



# Socially optimal social security and education subsidization in a dynastic model with human capital externalities, fertility and endogenous growth

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## ABSTRACT

This paper considers socially optimal government policies in a dynastic family model with physical capital, human capital, endogenous fertility and positive spillovers from average human capital. Such spillovers reduce human capital investment but raise fertility from their social optimum. We first characterize the social optimum with a non-convex feasible set due to the quantity–quality tradeoff concerning children. We then show that social security and education subsidization together, financed by labor income taxes, can fully eliminate the efficiency losses of the spillovers and achieve the social optimum under plausible conditions. However, none of the policies can do so alone.

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## 1. Introduction

Social security and education subsidization have long been key public programs in many countries since the early development stage marked by high fertility and little formal education. In the OECD countries (OECD, 2008), on average public education spending is about 5% of GDP, while social security contributions range from 10% to 20% of wage income or higher (mainly pay-as-you-go or PAYG; see Social Security Administration and International Social Security Association, 2008). Such large scale public policies suggest that there may be certain factors such as human capital externalities that cause a wedge between a competitive equilibrium allocation and the socially optimal allocation.

Indeed, many empirical studies (e.g. Borjas, 1992, 1994, 1995; Rauch, 1993; Davies, 2002; Moretti, 2004a, b) document various forms of human capital externalities such as ethnic groups, neighborhoods, work places, or state funding of schools. By reducing the private returns, such externalities reduce human capital investment and raise fertility through the

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tradeoff between the quality and quantity of children in the spirit of Becker and Lewis (1973). This quantity–quality tradeoff receives empirical support in Rosenzweig and Wolpin (1980), Hanushek (1992), Li et al. (2008), and Becker et al. (2010). Therefore, incorporating these elements may be highly relevant in the analysis of public policies.

Education subsidization and social security have drawn a great deal of attention. Even at the beginning of modern economics Adam Smith (1776) recognized the important role of education in development in his influential work, *The Wealth of Nations*. The recent endogenous growth theory also regards human capital accumulation as an engine of sustainable growth since Lucas (1988). For instance, in Azariadis and Drazen (1990) growth cannot occur without a sufficiently high level of human capital investment relative to income; in Laitner (1993) human capital accumulation through education adds 30–50% to long-run growth. Also, Zhang (1996) finds that education subsidization with labor income taxation alleviates underinvestment caused by human capital externalities. Zhang and Casagrande (1998) find empirical evidence that education subsidies promote economic growth but have little effect on fertility in cross-country data.<sup>1</sup>

The impacts of social security on savings and economic growth have also been examined extensively. Barro (1974) argues that social security, like public debt, should be neutral in an infinitely-lived agent model, while Feldstein (1974) claims that social security reduces savings and impedes capital accumulation and growth in a life-cycle model.<sup>2</sup> However, Zhang (1995) shows that social security can promote growth by raising human capital investment and reducing fertility without changing the saving rate. Using cross-country panel data, Zhang and Zhang (2004) find evidence that social security has a negative effect on fertility, positive effects on secondary school enrollment and economic growth, but no statistically significant effect on the saving rate.

Social security's welfare implications differ in models with or without private intergenerational transfers. Without such transfers, the competitive allocation in the life-cycle model may be Pareto dominated, and social security may improve welfare for a majority of the population as shown in Cremer and Pestieau (1998).<sup>3</sup> With investment externalities, Pareto improvements can be made by subsidizing investment and making transfers from the young to the old in a life-cycle model of Wigger (2001). With altruistic intergenerational transfers in Zhang and Zhang (2007) and Yew and Zhang (2009), social security can improve welfare when there are spillovers from average physical or human capital. Moreover, Cremer et al. (2008) consider the design of pension schemes with subsidization or taxation based on fertility. However, these models do not focus on the socially optimal allocation.

Some studies consider social security and education subsidization jointly. Kemnitz (2000) and Poutvaara (2006) analyze social security and public education in political equilibria. Glomm and Kaganovich (2003) investigate how public education and social security affect human capital distribution in an economy with heterogeneous agents. Kaganovich and Zilcha (1999), Pecchenino and Pollard (2002) and Rojas (2004) show that social security reduces welfare or hinders growth in the presence of education subsidization. Boldrin and Montes (2005) show that public financing of education and public pension financed by lump-sum taxes can support the complete market allocation when credit markets for human capital investment are missing. Docquier et al. (2007) show that the social optimum for all generations can be decentralized into an equilibrium for agents who only care about their own life-cycle consumption by making a transfer to the old and an education subsidy through lump-sum taxes.

Our present paper uses social security and education subsidization to eliminate the efficiency losses of human capital externality for the social optimum in an endogenous growth model with fertility, life-cycle saving and human capital investment. The tradeoff between the number of children and investment per child creates non-convexity in the feasible set. It remains unclear how to characterize and decentralize the social optimum in this empirically plausible case. We first provide the sufficiency of the first-order conditions and the transversality conditions for the social optimum. This extends the study of social efficiency with endogenous fertility (e.g. Golosov et al., 2007) into an endogenous growth model with human and physical capital. We then derive conditions for social security and education subsidization to achieve the social optimum: a strong enough taste for the welfare of children relative to the taste for the number of children such that social security financed by labor income taxation reduces fertility.

Education subsidization for a lower education cost appears to be an ideal means to tackle the under-investment and the over-reproduction caused by the externality. However, the accompanying tax on wage income counteracts the positive effect of education subsidization on human capital investment and the negative effect on fertility. Thus, education subsidization financed by labor income taxation alone cannot fully eliminate the efficiency losses from human capital externalities with endogenous fertility.

Similarly, social security financed by labor income taxation alone cannot fully eliminate the efficiency losses from this externality, because of its conflicting effects on fertility and human capital investment. On the one hand, social security raises the time cost of children through the foregone earnings-dependent social security benefits, and raises the bequest cost to ease the increased tax burdens on children. It also raises the benefit of human capital investment when social security benefits are earnings-dependent. On the other hand, the labor income tax for social security reduces both the time cost of a child and the return on human capital investment. The net effects of social security on fertility and on human

<sup>1</sup> As shown in Glomm and Ravikumar (1992), Benabou (2002) and Wigger (2004), education subsidization or public education can be useful for redistributive considerations with heterogeneous agents.

<sup>2</sup> Also, see, e.g., Hubbard and Judd (1987), Rosati (1996), Corneo and Marquardt (2000), Sánchez-Losada (2000), and Kemnitz and Wigger (2000).

<sup>3</sup> Also, see e.g., Samuelson (1958), Diamond (1965), Eckstein and Wolpin (1985), Hubbard and Judd (1987), Hansson and Stuart (1989), Cooley and Soares (1999), Kaganovich and Zilcha (1999), and Corneo and Marquardt (2000).

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