



# Optimal social security in a dynastic model with human capital externalities, fertility and endogenous growth

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## ARTICLE INFO

### Article history:

Received 8 January 2008

Received in revised form 2 August 2008

Accepted 14 October 2008

Available online 30 October 2008

### JEL classification:

H55

J13

O41

### Keywords:

Social security

Welfare

Fertility

Human capital externalities

Savings

## ABSTRACT

In this paper we investigate the optimal scale of pay-as-you-go social security in a dynastic family model with human capital externalities, fertility and endogenous growth. Human capital externalities reduce the return to human capital investment and hence lead to underinvestment in human capital and over-reproduction of the population. If the taste for the number of children is sufficiently weak relative to the taste for the welfare of children, social security can be welfare enhancing by reducing fertility and raising human capital investment per child.

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## 1. Introduction

In this paper we investigate the implication of human capital externalities for optimal pay-as-you-go (PAYG) social security in a dynastic family model with two types of capital and with endogenous fertility. Human capital accumulation has been recognized as a key factor for earnings; see, e.g., some related studies in the survey article of Lemieux (2006). Yet, the outcome of human capital accumulation for children is under the influence of parental factors as well as social factors outside their families (i.e. external to families). According to empirical evidence by Solon (1999), about half of children's earnings are correlated with their parental earnings. This evidence suggests that non-parental factors or human capital externalities may be quantitatively substantial in the formation of one's human capital. Indeed, some empirical studies find evidence on human capital externalities in the determination of individuals' earnings through channels such as ethnic groups, neighborhoods, work places, or state funding of schools; see, e.g., Borjas (1992, 1994, 1995), Rauch (1993), Davies (2002) and Moretti (2004a,b). For example, according to the studies of Borjas, the earnings of children are affected significantly not only by the earnings of their parents, but also by the mean earnings of the ethnic group in the parents' generation through ethnic neighborhoods in the United States. Also, Moretti (2004b) finds evidence on the effects of human capital externalities on individuals' earnings in manufacturing establishments across cities in the United States. The existence of human capital externalities found in the literature implies that the private rate of return to human capital investment should be lower than the social rate of return. This tends to engender underinvestment in human capital and thus may have strong policy implications for optimal social security.

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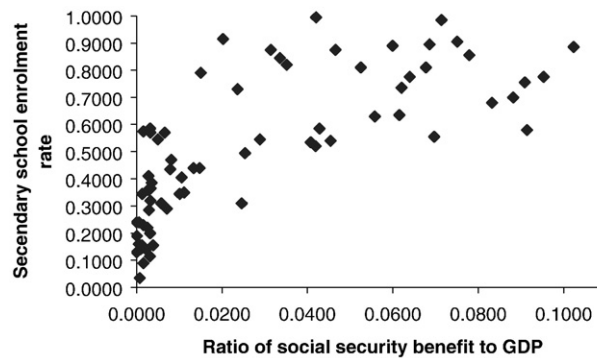


Fig. 1. Secondary school enrolment versus social security across 70 countries.

As important family decisions according to the well known trade-off between the quality and quantity of children in [Becker and Lewis \(1973\)](#), human capital investment and fertility have been found to be responsive to social security and thus serve as channels through which social security affects economic growth and population growth in [Zhang \(1995\)](#). Using cross-country data for the period 1960–2000, [Zhang and Zhang \(2004\)](#) investigate the effect of social security on growth and growth determinants (savings, human capital investment, and fertility).<sup>1</sup> Their empirical analysis allows for feedback from growth to social security and treats growth, fertility, human capital investment and savings as endogenous variables using the IV estimation method. They also allow for country-specific fixed effects in a panel regression. They find that the ratio of social security benefits to GDP has a positive effect on human capital investment and a negative effect on fertility, as suggested in [Figs. 1 and 2](#) that plot secondary school enrolment and fertility respectively against the ratio of social security benefits to GDP in 70 countries of market economies. It is thus interesting to extend this line of research to explore the welfare implication and the optimal scale of social security in a dynastic family model with both human capital and fertility. This task is highly relevant today when many countries have been debating on whether PAYG social security should be reformed.

While most studies on social security focus on its implication for capital accumulation, few have paid close attention to its welfare implication. Among them, [Cooley and Soares \(1999\)](#) have used a majority voting mechanism to justify why social security receives a majority support once it is already in place, although their model does not explain why it was instituted in the first place. Also, [Zhang and Zhang \(2007\)](#) have considered optimal social security with investment externalities in the final production sector in an extended neoclassical growth model without sustainable growth. However, having ignored human capital accumulation, these models do not capture the interaction between social security on the one hand and the trade-off between the quality and quantity of children on the other.

The inclusion of human capital investment can be highly relevant in the analysis of optimal social security. On the one hand, the payroll tax for social security reduces the after-tax wage rate or the after-tax rate of return on human capital investment, thereby tending to reduce human capital investment. Thus, considering human capital investment in the analysis may make it more likely for social security to reduce welfare. On the other hand, when social security reduces fertility, human capital investment per child may rise via the trade-off between the quantity and quality of children. Because of these opposing forces, social security may engender a welfare gain only when the human capital externality causes fertility to be above its first-best level and causes human capital investment per child to be below its first-best level. If social security does improve welfare, it is also interesting in theory and relevant in practice to gauge the size of the optimal social security tax rate numerically for plausible parameterizations and compare it to the observed social security payroll tax rates in the real world.

The rest of the paper proceeds as follows. The next section introduces the model. Sections 3 and 4 determine the equilibrium solution and derive the results. Section 5 concludes.

## 2. The model

The model is an extension of [Zhang and Zhang \(2007\)](#) to incorporate human capital accumulation and to explore the welfare implication of social security with an externality in the form of spillovers of average human capital to all children's learning. This extension departs from the neoclassical growth model toward an endogenous growth model. The model economy is inhabited by overlapping generations of a large number of identical agents who live for three periods. In their first period of life, they embody human capital and do not make any decision. In their second period of life, they work and make decisions on life-cycle savings and on the number and education of identical children. In their third period of life, they retire and decide only on the allocation

<sup>1</sup> Their data for social security benefits under statutory schemes are from the International Labor Office (ILO, various years); secondary school enrollment ratios and adult populations' education attainment, used as proxies for human capital investment and human capital stock respectively, are from UNESCO (various years); GDP, consumption and saving are based on the Penn World Table by [Summers and Heston \(1988\)](#) and [Heston, Summers and Aten \(2002\)](#); government education, government consumption, government transfers, population, fertility net of child mortality, revolutions, coups and assassinations are from [Barro and Lee \(1994\)](#) and the United Nations' *Demographic Yearbook* (various years).

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