \beta R.$$

  - A decrease in the interest rate, for example, will lower (increase) the growth rate of consumption (labor supply) and households extend more work effort at older ages.

In the next section, we assume a particular functional form for the utility from consumption and work disutility to highlight the roles of the CRRA and IES.

2.2. A two-period model with analytical solutions

Households live for two periods. They choose sequences of consumption $\{c_j\}_{j=1}^{2}$ and labor supply $\{\ell_j\}_{j=1}^{2}$ in order to maximize life-time utility. Agents can save or borrow at the gross interest rate R. Both the interest rate and the wage per efficiency unit w are exogenously given. Labor income is given as $w\varepsilon_j\ell_j$, where ε_j is

[2] Rogerson and Wallenius (forthcoming) find large macro elasticities, 2.25 to 3, when they vary the IES from 0.05 to 1.25 in an experiment in which the labor income tax rate is raised from 30% to 50% with the proceeds returned in a lump sum fashion. They use a continuous time life cycle model of a complete market with no borrowing constraint in which individuals choose not only the hours worked but also the fraction of the life cycle spent in market activities. The decrease in aggregate hours worked is essentially the same for any IES in the range they consider. However, the hours profile is affected more significantly.